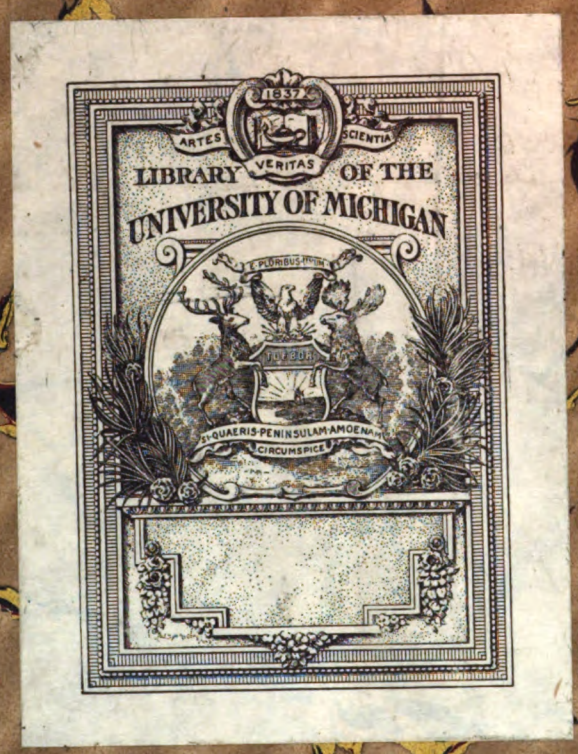
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INDEX TO "INDUSTRIES."

Articles.

*(All Articles marked thus * are Illustrated.)*

Adams' Automatic Bolt Cutter, 234*
Adamson, The Late, Daniel, 63*
Admiralty Dynamo Specification, The, 350
Agricultural Show, Royal, 584*, 601*
Agricultural Show at Rochester, 568
Air Propeller, Verity's "Silent," 65*
Air Propellers, Sayer's, 257*
Allen, The Late Horatio, 111*
Allen's Pumping Machinery for the Japanese Government, 268*
Alloys, Notes on, 115, 236, 355, 409, 475
Alternating Circuits, Arc Lamps on, 498
Alternating Current Apparatus, Some Tests of the Efficiency of, 401*
Alternator, Mather & Platt's, 64*
Aluminium and its Uses, 410
Aluminium Process, The Heroult, 499*
America, Bridge for Central, 243*
America, National Electric Light Association of, 235
American and English Practice in Electrical Engineering, 254
American Institute of Electrical Engineers, 571, 594, 617
American Navy Proposals, 86
American Society of Engineers, 529, 556*
Anderson & Gallwey's 200-Ton Hydraulic Riveting Plant, 316*
Arbey's Tools at the Late Paris Exhibition, 97*, 176*, 228*, 265*
Arbitration among Scotch Miners and Paper-makers, 86
Arc Lamps on Alternating Circuits, 498
Architects' Registration Bill, 351
Arnold's Steam Boiler, 416*
Aron Electric Meter, The, 139
Arrol on Labour Questions, Sir William, 230
"Audio" Telephone Mouthpiece, 473*
Austin's "Infant" Dynamo, 572*

Bailey-Friedrich Steam Motor, 112*
Baines, The Late Sir Edward, 230
Baker's Biscuit Making Machinery, 368*
Band Saw Machines for Heavy Timber, 217*
Band Saw Machine, Watts' Double, 461*
Barlow & Jones v. Johnson & Co., 256
Barraclough's Wire Covering Machine, 121*
Barraclough's Wire Straightening Machine, 5*
Bath, Electric Lighting at, 616
Battery, Weymersch Primary, 234, 616
Bending Moment Delineator, 484*
Benest's Submarine Grapnel, 424*
Bennerley Furnaces, Boiler Explosion at, 128
Bennett & Sayer's Brick Making Machines, 145*
Bennie's Large Lever Punching Machine, 84*
Bent's Tool Holder, 464*
Berlin Labour Conference, The, 349
Biggs' Tubular Lock, 496*
Biscuit Making Machinery, 368*
Board of Trade and Electric Lighting, 546, 594, 617
Board of Trade Rules on Life-Saving Appliances, 329, 351
Boiler, Arnold's Steam, 416*
Boiler Explosion at Bennerley Furnaces, 128
Boiler Explosion at Dudley, The, 400*
Boiler Flue, Farnley, 15*
Boiler Flues, Midgley's, 128*
Boiler Legislation, Steam, 37
Boilers, Evaporation in Lancashire, Paper read by M. Longridge before the Manchester Association of Engineers, 98*
Boilers, Grate for Vertical, 196*
Boilers, Marine, Paper read by Mr. C. B. Casebourne before the North-East Coast Institute of Engineers and Shipbuilders, 18*
Bolt Cutter, Adams' Automatic, 234*
Boring and Drilling Machine, Horizontal, 156*
Boult's Cylinder Lubricant Tester, 149*
Boult's Tricord Light Adjuster, 185*
Brakes, Continuous, Paper read by G. Kiernan before the Manchester Association of Engineers, 207
Brebner, The Late A., 255
Brick Making Machine, 137*, 145*, 185*
Bridge Erection in Glasgow, Rapid, 567
Bridge for Central America, 243*
British Association, The, 518
Budget, The, 397
Buenos Ayres, Exhibition at, 296*
Burnham's Steam Loop, 601*
Burns, The Late Sir George, 543
Butler's Domestic Petroleum Engine, 464*

Cables, Insulation Resistances of, 544
Canal, Forth and Clyde, 132
Canal, Japanese, 80*
Canal, Manchester Ship, Progress during 1889, 32
Canal, Suez, 588
Candle, Devonshire's Everlasting, 348*
Cardew's Earthing Device, 379*
Carlisle Railway Accident, 470, 494
Carter's Road Wheel, 457*
Cartridge, Mullineux's, 8*
Cellulose and its Constitution, 19
Cement from Slag, Manufacture of Portland, 402*
Cements and Weight Saving in Ship Structures, Protective, 147
Channel Tunnel, The, 77,
Chapman's Quadruple Evaporator, 148*
Charlesworth, Hall, & Co.'s Dynamo, 304*
Charlottenburg Testing Station, The, 425
Chelmsford, Electric Lighting at, 374
Chemical Industry, Society of, 44, 139, 403, 548; Manchester Section, 67, 164, 259, 355, 476; Liverpool Section, 186, 260, 356; Glasgow and Scottish Section, 186, 260, 356, 500, 572; Newcastle Section, 68, 164
Chemical Progress in 1889, 50
Chemical Society, The, 620
Chimney Shafts from Lightning, Protection of, 289
Chimney Shafts, Straightening, 195
China, Cotton Mills in, 327
China, Difficulties of Foreign Enterprise in, 39
China, Opening of Western, 254, 326
Chinese Railways, 109
"Chiyoda," Japanese Cruiser, 540
Chlorine Processes, Nitric Acid, 404
"City of Rome," Accident to the, 567, 588*
"City of Paris," Breakdown of the, 320, 348, 374, 615
Civil Engineers, Institution of (see Engineers, Institution of Civil)
Cleathero & Nichols' Apparatus for Feeding Printing Machines, 378*
Cleveland Institution of Engineers, 135
Clyburn Spanner, Improved, 588*
Clyde and Forth Canal, 132
Clyde Shipbuilding, 159, 234, 396, 512, 584
Clyde, Tunnel Under the, 149
Coal Cargoes, Spontaneous Ignition of, Paper read by Professor V. B. Lewes before the Institution of Naval Architects, 386
Coal Crisis, The, 279
Coal Fields of the Transvaal, 296
Coal in Kent, 182, 195, 280
Coal, Iron, and Cognate Industries, 63, 159, 272
Coal Supply, Duration of Our, 61
Coats, The Late Sir Peter, 255
Coke Crusher, Welch's, 553*
Colliery Engines, Semi-portable, 252*
Commerce and Industries during 1889, 1
Commercial Education, 156
Commercial Morality, 158
Condensation and Re-evaporation in Marine Engine Cylinders, 326
Conductors by Electric Currents, Heating of, 185*
Conley-Lancaster Process for Extracting Iron from Ore, 522
Co-operation, Lord Rosebery on, 518
Copper in 1889, Prices of, 40*
Cotton Industry, The, 398
Cotton Mills in China, 327
Crane, Spencer's Travelling, 248*
Crompton & Co. *v.* Eliesen Electric Lighting Company, 568
Crompton's Four-pole Drum Dynamo, 396*
Crooks, Roberts, & Co.'s Slotting Machine, 481*
Cruiser "Chiyoda," The Japanese, 540
Cruiser "Latona," Her Majesty's, 492*
Cruiser "Newark," United States, 440*
Cruiser "San Francisco," United States, 8*
Crushing Machine, The Fulton Ore, 409*
Crushing Mill, The Lamberton Ore, 516*
Cycle Show, The Stanley, 104

Daimler's Petroleum Engine, 553*
Deptford Central Electric Lighting Station, 618*
Devonshire Everlasting Candle, The, 348*
Dock Improvements at Liverpool, 560*
Dockyards during 1889, Work in the Royal, 73
Dodman's Horizontal Engine, 75*
Downie's Packing Rings, 73*
Downing's Grate for Vertical Boilers, 196*
Drains, Gradient Indicator for, 128*
Draught, Progress of Forced, 158
Drilling and Boring Machine, Horizontal, 156*
Drilling Machines for Large Boiler Shells, 300*
Drilling Machine, Parkinson's, 416*
Drilling Machine, Radial, 196*
Drilling Machine, Sensitive, 433*
Drilling Machine, Wall-bracket Radial, 344*
Drilling Machines, Herbert & Hubbard's, 289*
Dudley, Boiler Explosion at, 400*
Dutton's Oil Measuring Pump, 497*
Dutton's Signal Lamps, 608*
Dynamine, Lubricator for, 224*
Dynamo and Engine, Smit's Combined, 348*
Dynamo, Austin's "Infant," 572*
Dynamo, Charlesworth, Hall, & Co.'s, 304*
Dynamo, Crompton's Four-pole Drum, 396*
Dynamo, Mather & Platt's Alternating Current, 64*
Dynamo Specification, The Admiralty, 350
Dynamo, Wenström's, 281*
Dynamos and Motors, Graphic Construction for, 42*, 90*, 114*, 138*

Earthing Device, Cardew's, 379*
Edinburgh Exhibition, 44*, 320, 400*, 423, 440*
Edinburgh Exhibition, Electric Lighting at the, 440*, 536*
Edinburgh Exhibition—Prime Movers, I., 488*, 512*
Edinburgh Underground Railway, 206, 615
Education, Commercial, 156
Education Prevent Strikes? Can an Improved, 469
Electric Currents, Heating of Conductors by, 185*
Electric Lamps, The Physics of, 185
Electric Light Association of America, The National, 235
Electric Light Regulations, 86
Electric Lighting at Bath, 616
Electric Lighting at Chelmsford, 374
Electrical Lighting at New York, 19
Electric Lighting at the Edinburgh Exhibition, 440*, 536*
Electrical Lighting Station, The Deptford Central, 618*
Electric Lighting, The Board of Trade and, 546, 594, 617
Electric Locomotive for Mines, 209*
Electric Meter, The Aron, 139
Electric Supply Stations at Paris, 355
Electric Switch, Double-pole Tramway, 115*
Electric Traction, The Waller-Manville System of, 448*
Electric Tramcar, Jarman's, 519
Electric Tramway, Lineff's, 616
Electric Welding Process, The, 616
Electrical Distribution, Safety in, 258, 281
Electrical Engineering, English and American Practice in, 254
Electrical Engineering in 1889, Progress of, 49
Electrical Engineers, American Institute of, 571, 594, 617
Electrical Engineers, Institution of (see Engineers, Institution of Electrical)
Electrical Subways in New York, Practical Working of the, 259, 282, 306, 330
Electricity as a Hastener in the Tanning of Hides, 498
Electricity versus Gas, Presidential Address by J. West before the Manchester Association of Engineers, 56
Elliott's Smoke Annihilator, 616
Emperor of Germany and the Labour Question, 157
Engine and Boiler, The Bailey-Friedrich Combined, 112*
Engine and Dynamo, Smit's Combined, 348*
Engine Cylinders, Condensation and Re-evaporation in Marine, 326
Engine, Development of the Steam, 229
Engine, Dodman's Horizontal, 75*
Engine, Richardson's Compound High Speed, 425*
Engine Trials, Research Committee on Marine, 544*, 553*, 577*
Engine, Triple Expansion Mill, 123*
Engineering in Italy, 542
Engineering Progress in 1889, 25, 32, 41, 49
Engineering Society, The Liverpool, 612
Engineers, American Institute of Electrical, 571, 594, 617
Engineers, American Society of, 529, 556*
Engineers and Shipbuilders, North East Coast Institution of, 18*, 249
Engineers, Cleveland Institution of, 135

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Engineers, Federated Institution of Mining, 139, 423
Engineers in the Navy, Appointment of Assistant, 398
Engineers, Institute of Marine, 207, 248, 280, 351, 468, 492
Engineers, Institution of Civil, 75, 136, 183, 257, 296, 344, 376, 496, 555
Engineers, Institution of Electrical, 66*, 89*, 112, 162*, 209, 234, 283, 305*, 331, 379, 473*, 497, 521, 546
Engineers, Institution of Mechanical, 111, 122, 169*, 219*, 433, 544*, 553*, 577*
Engineers, London Association of Foremen, 248, 280
Engineers, Manchester Association of, 56, 98*, 207, 353
Engineers of Japan, Institution of, 614
Engineers, Society of, 176, 224, 588
Engines and Boilers of the s.s. "Prins Willem II.," 409*, 433*
Engines for Collieries, Semi-Portable Hauling, 252
Engines, Horse-Power of Marine, 421
Engines of the s.s. "Friesland," 33*, 64
Engines of the s.s. "Stuttgart, 52*
Evaporator and Feed Water Heater, Morison's, 472*
Evaporator, Chapman's Quadruple, 148*
Euphrates, Navigation of the, 509
"Exact" Governor, Schaeffer & Budenberg's 42*
Explosion at Bennerley Furnaces, Boiler, 128
Explosion near Dudley, Boiler, 400*

Farnley Boiler Flue, 15*
Feed Water Heater, Morison's Evaporator and, 472*
File, Howarth's Tri-cut, 224*
Finsbury College, Technical Education at, 530*
Flax Scutching Machine, Spiegelberg's, 612*
Flue, Farnley Boiler, 15*
Flues, Midgley's Boiler, 128*
Forge at West Hartlepool, Gray's New, 97*
Forth and Clyde Canal, 132
Forth Bridge, 17*, 40, 88, 110, 200*, 205, 231, 232, 273*
Forth Bridge, Testing the, 88
Fox Patents, The Lane, 473
France and England, Communication Between, 541
French Exhibition, 497
Friction and Lubrication of Cylindrical Journals, Paper read by Professor J. Goodman before the Manchester Association of Engineers, 353
"Friesland," Engines of the s.s., 33*, 64
Fulton Ore Crushing Machine, The, 409*
Furnace, A New Form of Siemens, 75*
Furnace, Meldrum's Breeze, 580*

Gas, Detection of Water, 211
Gas Engine and Pump, 485*
Gas Generator, Thwaite's "Simplex," 330*
Gas Retorts, Yeadon & Adgie's, 426*
Gas, Steenberg's Water, 306*
Gas versus Electricity, Presidential Address of J. West before the Manchester Association of Engineers, 56
Gesner's Rust-Proof Process, 451*
Girard Hydraulic Railway, The, 352*
Glasgow and District Subway, Proposed, 39
Glasgow, Rapid Bridge Erection in, 567
"Globe" Separator, The, 513*
Glycerine, Examination of Commercial, 115
Godfrey Printing Machine Company's Gripper Platen Printing Machine, 337*
Gold Chlorination Processes, 450
Gold Extracting Process, Pollok's, 161*
Governor, Schaeffer & Budenberg's "Exact," 42*
Gradient Indicator for Drains, 128*
Grapnel, Benest's Submarine, 424*
Grate for Vertical Boilers, 196*
Gray, The Late Thomas, 279
Gray's New Forge at West Hartlepool, 97*
Gunboat, A French Submarine, 416
Gunboats for the Zambesi, 464, 540*
Gunpowders, Smokeless, 547
Gymnote, The French Submarine Gunboat, 416

Halske, The Late J. G., 303
Hartlepool, Gray's New Forge at West, 97*
Haseley Tedder, The, 584*
Heating of Conductors by Electric Currents, 185*
Herbert & Hubbard's Drilling Machines, 289*
Heroult Aluminium Process, The, 499*
Hetherington's Boring and Drilling Machine, 156*
Hetherington's Plate Planing Machine, 132*
Hetherington's Wall-bracket Radial Drilling Machine, 344*
Hirn, The Late Gustav, 135
Housing Gear for Rolling Mills, Jardine's, 458*
Howarth's Tri-cut File, 224*
Hudson Tunnel at New York, 508*
Hughes & Lancaster's Low-pressure Compressed Air Tramcar, 267*
Hungary, Metals and Machinery in, 580

Indiarubber, The Future Supply of, 187
Indicator, Steam Engine, Paper read by C. F. Budenberg before the Owens College Engineering Society, 152*
Industrial League, Irish, 14
Industrial Outlook, 253
Industries and Commerce during 1889, 1, 25, 41, 49
Inglis, The Late William, 398
Insulation Resistances of Cables, 544
Irish Industrial League, 14
Iron and Steel, Chart Showing Variation of Prices during 1889, 68*
Iron and Steel, Critical Points of, Paper read by M. Osmond before the Iron and Steel Institute, 481*, 493, 505*
Iron and Steel Institute, 446, 458, 481*, 505*
Iron, Coal, and Cognate Industries (see Coal, Iron, and Cognate Industries)
Iron from Ore, The Conley-Lancaster Process for Extracting, 522
Iron, Manufacture of Basic Pig, Paper read by H. Pilkington before the South Staffordshire Institute of Iron and Steel Works Managers, 337
Ironmongers' Exhibition, 290
Italy, Engineering in, 542

Jacket, Experimental Value of Steam, 579
Japan, Affairs in, 518
Japan, Foreign Trade of, 590
Japan, Institution of Engineers of, 614
Japan, Our Treaties with, 542
Japanese Canal, A, 80*
Japanese Cruiser "Chiyoda," 540
Japanese Exhibition, 1890, 280*, 577
Japanese Government, Pumping Machinery for the, 268*
Japanese Treaty Revision, 135
Jardine's Housing Gear for Rolling Mills, 458*
Jarman's Electric Tramcar, 519
Johnson's Brick-making Machines, 137*, 185*
Joule Memorial, International, 87
Joule, The Scientific Work of, 110
Journals, Friction and Lubrication of Cylindrical, Paper read by Professor J. Goodman before the Manchester Association of Engineers, 353

Kane, The Late Sir Robert, 206
Kent, Coal in, 182, 195, 280
Knight's Direct-acting Hydraulic Pumping Engine, 392*
Kuhlmann's Testing Machines, 52*

Labour Conference, The Berlin, 349
Labour Movements on the Continent and at Home, 373
Labour Question, Emperor of Germany and the, 157
Labour Question, Sir William Arrol on the, 230
Lamberton Ore Crushing Mill, 516*
Lamp Cleaning Machine, 581*
Lamps, Dutton's Signal, 608*
Lane Fox Patents, The, 473
Lathe, Shepherd, Hill, & Co.'s Tyre Turning, 605*
Lathe, The "Lukin," 193*
"Latona," Launch of H.M.S., 492*
Lead in the Water Supply of Northern Towns, 187
League, Irish Industrial, 14
Legal Proceedings: Barlow & Jones *v.* Johnson & Co., 256; Morgan & Co. *v.* Windover & Co., 327; Crompton & Co. *v.* Eliesen Electric Lighting Co., 568; Oakey *v.* Flatau, 591
Leeds Exhibition, The, 416
Legislation and Industry, 133
Legislation in 1890, Industrial, 302
Liability Bill, Employers', 374
Life Saver, Manwell's Ready, 581*
Life Saving Appliances, Board of Trade Rules on, 329, 351
Life Saving Appliances, New Rules for, 180
Light, The Present Standard of, 181
Light Adjuster, Boult's Tricord, 185*
Lighting, Electric (see Electric Lighting)
Lighthouse Illuminants, 446
Lightning Conductors from a Modern Point of View, 570
Lightning, Protection of Chimney Shafts from, 289
Lineff's Electric Tramway, 616
Lister's Screwing Machine, 569*
Liverpool, Dock Improvements at, 560*
Liverpool Engineering Society, 612
Lloyd's Committee of Shipbuilding, 252, 423
Lloyd's Register of Shipping, 134
Load Line Act, The, 613
Load Line Bill, The Compulsory, 230
Lock, Biggs' Tubular, 496*
Locomotive for Mines, Electric, 209*
Locomotive, Worsdell's Compound Passenger, 28*
Locomotives in Russia, Compound, Paper read by T. Urquhart before the Institution of Mechanical Engineers, 169*
Loop, Burnham's Steam, 601*
Lubricant Tester, Boult's Cylinder, 149*
Lubricator for Dynamine, 224*
"Lukin," Lathe The, 193*
Lyon's Improvements in Slide Valves, 272*

Machinery from Rating, Exemption of, 206, 543
Magnetic Phenomena, 210
Manchester Association of Engineers (see Engineers, Manchester Association of)
Manchester Ship Canal during 1889, Progress of the, 32
Marine Engineers, Institute of (see Engineers, Institute of Marine)
Mannesmann Process for Making Seamless Tubes, 569
Manwell's Ready Life Saver, 581*
Mather & Platt's Alternating Current Dynamo, 64*
Mauricewood Disaster, Report on the, 302
Mechanical Engineers, Institution of (see Engineers, Institution of Mechanical)
Meldrum's Breeze Furnace, 580*
Merchant Service, Efficiency in the, 278
Meteorological Society, Royal, 182
Mexico, British Investments in, 278
Midgley's Boiler Flues, 128*
Miley's Tapping Tool, 290*
Military and Naval Departments, Report on the, 422
Milk Factory, Swiss Condensed, 547*
Mill Disaster, The Templeton, 182
Miners and Papermakers, Arbitration Among Scotch, 86
Mines, Electric Locomotive for, 209*
Mining Engineers, Federated Institution of, 139, 423
Mining in 1889, 41, 517
Mixer, Welch's Improved, 329*
Morality, Commercial, 158
Morgan & Co. *v.* Windover & Co., 327
Morison's Evaporator and Feed Water Heater, 472*
Moseley's Packing for Engines, 379*
"Mosquito," H.M. Gunboat, 464, 540*
Mullineux's Cartridge, 8*
Mumford & Moodie's Separator, 385*
Musgrave's Triple-Expansion Mill Engine, 123*

Nasmyth, The Late James, 446
Naval Architects, Institution of, 303, 313, 325, 338*, 361*, 385
Naval and Military Departments, Report on the, 422
Navigation, International Congress on Inland, 566
Navy, Appointment of Assistant Engineers in the, 398
Navy, Engines and Engineers of the, 301
Navy Estimates, The, 277
Navy Proposals, American, 86
Navy, Speed of Vessels in Our, 38
New York, Electric Lighting at, 19
New York Electrical Subways, Practical Working of the, 259, 282, 306, 330
New York, The Hudson Tunnel at, 508*
"Newark," United States Cruiser, 440*
Nitrate, Trade in, 212

Oakey *v.* Flatau, 591
Oerlikon Screwing Machine, 5*
Oil Measuring Pump, Dutton's, 497*
Ore Crushing Mill, The Fulton, 409*
Ore Crushing Mill, The Lamberton, 516*
Oxygen Dissolved in Water, Estimation of, 115
Oxygen, Mechanical Appliances Employed in the Manufacture and Storage of, Paper read by K. S. Murray before the Institution of Mechanical Engineers, 219*

Packing Rings, Downie's, 73*
Packing for Engines, Moseley's, 379*
Paper Trade, Hours of Labour and Wages in the, 62
Papermakers and Miners, Arbitration among Scotch, 86
Paris, Electric Supply Stations at, 355
Paris Exhibition, The Late, 416
Parkinson's Drilling Machine, 416*
Patent Statistics, 1864–1889, 74
Patents, Notes on, 62, 121, 147, 219
Patents, The Lane Fox, 473
Petroleum Engine, Butler's Domestic, 464*
Petroleum Engine, Daimler's, 553*
Physical Society, 92, 160, 211, 283, 304, 401, 450, 524, 595
Pickles' Planing, Thicknessing, and Glass Papering Machine, 608*
Pictures by Telegraph, Sending, 195*
Planing Machine, Plate, 132*
Planing, Thicknessing, and Glass Papering Machine, 608*
Pollok's Gold Extracting Process, 161*
Polytechnic Institute for South West London, 300
Post, Imperial Penny, 566
Postal Jubilee, 485
"Princess Victoria," Royal Mail Paddle Steamer, 449
"Prins Willem II.," The s.s., 409*, 433*
Printing Machine, Godfrey Printing Machine Company's, 337*
Printing Machines, Apparatus for Feeding, 378*
Professions, Three Modern, 457
Profit Sharing, 14
Protractor, Draughtsman's, 224*
Pump and Gas Engine, 485*
Pumping Engine, Knight's Direct Acting Hydraulic, 392*
Pump, Dutton's Oil Measuring, 497*
Pumping Machinery for the Japanese Government, 268*
Punching Machine, Bennie's Large Lever, 84*

Railway Accident at Carlisle, 470, 494
Railway and Canal Traffic Act, 158, 206, 398
Railway, Edinburgh Underground, 206, 615
Railway, Girard's Hydraulic, 352*
Railway Rates Inquiry, 38, 470
Railway Sleeper, Improved, 41*
Railway Trucks for Mineral Traffic, Large, 85
Railways and British Traders, British, 494
Railways, Chinese, 109
Railways, Webb & Thompson's Staff Apparatus for Single Line, 104*
Ransome, Sims, and Jefferies' Valve Gear, 77*
Rating of Machinery, The, 206, 543
Rates Inquiry, Railway, 38, 470
Reducing Valve, Reid's, 196*
Retorts, Yeadon & Adgie's Gas, 426*
Richardson's Compound High Speed Engine, 425*
Riveting Plant, 200-ton Hydraulic, 316*
Rochester, Agricultural Show at, 568
Rolling Mills, Jardine's Housing Gear for, 458*
Rosebery on Co-operation, Lord, 518
Royal Institution Lectures for Juveniles, 15, 39
Royal Society's Conversazione, 472, 590
Russian Shipbuilding, 615
Rust-proof Process, Gesner's, 451*

Salt Trade, Outlook in the, 211
"San Francisco," United States Cruiser, 8*
Sand Blast for Cleaning Castings, 128*
Sawing Machine, Watt's Double Band, 461*
Sawing Machines for Heavy Timber, 217*
Sayer's Air Propellers and Blowers, 257*
Schaeffer & Budenberg's "Exact" Governor 42*
Scotch Affairs, 445
Screw Slotting Device, 224*
Screwing Machine, Lister's, 569*
Screwing Machine, Oerlikon, 5*
Screws, Ship Propulsion by Multiple, 278
Scutching Machine, Spiegelberg's Flax, 612*
Separator for Regaining Metallic Turnings, &c., from Refuse, 74*
Separator, Mumford & Moodie's, 385*
Separator, The "Globe," 513*
Separator, Watson, Laidlaw, & Co.'s Cream, 604*
Sewage Treatment, Carbonised Refuse System of, 523*
Sharp's Separator for Regaining Metallic Turnings, &c., from Refuse, 74*
Shepherd, Hill, & Co.'s Tyre Turning Lathe, 605*
Ship Propulsion by Multiple Screws, 278
Ship Structures, Protective Cements and Weight-Saving in, 147
Ships, Loading, Discharging, and Steering, Paper read by A. B. Brown before the Institution of Naval Architects, 339*

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Ships, the Strength of, Paper read by Professor P. Jenkins before the Institution of Naval Architects, 361*
Shipbuilding, Clyde (see Clyde Shipbuilding)
Shipbuilding, Lloyd's Committee of, 134, 252, 423
Shipbuilding, Russian, 615
Shipping Facilities, British Shipping and, 589
Shipping Industry, 134
Shipping, The Chamber of, 182
Siemens Furnace, A New Form of, 75*
Signal Lamps, Dutton's, 608*
Slag, Utilisation of, 140
Slag, Manufacture of Portland Cement from, 402*
Slates, Quality of Roofing, 426
Sleeper for Railways, 41*
Slide Valves, Lyon's Improvement in, 272*
Slotting Device for Screw Heads, 224*
Slotting Machine, Crooks, Roberts, & Co.'s, 481*
Smit's Combined Engine and Dynamo, 348*
Smoke Annihilator, Elliott's, 616
Smyth, The Late Sir Warington W., 615
Snell, The Late W. H., 255
Societies, Recent Growth of Technical, 145, 241
Speed of Vessels in Our Navy, 38
Spencer's Travelling Crane, 248*
Spiegelberg's Flax Scutching Machine, 612*
Staff Apparatus, Webb & Thompson's, 104*
Stanley Cycle Show, The, 104
Statistical Society, The Royal, 585
Steam Jacket, the Experimental Value of the, 579
Steam Loop, Burnham's, 601*
Steel and Pig Iron, Chart Showing Variations of Price During 1889, 68*
Steenbergh's Water Gas, 306*
Stewart, The Late Mr. James, 110
Strikes? Can an Improved Education Prevent, 469
Stuffing Box, Wood's "Universal," 32*
"Stuttgart," Engines of the s.s., 52*
Subway, Proposed Glasgow and District, 39
Suez Canal, The, 588
Sutcliffe's Carriage Wheel Making Machine, 241*
Swiss Condensed Milk Factory, 547*
Switch, Double-pole Two-way, 115*
Syndicated Industries, 565

Tanning of Hides, Electricity as a Hastener in the, 498
Tapping Tool, Miley's, 290*
Tedder, The Haseley, 584*
Telegraph, Sending Pictures by, 195*
Telephone Mouth-Piece, The "Audio," 473*
Templeton Mill Disaster, 182
Testing Machines, Kuhlmann's, 52*
Testing Station at Charlottenburg, German, 425
Thomas's Drilling Machine for Large Boiler Shells, 300*
Thwaite's "Simplex" Gas Generator, 330*
Tilghman's Sand Blast for Cleaning Castings, 128*
Tool Holder, Bent's, 464*
Tower Bridge, The, 584
Tower in London, Proposed Great, 422, 447*, 593*
Trade Marks, Words as, 255
Trade of the Past Year, 13
Traders, British Railways and British, 494
Trades and Crafts, Training for, 146, 193, 266
Tramcar, Hughes & Lancaster's Low-pressure Compressed Air, 267*
Tramcar, Jarman's Electric, 519
Tramway, Lineff's Electric, 616
Tramway, Waller and Manville's Electric, 448*
Transformer, Tests of a Ten-Light, 19
Transvaal, Coal Fields of the, 296
Trucks for Mineral Traffic, Large Railway, 85
Trucks, Patent Folding, 330*
Tubes, Mannesmann Process for Making Seamless, 569
Tunnel at New York, The Hudson, 508*
Tunnel, The Channel, 77
Tunnel under the Clyde, 149

United States Cruiser "Newark," 440*
United States Cruiser "San Francisco," 8*

Valve Gear, Ransome, Sims, and Jefferies', 77*
Valve, Reid's Reducing, 196*
Valves, Lyon's Improvements in Slide, 272*
Ventilators and Blowers, Sayer's, 257*
Verity's Air Propeller, 65*

Wallas' Gradient Indicator for Drains, 128*
Waller-Manville System of Electric Traction, 448*
Warren's Radial Drilling Machine, 196*
Watch and Clock Making, Progress of British, Paper read by Mr. J. Tripplin before the Society of Arts, 290*
Water Supply of Northern Towns, Lead in the, 187
Watson, Laidlaw, & Co.'s Cream Separator, 604*
Watt Anniversary, The, 88
Watt's Double Band Saw Machine, 461*
Webb & Thompson's Staff Apparatus, 104*
Webster's Wood Wool Making Machine, 180*
Welch's Coke Crusher, 553*
Welch's Improved Mixer, 329*
Welding Process, The Electric, 616
Wenström Dynamo, Improved, 281*
Weymersch Primary Battery, 234, 616
Wheel, Carter's Improved Road, 457*
Wheel Making Machine, Carriage, 241*
Wild's Semi-Portable Hauling Engines for Collieries, 252*
Wills in 1889, Industrial, 39
Wire Covering Machine, Barraclough's, 121*
Wire Straightening Machine, Barraclough's, 5*
Wood Wool Making Machine, 180*
Woodhouse & Rawson's Double-pole Two-way Switch, 115*
Wood's "Universal" Stuffing Box, 32*
Worsdell's Compound Passenger Locomotive, 28*

Yarrow's Gunboats for the Zambesi, 464, 540*
Yeadon & Adgie's Gas Retorts, 426*

Zambesi, Gunboats for the, 464, 540*

Signed Contributions.

*(All Contributions marked thus * are Illustrated.)*

Bale, M. Powis
Band Sawing Machines for Heavy Timber, 217*

Dyer, Henry, C.E., M.A.
Training for Trades and Crafts, 146, 193, 266

Lodge, Prof. Oliver J.
Lightning Conductors from a Modern Point of View, 570; Remarks on the Electric Welding Process, 616

Molyneux, C., & Wood, J. M.
The Straightening of Chimney Shafts, 195; The Protection of Chimney Shafts from Lightning, 289

Smith, Prof. R. H.
Graphic Construction of Dynamos and Motors, 42*, 90*, 114*, 139*

Swinburne, J.
Safety in Electrical Distribution, 258, 281

Trotter, Alex. P.
The Heating of Conductors by Electric Currents, 185*

Leading Articles.

Berlin Labour Conference, The, 349
Boiler Legislation, Steam, 37
Budget, The, 397

Chinese Railways, 109
Coal Supply, Duration of Our, 61

Emperor and the Labour Question, The German, 157
Engine, Development of the Steam, 229
Engines, Horse Power of Marine, 421

Forth Bridge, Opening of the, 205
France, Communication Between England and, 541

Industrial Outlook, 353
Iron and Steel, Critical Points of, 493

Labour Movements on the Continent and at Home, 373
Legislation and Industry, 133
Light, The Present Standard of, 181
Lead Line Act, The, 613

Mining during 1889, 517

Naval Architects, Institution of, 325
Navy, Engines and Engineers of the, 301
Navy Estimates, The, 277

Railway Trucks for Mineral Traffic, Large 85

Scotch Affairs, 445
Shipping Facilities, British Shipping and, 589
Strikes? Can an Improved Education Prevent, 469
Syndicated Industries, 565

Trade of the Past Year, 13

Digitized by Google

Reviews.

Analysis, Handbook of Quantitative. By J. Mills and B. North, 425
Assaying, Textbook of. By C. Beringer and J. G. Beringer, 16
Australasian Progress, Half a Century of. By W. Westgarth, 376

Babbage's Calculating Machines, 400
Bridges, American Railroad. By T. Cooper, 592
Builders' and Contractors' Price Book, Lockwood's, 593

Capillar-Analyse. By Prof. F. Goppelsroeder, 449
Chemistry, Dictionary of Applied. By Prof. T. E. Thorpe, 520
Chemistry, Treatise on. By Sir H. E. Roscoe and Prof. Schorlemmer, 520
Civil Engineers, Minutes of the Proceedings of the, 233
Chronological and Heraldic Charts. By I. A. Timmis, 568

Electric Light Installations and the Management of Accumulators. By Sir D. Salomons, 233
Electric Transmission of Energy. By Gisbert Kapp, 424
Electrical Engineering for Electric Light Artizans and Students. By W. Slingo and A. Brooker, 449
Electrical Notes and Definitions, Practical. By W. Perren Maycock, 16
Electrical Trades Directory, The "Electrician's," for 1890, 160
Electricity in Modern Life. By G. W. de Tunzelman, 40
Electrique, Traité Elémentaire de l'Energie. By E. Hospitalier, 233
Electrotechniker, Kalender für. By F. Uppenborn, 233
Empire, Federation of the British. By Sir George F. Bowen, 40
Empire, Future of the. By Alexander Gordon, 40
Engineering Enterprise, Aid Book to. By Ewing Matheson, 593
Engineering Estimates, Costs, and Accounts. By a General Manager, 449
Engineering Popularly and Socially Considered, Civil and Mechanical. By J. W. C. Haldane, 521
Engineers and Shipbuilders in Scotland 1888-9, Transactions of the Institution of, 496
Engineers' Diary and Reference Book for Engineers, Machinists, Contractors, and Users of Steam for 1890, Spon's, 568
Engineer's Handbook, The Practical. By W. S. Hutton, 328
Engineers, Society of; Transactions for 1888, 16
Farbelectrochemische Mittheilungen. By Prof. F. Goppelsroeder, 208

Gas and Petroleum Engines. By William Robinson, 567
Gas Engineers and Managers, Handbook for. By T. Newbigging, 520
Gold Amalgamation and Notes on the Concentration of Gold and Silver Ores. By W. McDermott and P. W. Duffield, 592

Hydraulic Motors: Turbines and Pressure Engines. By G. R. Bodmer, 136

Iron and Steel Institute, Journal of the, No. 1, 1889, 208
Iron, Treatise on the Metallurgy of. By H. Bauerman, 449

Magnetism and Electricity. By A. W. Poyser, 520
Mechanics, Applied. By James H. Cotterill, 328
Mechanics, Elementary Text Book on Applied. By D. A. Low, 472
Metrology, The Science of. By Hon. E. Noel, 328

Navigazione; Naviglio. By Salvatore Raineri, 378
Petroleum, Marine Transport of. By G. H Little, 473
Physics, Alternative Elementary. By J. Mills, 496

Romance of Modern Industry. By J. Burnley, 521

Steam Engine and Indicator. By W. B. Le Van, 377
Steam Engine, Development and Philosophy, of the. By Robert H. Thurston, 16

Technical Education in England and Wales· 616
Thermodynamics, Heat Motors, and Refrigerating Machines. By De Volson Wood, 233
Thermodynamics of the Steam Engine and Other Heat Engines. By C. H. Peabody, 377

Works Manager's Handbook, The. By W. S. Hutton, 328
Workshop, Amateur's. By the Author of "Pattern Making," 208
Workshop Practice, Modern: as applied to Marine, Land, and Locomotive Engines, Floating Docks, Dredging Machines, Bridges, Shipbuilding, Cranes, &c. By J. G. Winton, 160

Notes.

Accidents in New York, Electric, 68, 92
Accumulators, Theory of, 140
Africa, French Railways in, 428
Africa, Mining Machinery in South, 308
African Railways, South, 380
Agricultural Machinery in Russia, 524
Agriculture in Queensland, 524
Algeria, Phosphates in, 620
Algeria, Ramie in, 620
America, Industrial Development of the Southern States of, 284
American Cotton, 596
American Shipping, Subsidies for, 356
Ardrossan Harbour Works, 356
Argentine Securities, 356
Armoury and Brass Work Exhibition, 45, 500
Artillery, Turkish, 500
Atlantic Steamers, New Lines of, 356
Atlantic Steamers, Telegraphic Messages for, 572
Australia, Gold Fields of Western, 524
Australia, Vine Diseases in, 236

Baku Petroleum, 452
Barcelona, Imports at, 548
Bavaria, Industries of, 548
Bell Rock, Explosion at, 356, 404
Benzene Theory, 25th Anniversary of the, 284
Bosphorus, Proposed Bridge Across the, 20, 380
Brass Work and Armoury, Exhibition of, 45, 500
Brazil, Anti-foreign Feeling in, 596
Brazilian Rubber Monopoly, 68
British Association, 548
Butter Shows, 116

Camphor Substitute, Naphthalene as a, 500
Canada, Minerals in, 212
Canal, Corinth, 404
Canal, Forth and Clyde, 164, 188
Canal in Hungary, A New, 116
Canal in Russia, Proposed, 428
Carolina Phosphates South, 452
Catalogues—Telegraph Manufacturing Company, 80; Archibald Smith & Stevens, 80; Crompton & Co., 81; John Birch & Co., 129; Mr. A. E. W. Gwyn, 201; Acme Electric Works, 201; Messrs. Burke & Co., 201; Hetherington & Sons, 609; J. Guthrie & Co., 609
"Challenger" Expedition, The, 476
Chemicals at Genoa, 572
Chicago, Steel Shipbuilding in, 380
Chili, Mining in, 284, 524
Chili, The Trade of, 452
China, Mining in, 572
China, Paper Mills in, 524
China, Postal Arrangements in, 596
China, Telegraphs in, 188
China, Textiles in, 572
Chinese Defences, 164
Chinese Engineering Literature, 212
Chinese Gold Mines, 404
Chinese Telegraph Convention, 452
Clyde and Forth Canal, The, 164, 188
Coal Contracts, Locomotive, 45
Coal Deposits of Europe, 380
Coal, Foreign Output of, 260
Coal in Japan, 380, 452
Coal, Machinery for Cleaning, 116
Coal Owners, Federation of, 188
Colorado, Minerals in, 45
Companies, Law of Limited Liability, 212, 260
Companies in Scotland, Public, 404
Commerce, London Chamber of, 9
Contract, Freedom of, 45
Corea and Japan, 212
Corinth Canal, 404
Cotton, American, 596
Cotton Trade, 20, 92, 212, 236, 308, 572
Cumberland, New Steel Works in West, 356

Damascus, Trade of, 548
Denmark, Proposed New Railway in, 225
Deptford Electric Light Station, 88
Dübs & Co., Semi-Jubilee of Messrs., 116
Dynamo, A Unipolar, 20
Dynamo Design, A New Theory in, 45
Edinburgh Exhibition, 20, 45, 140
Edinburgh, Proposed Underground Railway in, 284
Education, Grants for Technical, 596
Electric Construction Corporation, The, 297
Electric Light, Safety of, 188
Electric Light Station, Deptford, 88
Electric Subways, Ventilating, 45
Electric Targets, Paterson's, 500
Electric Tramways, 116
Electric Tramways, Telephones and, 620
Electrical Contractors, A New Firm of, 236
"Electrical Industries," 45
Electrical Interests, Amalgamation of, 92
Electricity in Japan, 404
Electricity, Safety of, 68, 92
Electromotors in Engine Works, 308
Electromotors, Sprague's, 572
Emery Mines of Greece, 428
Enamel on Tiles, Oriental, 45
Engine Keepers' Association, West of Scotland, 428
Engineers, Institute of Marine, 92
Engines, Semi-portable Hauling, 273
Essen, Krupp Works at, 380
Europe, Coal Deposits of, 380
Exhibitions, Advantages of, 524
Exhibitions and their Tendencies, 68

Facilegraph, Macfarlane's, 164
Fire Brigade Handbooks, 201
Fire, Prevention of, 177
Fisheries of the United Kingdom, 428
Forth and Clyde Canal, The, 164, 188
France, Public Works in, 452, 620
French Exhibition in London, 308
French Navy, The, 212

Galloway's, Description of Boiler Works, 105
Gartsherrie, Technical School at, 188
Gas, Odorising Water, 548
Gas, Oxygenated Oil, 404
Gas Purification, Oxygen Process for, 476
Gas Retort, Automatic, 596
Gas, Steenbergh's Water, 236
Gas Stokers' Strike, The End of the, 164
Genoa, Chemicals at, 572
Glasgow University and the Technical College, 20
Gold Fields of Western Australia, 524
Gold Mines, Chinese, 404
Granite in Sweden, Black, 225
Greece, Emery Mines of, 428
Greece, Public Works in, 596
Gunboats for the Zambesi, 297

"Henry," The, 596
Holyhead, Improvement of the Port of, 500
Hong Kong, Manufactures of, 380
Hungary, A New Canal in, 116

Indiarubber Monopoly in Brazil, 68
"Industries, Electrical," 45
Information, Exchange of, 116
Insulating Varnish, 45
Iron and Steel, Phosphorus in, 116
Ironmongers' Exhibition, 45

Jamaica, Exhibition at, 20
Japan and Corea, 212
Japan, Coal in, 380, 452
Japan, Electricity in, 404
Japan, Foreign Trade of, 284
Japan, Recent Floods in, 20
Japan, Silk Trade of, 428
Japanese Lacquer, 45, 140
Japanese Lacquer for Ships' Bottoms, 140
Johannesburg, State of, 356

Krupp Works at Essen, 380
Kustendje, Public Works at, 596

Labour Conference, Another Proposed, 500
Labour, Hours of, 212
Labour Market, Skilled, 188
Lacquer, Japanese, 45, 140
Languages, Commercial Value of Oriental, 68
Lead, Electrolytic White, 212
Lead Poisoning by Patent Stoppers, 236
Liability Act, Amendments of the Limited 212

Digitized by Google

Liability Companies, Law of Limited, 260
Light, The Standard of, 404
Liverpool Engineering Society, 273
Locomotive Building in New South Wales 380
Locomotive Coal Contracts, 45
London and Southwark Subway, 140

Machinery, Unfenced, 260
McKinley Tariff Bill, The, 548
Madeira, Dry Goods in, 572
Malta as a Coaling Station, 452
Manganese Oxalate as a Dryer, 45
Manure, Basic Slag as an Artificial, 428
Manures, Artificial, 116
Marine Engineers, Institute of, 92
Marshes, Draining the Roman, 386
Mechanical World Pocket Book and Diary, 57
Microscope, Tercentenary of the, 500
Minerals in Canada, 212
Minerals in Colorado, 45
Mining Accidents in 1889, 500
Mining and Metallurgy, Exhibition of, 188
Mining in Chili, 284, 524
Mining in China, 572
Mining Machinery in South Africa, 308
Music, Physical Foundation of, 596

Naphthalene as a Camphor Substitute, 500
Navy, The French, 212
New South Wales, Locomotive Building in, 380
New York, Electrical Accidents in, 68, 92

Oil Gas, Oxygenated, 404
Oil Trade, 92
Omnibus Licences, 9
Ordnance Survey, 476
Oxalate of Manganese as a Dryer, 45
Oxygen Process for Gas Purification, 476
Oxygenated Oil Gas, 404
Ozone, Manufacture of, 308

Palestine, Railway through, 404
Panama, Present Condition of, 332
Pan-American Zollverein, 380
Paper, Detection of Wood in, 260
Paper in the United States, Manufacture of, 548
Paper Makers' Directory, 297
Paper Mills in China, 524
Parker, Presentation to Mr. Thos., 20
Patent Abstracts, 20
Patents in Queensland, 284
Paterson's Electric Targets, 500
Persia, Russian Influence in, 404
Petroleum, Baku, 452
Petroleum, Sulphur Compounds in Crude, 116
Phosphates in Algeria, 620
Phosphates in South Carolina, 452
Phosphorus Compound, A New, 284
Phosphorus in Iron and Steel, 116
Photographic Exhibition at the Crystal Palace, 308
Photography, Engineering, 524
Picric Acid, 620
Pig Iron in the United States, Production of, 284
Pistachio Nuts at Aleppo, Cultivation of, 428
Polish Trade, 548
Polytechnics, The London, 500
Post Office Guide, 45
Postal Arrangements in China, 596
Practical Engineer's Pocket Book and Diary, 80
Printing, Economies in State, 476
Profit Sharing, 68, 548

Queensland, Agriculture in, 524
Queensland, Industries in, 236
Queensland, Patents in, 284

Railway Construction in the United States, 284
Railway in Denmark, Proposed New, 225
Railway in Edinburgh, Proposed Underground, 284
Railway Returns, Scotch, 332
Railway, Sahara, 380
Railway, Siberian, 260
Railway through Palestine, 404
Railways in Africa, French, 428
Railways, South African, 380
Ramie in Algeria, 620
Retorts, Automatic Gas, 596
Review, A New Quarterly, 476
Roman Marshes, Draining, 380
Roumania, Iron and Machinery in, 452
Roumania, Textiles in, 620
Roumanian Industries, 596
Russia, Agricultural Machinery in, 524
Russia, Proposed Canal in, 428
Russian Influence in Persia, 404
Rysselberghe System, The Van, 524

Sahara Railway, The, 380
Salomons Scholarship, The, 236
Salt Field, A Large, 284
Salt in Cheshire, 332
Sanitary Inspectors, Association of, 332
Scholarship, The Salomons, 236
School at Gartsherrie, Technical, 188
Scotch Railway Returns, 332
Scotland Engine Keepers' Association, West of, 428
Scotland, Public Companies in, 404
Screw Thread, Standard Small, 116
Shipbuilding, Foreign, 452
Shipbuilding in Chicago, Steel, 380
Shipbuilding Notes, 8, 32, 81, 129, 176, 224, 256, 280, 321, 345, 393, 417, 465, 489, 513, 537, 585, 608
Shipping, Subsidies for American, 356
Siberian Railway, The, 260
Silk Trade of Japan, 428
Slag as an Artificial Manure, 428
Southwark Subway, City of London and, 140
Sprague's Electromotors, 572
Steamer, Raising a Sunken, 369
Steamers, Mixed Fuel for, 428
Steamers, New Lines of Atlantic, 356
Steamship, A Miniature, 476
Steel and Iron, Phosphorus in, 116
Steel in 1889, Basic, 188
Steel Works in West Cumberland, New, 356
Steenbergh's Water Gas, 236
Subway, London and Southwark, 140
Subways, Ventilating Electric, 45
Suez Canal, The, 452
Suez Canal Traffic, 260, 428
Sulphur Compounds in Crude Petroleum, 116
Sweden, Black Granite in, 225

Tanning, Substitute for Oak Bark in, 45
Targets, Paterson's Electric, 500
Tariff Bill, The McKinley, 548
Technical Education, Grants for, 596
Technical School at Gartsherrie, 188
Telegraph Convention, Chinese, 452
Telegraphic Messages for Atlantic Steamers 572
Telegraphs in China, 188
Telemeter, A New, 68
Telephones and Electric Tramways, 620
Textiles in China, 572
Textiles in Roumania, 620
Thames Tunnel at Blackwall, 200
Tiles, Oriental Enamel on, 45
Trade Combinations, 212
Tramways, Electric, 116
Tramways, Telephones and Electric, 620
Transformers, Safety Apparatus for, 20, 44
Tunnel through Thames at Blackwall, 200
Turkish Artillery, 500

United States, Manufacture of Paper in the, 548
United States, Production of Pig Iron in, 284
United States, Railway Construction in the, 284
United States, Wealth of the, 212

Valves, Improvement in Slide, 177
Varnish, Insulating, 45
Ventilating Electric Subways, 45
Villas, Wooden, 188
Vine Diseases in Australia, 236

Water on Wood at High Temperatures, Action of, 20
Wheat Supply of Britain, 380
Wood at High Temperatures, Action of Water upon, 20
Wood in Paper, Detection of, 260
Wood Supply of Great Britain, 332

Yangtze, Opening of the Upper, 380
Yarrow's Gunboats for the Zambesi, 297
Yokohama, Harbour Works at, 428

Zambesi, Yarrow's Gunboats for the, 297
Zollverein, Pan-American, 380

Letters to the Editor.

Admiralty Dynamo Specification—J. Farquharson, 399
Arrowroot, Machinery for Treating—W. R. Dell & Son, 15

Blasting Gelatine Patents—Patentee, 256
Bleichert's Wire Rope Tramways—Inquirer, 88
Boiler Legislation, Steam—Policy, 63; S. Boswell, 63, 111; Boiler Inspector, 87, 159; John D. Young, 136
Brakes for Goods Trains, Continuous—J. E., 159
British Manufactures on the Continent—Trader, 544, 591; T. R., 567, 616

Carlisle Accident—Pressure, 495
Chair and Sleeper, Improved—J. W. White, 63
Channel Bridge—Speculator, 15
Chilian Government and Import Duties—J. Harris, 87
Chimneys, Wrought Iron—R. M. Bancroft, 615
"City of Paris," Accident to the—George Quick, 399; Marine Engineer, 423
Coal in Kent—F.G.S., 207
Coal Supply, Duration of Our—Black Diamond, 135

Deptford Electric Light Station—F. S., 375

Electric Lighting Plant, A ½-Kilowatt—Ed. C. de Segundo, 591
Engineers, Institution of Mechanical—Thos. Hunt, 471; Marine Engineer, 471

Fog and Atmospheric Electricity—W. H. Daniels, 207
Forth and Clyde Canal, The—Eon Strathaar, 375
Forth Bridge, Steel at the—F. J. R. Carulla, 256
France and England, Communication between—T. C., 40, 136; Eug. Obach, 111; Thomas Davis, 591

Gas, Melting Steel with Water—Gas, 327
Gas Stokers' Disputes—T. M., 15, 39; Chas. W. Rausch.

Howe's Metallurgy of Steel—Metallurgist, 615

Iron and Steel Institute, The—Metallurgist, 495
Italy, Protection in—Tariff, 592

Japan, Production of Coal in—Mitsui & Co., 399
Journals, Friction and Lubrication of Cylindrical—John Goodman, 399

Labour Disputes, Adjustment of—Sir J. Lubbock and K. B. Murray, 159
Lane Fox Patents—C. A. Stephenson, 543 567
Letter Express, A—F. G. Heath, 543
Locomotive Practice—Loco, 256

Machinery, Rating of—F. B., 303
Manchester Ship Canal—Inquirer, 183
Marking of Goods—A. Rose, 87
Mining Engineering, Electricity in—M. E., 135
Mining Machinery for South Africa—S. A., 231
Murdoch, William—A. Murdoch, 111; C. J. W., 183

Naval Architects, Institution of—Sigma, 447

Paris Exhibition, The British Committee of the late—H. Trueman Wood, 303
Piece Work—J. D. W., 495, 567; A. P. Trotter, 519; A Former Mechanic, 543
Pig Iron Warrants—A User of Iron, 519
Platinum for Electrical Purposes—W. M., 279
Plumbago—Galicia, 616

Rack-rented Tradesmen and their Customers—J. Haysman, 231
Railway System, Suggestions for a New Scottish Main—Eon Strathaar, 399, 471; M., 448
Railway Trucks for Mineral Traffic, Large—M. R. Jefferds, 135

Silicon in Iron and Steel—Metallurgist, 183
Silk Exhibition, The—Thos. Wardle, 279
Smit's Combined Engine and Dynamo—An Engineer, 376; L. Chandler, 399
Steatite as a Pigment for Anti-Corrosive Paints—C. Fairholme, 424
Strikes? Can an Improved Education Prevent—J. Stafford Ransome, 544
Sun and Planet Motion—A. Murdoch, 88

Telegraph, Paying Cheques by—H. Rickinson, 375
Then and Now—A Scot in London, 255
Torpedo Boats, English *v.* German—F. W. Crohn, 15
Tramcars, Compressed Air—Car, 327, 375, 471, 544; A. W., 327; Hughes & Lancaster, 351, 424, 519; F. Baines, 398
Transformers, Safety Apparatus for—B. Drake, 40

Welding, Thomson's Electric—N. D. O., 327
Wolseley Sheep Shearing Machine, The—H. E. Macleod, 592

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Supplements.

Index to *Industries*, Twelve-Page Supplement, 10th January, 1890
Compound Passenger Locomotive for North-Eastern Railway, Double-Page Supplement, 10th January, 1890
Forth Bridge Portraits, Four Single-Page Supplements, One Four-Page Supplement, 28th February, 1890
Forth Bridge, General View, Double-Page Engraving, 21st March, 1890
Edinburgh Exhibition, The, Double-Page Engraving, 25th April, 1890.
Some of the Designs for the Great Tower in London, Double-Page Engraving, 9th May, 1890

Miscellaneous.

HOME INDUSTRIES.

Barrow, 11, 35, 59, 83, 131, 179, 203, 227, 251, 275, 299, 323, 347, 371, 395, 419, 443, 467, 491, 515, 539, 563, 587, 611
Belfast, 35, 131, 179, 275, 371, 419, 467, 515, 563, 611
Birmingham, 59
Cardiff, 59, 83, 107, 155, 203, 227, 251, 275, 299, 323, 347, 371, 395, 443, 467, 491, 539, 563, 587, 611
Derby, 11, 155, 299, 491
Dundee, 11, 59, 107, 155, 203, 251, 299, 347, 395, 443, 491, 539, 587
Glasgow, 10, 34, 58, 82, 106, 130, 154, 178, 202, 226, 250, 274, 298, 322, 346, 370, 394, 418, 442, 466, 490, 514, 538, 562, 586, 610
Leeds, 11, 58, 107, 154, 250, 298, 346, 395, 443, 491, 538, 587
Leicester, 35, 83, 131, 179, 227, 275, 323, 371, 419, 467, 515, 563, 611
Liverpool, 10, 34, 58, 82, 106, 130, 154, 179, 203, 226, 250, 275, 298, 322, 346, 370, 394, 418, 442, 467, 490, 515, 538, 563, 587, 610
London, 10, 34, 58, 82, 106, 130, 154, 178, 202, 226, 250, 274, 298, 322, 346, 370, 394, 418, 442, 466, 490, 514, 538, 562, 586, 610
Manchester, 10, 34, 58, 82, 106, 130, 154, 178, 202, 226, 250, 274, 298, 322, 346, 370, 394, 418, 442, 466, 490, 514, 538, 562, 586, 610
Middlesbrough, 11, 35, 59, 83, 107, 131, 155, 179, 203, 227, 251, 275, 299, 323, 347, 371, 395, 419, 443, 467, 491, 515, 539, 563, 587, 611
Newcastle, 11, 35, 59, 83, 107, 131, 155, 179, 203, 227, 251, 275, 299, 323, 347, 371, 395, 419, 443, 467, 491, 515, 539, 563, 587, 611
North Staffordshire, 35, 59, 83, 131, 155, 227, 251, 299, 323, 347, 371, 395, 419, 443, 491, 515, 539, 563, 587
Sheffield, 11, 34, 59, 83, 107, 131, 155, 179, 203, 227, 251, 275, 299, 322, 346, 371, 395, 419, 443, 467, 491, 515, 539, 563, 587, 611
Sunderland, 11, 35, 59, 83, 107, 155, 203, 251, 299, 347, 395, 443, 491, 539, 587
Swansea, 35, 131, 179, 227, 275, 323, 371, 419, 467, 515, 563, 611

FOREIGN INDUSTRIES.

Amsterdam, 7, 31, 54, 78, 103, 126, 151, 174, 199, 223, 247, 271, 295, 319, 343, 367, 391, 414, 439, 463, 487, 510, 535, 559, 583, 606
Copenhagen, 7, 31, 55, 79, 103, 127, 151, 175, 199, 223, 247, 271, 295, 319, 343, 367, 391, 415, 439, 463, 487, 510, 535, 559, 583, 607
Berlin, 6, 30, 54, 78, 102, 126, 150, 174, 198, 222, 246, 270, 294, 318, 342, 366, 390, 414, 438, 462, 486, 510, 534, 558, 582, 606
Brussels, 6, 30, 54, 78, 102, 126, 150, 174, 198, 222, 246, 270, 294, 318, 342, 366, 390, 438, 462, 486, 558, 582, 606
Düsseldorf, 6, 30, 54, 78, 102, 126, 150, 174, 198, 222, 246, 270, 294, 318, 342, 366, 390, 414, 438, 462, 486, 510, 534, 559, 582, 606
Lille, 7, 30, 54, 78, 103, 126, 150, 174, 198, 222, 246, 271, 294, 319, 342, 367, 391, 414, 438, 463, 487, 510, 535, 559, 583, 606
Madrid, 7, 55, 79, 103, 127, 151, 175, 199, 223, 247, 271, 295, 319, 343, 367, 391, 415, 439, 463, 487, 511, 535, 559, 583, 607
New York, 7, 31, 55, 79, 127, 151, 175, 199, 223, 247, 271, 295, 319, 343, 367, 391, 415, 439, 463, 487, 511, 535, 559, 583, 607
Paris, 6, 30, 54, 78, 102, 126, 150, 174, 198, 222, 246, 270, 294, 318, 342, 366, 390, 414, 438, 462, 486, 510, 534, 558, 582, 606
Philadelphia, 295, 319, 367, 415, 439, 463, 511, 535, 559, 583, 607
Vienna, 6, 30, 54, 78, 102, 126, 150, 174, 198, 222, 246, 270, 294, 318, 342, 366, 390, 414, 438, 462, 486, 510, 534, 558, 582, 606

NOTICES OF MEETINGS.

9, 33, 57, 81, 105, 129, 153, 177, 201, 225, 249, 273, 297, 321, 345, 369, 393, 417, 441, 465, 489, 513, 537, 561, 585, 609

PRICES CURRENT.

9, 33, 57, 81, 105, 129, 153, 177, 201, 225, 249, 273, 297, 321, 345, 369, 393, 417, 441, 465, 489, 513, 537, 561, 585, 609

FOREIGN TELEGRAPHIC ADVICES.

9, 33, 57, 81, 105, 129, 153, 177, 201, 225, 249, 273, 297

BOOKS RECEIVED.

16, 136, 160, 208, 328, 376, 519, 592

Patents.—Subject Matter.

(*All Abstracts marked thus * are Illustrated.*)

Accumulator Plates, 287
Accumulators, Electric Switch for, 456
Acid Resisting Lining for Barrels, 240
Air Compressors, 214*, 431*
Air Propellers, 71, 119*, 142, 286, 335, 384
Alcohol, Rectifying, 24
Aluminium, 240, 504
Aluminium Alloys, 480
Ammonium Calcium Phosphate, 240
Anchors, 214
Annealing Furnaces, 384
Annunciator, Electric, 312
Anti-Friction Rings, 264
Arc Lamps, Electric, 168*, 408*, 456, 528*
Armour Plating, 47, 382
Axles, Manufacture of, 190*

Bark Mills, 431*
Barrels to Resist Acids, Lining, 240
Bars, Cutting Metal, 311
Batteries, Primary, 360, 456
Battery Plates, Secondary, 287
Bearings, 190, 287, 454, 480
Bearings, Thrust, 215
Bell, Electric, 144
Bells for Signalling, 95, 456
Belts, Driving, 72
Bending Plates, 118
Bends, Flexible, 359
Bleaching Fabrics, 72
Blowers, 71, 119*, 142, 286, 335, 384
Boats, Ferry, 286
Boats, Paddle, 119
Bobbins, 190
Boiler Tube Stoppers, 215, 335
Boilers, Removing Scale from, 71
Boilers, Steam, 72, 96*, 142, 143, 239, 311, 334, 382, 430, 624*
Bolts and Nuts, Shaping, 287*
Boot Machinery, 407*, 455
Bottle Washing Machine, 432*
Braces, Ratchet, 312
Brake for Hoisting Apparatus, 46, 71
Brakes, Railway, 406, 527*, 576
Branding Machines, 551*
Brewing, Preparing Cereals for, 527*
Brick Making Machines, 71*, 430
Bronze, Silicon, 192
Buffers, 215, 407

Cables for Electric Conductors, 120
Calcining Furnaces, 263*
Calcium Phosphate, Ammonium, 240
Calendering Apparatus, 359
Canal Boats, Propelling, 552
Capstans, 598*
Carbonic Acid, Collecting, 384
Carding Engines, 46*, 166, 358*, 478
Carding Flats, 287
Carding Flats, Grinding, 334
Carding the Backs of Cords, 191
Casting Metals, 311*, 527
Casting under Pressure, 382*
Cellulose, Sulphite, 72
Centrifugal Dye Extractors, 48, 215*
Centrifugal Separators, 216, 478*, 574
Chain and Rope Gearing, 287
Chain Gearing, 622
Chains, Manufacture of, 311*
Chlorine, 120, 288*
Circular Form, Reducing Bodies to a, 479*
Clipping Animals, Apparatus for, 310*
Cloth, Apparatus for Treating, 263*
Cloth, Cooling, 120
Clutch, 359
Coal Screening and Breaking Apparatus, 239
Coal Waggons, Loading, 526*
Cock, Gas, 576
Coir Yarn Mat Machinery, 455*
Coke Ovens, 384
Colliery Tub Wheels, 382
Colouring Matters, 24, 144, 168, 192, 312, 384, 456, 528
Combing Machines, 22*, 94*, 527
Compressors, Air, 214*, 431*
Condensers, 168
Conductors, Cables for Electric, 120
Conductors, Conduits for Electric, 240, 600
Conductors, Supporting Electric, 456
Conductors, Testing Electric, 192
Conduits for Electric Conductors, 240, 600
Conveyer, Screw, 167
Conveyers, Grain, 71
Copper, 288
Copper and its Alloys, 240
Copper, Coating Iron with, 336
Cork Making Machines, 598*
Corliss Valves, 239
Corrosion, Material for Preventing, 336
Cotton, Drying, 239
Couplings, Railway, 334*, 407, 526
Cranes and Turntables, 262
Cranes, Hydraulic, 118*
Cranes, Safety Valve for Hydraulic, 46
Crank Pins, Adjustable, 382*
Crushing Mills, 144, 167, 190, 215*, 239, 286*
Cushioning Devices, 430
Cut-outs, Electric, 480*, 600*
Cutting Metal Bars, 311
Cutting Metals, 167
Cyanogen Compounds, 120

Damping Warps in Looms, 94, 310
Decorticating Ramie, 623*
Despatch Apparatus, Electromagnetic, 168*
Dies for Rolled Forgings, 263
Disinfecting Fluids, Diffusing, 552
Distillation, Fractional, 168
Distributor, Pneumatic, 214
Drain Openings, Covers for, 22
Draining Land, 120*
Drawing Metals, 336
Dredgers, 71*, 142, 238*
Drills, Rock, 71*, 166*, 214, 575, 622
Driving Belts, 72
Drying Apparatus, 455*
Dust Collector, 359
Dye Extractors, 48, 215*
Dyeing and Printing Fibres, 192
Dyeing Yarns, 360
Dynamometers, 431*
Dynamos, 48, 48*, 384*, 432*, 504*, 504, 600
Dynamos, Regulating, 360*

Eccentrics, Adjustable, 382*
Electric Arc Lamps, 168*, 408*, 456, 528*
Electric Alarm for Pressure Gauges, 576
Electric Annunciator, 312
Electric Bell, 144
Electric Cables, 120
Electric Circuits, Interrupting, 552*
Electric Conductors, 192
Electric Conductors, Conduits for, 240, 600
Electric Conductors, Supporting, 456
Electric Control for Steam Steering Gear, 240*
Electric Cut-outs, 480*, 600*
Electric Firing Apparatus, 432
Electric Firing Fuses, 360
Electric Furnaces, 528*
Electric Incandescent Lamps, 120, 144, 312, 360, 504, 624
Electric Instruments, Bases for, 191
Electric Lamp Holders, 72
Electric Meters, 168, 191, 312*, 360*
Electric Railways, 72, 191, 336, 552

Digitized by Google

Electric Regulation, 96, 144, 264*, 360*, 408* 624*
Electric Signalling Lamps, 264*
Electric Switch for Accumulators, 456
Electric Switches, 120*, 168, 168*, 383, 504
Electric Transformers, 383
Electric Welding, 288*
Electricity on Railway Trains, Generators of, 264
Electrolysis, 408*
Electromagnetic Despatch Apparatus, 168*
Electromechanical Movements, 480
Electromotors, 192*, 432*, 504*, 528
Electromotors, Regulating, 408*
Elevators (see Lifts and Hoists)
Elevators for Grain, 575*
Engine for Terrestrial and Aërial Propulsion, 406*
Engines, Gas, 23*, 46, 48*, 119, 119*, 143*, 166, 167, 191*, 287, 311*, 336, 358*, 359, 407*, 430*, 527*, 550*, 575
Engines, Hot Air, 622*
Engines, Petroleum, 144*, 430*, 550, 574, 575
Engines, Rotary, 71, 216*, 262*, 335*, 383*, 406*, 527*, 550*
Engines, Steam, 24, 167, 214*, 215, 238*, 263, 287*, 311*, 334*, 336*, 574*, 576, 624
Engines, Steam and Air, 382*, 407*
Ensilage, 384
Ethers, Para-amidophenol, 144
Evaporating Apparatus, 22*, 96*, 600
Excavators, 71*, 142, 238*
Explosives, 192, 240

Fans, 71, 119*, 142, 286, 335
Fans, Electrically Driven, 384
Feed Water Heaters, 576
Feed Water, Purifying, 239*, 454*, 503
Feed Water, Regulating, 455
Ferry Boats, 286
Filaments for Electric Lamps, 336
Filter Presses, 70*, 383, 384, 504
Fire Damp, Indicating Presence of, 312
Fire Escapes, 72, 216*
Fire Extinguishing Sprinklers, 142*
Firing Apparatus, Electric, 432
Flanges, Pipe, 335
Flanging and Shaping Metal Plates, 239
Flats, Carding, 287
Flats, Grinding Carding, 334
Fly Wheels, 263
Fog Signals, 480, 526
Forgings, Dies for Rolled, 263
Friction Gearing, 622
Fuel, Machines for Making Block, 359*, 408
Furnaces, Annealing, 384
Furnaces, Boiler, 23, 168*, 262, 336, 478, 502, 502*, 503, 551, 574, 623*
Furnaces, Calcining, 263*
Furnaces, Electric, 528*
Furnaces, Gaseous Fuel, 70*, 120
Furnaces, Iron and Steel, 120
Furnaces, Liquid Fuel, 118*
Furnaces, Locomotive, 287
Fuses, Electric Firing, 360

Galvanometers, 480*
Gangways, Ships', 431
Gas Cock, 576
Gas Engines (see Engines, Gas)
Gas Lamps, Regenerative, 24*
Gas, Manufacture of, 24*, 47, 455, 575
Gas Producers for Marine Boilers, 120
Gas Retorts, 575
Gas, Water, 264
Gases, Altering the Proportion of Mixed, 431*
Glass Lined Tubes, 479
Glass, Ribbed, 550
Glass Tanks for Acids, 552
Gold and Silver, Extraction of, 24, 360*, 432, 456*
Governors, 118*, 430
Grain Conveyers, 71
Grain Elevators, 575*
Grain Separators, 71
Grinding Rollers, 24
Guns on Railways, Working, 622
Guns, Turret Mounting for, 551*

Hackling Machines, 263*
Hammers, Steam, 166, 623*
Hand-Driving Mechanism and Treadle Combined, 478
Heating Apparatus, 430, 479, 504
Heeling Machines, 191
Hoisting Apparatus, Brake for, 46, 71
Hoists, 47, 47*, 454
Hydraulic Transmission of Power, 336

Incandescent Electric Lamps, 120, 144, 312, 360, 504, 624
Indiarubber, Substitute for, 192
Injectors for Raising Acid Liquors, &c., 70*
Insulators, 287
Interlocking Apparatus for Railways, 142*
Iron and Steel Furnaces, 120
Iron Bars, Piling Wrought, 166
Iron Carrier and Breaker, Pig, 336
Iron, Extraction of, 288
Iron, Homogeneous, 288
Iron Wires, Coating, 336
Iron with Copper, Coating, 336
Ivory, Substitute for, 336

Jacks, Lifting, 143*, 503
Jacquard Cards, Reading and Punching, 118
Journal Boxes, 119

Knitting Machines, 191*

Lace, Stretching, 383
Lamp Holders, Electric, 72
Lamps, Electric Arc, 168*, 408*, 456, 528*
Lamps, Electric Incandescent, 120, 144, 312, 360, 504, 624
Lamps, Electric Signalling, 264*
Lamps for Railway Carriages, 72
Lamps, Miners', 528*
Lamps, Regenorative Gas, 24*
Lathes, 190*, 216, 239, 263
Lathes for Stone, 46
Lead, White, 24, 312, 384
Leather Rolling Machine, 96*
Leather Skiving Machines, 478*
Lifts and Hoists, 47, 454
Lifts, Hydraulic, 23*, 71, 623*
Lightning Arresters, 264*
Liquids, Separating Solids from, 167*
Lock Nut, 238, 262
Locomotive Furnaces, 287
Locomotives, 358
Locomotives, Compound, 22*
Locomotives for Towing Purposes, 503*
Log, Ship's, 431*
Looms, 22, 48, 94, 95*, 119, 168, 263, 286, 310, 334*, 335*, 382, 431, 502, 526*, 551*, 599
Lubricators, 118, 142*, 190*, 407, 431, 478, 599

Magnesium Chloride and Oxychlorides, 504
Magneto-electric Machines, 216
Malt, Cleaning, 574*
Malt, Making and Drying, 576
Mat Machinery, Coir Yarn, 455*
Mercaptan, Ethyl, 384
Metallic Coverings, Flexible, 239*
Metals, Cutting, 167
Meters, Electric, 168, 191, 312*, 360*
Meters, Liquid, 551*
Milk, Purifying and Preserving, 384
Milling Cutters, 216
Milling Machine, 430
Milling Tools, Apparatus for Cutting, 94*
Miners' Safety Lamps, 528*
Motive Power, Obtaining, 95*
Mules, 263, 383*

Nut Locks, 238, 262
Nuts and Bolts, Shaping, 287*

Oil Presses, 550*
Oils, Distilling, 552*
Ores, Treating, 192, 504*
Ores, Washing, 144

Packing for Piston Rods, 622
Paddle Wheel Boats, 119.
Petroleum Engines (see Engines, Petroleum)
Petroleum Tanks, 526
Phonographs, 312
Phosphate, Ammonium Calcium, 240
Phosphorus, 576
Pickle, Waste Sulphuric Acid, 264
Pig Iron Carrier and Breaker, 336
Piling Wrought Iron Puddle Bars, 166
Pipe Flanges, 335
Piston Rings, 479*
Piston Rods, Packing for, 622
Pistons, 118, 574*
Plates, Armour, 47, 382
Plates, Bending, 118
Plates, Flanging and Shaping Metal, 239
Ploughs, Snow, 600*
Pneumatic Distributor, 214
Posts, Fixing, 600
Potassium and Sodium Hydrates, 264
Power, Hydraulic Transmission of, 336
Power, Obtaining Motive, 95*
Presses, 23*, 502*, 503*
Presses for Extracting Oil, 550*
Presses for Plastic Substances, 550
Presses for Pulp, 600
Presses, Hydraulic, 432*
Pressure Gauges, 575, 576
Printing and Dyeing Fibres, 192
Printing Machines, 70
Printing Telegraphs, 120
Propeller Shafts, Screw, 238
Propellers, Appliance for Removing Screw, 94
Propellers, Governing Screw, 526*
Propellers, Screw, 94, 168, 215, 406, 456
Propelling Ships, 311, 359*, 574, 622
Pulley Blocks, 143
Pulleys, 622
Pulleys, Split, 358
Pulleys upon Shafts, Securing, 310
Pulverisers, 144, 167, 190, 215*, 239, 286*
Pump, Air, 406
Pumping Engines, 214*, 215, 262, 359*, 479, 552, 575, 576
Pumps, 335, 454, 622
Pumps and Fans, Centrifugal, 71, 119*, 142
Punkahs, Apparatus for Working, 47

Railway Brakes, 406, 527*, 576
Railway Couplings, 334*, 407, 526
Railway Signalling, 287, 288, 335
Railway Switches, 239
Railway Wheels, 599
Railway Trains, Generation of Electricity on, 264
Railways, Electric, 72, 191, 336, 552
Railways for Ships, 95
Railways, Indicating Names of Stations on, 264
Railways, Interlocking Apparatus for, 142*
Railways, Permanent Way of, 48, 95, 166, 239, 288
Railways, Working Guns on, 622
Ramie Machinery, 623*
Ratchet Braces, 312
Reaping Machines, 383*
Reciprocating into Rotary Motion, Converting, 239
Reciprocating Rotary Motion, 142
Refrigerating Chambers, 47
Refrigerating Machines, 215, 430
Regulation, Electric, 96, 144, 264*, 360*, 408*, 624*
Retorts, Gas, 575
Rings, Anti-friction, 264
Rock Drills, 71*, 166*, 214, 575, 622
Rolled Forgings, Dies for, 263
Rollers, Coverings for, 142
Rollers, Grinding, 24
Rolling Mills, 94*, 119, 311
Rolling Seamless Tubes, 166*
Rope and Chain Gearing, 287
Rope Driving Gear, Reversible, 119
Ropes, Hemp, 480
Ropes, Wire, 118
Rotary Engines (see Engines, Rotary)
Rotary Motion, Converting Reciprocating into, 239
Rotary Motion, Reciprocating, 142
Rudders, Duplex, 359

Sand Blast Machinery, 95*, 190, 238*
Sawing Machinery, 48, 527
Sawing Stone, 575*
Saws, Veneer, 94
Scale from Boilers, Removing, 71
Screening and Breaking Coal, 239
Screw Conveyer, 167
Screw Cutting Lathes, 239
Screw Threads, Forged, 574
Scutching Machines, 286, 310*, 479*
Separators, Centrifugal, 216, 478*, 574
Separators for Grain, 71
Shaping Machines, 239, 383
Shearing Animals, Apparatus for, 310*
Ship Railways, 95
Ships, 214, 336, 479
Ships' Bottoms, Protecting, 528
Ships' Gangways, 431
Ships, Propelling, 311, 359*, 574, 622
Ships, Raising Sunken, 143
Ships, Signalling Between, 430
Signal Bells, 95, 456
Signalling Between Ships, 430
Signalling Lamps, Electric, 264*
Signalling, Railway, 287, 288, 335
Signalling upon Steamships, 288
Signals, Fog, 480, 526
Silicon Bronze, 192
Silk, Artificial, 120
Silk Winding and Drawing Machines, 239
Silver and Gold, Extraction of, 360*, 456*
Slag, Utilisation of, 576
Sleepers and Chairs, Railway, 95
Smoke Consumers, 598*
Snow from Streets, Removing, 216
Snow Ploughs, 600*
Sodium and Potassium Hydrates, 264
Solids from Liquids, Separating, 167*
Sounding Apparatus, 335*
Speaking Tubes, 72, 432
Spindle Bearings, 120
Spinning Machines, 118, 262*, 286, 407*, 454* 599*
Spring Making Machines, 48*
Springs, Laminated, 407
Sprinklers, Fire Extinguishing, 142*
Stamping Machines, 23*
Starting Vehicles, 214*
Steam, Drying, 624
Steam Engines (see Engines, Steam)
Steam Traps, 95*, 262, 502
Steamships, 336
Steamships, Reversible, 574
Steamships, Signalling upon, 288
Steel, 384, 431, 455
Steel and Iron Furnaces, 120
Steel Tubes, Hardening, 240
Steering Gear, 359
Steering Gear, Electrically Controlled Steam, 240*
Steering Gear, Steam, 47, 311*, 599
Stokers, Mechanical, 238, 286, 623*
Stone Breaking Machinery, 22*
Stone, Lathes for, 46
Stone Sawing Machines, 575*
Stone, Tools for Working, 119*
Stoppers, Boiler Tube, 215, 335
Sulphuric Acid Pickle, Waste, 264
Sunken Ships, Raising, 143
Switch for Accumulators, Electric, 456
Switches, Electric, 120*, 168, 168*, 383 504
Switches, Railway, 239

Tanks for Acids, Glass, 552
Tapping Tool, 310*
Telegraphs, Printing, 120
Telephone Mouth Pieces, 216
Telephone Transmitters, 287
Telephones, 96*
Telephones, Water, 408*
Textile Fabrics, Finishing, 598*
Theatre Doors, Controlling, 600
Thrashing Machines, 70
Thrust Bearings, 215
Tides, Obtaining Motive Power from, 24
Tinplate Mills, Grinding the Rolls of, 119
Tinplate Scrap, Treatment of, 576
Tinplates, 216, 240*, 526*, 528
Tramcars, Restarting, 502*
Tramway Engines, 311*
Tramway Points, 48, 286
Transformers, Electric, 383
Transmission of Power, Hydraulic, 336
Traps, Steam, 95*, 262, 502
Treadle and Hand Driving Mechanism, 478
Tube Stoppers, Boiler, 215, 335
Tubes, Flexible Metallic, 478
Tubes, Forming and Polishing, 72*
Tubes, Glass Lined, 479
Tubes, Hardening Steel, 240
Tubes, Manufacture of Metallic, 455*
Tubes, Rolling Seamless, 166*
Tubes, Speaking, 72, 432
Turbines, 167*
Turbines, Percussion, 216
Turbines, Steam, 358
Turn-Tables and Cranes, 262
Tuyeres, 167*, 407, 478
Twisting Machine, Wire, 143*
Twisting Yarn, 454*

Valve, Air, 240
Valve Gear, 191, 286*, 503*, 527
Valve, Mixing and Suction, 72
Valves, Corliss, 239
Valves, Gate, 95
Valves, Slide, 22, 143, 479, 502
Vehicles, Starting, 214*
Velocipede, Water, 551
Veneer Saws, 94
Vices, 214

Waggons, Loading Coal, 526*
Warp Balling Machine, 599*
Warping Machines, Sectional, 382*
Washing Bottles, Machine for, 432*
Water, Softening and Clarifying, 96
Welding, Electric, 288*
Wheels, Colliery Tub, 382
Wheels, Fly, 263
Wheels, Gear, 214
Wheels, Railway, 599
Winding Yarn, 406
Wire, Coating Iron, 336
Wire Ropes, 118
Wire Straightening and Cutting Machine, 551*
Wire Twisting Machine, 143*
Wire with Cotton, Covering, 47*
Wringing Machines, 216

Yarn, Twisting, 454*
Yarn, Winding, 406
Yarns, Dyeing, 360

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Names of Patentees.

Abel, C. D.—Colouring Matters (Actiengesellschaft für Anilinfabrikation), 24, 312; Propeller Shafts (Gas Motoren Fabrik Deutz), 238
Ackermann, A.—Dynamometers, 431*
Adams, M. J.—Gas Engines, 119
Adler, C., and another—Signalling Trains, 288
Aiken, H.—Manufacture of Railway Axles, 190*; Casting Ingots, 311*
Allan, J., and others—White Lead, 312
Alley, S.—Treating Metallic Ores, 504*
Amoroso, F. F. (see Haddan, H. J.)
Anchill, F. W., and another—Grain Elevators, 575*
Andersen, F. V.—Galvanometers, 480*
Anderson, R. W.—Lubricators, 142*
Andrews, T.—Screws for Furnace Feeding, 238
Anilinfabrikation, Actiengesellschaft für (see Abel, C. D.)
Appleberg, J. T.—Purifying and Preserving Milk, 384
Archbutt, L., and another—Softening and Clarifying Water, 96
Archer, T., and others—Signalling upon Steamships, 288
Armitage, A., and another—Apparatus for Cooling Cloth, 120
Armstrong, J.—Glass Tanks for Batteries, 552
Ashworth, J., and another—Looms, 599
Atherton, J.—Wire Twisting Machine, 143*
Atkins, E. E., and another—Oil Lamps for Railway Carriages, &c., 72
Atkinson, L. B.—Electric Motors, 528
Atkinson, T., and another—Damping Warps in Looms, 94

Babo, A.—Chain Gearing, 622
Baker, J. S.—Paddle Wheel Boats, 119
Bamberg, G.—Alloys of Aluminium, 480; Aluminium, 504
Banfield, R. C. A.—Refrigerating Chambers, 47
Bang, I., and another—Coating Plates with Tin, 528; Treatment of Tinplate Scrap, 576
Bangs, E. D.—Lubricators, 118
Banner, S.—Lubricating Apparatus, 190*
Bannister, M. C.—Refrigerating Machines, 215*
Barber-Starkey, W. J. S.—Electric Cut-outs, 480*
Barker, F.W.—Driving Belts (Nichols F.W., & Ingersoll, J. E.), 72
Barlow, J.—Chucks for Lathes, 263
Barn, J. N. (see Thompson, W. P.)
Barnett, G.—Recovering Sunken Vessels, 143
Barraclough, T. C.—Covering Wire with Cotton, &c., 47*
Barthel, A. E.—Production of Homogeneous Iron, 288
Bass, T.—Ratchet Braces, 312
Bastow, S.—Sawing Machinery, 527
Baumgartner, R. A.—Cleaning Malt, 574*
Bayer, F., & Co. (see Willcox, B.)
Bear, T. M., and another—Shaping Machines, 383
Beaumont, W.—Centrifugal Pumps, 142
Becher, J. M. (see Justice, P. M.)
Beckfield, J. C., and another (see Lake, H. H.)
Beckwith, J. H., and another—Slide Valve Gear, 502
Bell, T.—Lining Barrels to Resist Acids, 240
Bénier, L.—Steam Engines, 334*
Benson, W. A. S.—Supporting Electric Conductors, 456
Berkefeld, H. W.—Cleansing Filters, 383
Berry, B., and another—Picking-Stick Tappets of Looms, 382
Berry, F. H.—Electric Bell, 144
Bilharz, O. (see Dymond, G. C.)
Bird, E. E.—Wire Ropes, 118
Birkbeck, H.—Grinding Mills (Jones, J. & A. J.), 144
Blair, W.—Propelling Vessels, 311
Blass, E., and another—Water Gas, 264; Altering the Proportion of Mixed Gases, 431*
Bleasdale, H.—Rotary Engines, 527*
Blendorf, A. S. von, and another—Signalling Trains, 280
Bohnen, L., and another—Rotary Engines, 383*
Bond, B. R.—Spindle Bearings, 120
Bontemps, L., and another (see Boult, A. J.)
Bontet, P., and another (see Boult, A. J.)
Bookwalter, J. W. (see Boult, A. J.)

Booth, J.—Machines for Knitted Pile Fabrics, 191*
Boult, A. J.—Gas Motors (Capitaine, E.), 167; Compressed Air Generators (Bontemps, L., & Bontet, P.), 431*; Converters for Metal (Bookwalter, J. W.), 455
Boulton, J. W.—Steam Generators, 382
Bour, E. F.—Water Velocipede, 551
Bower, J.—Appliance for Removing Screw Propellers, 94
Bowron, G.—Magneto-Electric Machines, 216
Boyd, J.—Spinning and other Machinery, 262*
Boys, C. V.—Insulators, 287
Bradford, T.—Water-Heating Apparatus, 430
Brassington, J. T., and another—Rolling Mills, 94*
Brearley, A. & R.—Apparatus for Treating Cloth, 263*
Briggs, D. B., and another—Picking-Stick Tappets of Looms, 382
Brindle, J., and others—Carding the Backs of Cords, &c., 191
Brindley, J.—Steam Vacuum Pumps, 552
Brocklehurst, H., and another—Indicating Stations, &c., 288
Bronner, P.—Manufacture of White Lead, 384
Brooke, M. E., and another—Fog Signals, 480
Brotherhood, P.—Slide Valves, 479
Brown, A.—Steam Ferry Boats, 286
Brown, A. G.—Steam Dryer, 624
Brown, C. H., and another (see Sloan, R. A.)
Brown, E. V.—Bark Mills, 431*
Brown, J. W., and another—Steam Engine Governors, 430
Brüngger, H., and another—Sulphite Cellulose, 72
Brutton, R. H., and another—Starting Gas Engines, 287
Bryden, W., and another—Self-acting Mules, 263
Budd, G. W., and another—Lathes, 190*
Bull, J. C.—Petroleum Engines, 574
Bullough, J.—Carding Engines, 358*
Burges, G., Jun.—Bottle Washing Machinery, 432*
Burleigh, W. F.—Interlocking Apparatus for Railways, 142*
Burnell, R. A.—Primary Batteries, 456
Burrow, J., and another—Tramway Points, 286
Butler, W. F.—Colliery Tub Wheels, 382

Caldwell, E. P. (see Thompson, W. P.)
Callard, P. & V. (see Thompson, W. P.)
Cannon, W. G.—Hot Water Coils, 479
Cant, B. C. C.—Electric Indicators, 312
Capeyron, C.—Steam Engines, 287*
Capitaine, E. (see Boult, A. J.)
Carbonnier, G. (see Pass, E. de)
Carey, A. E., and another—Turbines, 167*
Carey, R., and another—Hydraulic Cranes, 118*
Carlton, S. W.—Buffers, 215
Carson, and another—Boiler Furnaces, 623*
Carter, H. M., and others—Briquette Machinery, 408
Carter, T., and another—Apparatus for Cooling Cloth, 120
Casella, L., & Co. (see Pitt, S.)
Casey, J., and others—Tanks for Storing Petroleum, 526
Casper, E., and another—Gas Engines, 336
Cawley, G.—Vertical Boilers, 624*
Chaize, N. & J. (see Heys, W. E.)
Challen, S. W., and another—Power Presses, 23*
Chambers, A. M., and another—Coke Ovens, 384
Charlton, T., and others—Tanks for Storing Petroleum, 526
Cheetham, W. J., and another—Double-Lift Jacquards for Looms, 502
Chenhall, J. S. & J. W.—Grinding Mills, 215*
Chevalet, L. A.—Purifying Feed Water, 503
Christie, R. C.—Rolling Screw Threads, 574
Cito, J. P., and another—Lifting Jack, 503
Clark, A. M.—Anti-Friction Rings (Ladd, J. J.), 264
Clark, W.—Electrically Controlled Steam Steering Gear (Schuckert, S., & Co.), 240*
Clarke, C., and another—Speaking Tubes, 72
Clarke, J. A.—Compound Engines, 336*
Clarke, J. H.—Railway Tracks, 166

Clarkson, G. J.—Rotary Engines (Fisker, R. C.), 550*
Clegg, D.—Locomotive Furnaces, 287
Clegg, J.—Self-acting Mules, 383*
Clegg, R.—Finishing Textile Fabrics, 598*
Clemenson, J.—Railway Wheels, 599
Clements, F., and another—Machine for Draining Land, 120*
Cleminson, J.—Brake Gear for Railways, &c., 406
Clerk, A.—Navigable Vessels, 479
Cleveland, F. W., and another—Obtaining Motive Power, 95*
Clifford, W.—Pressure Gauges, 575
Cockburn, S. M.—Excavator Grabs, 238*
Collett, G., and another—Milling Machines, 430
Combe, A.—Hackling Machines, 263*
Comings, W. R.—Forming and Polishing Tubes, 72*
Condy, H. B.—White Lead, 24
Constein, H., and another—Indicating Stations, &c., 288
Coomes, M. F., and another—Steel, 431
Cooper, A. W.—Governors, 118*
Cooper, D. (see Northrop, S.)
Copenhagen Horse Shoe Manufactory, The (see Lake, H. H.)
Cornell, E. B. (see Lake, H. H.)
Cornish, P., Jun.—Drying Substances, 455*
Cotterell, R.—Telephone Mouth Pieces, 216
Coulong, J.—Steam Traps, 502
Cousens, R. L.—Extracting Precious Metals from Ores, 456*
Covert, H. C., and another—Gas Engines, 191*
Coward, W. H.—Crushing Ores, 239
Cowley, J., and others—Capstans, 598*
Crawshay, A. G. D.—Manufacture of Chains, 311*
Crist, W. E., and another—Gas Engines, 191*
Crompton, R. E. B.—Electric Conduits, 600
Crompton, W. H., and another—Looms, 334
Crook, W., and another—Reciprocating Rotary Motion, 142
Crossley, T. J.—Wire Straightening and Cutting Machines, 551*
Crow, S.—Machine for Wringing Clothes, 216
Crowder, J., and others—Glass Lined Tube Fittings, 479
Crowe, E. & H.—Gas Engines, 550*
Curtis, N. W., and another—Turbines, 167*
Curtis, R., and another—Spinning Machinery, 599*
Cussons, H. R.—Pumps, 622*
Cutmore, H. A. (see King, G.)

Daimler, G.—Gas Engines, 527*
Danchell, F. H.—Separating Solids from Liquids, 167*
Darbyshire, B., and another—Furnace Bridge for Boilers, 478
Darley, A. E., and others—Collecting Carbonic Acid, 384
Darlington, A., and others—White Lead, 312
Daugy, F.—Reversing Mechanism for Engines, 527
Davies, A. R., and others—Hoisting Machinery, 454
Davies, R. & J., and others—Coating Metal Sheets with Tin, 240*
Daw, S.—Waste Sulphuric Acid Pickle, 264
Daws, A. W. & T. W.—Percussion Rock Drills, 166*
Deakin, T.—Steam Engines, 215
Dearden, S. & W.—Sawing Stone, 575*
Deeley, M., and another—Softening and Clarifying Water, 96
Deer, T.—Pulley Blocks, 143
Dennys, N. B.—Nut-Locks, 238
Dewar, J., and another—Distilling Oils, 552*
Dewrance, J.—Gate Valves (Pratt, R. M.), 95
Dewrance, J., and another—Lubricators, 478
Dey, A. (see Pitt, S.)
Dickenshied, T. S., and others—Vices, 214
Dickenson, A.—Driving Electrical Vehicles, 336
Dickinson, J.—Spinning and Doubling Machines, 118
Dines, W. H., and another—Measuring Electric Currents, 191
Dobson, E.—Boiler Furnaces, 23
Don, P. E. & M. J. A. (see Leigh, H. H.)
Donaldson, J.—Purifying Feed Water, 239*
Dopson, H. E., and another—Fixing Electric Lamps, 624

Dorman, G. E.—Dynamo Electric Generators and Motors, 504*
Dougill, A.—Fans or Blowers, 286
Dove, L., and another—Obtaining Motive Power, 95
Dover, W.—Boiler Tube Stoppers, 215
Dow, G. E.—Multiplex Plunger Pumps, 359*
Dramant, I., and another—Obtaining Motive Power from Tidal Waters, 24
Dredge, E.—Restarting Tramcars, &c., 502*
Drummond, A.—Ribbed Glass, 550
Drury, J.—Pistons, 574*
Duhamel, P., and another—Fire Escape, 216*
Duncan, G., and another—Cork Making Machines, 598*
Dunlop, J. B.—Air Valve, 240
Dunsmuir, H.—Marine Engines, 576
Dymond, G. C.—Washing Ores (Bilharz, O.), 144

Earp, W., and others—Heeling Machines, 191*
Eddington, S., and another—Rope and Chain Gearing, 287; Engine Valve Gear, 503*
Eddleston, T.—Pumps, 335
Edgerton, R. H.—Steam Engines, 167
Edmundson, J. W.—Incandescent Electric Lamps, 312
Edwards, E.—Pipe Flanges (Weyher, R.), 335; Rock Drills (Terp, O.), 622
Edwards, R.—Steam Engines, 576
Elliott, H. J.—Bearings, 480
Elliott, R.—Apparatus for Removing Scale from Boilers, 71
Elwell, P. B., and another—Electrically Driving Vehicles, 191
English, T.—Working Guns on Railways, 622
Entwistle, E., and another—Reciprocating Rotary Motion, 142
Entwistle, H. A.—Centrifugal Pumps and Fans, 71
Entwistle, J., and another—Furnace Bridge for Boilers, 478
Erskine, J.—Hackling Flax, 623*
Escher, Wyss, & Co. (see Wise, W. L.)
Evans, G. F.—Friction Gearing, 622
Everitt, W. E.—Coating Iron Plates, 336
Eynon, T.—Milling Cutters, 216

Facer, J. A.—Steam Hammers, 166
Facien, E. E. de—Screw Propellers, 215
Faulkner, C., and another—Manufacture of Metallic Tubes, 455*
Fawcett, H.—Looms, 526*
Ferranti, S. Z. de—Electric Switches, 120*; Bearing for Shafts and Crank Pins, 190; Flexible Bends, 359; Arc Lamps, 408*
Fidler, J., and another—Making Grinding Rollers, 24
Field, E.—Steam and Hot Air Engines, 407*
Fischer, R. C. (see Clarkson, G. J.)
Fischer, W.—Mixing and Suction Valve, 72
Fisher, T.—Screw Propellers, 456; Protecting Ships' Bottoms, 528
Fletcher, J.—Signalling Apparatus, 430
Fowler, H. E.—Welding Metal by Electricity, 288*
Fox, S., and another—Water Gas, 264; Altering the Proportion of Mixed Gases, 431*
Fraser, C. E., and others—Briquette Machinery, 408
Frost, J.—Evaporating Apparatus, 96*
Frost, J. H., and another—Looms, 119
Funck, P., and another—Lifting Jack, 503

Gabet, G. A. H.—Ammonium Calcium Phosphate, 240; Potassic and Sodic Hydrates, 264
Gale, J.—Sound Recording Apparatus, 312*
Galloway, E. M., and another—Slide Valve Gear, 502
Gare, T.—Appliance for Cutting Milling Tools, &c., 94*
Garrard, H., and another—Speaking Tubes, 72
Garside, A. A.—Rotary Engine, 335*
Garton, R. C. & C. H., and another—Evaporating Liquids, 600
Garvey, J. M., and another—Bending Plates, 118
Gas Motoren Fabrik Deutz (see Abel, C. D.)
Gatward, L. W., and another—Measuring Electric Currents, 191
Geigy, J. R. & Co. (see Shillito, T. R.)
Gelder, P. van—Separating Cylinders for Grain, 71

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Getz, C., and others—Vices, 214
Gibb, A.—Cushioning Parts of Machinery, 430
Gibson Electric Co., The (see Wise, W. L.)
Gibson, W. P.—Hydraulic Lifts, 623*
Gilchrist, P. C.—Manufacture of Copper, 288
Glaser, F. C. (see Imray, O.)
Goldsmith, W. H., and another (see Lake, H. H.)
Goldston, A. A.—Incandescent Lamps, 504
Goldston, A. G.—Electric Switches, 383
Goolden, W. T., and another—Dynamo Electrical Machines, 48
Gough, A.—Making and Drying Malt, 576
Gould Rolling Machine Co., The (see Lake, H. H.)
Goulding, J. C.—Telephone Transmitters, 287
Grant, A. M.—Engine Packing, 622
Gray, J. R.—Fire Extinguishing Apparatus, 142*
Green, R. E.—Aluminium, 240
Greening, F.—Substitute for Ivory, &c., 336
Greenwood, J., and another—Looms, 599
Greeven, G. A.—Dyeing Yarn in Skeins, 360
Griffiths, W. J.—Propelling Canal Boats, 552
Grill, L.—Steam Pumps, 576
Grime, J., and another—Damping Warps in Looms, 94
Grob, J. M., and others—Petroleum Engines, 575
Gubbins, R. P.—Piling Wrought-iron Puddle Bars, 166
Gwosdeff, E.—Telephones, 96*

Haddan, H. J.—Electromagnetic Despatch Apparatus (Williams, J. T.), 168*; Boiler Furnaces (Amoroso, F. F.), 551
Haddan, R.—Railway Brake (Wiegel, R.), 576
Hales, E.—Boiler Furnaces, 168*
Hall, C. J., and another—Testing Electric Conductors, 192
Hall, J.—Signal Bells, 456
Hall, J., and others—Signalling upon Steamships—288
Hall, T.—Twisting, &c., Yarns, 454*
Halpin, D.—Condensers, 168
Halpin, D., and another—Fly Wheels, 263
Hamilton, W. J. L.—Regulating Apparatus, 408
Hampshire, J., and another—Looms, 431
Hannay, J. B.—Manufacture of Liquid Chlorine, 288*
Hardwicke, J. B.—Thrust Bearings, 215
Harfield, W. H.—Steam Steering Gear, 311*
Harris, H. J.—Controlling Theatre Doors, 600
Harris, T.—Safety Valves for Hydraulic Cranes, &c., 46
Harrison, E. Y.—Grab Dredger Buckets, 142
Hartley, H.—Looms, 263
Hartness, J.—Incandescent Electric Lighting, 120
Harvey, E. A., and another—Fog Signals, 480
Harvey, F. G.—Preventing the Racing of Propellers, 526*
Haskins, J.—Lift Apparatus, 47*
Hauberg, S. C.—Centrifugal Separators, 574
Haverkamp, H. D. (see Thompson, W. P.)
Hawkesley, G. W.—Filtration of Water, &c., 504
Hayes, C. F. H.—Apparatus for Compressing Air, 214*
Hayward, R. H.—Machines for Scutching Flax, 310*
Heap, C. R.—Controlling Electric Currents, 360*
Hearsey, C. C.—Indicator for Railways, 264
Heathfield, R.—Coating Metal Sheets with Tin, &c., 216
Heaton, R.—Presses for Fruit, &c., 503*
Heck, J. H.—Vertical Boilers, 72
Henderson, T.—Furnace Fire Bars, 502*
Hetherington, J. M.—Carding Engines, 166
Hett, C. L.—Percussion Turbines, 216
Heys, W. E.—Electric Cut-outs (Chaize, N. & J.), 600*
Hill, A.—Stone Breaking Machinery, 22*
Hill, J.—Filter Presses, 384
Hillas, I.—Looms, 22
Hinchliffe, T. A., and another—Shedding Mechanism of Looms, 168
Hodder, E., and another—Coir Yarn Mat Machinery, 455*
Hodgkinson, A., Jun.—Extraction of Iron, 288*
Hoff, B.—Fractional Distillation, 168
Hohage, F., and another—Spring Making Machine, 48*
Holden, H. C. L.—Electric Firing Fuses, 360
Holker, W.—Direct-acting Steam Pumps, 479
Holland, W.—Signalling on Railways (Wood, S. P.), 335
Hollick, T. D.—Electric Tramcars, 552
Hollingworth, J., and another—Milling Machines, 430
Holt, E.—Collectors for Dynamos, &c., 504
Holzapfel, A. C. A.—Ships, 214; Flanging and Shaping Plates, 239
Holzapfel, J. J., and another—Lathes, 190*
Hookham, G.—Electric Meters, 360*; Arc Lamps, 456
Hopcraft, L.—Screw Conveyers, 167
Höper, G.—Casting Metal, 527
Horing, J. L. (see Mills, B. J. B.)
Hornsteiner, R.—Reversible Rope Driving Gear, 119
Horrocks, W., and another—Looms, 334*
Hucks, W.—Centrifugal Separators, 478*
Hudson, J. C.—Fire Escapes, 72
Hudson, W., and another—Switches for Suspended Arc Lamps, 168*
Hurst, W.—Scutchers, 286
Husbands, M.—Piston Rings, 479*
Huson, L. C.—Rotary Engine, 216*
Hussmant, C., and another—Obtaining Motive Power from Tidal Waters, 24
Hutchison, M.—Steam Boilers, 311
Hyde, A. W., and another—Steel, 431
Hydes, T.—Furnace Slag, 576

Igel, H.—Rotary Engines, 406*
Illingworth, F.—Combing Machines, 94*
Imray, O.—Gaseous Fuel Furnaces (Ware, E. R.), 70*; Safety Brakes for Lifts, &c. (Pifre, A.), 71; Colouring Matters (The Farbwerke vormals Meister, Lucius & Brüning), 456; Petroleum Engines (Glaser, F. C.), 550*; Steam Vacuum Pumps (Irrigation Pump Co.), 576
Ineson, W.—Healds of Looms, 48
Ingersoll, J. E., and another (see Barker, F. W.)
Inwood, C.—Screw Propellers, 168
Irrigation Pump Company (see Imray, O.)
Irving, D.—Hydraulic Gas Mains, 47

Jackson, A.—Lifting Jacks (Jackson, C.), 143*
Jackson, C. (see Jackson, A.)
Jardine, J., and another—Rolling Mills, 94*
Jenkins, W., and another—Grinding Rolls in Tinplate Mills, 119
Jobling, W. J.—Steam Boilers, 334
Johnson, A. H., and another—Railway Switches, 239
Johnson, J.—Thrashing Machines, 70
Johnson, J. Y.—Steel Armour Plates (Pieper, C.), 382
Johnson, R., and another—Tramway Points, 286
Johnson, W. C., and another—Electrical Transformers, 383
Joicey, E. R.—Steam Boilers, 239
Jones, H. & D. E.—Machinery for Rolling Metal, 311
Jones, J.—Covers for Drain Openings, &c., 22
Jones, J.—Grinding Card Flats, 334
Jones, J., and another—Iron and Steel Furnaces, 120
Jones, J. & A. J. (see Birkbeck, H.)
Jonsson, S. (see Wise, W. L.)
Jordan, T. R.—Pulveriser, 167
Julian, A.—Electric Alarm for Pressure Gauges, 576
Justice, P. M.—Screw Cutting Turret Heads (Becher, J. M.), 239

Keartland, S.—Tuyeres, 407
Kellogg, C. (see Thompson, W. P.)
Kennedy, L. B.—Brick and Tile Machines, 71*
Kennedy, R.—Steam Engines, 214*
Kent, W. G., and another—Pistons, 118
Kenyon, S.—Substitute for India Rubber, 192
Kern, L. & L.—Raising or Forcing Liquids, 70*
Ketchum, O. W.—Generation of Steam with Gases, 96*
Key, G. M.—Stoppers for Boiler Tubes, 335
Killiani, M.—Electrolysis, 408*
Kincaid, S. B.—Signalling Trains, 287
King, F.—Conduits for Electric Conductors, 240
King, G.—Speaking Tubes (Cutmore, H. A.), 432
Kirby, J. F.—Journal Lubricators, 431
Kleber, M., and another—Rotary Engines, 383*
Knipping, H., and another—Spring Making Machine, 48*
Koch, O.—Shaping Bolts and Nuts, 287*
Koernig, F.—Locomotives for Towing Purposes, 503*
Krämer, H. (see Thompson, W. P.)
Kramer, M. (see Wise, W. L.)
Kühne, H.—Expansion Gear (Proell, W. R.), 191

Lacombe & Co. (see Lake, H. H.)
Lacoste, J.—Liquid Meters, 551*
Ladd, J. J. (see Clark, A. M.)
Lake, H. H.—Rolling Mills (The Copenhagen Horse-Shoe Manufactory), 119; Dies for Rolled Forgings (The Gould Rolling Machine Co.), 263; Safety Devices for Electric Circuit (Thomson, E.), 264*; Generation of Heat in Furnaces (Cornell, E. B.), 336; Winding Yarn (Goldsmith, W. H., and Wright, J. H.), 406; Gas Engines (Beckfield, J. C., and Schmid, A.), 430*; Carbons for Electric Lamps (Lacombe & Co.), 456
Lane, F. R.—Sawing Machinery, 48
Lässoe, V. F.—Duplex Rudders, 359
Latta, J., and another—Cork Making Machines, 598*
Laurence, Paris, & Scott, and another—Metering Electric Energy, 312*
Laval, C. G. Patrik de—Steam Turbines, 358
Lawrence, W., and others—Evaporating Liquids, 600
Lawson, D. T.—Steam Boilers, 624
Lea, H.—Driving Pulleys, 622
Leach, W.—Mechanical Stokers, 286
Lee, W., and another—Boiler Furnaces, 574
Leek, G., and another—Shedding Motion for Looms, 335*
Leigh, H. H.—Rotary Engines (Don, P. E. and M. J. A.), 71
Lelen, F. & J., and another—Capstans, 598*
Lewes, V. B.—Purifying Water, 454*
Lewis, C. E.—Leather Skiving Machines, 478*
Liebert, E.—Explosive Compounds, 240
Lindley, L.—Stretching Lace, 383
Little, R. R., and others—Signalling upon Steamships, 288
Lloyd, W. E., and another—Manufacture of Metallic Tubes, 455*
Lock, C.—Gear Wheels, 214
Lones, E., and others—Coating Metal Sheets with Tin, 240*
Lord J.—Damping Warps in Looms, 310
Lorey, W., and others—Vices, 214
Lowrie, W., and another—Testing Electric Conductors, 192
Lowry, G.—Pulverisers, 286*
Lucas, A. H.—Steamships, 336
Lucas, H. M.—Converting Reciprocal into Circular Motion, 239
Lyte, F. M.—Magnesic Chloride and Oxychlorides, 504

McCann, J.—Blast Furnace Blocks and Tuyeres, 478
McClure, J.—Gas Engines, 46
McColl, H.—Steam Boilers, 143
McFerran, J. A.—Compressing Machines, 502*
McGregor, D.—Log or Current Meter, 431*
McGregor, P., Jun.—Boiler Furnaces, 262
McIvor, R. W. E., and others—White Lead, 312
McKibbin, G. N., and another—Electric Railways, 72
Mackintire, J.—Casting Under Pressure, 382*
MacNeill, W.—Rock Drills, 575
McQueen, J.—Carding Engines, 46*
Mahr, J. H. (see Thompson, W. P.)
Mallet, J. F. A.—Locomotives, 358
Mark, R. M.—Railway Couplings and Buffers, 407
Marsden, L. H., and another—Looms, 119
Marshall, J.—Slide Valves, 143
Martinez-Ancira, J.—Centrifugal Pump, 119*
Marx, F.—Electrodes for Galvanic Batteries, 360
Masters, J., and others—Leather Rolling Machines, 96*
Mathewson, J. E.—Sand Blast Apparatus, 190, 238*
Maxim, H. S.—Explosive Compounds, 192
Meiklejohn, N.—Hydraulic Mains for Gas, 455
Meister, Lucius & Brüning (see Imray, O.)
Meritens, A. de—Rectifying Alcohol, 24
Mersing, D. P. A.—Veneer Saws, 94
Michl, W. R.—Regulator for Electric Currents, 264*
Middleton, A., and others—Briquette Machinery, 408
Middleton, R.—Safety Appliance for Hoists, 47; Corliss Steam Valves, 239; Valve Gear, 286*
Miley, J.—Tapping Metals, 310*
Millet, F. T.—Engine for Terrestrial and Aërial Propulsion, 406*
Mills, A., and others—Leather Rolling Machines, 96*
Mills, B. J. B.—Steering Vessels (Horing, J. L.), 47
Moffatt, A. C.—Feed Water Heaters, 576
Moon, G. W.—Coupling Railway Carriages, 526
Morant, R., and others—Glass Lined Tube Fittings, 479
More, J., and another—Printing Telegraphs, 120
Morell, J. F.—Journal Boxes, 119
Morgan, E. H.—Starting Vehicles, 214*
Morris, R.—Electrical Firing Apparatus, 432
Morton, J. S.—Propelling Vessels, 622
Moulson, J. M., and others—Carding the Backs of Cords, &c., 191
Muir, A.—Clipping Apparatus, 310*
Mullins, G. G.—Copper and its Alloys, 240

Newton, P. A.—Holders for Incandescent Lamps (Swan, A.), 312
Niblett, J. T., and another—Indicating the Presence of Fire Damp, 312
Nichols, F. W., and another (see Barker, F. W.)
Nichols, M.—Delivering Coals to Wagons, &c., 526*
Nicholson, F. B.—Electric Switches, 504
Niel, P. (see Repland, E.)
Niemczik, A., and others—Petroleum Engines, 575
Nightingale, G. P.—Branding Machines, 551*
Nordenfelt, T.—Turret Mountings for Guns, 551*
Norris, D. P.—Wool-combing Machines, 2*
Northrop, S.—Steam Pumps (Cooper, D.), 575
Nutting, S. E.—Electro-mechanical Movements, 480

Oakes, S., and others—Laminated Springs, 407
Ogle, P. J.—Stamps for Crushing Ores, 190
Okes, J. C. R.—Pumps, 215
Owens, C. E.—Duplex Pumps, 262

Paddon, E. F.—Furnaces, 503
Parensen, T.—Propulsion of Ships, 359*
Parker, H., and another—Switches, 168
Parker, J. G.—Moulds for Bricks, 430
Parker, T., and another—Manufacture of Chlorine, 120; Cyanogen Compounds, 120; Phosphorus, 576
Parkin, C.—Bells for Signalling, 95
Parnell, E. B.—Treatment of Ores, 192; Calcining Furnaces, 263*
Parr, T. H., and others—Heeling Machines, 191*
Partridge, M., and another—Starting Gas Engines, 287
Pass, E. de—Spinning Rollers (Carbonnier, G.), 286
Patterson, R., and another—Carding Flats, 287
Paul, G., and others—White Lead, 312
Paxman, J., and another—Shaping Machines, 383
Peacock, J. C.—Sand Blast Machinery, 95*
Pearson, T.—Preserving Grass, &c., 384
Peberdy, T., and others—Heeling Machines, 191*
Peebles, D. B.—Gas Engines, 143*
Pendred, L. St. L.—Engine Cylinders, 624
Perry, A.—Preparation of Cereals for Brewing, 527*
Phillips, S. E., and another—Electrical Transformers, 383
Piat, C. A.—Hydraulic Presses, 432*
Pickering, J. T., and others—Hoisting Machinery, 454
Pickering, Ld., and others—Hoisting Machinery, 454
Pickles, T. & J. H.—Calendering Apparatus, 359
Pieper, C. (see Johnson, J. Y.)
Pieper, H.—Electric Lamps, 528*
Pierce, P.—Reaping Machines, 383*
Piers, E. F.—Employment of Gas Engines for Locomotion, 311*
Pifre, A. (see Imray, O.)
Pinnington, G.—Hydraulic Transmission of Power, 336
Pitkin, J., and another—Indicating the Presence of Fire Damp, 312
Pitt, S.—Cables for Electric Conductors (Dey, A.), 120; New Red Colouring Matter (Casella, L., & Co.), 384; Colouring Matters (Casella, L., & Co.), 528
Plant, T.—Bridges for Boiler Furnaces, 502
Platt, J. E., and another—Making Grinding Rollers, 24

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Plumb, F. E.—Machinery for Making Flexible Metallic Covering, 239*
Poleschko, A.—Dynamo Electric Machines, 48*
Pollok, J. H.—Extraction of Gold, 432
Pomroi, E. W. G.—Bearings for Shafts, 287
Pool, F. W. (see Thompson, W. P.)
Porion, L. J.—Feed-Water Apparatus, 455
Pötzsch, R., and another—Turning Cylindrical Staves, 216
Powell, J. E. & R. J., and another—Rock Boring and Drilling Machines, 71*
Pratt, R. M. (see Dewrance, J.)
Price, H. S., and another—Pistons, 118
Price, J.—Compressing Plastic Substances, 550
Priestman, W. D. & S.—Hydrocarbon Engines, 430*
Prime, E., and another—Boiler Furnaces, 574
Pring, J.—Block Fuel Machinery, 359*
Proctor, N., and others—Briquette Machinery, 408
Proell, W. R. (see Kühne, H.)
Purcell, M. F., and others—Collecting Carbonic Acid, 384

Radcliff, D. R., and another—Bending Plates, 118
Radcliffe, T.—Pickers of Looms, 286
Ranft, J. A. H. F.—Extraction of Gold and Silver, 360*
Ravenshaw, H. W., and another—Dynamo Electrical Machines, 48
Rawson, F. L.—Bases for Electrical Instruments, 191
Reade, R. L., and others—Carding the Backs of Cords, &c., 191
Rebmann, J.—Lubricators, 599
Redwood, B., and another—Distilling Oils, 552*
Reed, F. H., and another—Electric Railways, 72
Rees, E. S. G., and another—Switches, 168
Rees, J. P.—Electric Signalling Lamps, 264*
Renaut, M. J.—Ramie Machines, 623*
Renshaw, W. R.—Steam Engines, 574*
Repland, E.—Gas Engines (Niel, P.), 48*
Rhodes, B.—Non-corrosive Material, 336
Rhodes, F.—Dye Extractors, 48
Ridgway, A.—Winding and Drawing Machines for Silk, 239
Riedler, A.—Valve Gear, 503*
Riley, J.—Steel, 384
Rimell, J. H., and another—Machine for Draining Land, 120*
Ritson, J. H. R., and another—Grinding Rolls in Tinplate Mills, 119
Roberts, L., and another—Iron and Steel Furnaces, 120
Robins, G.—Permanent Way of Railways, 48
Robinson, A. E., and another—Cyanogen Compounds, 120; Manufacture of Chlorine, 120; Phosphorus, 576
Rogers, J. E.—Valve Gear of Pumping Engines, 214*
Rogers, M., and another—Gas Engines, 358*
Roots, J.—Gas Engines, 23*, 407*
Rose, W.—Ships' Anchors, 214
Ross, B., and another—Shedding Mechanism of Looms, 168
Ross, J. H., and another—Oil Lamps for Railway Carriages, &c., 72
Ross, W.—Boot Machinery, 407*
Rothwell, E. & W. A.—Sectional Warping Machines, 382*
Rouse, W.—Printing Machines, 70
Ruffin, A., and another—Coating Plates with Tin, 528; Treatment of Tinplate Scrap, 576
Ryder, H. D., and another—Fixing Electric Lamps, 624
Rylands, D., and others—Glass Lined Tube Fittings, 479

Sadler, G., and another—Brake for Hoisting Apparatus, 46
Salendre, E.—Rock Boring Tool, 214
Salomon, F., and another—Sulphite Cellulose, 72
Sanders, F.—Gas Retorts, 575
Sanguinetti, H., and another—Making Hollow Ware, 600
Sant, E. W., and others—Hoisting Machinery, 454
Savin, G.—Pumps, 454
Schimming, G.—Steam Engines, 311*
Schlesinger, L. B., and another—Petroleum Engines, 144*
Schmid, A., and another (see Lake, H. H.)
Schmidt, W.—Motors, 382*
Schnarrendorf, J. F. A.—Steam Boilers, 430
Schuckert, S., & Co. (see Clark, W.)
Schultze, O., and others—Petroleum Engines, 575
Schumacher, A., and another (see Thompson, W. P.)
Schurr, A. E.—Railway Couplings, 334*
Schwartz, W. H.—Obtaining Soundings at Sea, 335*
Scott, G.—Gas Producers for Marine Steam Boilers, 120
Scott, W. H., and others—Metering Electric Energy, 312*
Sharp, J. W.—Boot Machinery, 455*
Sheldon, E. E., and others—Leather Rolling Machines, 96*
Shepard, A. L.—Electric Regulating Apparatus, 96; Transmission of Rotary Motion, 359
Shepherd, J.—Coverings for Rollers used in Textile Machinery, 142
Shillito, T. R.—Colouring Matters (Geigy, J. R., & Co.), 168
Sidebottom, W. R.—Bobbins for Spinning, &c., 190
Siemens Bros. & Co., Ld.—Regulator (Taylor, A. M.), 144; Electric Regulator, 624*
Simon, H.—Coal Screening and Breaking Apparatus, 239
Simons, W. M., and another—Brake for Hoisting Apparatus, 46
Simpson, M. H.—Extraction of Gold, 24
Slaiter, T.—Evaporating Apparatus, 22*
Sloan, R. A.—Incandescent Electric Lamps (Wilson, G. W., and Brown, C. H.), 144
Smallman, J. W.—Lock-nut, 262
Smith, B.—Starting Engines, 119*
Smith, T., and another—Coke Ovens, 384
Smith, W.—Railway Cars for Conveying Ships, 95
Smith, W., and another—Fog Signalling Apparatus, 526
Smither, L., and another—Fire Escape, 216*
Sneath, A.—High-speed Engines, 263
Somzée, L.—Regenerative Gas Lamps, 24*
Soveral, E. P. de—Steam Engines, 24
Sowden, A.—Loom Dobbies, 95*
Sparrow, R. B.—Pig Iron Carrier and Breaker, 336
Spiegelberg, A.—Machines for Treating Flax, &c., 479*
Stansfield, H., and another—Self-acting Mules, 263
Starley, J. K., and another—Electrically Driving Vehicles, 191
Steel, Peech, & Tozer, Ld., and another—Laminated Springs, 407
Steevenson, J. E., and another—Rope and Chain Gearing, 287; Engine Valve Gear, 503*
Steinhart, C. J.—Ethyl-Mercaptan, 384
Stephenson, G., and another—Fog Signalling Apparatus, 526
Stephenson, J. E., and another—Combing Machines, 527
Stevens, L. B., and another—Railway Switches, 239
Stevenson, J.—Grain Conveyers, 71
Stewart, J., and others—Tanks for Storing Petroleum, 526
Sudron, T. & Co., and another—Steam Boilers, 382
Sumner, H.—Gas Engines, 359
Sunderland, J. J. & J. P.—Warp Balling Machine, 599*
Sutcliffe, S., and another—Double-lift Jacquards for Looms, 502
Sutcliffe, W. W., and another—Steam Engine Governors, 430
Swain, R., and another—Coir Yarn Mat Machinery, 455*
Swan, A. (see Newton, P. A.)
Swinburne, J.—Dynamos and Motors, 432*

Tatham, R.—Steam Boilers, 142; Cylinders, &c., of Carding Engines, 478
Taussig, E.—Electric Furnaces, 528*
Tavernier, A. E., and another—Petroleum Engines, 144*; Gas Engines, 336
Taylor, A. M. (see Siemens Bros. & Co., Ld.)
Taylor, C. & G. B.—Bearings for Shafts, 454
Taylor, H. F.—Coating Metal Sheets with Tin, &c., 526*
Taylor, J., and others—Carding the Backs of Cords, &c., 191
Taylor, J. S., and another—Power Presses, 23*
Terp, O. (see Edwards, E.)
Thame, J. R., and another—Making Hollow Ware, 600
Thoens, B.—Steam Traps, 95*
Thomas, L. W.—Bush for Shafting, 310
Thomas, T.—Miners' Safety Lamps, 528*
Thompson, W.—Dynamos, 384*
Thompson, W. P.—Slide Valves (Haverkamp, H. D.), 22; Rolling Seamless Tubes (Kellogg, C.), 166*; Electric Meters (Tudor, H. C.), 168; Electric Motors (The Westinghouse Electric Company), 192*; Ventilator (Krämer, H.), 359; Reducing Bodies to a Circular Form (Barn, J. N.), 479*; Oil Presses (Schumacher, A., & Tschiffeli, C.), 550*; Rotary Shuttles (Mahr, J. H.), 551*; Interrupting Electric Currents (Westinghouse Electric Company), 552*; Reversible Boats (Pool, F. W.), 574; Steering Gear (Callard, P. & V.), 599*; Snow Ploughs (Caldwell, E. P.), 600*; Dynamo Cores (Westinghouse Electric Company), 600
Thoms, W. A. Drawing Metallically Coated Metals, 336
Thomson, E. (see Lake, H. H.)
Thomson, G., and another—Looms, 431
Thomson, W. H.—Fixing Posts, 600
Thornycroft, J. I.—Pressure Gauges, 575*
Threlfall, R. J.—Sight Feed Lubricators, 407
Thwaite, B. H.—Production of Combustible Gases, 24*
Tichborne, C. R. C., and others—Collecting Carbonic Acid, 384
Tilgman, B. C.—Cuting Medals, 167
Timmis, I. A.—Dynamos, 48; Electric Lamp Holders, 72; Generation of Electricity on Railway Trains, 264; Incandescent Lamps, 360
Timmis, I. A., and another—Fly Wheels, 263
Tomkin, H., and others—Steam Boilers, 382
Tomkins, M. H.—Hemp Ropes, 480
Tomkinson, G., and another—Annealing Furnaces, 384
Tomlinson, Walker W.—Split Pulleys, 358
Town, C. A.—Reading and Punching Jacquard Cards, 118
Townsend, G. H.—Adjustable Eccentrics or Crank Pins, 382*
Townson, C.—Ships' Gangways, 431
Trier, F.—Machinery for Working Stone, 119*
Trott, S. (see Vaughan, G. E.)
Tschiffeli, C., and another (see Thompson, W. P.)
Tudor, H. C. (see Thompson, W. P.)
Turner, A. W., and another—Annealing Furnaces, 384
Turner C.—Drying Cotton, &c., 239
Turner, T.—Lathes for Stone, 46
Tweddell, F.—Tramway Points, 48

Unger, M. E.—Automatic Switch for Accumulators, 456
Upward, A. R.—Diffusing Disinfectants, 552

Varaldi, D. F.—Vacuum Pumps, 406
Vaughan, G. E.—Silicon Bronze (Weiller, L.), 192; Electric Railways (Trott, S.), 336
Verity, B. & J. B.—Air Propellers, 335
Vicars, J. J., T., & J.—Mechanical Stokers, 623*
Vingner, A. A.—Hydraulic Lifts, 23*
Vivier, J. H. du—Artificial Silk, 120
Vogt, H. C.—Ships' Propellers, 406

Wagg, F., and another—Switches for Suspended Arc Lamps, 168*
Wain, J., and another—Spinning Machinery, 599*
Waldbaur, A.—Centrifugal Apparatus, 215*
Walker, H. C., and another—Hydraulic Cranes, 118*
Walker, J., and another—Grain Elevators, 575*
Walker, J. C., and another—Combing Machines, 527
Walker, R. & D.—Consuming Smoke, 598*
Walker, S., and another—Shedding Motion for Looms, 335*
Walker, W.—Water Telephones, 408*
Wall, G. H., and another—Lubricators, 478
Wallace, P.—Spinning, &c., Machinery, 454*
Wallis, A., A. H., J. E., & W. A.—A Pneumatic Distributor, 214
Walton, F.—Flexible Metallic Tubes, 478
Ward, J.—Armour Plating, 47
Ware, E. R. (see Imray, O.)
Warren, O. A.—Removing Snow from Streets, 216
Watel, H. G.—Electrically Driven Fans, 384
Watson, T.—Spinning Machinery, 407*
Watson, T. T.—Apparatus for Working Punkahs, 47
Watson, W.—Steam Traps, 262
Webb, B. A., and others—Coating Metal with Tin, 240*
Webb, F. W.—Compound Locomotives, 22*
Webster, W.—Manufacture of Tuyeres, 167
Weiller, L. (see Vaughan, G. E.)
Wells, C.—Hot Air Engine, 622*
Wenger, A.—Pneumatic Brakes, 527*
Werdenberg, E.—Water Heaters, 504
Werner, C., and another—Turning Cylindrical Staves, 216
Westinghouse Electric Co., The (see Thompson, W. P.)
Westwood, C. J.—Cutting Metal Bars, 311
Weyher, R. (see Edwards, E.)
Wharry, J. A., and another—Gas Engines, 358*
Whitaker, T.—Excavating Cranes, 71*
Whitaker, W., and others—Rock Boring and Drilling Machines, 71*
White, J. L. & H. S. Steam Boilers, 142
White, T., and another—Boiler Furnaces, 623*
Wiegel, R. (see Haddan, R.)
Willcox, B.—Para-amido-phenol Ethers (Farbenfabriken v. F. Bayer & Co.), 144; Colouring Matters (Farbenfabriken v. F. Bayer & Co.), 144; Colouring Matters (Bayer, F., & Co.), 192; Dyeing and Printing Fibres (F. Bayer & Co.), 192
Williams, H.—Gas Engines, 166, 575
Williams, J. T. (see Haddan, H. J.)
Williams, W.—Turn-Tables and Cranes, 262
Williamson, D.—Rotary Engines, 262*
Wilson, G. W., and another (see Sloan, R. A.)
Wilson, W.—Steam Engines, 238*
Wise, W. L.—Centrifugal Separating Machines (Jonsson, S.), 216; Hardening Steel Tubes (Kramer, M.), 240; Secondary Battery Plates (The Gibson Electric Co. of Europe), 287; Manufacture of Clear Ice (Escher, Wyss, & Co.), 430
Wood, S. P. (see Holland, W.)
Woodward, J.—Railway Sleepers and Chairs, 95
Wright, J. E., and another—Printing Telegraphs, 120
Wright, J. H., and another (see Lake, H. H.)
Wright, R.—Hydraulic Hoists, 46
Wrigley, E. W., and another—Carding Flats, 287

Young, G. R.—Feeding Liquid Fuel to Furnaces, 118*

Zehren, J. & A.—Gas Cock, 576
Zimer, F. W.—Combined Treadle and Hand Driving Mechanism, 478
Zingler, M.—Bleaching Fibres, 72

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Industries.

INDUSTRIES AND COMMERCE DURING 1889.

IT has not hitherto been our agreeable duty to undertake the presentation of so favourable a report on the circumstances of national industry and commerce as we are able to offer on the trade of the past year. There have, as will always be the case, been certain aspects of business that have been matter for regret. There have been more strikes than is usual, and some of them have been attended with a good deal of loss and suffering. There has also been more speculation, especially in the iron and cotton trades, than is compatible with sound and solid business, and the apprehensions of legitimate manufacturers and dealers have thereby been justly excited. But our trade, taken as a whole, has developed a healthy activity, which has culminated in a higher range of prices nearly all round, and the year closes with better prospects for our principal industries, and notably for the iron, steel, cotton, engineering, and shipbuilding trades—which are really the backbone of our industrial fabric—than they have known for years.

In the figures which are used for the purpose of illustrating and setting forth the course of our trade in 1889, we shall drop the last three figures, which are of little use for such a purpose when dealing with millions, and both complicate details and fatigue the eye. When we speak of 1889, we refer, of course, to the first eleven months of that year only, as the complete returns for the twelve months will not be available for some little time; and when we speak of comparing 1889 with previous years we shall deal with the corresponding periods, or first eleven months only.

AGRICULTURE.

The Returns issued by the Agricultural Department, showing the condition of the harvest of 1888, were by no means so satisfactory as might have been desired. They showed a decrease of serious amount in the production of wheat and potatoes, although there was a substantial increase in the production of oats, barley, beans and peas, turnips and hay. The harvest on the whole was, however, better than that of the previous year, and this, no doubt, has had its due amount of weight in reference to the range of prices and the extent of our imports of agricultural produce during the period that has since intervened.

The general current of prices has not flowed in the same direction, at any rate not to anything like the same extent, as that of other staple productions. The prices of wheat, flour, mutton, potatoes, and prime beef were actually lower at the end than at the beginning of 1889. Barley and oats, on the contrary, notwithstanding the fairly good crops of 1888, have taken a higher range. The current rates do not, on the whole, differ much from those quoted in 1887 and 1888, when the general circumstances of trade and commerce were far from being as favourable as they now are.

One of the most striking, and at the same time satisfactory, features of the import trade of the current year has been the enormous extent to which we have increased our consumption of food and drink. We have spent in our imports of these about 15 millions more than in 1888, and if we add the increase in our imports of tobacco, the amount of difference is brought up to about 16¼ millions. This, of course, means that there has been a great increase of purchasing power on the part of the masses—an increase which applies equally to almost all descriptions of food and drink, whether dutiable or not. Some descriptions of both have taken a higher range of prices than formerly, but the difference in this respect, taken over the whole, has not been very material. The increase of population, amounting to some 400,000 per annum on an average, would of course naturally lead to an increased consumption of imported breadstuffs, but the increase in 1889 has been far greater than would be likely to accrue from that source. The following table shows the quantities imported, and the average prices, deduced from the declared values, as set out in the Board of Trade returns:—

Imports of Corn and other Food Products into the United Kingdom in 1889 *compared with* 1888 (1 = 1,000).

	Quantities.		Values.		Average Value per cwt.	
Cereals, &c.:	1888. cwt.	1889. cwt.	1888. £	1889. £	1888. s.	1889. s.
Wheat	50,901	53,624	19,770	20,629	7·7	7·6
Flour	15,727	13,143	8,787	7,652	11·1	11·6
Barley	18,235	15,955	5,113	4,533	5·6	5·6
Oats	17,169	14,691	4,169	4,063	4·8	5·5
Indian corn	23,687	34,113	6,430	8,089	5·4	4·7
Oats	2,200	1,518	634	494	5·7	6·5
Beans	2,807	3,301	854	1,037	6·0	6·2
Potatoes	2,275	1,846	779	732	6·8	7·9
Butcher's Meat, &c.:						
Bacon	2,563	3,147	5,713	6,623	44·5	42·0
Hams	677	897	1,785	2,301	52·7	51·3
Fresh beef	755	1,251	1,733	2,739	45·9	43·7
Fresh mutton	912	1,117	1,793	2,367	39·3	42·3
Dairy Produce:						
Butter	1,524	1,760	8,089	9,310	106·1	105·7
Cheese	1,786	1,776	4,214	4,155	47·1	46·7

The import values appear to confirm the quoted rates for home agricultural produce during the year, and show that prices generally continue to take an exceptionally low range. Of course, it need hardly be observed that, so long as this low range of prices continues, it can hardly be well with English agriculturists, who have to compete with the agriculturists of every other country in the world. The rent of land has generally been so far reduced that farmers are better equipped for this struggle than they were, but local burdens continue to be very heavy, and the action that has been taken by many of the County Councils, in the way of local improvements, will probably increase them. There is, however, reason to believe that the number of farms unoccupied is much less than it was, and that the agricultural interest—the tenants as well as the landlords—is having a "better time." Wages have hitherto been falling, and have therefore been in their favour, but it is extremely unlikely that this advantage will be continued to the farmer if the wages paid to miners, dock labourers, and other inferior forms of employment keep up to their present level.

COTTON AND OTHER TEXTILES.

Up to the middle of 1889 the condition of the cotton industry could hardly be said to be satisfactory. The exports of cotton, both in the form of yarns and in that of manufactured goods, were on an exceptionally large scale, but the margin between yarn and cloth was narrow, and in all but the best mills was unprofitable. Grey piece goods were especially backward in price. The order books of manufacturers were by no means well filled, and as there was no disposition on the part of manufacturers to bear the risk of stocking goods, having regard to the frequent changes that have been current in widths and lengths, the outlook did not appear to be very promising. A number of the largest mills manufacturing T cloths and domestics were only running four days per week. Spinners, however, were making fairly satisfactory progress on the whole, in spite of the speculative manipulation of "futures" in New York and Liverpool, which was counteracted by hand and mouth buying generally, and in many cases by short time at the mills.

During the latter half of the year the cotton mills of Lancashire have been doing a very satisfactory business. The mills generally have been in full operation, and the most of them are well supplied with orders. There has been a disposition in several districts to take advantage of the situation by increasing the resources of production, and in the southern towns of Lancashire the additions now being made to existing plant are calculated to be equal to some 750,000 spindles. Cotton has been somewhat easier during the later months of the year, while yarn has kept up its price, so that spinners are in a somewhat better position than they were. The only probable rock a-head appears to be that of wages or other labour questions. An agitation has been commenced in Lancashire with a view to securing some amendments in the Factory and Workshop Act of 1878, providing more especially that each worker shall have 350 cubic feet of space; that every carding engine, coupling, neck, or socket shall be encased; and that every loom shall be provided with an effective shuttle-guard. There are a number of minor provisions that are not likely to be required so far as the best factories are concerned; but the more onerous provisions are likely to be irksome, and some of them will no doubt be regarded as totally uncalled for.

There has been a remarkable increase in the imports of raw materials for the textile manufactures, amounting to not less than £10,806,000. This increase, however, is not transferred to the other side of the accounts in the form of exports, the value of which have only increased by £958,000. Hence a paradox, that can only be explained by supposing that stocks of raw materials for the textile trades have been increased, which has not to any extent been the case; that the prices realised have not kept pace with the prices paid, which is also doubtful, seeing that the principal textile manufactures have been doing very well; or that a much larger proportion than usual of the raw materials imported have been worked up for home consumption, which would, of course, indicate a larger purchasing power on the part of the community generally.

The quantities and values of the raw materials imported for the textile trades compare as under for 1888 and 1889 (1 = 1,000):—

	1888. Quantity.	1888. Value.	1889. Quantity.	1889. Value.	Average Value per Cwt. 1888.	Average Value per Cwt. 1889.
	Cwt.	£	Cwt.	£	£	£
Cotton	12,810	32,902	14,620	38,353	2·5	2·4
Flax	1,704	2,753	1,641	2,801	1·6	1·7
Hemp	1,662	2,519	1,766	3,048	1·5	1·7
Jute	5,600	3,421	6,680	4,710	0·6	0·7
Totals	21,776	41,595	24,707	48,912		

	1888. Quantity.	1888. Value.	1889. Quantity.	1889. Value.	Average Value per lb. 1888.	Average Value per lb. 1889.
	lbs.	£	lbs.	£	d.	d.
Wool	583,396	23,721	655,786	26,764	9·7	9·8
Alpaca, &c.	3,873	161	4,562	230	9·9	12·0
Goats' hair	19,321	814	19,436	922	10·1	11·3
Raw silk	2,832	1,735	2,932	2,066	147·0	169·4
Totals	609,422	26,431	682,716	29,982		

These figures do not include the large quantity of woollen rags which we imported in 1889 to the amount of 63,470,000lb., in order to work them up again into woollen fabrics, nor the considerable quantity of silk imported as knobs, waste, and thrown or dyed material.

So far as the sources of the imports of textiles are concerned, what chiefly interests us in reference to cotton is the increase of 885,000cwt. in our imports from British India, but this, large though it appears, still fails to make up the total to those of some former years. The supplies from Brazil have greatly fallen off in 1889, while those from the United States have increased to the extent of about 750,000cwt. The increased supplies

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of wool have been mainly contributed by European countries, which have added some 39,000,000lb. to their record for 1888. British India has also sent us much larger supplies of raw silk, while Japanese silks have fallen off to the extent of over 200,000lb. China, however, continues to hold the field, and has increased the record for 1888 by some £300,000.

Coming, now, to the other side of the account, we find that the exports of textile fabrics in 1889 compared as under with the previous year as regards quantity and value (1 = 1,000):—

	1888. Quantity.		Value.
Cotton yarn and twist	lbs.	235,329	£10,698
„ piece goods	yds.	2,122,898	18,874
„ „ bleached	„	1,192,440	12,557
„ „ printed	„	—	
„ „ dyed	„	—	
Thread	lbs.	20,050	2,925
Jute yarn	„	24,377	247
„ manufactures	yds.	213,196	1,892
Linen yarn	lbs.	13,333	805
„ piece goods	yds.	160,882	3,831
„ thread	lbs.	2,576	327
Silk yarn, &c.	„	511	363
„ manufactures	yds.	1,438	232
Woollen yarns	lbs.	39,004	3,706
„ fabrics	yds.	81,719	7,818
Worsted „	„	135,224	6,894
Flannels	„	15,062	518
Carpets	„	11,103	1,144
Blankets	pairs	1,295	453
Alpaca, mohair, &c.	lbs.	10,362	874

	1889. Quantity.		Value.
Cotton yarn and twist	lbs.	233,631	£10,810
„ piece goods	yds.	2,102,894	18,422
„ „ bleached	„	1,089,738	11,364
„ „ printed	„	873,689	10,048
„ „ dyed	„	539,349	7,434
Thread	lbs.	15,810	2,466
Jute yarn	„	31,108	2,372
„ manufactures	yds.	242,049	500
Linen yarn	lbs.	12,713	762
„ piece goods	yds.	163,597	3,913
„ thread	lbs.	2,574	337
Silk yarn, &c	„	695	465
„ manufactures	yds.	1,470	200
Woollen yarns	lbs.	41,400	3,969
„ fabrics	yds.	63,279	5,965
Worsted „	„	156,767	9,721
Flannels	„	13,581	493
Carpets	„	11,159	1,176
Blankets	pairs	1,413	508
Alpaca, mohair, &c.	lbs.	12,192	1,067

The total value of our exports of yarn and textile fabrics in 1889 was £101,131,000, as compared with £100,173,000, the corresponding values of imports of raw materials having been £81,074,000 and £70,268,000.

The Board of Trade have this year introduced some changes in their tabulation of the returns of cotton imports, which are likely to be appreciated. They have for the first time, in tabulating the exports of cotton yarn, separately distinguished grey and bleached, and dyed yarn and twist. They have also for the first time separately distinguished printed piece goods, and dyed or coloured piece goods, from the total of all piece goods.

In the following table the average current quotations for textiles in the first week of December of each of the last three years are stated:—

	1887. Pence per lb.	1888. Pence per lb.	1889. Pence per lb.
Cotton, raw (middling upland)	5⅜	5½	5⅝
Yarn, 40 mule twist	8⅜	8¾	9
Wool, Southdown	11¼	11	12
„ N.S. Wales average	8	9½	11
	Per ton.	Per ton.	Per ton.
Flax, Petersburg	£28 0 0	£27 0 0	£23 0 0
Hemp, Manilla	36 10 0	42 10 0	52 0 0
Jute, good marks	14 0 0	17 0 0	16 0 0

IRON AND STEEL.

On examining the returns of the exports of iron and steel for 1889, it appears that there has only been the comparatively small increase overhead of 202,000 tons in the quantity, while there has been an increase of £2,299,000 in value. Pig iron, railroad iron, hoops and sheets, tinplates, and cast or wrought, show an increase, while there has been a decrease in the exports of bar and angle iron, wire, old iron, unworked steel, and steel manufactures. The total value of the exports of iron and steel in 1889 was £26,645,000, but it need hardly be observed that if the prices current in the last three months of the year had been current all round, the realised value would have been much greater than it really has been. There are always large quantities of iron and steel, as of most other commodities, being worked off at old prices, so that manufacturers are only able to take advantage of current rates as regards a part of their production only, and that part is often a small one. Of course, also, as regards the quantity exported during the first six months of the year, there was no great difference of current prices over those current in 1888.

It is not a little remarkable that so inconsiderable an increase of exports as 149,000 tons should have been coincident with an increase of nearly 100 per cent. in the price of pig iron all over the country. This apparent anomaly is no doubt largely due to the apprehended scarcity of supplies of raw materials, and to the consequently expected failure of the supply of pig iron to meet the demands. Up to the present time there has been no real famine of either, nor can there well be one of pig so long as the stocks of pig at Glasgow and Middlesbrough are so considerable. But the demand has undoubtedly been in excess of the normal supply. During the first six months of the year stocks were reduced throughout the country to the extent of nearly half a million tons. This fact, coupled with the great advance in prices, was calculated to lead to a large increase of production, and all the more so that one half of the blast furnace plant existing in the United Kingdom at the beginning of the year was returned as unemployed. As a matter of fact, however, there has only been a very limited increase of the number of furnaces in blast, and it is probable that when the returns of production are made up for the year, it will be found that there has been an actual increase of less than 500,000 tons. One explanation of this apparent anomaly is to be found in the comparatively small number of additional furnaces that are available for immediate use. During the last four or five years the number of furnaces unemployed has been practically equal to the number in blast. But many of those furnaces are too far out of repair to be of any use, and most of them would require re-lining, which is a costly and tedious process. If there were any degree of certainty as to the continuance of high prices, no doubt this cost would be undertaken; but pig iron makers do not care to incur the expense of re-lining furnaces that might never be wanted, even if there were no other difficulties in the way. But there are other difficulties, and those, too, of a serious character. The supplies of coke and of certain descriptions of iron ore have been scarcely equal to the demand for some time past. Both have, as a consequence, advanced considerably in price, coke now being quoted at 18s. 6d. to 21s. and Furness ores at 16s. per ton, as compared with 10s. and 11s. per ton some 18 months ago. This will mean a difference by increase of 23s. to 25s. per ton in the cost of producing pig iron, so that the profit goes very largely to the mineral owner, in cases where the pig iron maker has to buy his materials, as he would have to do in the case of blowing in new furnaces, in the open market. If, however, he found himself buying raw materials at current prices, even on short contracts, without being covered by sales of pig, the high profits that now look so probable might easily be converted into heavy losses; and this being so, there is hardly likely to be any considerable increase of production, so long, at least, as raw materials remain so scarce and dear. That they will long so continue is hardly to be expected. There are still abundant supplies of good coking coal in Durham, the Midlands, and South Wales. Undoubtedly, however, the best seams in some of the principal fields have been pretty well exhausted. Calculations made some years ago, by mining experts, indicated that the South Durham coking coal would last for a hundred and fifty years more at least, at the then rate of supply, which did not greatly differ from that of the present time. It is, moreover, possible, by the mechanical treatment of the coal of inferior quality, to adapt a much larger area for coking purposes than was at one time expected. A development of production in this direction may therefore be looked for; but it may not be on a large scale. It would, indeed, be a pity if it were. Coke-makers have for years been carrying on a very lean business. They have not been averaging more than 8s. or 9s. per ton at the ovens, and if this were again to become the normal price, there would be little inducement for fresh hands to go into the business, or for new collieries and coke works to be opened up by those already in it.

So far as iron ores are concerned, there has not been, and there is not likely to be, any scarcity of the inferior ores of Cleveland, Northampton, Lincolnshire, and North Staffordshire. It is in regard to the high-class hematites of the West Coast that a famine may be possible. It is a well-known fact that the demand for such ores within recent years has greatly increased. In 1868 the production of West Coast hematites amounted to 1,893,000 tons, which increased in 1888 to 2,672,000, being an increase of 779,000 tons. In the former year practically no ores of this class were imported into the United Kingdom, but in 1888 something like 3½ millions of tons of such ores were imported from Spain and other countries. In 1868 only 19 per cent. of all the iron made was from hematite ores, whereas, in 1888, 40 per cent. of our iron production was made from them. There has, therefore, been every inducement to develop the production of such ores on the West Coast—the only district in which they are found in any abundance—and yet they have only increased to a comparatively small extent. These facts appear to confirm the current rumours that there is not much likelihood of any great development in this direction, and that a scarcity may actually come about, if it is not already arrived at. There is, however, no danger of our foreign supplies failing if they are well looked after. In the Bilbao district there is still a great supply of Rubio ores available, and new deposits are being constantly opened up. In the South of Spain there are many virgin fields awaiting development, and in Swedish, Lapland, and other districts there are ascertained supplies of enormous extent, so that if the trade is hampered at all by the difficulty of obtaining supplies, it can only be for a short period.

In completing this brief statement of the condition and outlook of the iron industries, we present herewith a few tables that will throw some light on the course of prices. The first of these shows the extremes between the commencement and the end of the year 1889. It will be observed that the greatest amount of advance has occurred where, probably, it was most urgently required—in bar iron and steel rails. Those who have been engaged in these trades for the last five or six years have had a really very hard time of it, and it is well that they should now have a better prospect in view. Much of the difference in price is, of course, absorbed by the additional cost of the pig, which varies between 17s. 4d. in the case of Scotch, to £1 8s. 6d. in the case of hematite iron. Copper and tin have, as will be perceived, fallen in value, while English pig lead shows about the same advance as Scotch pig iron.

The average prices quoted for metals in the first week of January and the second week of December, 1889, were as under:—

	January.	December.	Increase.
Scotch pig	£2 1 6	£2 18 10	£0 17 4
Cleveland pig	1 14 0	3 1 0	1 7 0
Hematite	2 5 0	3 13 6	1 8 6
Cleveland bars	5 2 6	8 15 0	3 12 6
Steel rails	4 2 6	6 17 6	2 15 0
Copper (Chili bars)	77 7 6	49 2 6	-
Straits tin	98 17 6	97 17 6	—
English pig lead	13 5 0	14 2 6	0 17 6

In the next table, the quantity, official value, and the calculated average value per ton of the iron and steel exports of 1888 and 1889 are recorded. The general effect of the figures is to show a considerable increase of both exports and prices, but of course, as already shown, the quantities exported are not in all cases satisfactory. Tinplates, which continue to be practically a monopoly of our own makers, and to be limited mainly to South Wales, show a very substantial increase, both of volume and price, and those who produce their own bars must have done very well.

Statement showing the Quantities and Value of the Iron and Steel Exported in 1889, *compared with* 1888 (1 = 1,000).

	Quantity Exported. 1888. Tons.	1889. Tons.	Value. 1888. £	1889. £	Average Value per Ton. 1888. £ s. d.	1889. £ s. d.
Pig iron	967	1,116	2,052	2,728	2 2 4	2 8 0
Bars, angles, &c.	270	235	1,502	1,496	5 11 2	6 7 3
Railroad	941	998	4,295	4,287	4 11 2	4 5 9
Wire	59	51	793	750	13 8 1	14 14 1
Hoops, sheets, &c.	385	357	3,737	3,798	9 14 1	10 12 7
Tinplates	362	401	5,136	5,585	14 3 7	13 18 5
Cast and wrought, &c.	394	424	4,490	4,940	11 7 9	11 13 0
Old iron	138	134	377	391	2 14 3	2 18 3
Steel, unwrought	141	137	1,443	1,539	10 4 7	11 4 6
Steel manufactures	17	19	517	587	30 8 2	30 17 8

Average Prices of Exports of Iron and Steel, as deduced from the Board of Trade Returns.

	1875.	1880.	1885.	1889.
Old iron	£4·76	£4·78	£3·07	£2 18 3
Pig and puddled	72·80*s.*	63·94*s.*	43·56*s.*	2 8 0
Bar, angle, &c.	£9·87	£7·81	£6·13	6 7 3
Railroad iron	9·29	7·31	5·47	4 5 9
Wire (except telegraph)	18·48	13·99	12·51	14 14 1
Sheets and plates	15·18	10·67	8·13	10 12 0
Galvanised	24·46	18·33	13·41	—
Hoops	11·16	8·46	6·69	—
Tinned plates	26·64	20·48	14·84	13 18 5
Other iron	18·10	13·75	11·53	11 3 0
Steel ingots and blooms	—	6·28	5·05	—
Steel bars	36·31	28·24	22·01	—
Steel sheets	32·99	21·91	12·52	—
Steel manufactures	75·07	57·97	31·43	30 17 8

These figures are useful as affording some idea of the enormous extent of the reduction that has occurred in the average values of all the leading descriptions of iron

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and steel. The tendency was almost continuously downward for fifteen years until last year. This year prices have recovered very largely, but for many descriptions they are still lower than they were in 1883, and much lower all round than in 1873.

The stocks of pig iron in stores at the commencement of 1889 and at the end of December, in the three principal districts, were as under:—

	January. Tons.	December. Tons.	Decrease. Tons.
Scotland	1,031,748	943,775	87,973
Cleveland*	472,628	239,888	232,740
West Coast	429,639	380,310	49,329
Totals	1,934,015	1,563,973	370,042

The above figures are very healthy indeed, and no doubt it will be found, when the full returns for the year are made up, that the decrease of stocks in the hands of makers has been considerable, probably sufficient to bring the total decrease of stocks to some half a million tons. It is, however, impossible to say what may be the increase of production. In Scotland the production of pig has actually been about 29,000 tons less than in 1888, but this is not likely to have been the case in other districts.

COAL.

Although it will still be several months before the actual production of coal for 1889 can be ascertained, it can be no secret that it will be considerably in excess of that of 1880, which amounted to 169,935,000 tons. There has, indeed, been an increase of consumption in every direction. The quantity of coal exported and shipped for the use of steamers engaged in the foreign trade has exceeded by more than 2½ millions of tons the consumption of 1888. The railways at home, and the steamers engaged in the coasting trade, having done a much larger business than in the previous year, must have consumed more fuel. In the iron, steel, foundry, shipbuilding, chemical, and other trades, a much larger volume of business has been done, calling for a much more considerable quantity of coal. Domestic consumption is a constantly increasing quantity, and has this year increased quite as much as usual, people buying more coal, as they can better afford it. It would therefore probably be a safe thing to estimate that the consumption of British coal in 1889 will not be less than 175 millions of tons, of which the enormous quantity of 37 millons, or over 21 per cent., has been sent abroad, either for the consumption of foreigners, or for the use of our steamers in the foreign trade.

The European demand for British coal has now assumed portentous proportions, the quantities exported to the principal countries in 1888 and 1889 having been as under (1=1,000):—

	1888. Tons.	1889. Tons.
France	3,824	3,640
Italy	3,263	3,323
Germany	2,814	3,253
Sweden and Norway	1,793	2,145
Russia	1,501	1,758
Denmark	1,183	1,269
Spain	1,476	1,616
Holland	258	447

Our principal exports to countries out of Europe have been as under:—

	1888. Tons.	1889. Tons.
Egypt	1,295	1,333
Brazil	547	680
British East Indies	1,203	1,121
Turkey	398	398

The prices of coal have hardened steadily during the second half of the year, and are now fully 30 to 40 per cent. higher than they were in the month of January.

SHIPBUILDING.

No branch of the trade of the United Kingdom has been more active during 1889 than that of shipbuilding, which has, of course, created an equally active demand for shipbuilding materials, and especially for iron and steel and machinery. The total tonnage launched during 1889 has been returned at 1,286,679 tons, but as it seldom happens that the total turn-out of the year is ascertained at this early period, the aggregate is likely to be about 1,300,000 tons, which is greatly in excess of the quantity built in any former year except 1883, when the total rose to 1,250,000 tons. As only some 100,000 to 150,000 tons are ordinarily built for foreigners, the greater part of this vast tonnage must be added to the British register, and it is probable that after all wrecks and replacements have been allowed for, the actual addition to the register for 1889 will be some 700,000, which is an entirely phenomenal addition. The Tyne, Wear, Tees, and Hartlepool have supplied 718,000 tons towards the total of 1889, and the Clyde has followed with 335,000 tons. Next in order come Belfast with 80,000 tons, and the Mersey with about 35,000 tons. Prices have been well kept up, and the returns of the shipbuilding actually in hand appear to promise another prosperous year for this great industry. In Germany, Holland, and other European countries the increase of shipbuilding in 1889 has been important.

* Makers' stocks included.

SHIPPING.

One very satisfactory feature of our business for the past year is evidenced by the fact that, in spite of all the pessimistic talk that we hear from time to time as to the possibility of having to yield up a share of our shipping supremacy to other maritime nations, we still continue to carry our trade in much the same proportions under our own flag. The shipping entrances and clearances in 1889 amounted to a total of 56,594,000 tons, of which 14,080,000 tons were foreign vessels, being rather under 25 per cent. In 1887, the total entrances and clearances were 51,511,000 tons, of which 12,727,000 tons were carried in foreign vessels, being just about the same percentage of the whole. But it must not be forgotten that there was a much keener competition, and consequently much lower rates in 1887, so that foreign vessels had not the same chance as in 1889, when the freights for British bottoms took a higher range. It might, therefore, be expected that in 1889 foreign ships would have a much better chance of competing successfully, all the more so that there has, in not a few cases, been a difficulty in getting English ships at all. The largest amount of foreign tonnage that entered and cleared in 1889 carried the German flag, the next largest the Norwegian, and the next largest the Dutch. But although Germany has of late years made great efforts to increase her merchant shipping business, it is remarkable that, of the 5,086,000 tons of entrances and clearances from and to Germany in 1889, only 2,753,000, or little more than one-half, was German tonnage.

The countries with which we have done our shipping business during 1889 compare very favourably with those shown for previous years. So far as our export trade is concerned, which is the main factor, it appears that we increased our clearances for our principal markets in the proportions that follow:—

Exports, as represented by Shipping Clearances in

	1889. Shipping Tonnage.	1887. Shipping Tonnage.	Increase in 1889. Shipping Tonnage.
Germany	3,278,000	2,730,000	548,000
France	3,205,000	3,298,000	—
Spain	1,161,000	1,058,000	103,000
Italy	2,111,000	1,957,000	154,000
North Russia	1,203,000	1,080,000	123,000
South Russia	196,000	67,000	29,000
Sweden	1,132,000	935,000	197,000
Holland	1,672,000	1,377,000	295,000
Turkey	405,000	363,000	40,000
Egypt	829,000	776,000	53,000

There has, however, been a falling off in our clearances for the United States, France, Roumania, and Austrian territories, while to Belgium our clearances have been almost stationary. The reduced shipments to the United States are the most serious of all. In 1887 they were 3,211,000 tons, whereas in 1889 they only amounted to 2,970,000 tons, showing a falling off to the extent of 241,000. Much has been made of the fact that the present revival of trade has been in no degree due to the United States. These figures show, so far as they go, that, so far from that having been the case, there has been a substantial falling off in our shipping clearances to that country; and the Fair Traders are not likely to be comforted when they find that for the same periods our entrances into British ports from the States have advanced from 4,307,000 tons to 4,710,000 tons. This increase was, however, almost inevitable. The United States supply, not only the great bulk of our imported food supplies, which we buy there because we cannot buy cheaper elsewhere, and therefore buy in our own interest entirely; but they furnish the raw materials of some of our leading industries, and notably those of the cotton manufacture, which we re-export to other countries in the finished condition.

To our newer and less developed markets we owe a great deal of the demand that has stimulated the recent revival of trade. The Returns show that our shipping clearances to Brazil have advanced from 539,000 to 712,000 tons, to Chili from 183,000 to 259,000 tons, and to other countries, such as the Argentine and other South and Central American republics, from 1,428,000 to 2,165,000 tons. This last is a very hopeful feature indeed. South and Central America are now, next after China and Japan, the most promising neutral markets in the world. They do not to any great extent manufacture themselves, and they are every year increasing in importance. When we use the term neutral markets, we do not, of course, include our own colonies, to which the shipping clearances have been 5,238,000 tons—a falling off as compared with 1888, although a substantial improvement on 1887. This falling off is equally apparent in the East Indies, our Australasian colonies, and the Dominion of Canada, while, as regards the West Indies and our other colonial possessions, there has been a solid advance.

The shipping industry, which is always in a flourishing condition when the trade of the country is generally prosperous, has, as might be expected, responded fully to the upward and progressive movement in commerce and industry generally. The total tonnage of British and foreign vessels that have entered British ports during the eleven months of 1889 has been as much as 26,131,000 tons, as compared with 24,763,007 tons in 1888 and 23,910,000 tons in 1887. There has, therefore, been an increase of nearly 10 per cent. in 1889 over the corresponding period of 1887, which must be regarded as a satisfactory advance. There has been an equally remarkable advance in the clearances from British ports, which amounted to 30,464,000 tons in 1889, as compared with 29,055,000 tons in 1888 and 27,601,000 tons in 1887, thus showing an increase of 2,863,000 tons, or again about 10 per cent. over 1887. It is hardly necessary to remark that this increase has been an increase of volume entirely, and it therefore proves that our prosperity is not merely due to an increase in prices, but is an actual development of demand and of production all round.

THE LEATHER TRADES.

The old adage that there is "nothing like leather" appears to be once more verified in the conditions of the leather trade during the past year. To begin with, our imports of the raw, or rather dressed, materials have been greater than in any former year, reaching 96,250,000lb. as compared with 78,000,000lb. in 1887. We have also imported 1,469,300 dozen pairs of gloves, and 92,551 dozen pairs of boots and shoes. For these several items we have had to pay a little bill of over eight millions sterling, which is a pretty good thing for the French, who have mostly supplied us with the goods in question. Our showing on the other side of the account does not compare favourably with that just recorded. Our exports of leather, both unmanufactured and in the form of boots and shoes, amounted to only £3,207,000, which is considerably less than one-half the value of our imports. In all departments our exports of leather show a decrease as compared with 1888. The decrease, however, is not so serious as to justify any apprehension that the trade is going to the dogs, although there can be no doubt that, with the cheaper labour of France and other countries, and their more delicate methods of manipulation, it is not easy for English leather merchants or bootmakers to hold their own in the export trade.

MINOR INDUSTRIES.

When miscellaneous and minor industries are considered, the record for 1889, although undoubtedly leaving little to complain of, has not been so uniformly progressive as in the cases of the great staple industries with which we have already dealt. As regards some of them, indeed, there has been a considerable falling off, as the following figures show (1=1,000):—

Exports from United Kingdom.

		1888.	1889.
Boots and shoes	doz. pairs	606	605
Alkali	cwts.	5,826	5,570
Bleaching powder	"	1,453	1,384
Gunpowder	lbs.	12,675	10,026
Bags and sacks	doz.	3,357	2,873
Plate glass	sq. feet	3,966	3,524
Leather, unworked	cwts.	148	130
Seed oil	tons	71	63
Paper, writing, &c.	cwts.	731	644
Paperhangings	"	58	56
Other papers	"	214	196
Soap	"	452	448

Here we have a dozen important industries in regard to which the exports show a falling off as compared with 1888. In most of them the decline is immaterial, and in reference to most it will be found that prices have improved, but the revival of business is still one that is not universal, and it must be carefully tended if it is to be taken advantage of.

IMPORTS AND EXPORTS.

The year 1889, so far as our imports and exports are concerned, has been by far the most prosperous year that British trade and industry have ever known. Probably not many people have stopped to realise the fact that our foreign trade in 1889 will amount to 117½ millions more than that of 1886. These two years indicate the high and low water marks of British trade with foreign countries—1886

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IMPROVED SCREWING MACHINE.

CONSTRUCTED BY THE OERLIKON MASCHINENFABRIK, ZURICH.

(*For description see opposite page.*)

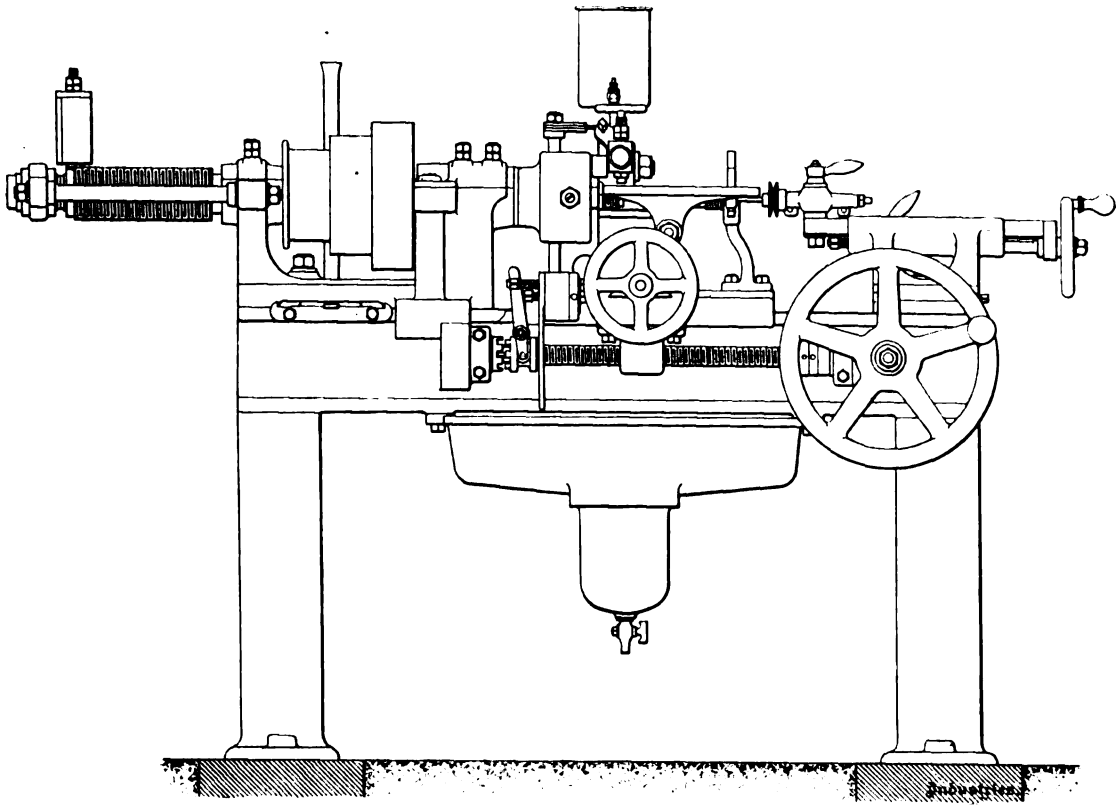


FIG. 1.

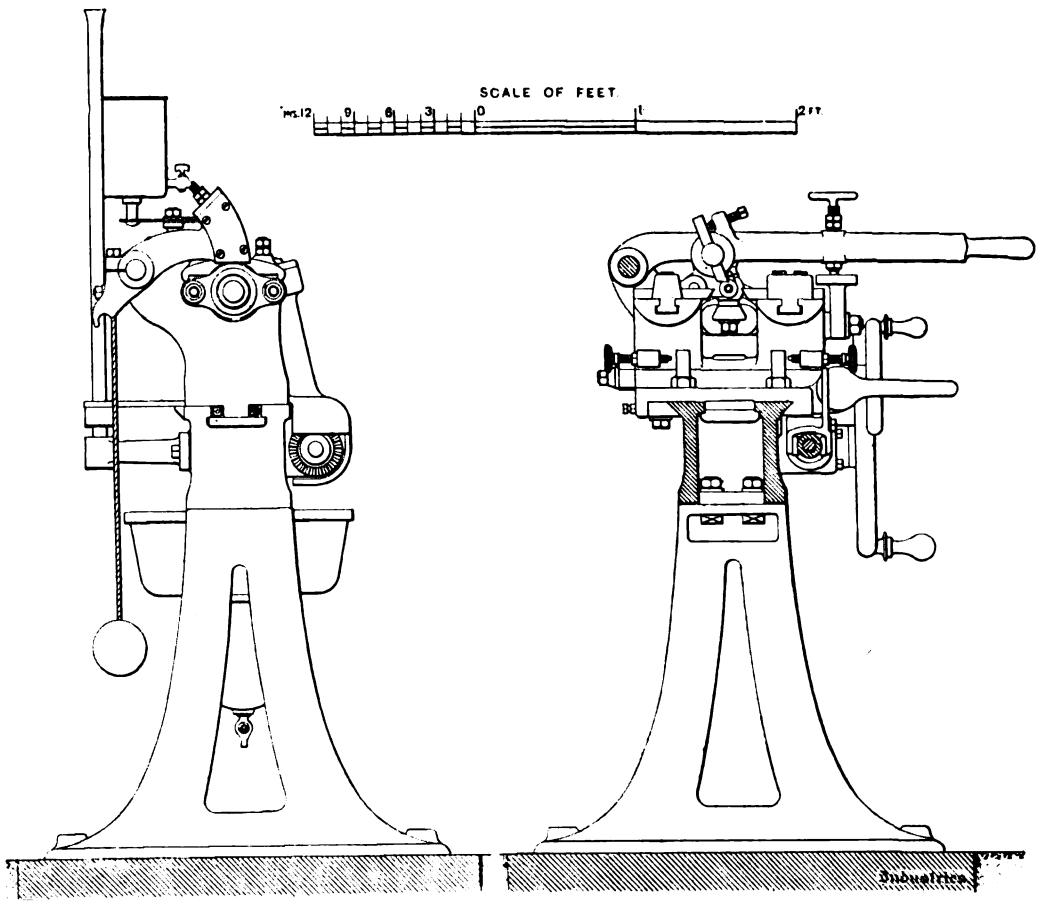


FIG. 2.

FIG. 3.

having been the year of lowest prices and smallest trade, and the year 1889, on the contrary, carrying us on the crest of a wave of bounding prosperity, which tends no one knows whither.

Up to the end of November, the total value of our imports amounted to 389¼ millions. If the value of the December imports be taken at the same figure as those of November—and they should be somewhat more if the daily average is much the same, seeing that there is one day more in December—it would follow that our total imports for the year will amount to rather over 430½ millions, which is an increase of 43 millions on those of 1888, 68¼ millions on 1887, and 80¾ millions on 1886. The total exports for 1889, assuming December to be again dealt with in the same way, will amount to 249½ millions, which is again an increase of 15¾ millions on 1888, 28 millions on 1887, and 37 millions on 1886. Our imports have, therefore, increased to the extent of more than twice the value of the increase of exports. This increase is largely due to the greater imports of breadstuffs, which are not, of course, directly a source of wealth, but it is, nevertheless, important to observe that we only buy our food supplies from abroad to the extent that we do because we cannot do better otherwise or elsewhere. The increased preponderance of imports over exports is a matter that is likely enough to fill with apprehension those who calculate that trade should be evenly balanced as between the two. It will be observed that for the past year there is a difference of 181 millions sterling, or, put in another way, that the difference is equal to 27 per cent. of the whole sum of both. The truth, therefore, seems to be that our imports are far on the way to doubling our exports, and it will no doubt be a hotly contested point among the political economists and others how this comes about, and how far it is hurtful or otherwise to British trade. It must never be forgotten that we have to reckon our imports plus the cost of ocean freight, whereas this item is not any part of the official cost of our exports. If we are to equalise the two for purposes of comparison, we must deduct some 70 millions sterling from our imports for this consideration, which would reduce the difference to little over 100 millions. There are many items that go to make up this difference, which have been again and again pointed out. But as regards the special circumstances of the year 1889, it must not be forgotten that imports have gone, in a material degree, to make up the sum of the trade that has been done at home to a very exceptional extent during the current year. To take one example only. We have this year imported nearly half a million tons more of iron ore than in 1888. This iron ore has been manufactured first into pig iron, and afterwards into rails, plates, bars, angles, &c., which have been used in our shipbuilding, railway, and other home trades, that do not figure at all in our export returns. Many other cases might be quoted to prove that imports and exports do not always run so far on all fours that an exact or relevant comparison can be made between them. And one fact stands out more prominently than any other—that, whatever the ultimate result may be, the differences to which attention has been called are strictly compatible and coincident with a rare degree of general prosperity.

In the exports of British and Irish produce, the total increase of value for 1889 has amounted to £12,224,000. The principal item of increase occurs under the head of raw materials, which embrace almost solely coal and wood. In coal alone there has been an increase to the amount of £3,235,000, as compared with a total increase for raw materials of £3,250,000. This has been largely an increase of price, although the actual quantity exported has advanced in 1889 to 26,737,000 tons, from 24,737,000 tons in 1888 and 22,363,000 tons in 1887. There are economists and others who are rather disposed to deplore the export of raw materials, which are, beyond all doubt, a substantial foundation, if not the main foundation, of our industry; but the period when we are likely to feel the effects of a scarcity of fuel is still a long way off. On the whole, however, it is perhaps more satisfactory to turn from raw materials to metals, machinery, and mill work, the exports of which for 1889 show an increase of £5,260,000 as compared with the previous year. This, again, is largely an increase of price, inasmuch as the actual increase of quantity only amounts to 202,000 tons as regards metals. Considering the great activity that has prevailed for months in the iron and steel industries, a much larger export might naturally have been looked for; but that activity has been largely created by an increase of demand at home. As this demand is likely to be more easily satisfied than a general demand from abroad, a larger increase of the latter would have been more encouraging.

There is one department of our export trade that has not yet been either dealt with or included in any of the figures that have gone before—namely, our exports of foreign and colonial produce. This is an important branch of commerce, inasmuch as it provides employment for a large part of our shipping, but it is not of much interest or value as affecting any other home industry. The re-exports of such products in 1889, reckoning December at the same figure as November, will be about 64½ millions, or, roughly, half a million more than the value of 1888. Adding this to the other items of foreign trade, the total comes out as 744 millions, which is just 12 millions in excess of the next best year in the history of our foreign trade—that having been 1883.

HOME DEMANDS.

Hitherto we have dealt with the foreign trade only. But it has been remarked that one of the most notable

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features of the revival of trade in 1889 has been the increase of home business. This increase has been chiefly reflected in the traffic returns of the railway companies, which do the greater part of the carrying trade at home. But it is also clearly established by the returns of the coastwise shipping trade, which show for 1889 an increase in entrances and clearances of 3,772,000 tons as compared with 1887. This is a remarkable increase, representing as it does a much more considerable weight of actual traffic; and, taken in conjunction with the railway returns, proves that the home demand for commodities has been much greater during 1889, although 1887, as we have already pointed out, was a prosperous year compared with 1885 and 1886. One feature of our coasting trade is that there has been a falling off, as between 1889 and 1887, in the shipping entries from Ireland, although there has been a substantial increase in the clearances to that country. There is still a certain proportion of our coasting trade carried in foreign ships, but it is only a fractional part, and it is every year getting smaller.

One of the most effective signs of the improvement of trade is the greater activity that exists in reference to the development of new industrial enterprises, both at home and abroad. This development, as regards each of the last two years, may be estimated by the following figures, which show the plans deposited for Bills coming before Parliament during the Session of 1890, compared with those for the previous Session :—

Bills	Session of 1890. Number.	Session of 1889. Number.
For Railways.....	67 ...	47
„ Tramways	12 ...	14
„ Miscellaneous..... ...	59 ...	54
„ Provisional Orders, Miscellaneous	35 ...	46
„ „ Electric lighting	159 ...	—
Total	332	161

It appears, therefore, that there will be just about double the amount of Private Bill legislation required in Parliament this year that obtained in 1888, which means, of course, that a much larger amount of work must be provided throughout the country in carrying out the various enterprises that are the subjects of these applications.

LABOUR DISPUTES.

The business of the past year has been a good deal interfered with by strikes and rumours of strikes, which are generally got up when trade has begun to mend. The workmen are in some cases less reasonable than they should be, most often from ignorance of the real facts. They appear to assume that, directly the price of a commodity improves, their employers enter into the full possession of the difference between the old and the new price. There could, however, be no greater fallacy. As a rule, manufacturers are working more or less under old contracts at old prices, and have probably only a limited part of their products free for sale. Not only so, but they have generally to pay an increased price for raw materials, which may, and in many cases actually does, absorb the greater part of the nominal difference between the old price and the one on which the men take action. The case of the iron trade illustrates this point very aptly. The price of Cleveland pig has been advanced from 25s. to 30s. per ton on the prices current up to a year or so ago. But against this the manufacturers have to pay some 10s. more, at least, in the price of coke, and probably 4s. to 6s. more in respect of other increased charges, so that all the difference that would come to the maker who bought his materials in the open market at current rates would be under 10s. per ton, and this is to be set off against years of depression, when he was making hardly any profit at all. The same complexity of arrangements runs through all other leading industries.

We intend next week to publish special reports dealing with the progress in engineering, electricity, and chemistry during the past year.

WIRE STRAIGHTENING MACHINE.

There are numerous uses for absolutely straight rods of various diameters in the construction of many classes of machines, but their production has always been an expensive process. Even after great care has been exercised, the result has not always been satisfactory, and it is quite certain that any rapid method of straightening wire or bars will be of great service to a large number of manufacturers. In the machine illustrated above the general principles are those embodied in a patent of Messrs. Wood & Smith, but certain additional features have been added by Mr. Barraclough, the head of the firm of Messrs. Barraclough & Co., Limited. The machine consists of three parts—the straightening, feeding or delivering, and the cutting. The straightening head A (Fig. 2) revolves in suitable bearings at a high velocity, and is provided with dies B, now preferably made of phosphor bronze and with semi-circular heads. These dies can be set up by means of the screws shown, and when set can be firmly locked in position. They are, when working, arranged so as to bend the rod alternately in each direction to such a degree that when it leaves the head all the kinks are effectually removed. In addition to this the rapid rotation of the die surfaces round the rod in its transit gives a polish to the latter which obviates in many cases any necessity for turning.

The second part of the machine is that which delivers the rod. This consists of two cams C C^1 set in opposite directions to each other. These press against a bowl in the lower part of the levers D D^1, and are so constructed that at each revolution they give a double motion to the latter. That is, they move the levers longitudinally and lift the lower end so as to cause a jaw fixed on the upper end of the levers to nip the wire against a suitably arranged jaw. These operations take place in the reverse order to that named, the round of operations being as follows: Assuming that the lever D is as near the straightening head as it can be, the cam C causes it to oscillate on the centre rod E, and thus nip the wire. The continued revolution of the cam then moves the lever D towards the delivery end for the length of its throw—4in.—when the wire is released by D, the cam being shaped to effect this. At this moment the second lever D^1, worked by its cam C^1, is at its innermost point, and grips the wire as it is dropped by D, beginning immediately to move towards the delivery end. In this way the cams work alternately but continuously, and except the slight pause, which is designedly given at the end of the stroke of each cam, the progress of the rod through the machine is continuous. This is a very simple and ingenious contrivance, and is practically effective.

The cutting apparatus is placed at the end of the machine, and consists of an upper fixed jaw and a lower sliding one, each carrying a cutter blade. The period at which one blade advances upon the other coincides with the slight pause made in the traverse of the wire as described. The slide is raised by means of a stud wheel F, the rotation of which can be regulated by change wheels, and which is fitted with one or more studs, as desired. These, in their revolution, raise the sliding cutter and cut the rod to any required length. It is easy to see that a modification of the rate of revolution of the stud wheel will alter the length cut off, and this is further aided by the employment of stops G, which enable the primary length moved at each traverse of the grips to be altered as desired. These stops are fixed, as shown, on a square bar placed at the upper part of the machine above the cams, and divided or ruled in fractions of inches or other standard measurement. By this combination practically any length from 4in. upwards can be cut.

The chief improvements made by Mr. Barraclough consist in a special arrangement of driving. As originally designed, the straightening head and delivery cams were driven separately, but they are now driven from one point in the centre of the machine, as shown, the speed of the cams being reduced by the use of three pairs of wheels and pinions compactly arranged. The machine is made in three sizes, the first of which deals with material from 7 B.W.G. to $\frac{7}{16}$in. diameter; the second from 7 to 18 B.W.G.; and the third from 18 B.W.G. to finer sizes. It effectually deals with the hardest steel, and we saw some specimen rods produced from a reel of wire on the machine which were quite fitted for immediate use without further preparation. In conclusion, it may be said that the general construction is satisfactory and the workmanship good, and the machine is likely to prove a valuable adjunct to machinists and others.

WIRE STRAIGHTENING MACHINE.

Constructed by Messrs. T. Barraclough & Co, Machinists, Manchester.

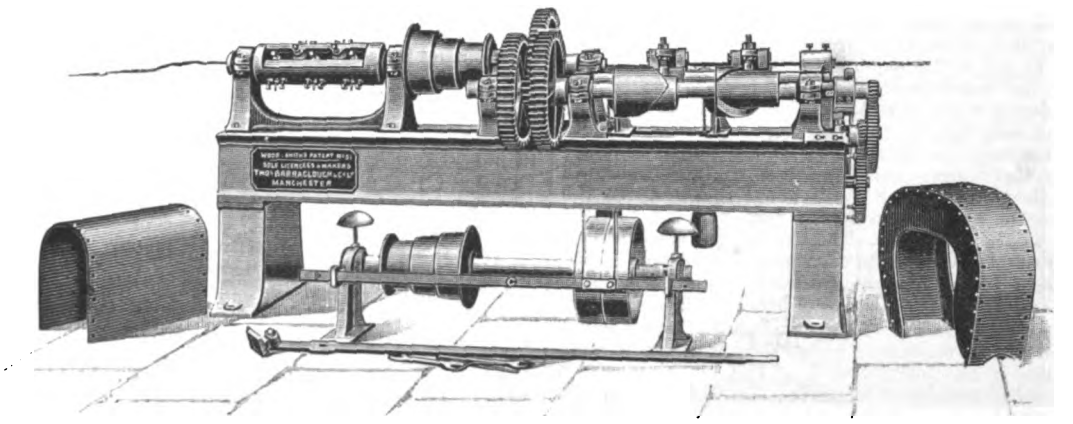


Fig. 1.—General View.

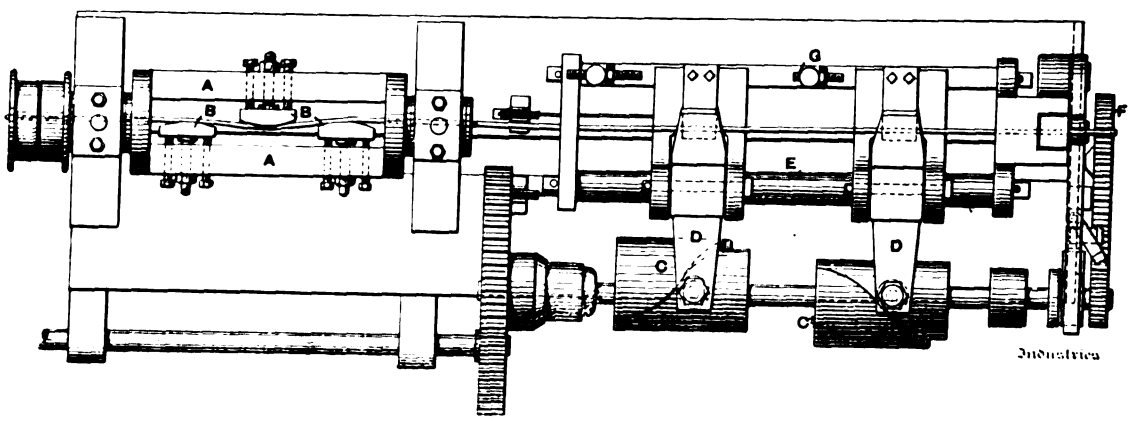


Fig. 2.—Plan.

IMPROVED SCREWING MACHINE.

We illustrate on page 4 a useful screwing machine of 8in. centres, exhibited at the late Paris Exhibition by the Maschinenfabrik Oerlikon, Zürich, Switzerland. Fig. 1 shows a front elevation; Fig. 2 an end elevation, as seen from the tail-pin end; and Fig. 3 a section through the bed looking towards the loose headstock. The general construction of the machine is clearly shown in the engravings. Stops are provided for all the motions, and the machine altogether is a good example of recent Continental types.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

(FOR LATEST TELEGRAPHIC DESPATCHES SEE PAGE 9.)

PARIS, 31st December, 1889.

IRON.—That the year 1890 will begin in circumstances favourable to the iron trade none doubt, but the view generally taken of the near future of that trade is probably destined to end in disappointment. The present position is likely to be maintained. Further improvement in any marked degree is not to be looked for. This is, at least, the opinion of some who are in a position to judge accurately of the tendency of events. There are no grounds for believing that a large quantity of iron will be consumed in Paris in the year on which we are about to enter. In the provinces the present activity may be kept up, but the demand will be easily met. The exceptional circumstance of heavy purchases on German account is not likely to be repeated in 1890. We may reasonably hope for a steady amount of business, but there will be no "boom."

METALS.—The future of the metal market is just now a matter of anxious concern to many. What is to be the course of business in the early months of 1890? This question is being asked with much misgiving as to the answer. As for copper, no one believes that the present prices can be maintained much longer. But the case is different for tin. It is the common opinion that a "ring" exists to run up the price of that metal. Zinc can hardly continue its upward course much farther, as the high prices have greatly restricted consumption; but as there are no stocks in hand, a speedy relapse is improbable. As for lead, the conditions of trade are such that the market cannot be greatly disturbed by any possible combination.

PREFERENTIAL RAILWAY RATES.—A strong agitation has been set on foot by the colliery owners of the North for the abolition of the preferential railway rates which favour the import trade in coal to the injury of the home coal mining industry. The advantages afforded the importers by these rates, they say, neutralise the effect of the protective duty imposed in the interests of the home trade. Examples are given to show that English coal is carried over distances of 50, 70, and even 100 kilometres practically free of charge. It seems likely that the agitation, which is well organised and persistent, will effect its purpose. This is a matter of considerable importance to the trade in English coal.

SHIPBUILDING.—The additions about to be made to the French Navy will tend to impart vigour to the iron trade. The Minister of Marine has, within the last few days, signed contracts for the construction of two armoured cruisers and three large ironclads. The Chantiers de la Gironde and the Forges et Chantiers de la Mediterranée will each build one of the former. The contract price is £344,000. One of the ironclads, which are to be of the Admiral Trehouart type, and of 6,700 tons displacement, is to be built by the Forges et Chantiers de la Mediterranée; the other two will be built by the Chantiers de la Loire. The contract price for the first is £492,960, and for the others £488,960.

THE MEASUREMENT OF HIGH TEMPERATURES.—At the last meeting of the Physical Society of France, M. Le Chatelier showed a new apparatus for measuring high temperatures, which will no doubt be capable of extensive application. Its action depends on the rate of increase of the resistance to the flow of gases through capillary tubes, according to the temperature of the tube. The experiments have shown that with a capillary silver tube ·43mm. in diameter and ·2m. long a certain amount of air at constant pressure took 80, 115, 270, 310, and 427 seconds to pass through it at temperatures of 15°, 100°, 320°, 500°, and 700° C. respectively.

THE TELEPHONE BETWEEN ROUEN AND PARIS.—The iron telephone wire between Paris and Rouen has lately been replaced by a bronze wire, and the hearing powers have been consequently much improved. It has, therefore, been decided to make the same change on all the trunk lines, and the next alteration will be on the Reims and Paris line.

THE INTERNATIONAL TELEGRAPH CONGRESS.—The next meeting of the International Telegraph Congress will be held at Paris in the year 1890, during the month of May. The president for the year will be the Director of Posts and Telegraphs.

BERLIN, 30th December, 1889.

BOURSE.—The colliers' strike in Belgium has given fresh impetus to the market in coal securities here. Within the last few days the demand for shares in colliery companies has become very brisk. It is significant of the situation of the coal mining industry that the price of shares in such companies has increased from 50 to 100 per cent. since the beginning of the year.

IRON.—The production of pig iron in Germany, including Luxemburg, in the month of November amounted to 389,570 tons, against 343,971 tons in the same month of last year. This brings up the total production for the first eleven months of the year to 3,996,435 tons, against 3,874,618 tons in the corresponding period of 1888. The output of the furnaces is still in some degree restricted by the short supply of coke. The exports in the first three quarters of the year 1889 were—For pig iron, 167,532 (121,191) tons; for finished iron and steel, 597,545 (636,409) tons; and for machines, 54,614 (57,231) tons; the figures within parentheses being those of the corresponding period of 1888.

THE NEXT INTERNATIONAL EXHIBITION.—There is a strong feeling in German commercial circles that the next great International Exhibition should, in the interests of German trade, be held in Berlin. This feeling has already shown itself in action, a number of influential persons in various callings and positions having met to discuss the question and to devise measures for promoting the scheme. The project is said to be regarded with favour in high official quarters.

DYERS' PRICES.—The Berlin woollen yarn dyers have resolved to advance their prices for all colours from the 1st January, 1890.

CEMENT PRICES.—The proprietors of the sixteen cement works who constitute the South-West Cement Manufacturers' Syndicate have announced an advance of 4½d. per cwt. in the price of their produce from the 1st January, 1890, to cover the additional cost of fuel occasioned by the rise in the prices of coal.

NEW QUICK-FIRING GUN.—The Gruson Ironworks Company have, it is said, purchased the patent rights of a new quick-firing gun. This gun, which is the invention of a Swedish officer, is said to be superior to any yet in the field for simplicity of construction.

STRAW HATS AND BONNETS.—The strike of the hat and bonnet makers, which is being maintained chiefly by contributions from abroad—England, France, Denmark, Switzerland, and the United States of America having each sent considerable sums for the support of the 800 men and women out—has directed attention to the export trade in straw hats and bonnets. The exports in the first ten months of the current year amounted to 2,430,753 articles. France is the largest buyer, 1,451,053 being set down to French account. English buyers took only 38,370. These figures relate only to the untrimmed articles. Of trimmed straw hats and bonnets there were exported 501,955, of which English customers took 8,983, while the French purchased only 3,807.

VIENNA, 30th December, 1889.

COALS.—The coal trade continues to be extraordinarily animated. Especially in Western Bohemia is the demand for export very brisk, on account of the great quantities which go to Saxony, where many factories, at other times procuring Westphalian coals, now buy from Bohemia. The traffic suffers from the want of rolling stock on the Bustehrad and Aussig-Teplitz railways. The Bustehrad Railway has just ordered 600 coal cars.

IRON.—The favourable tendency still prevails in the iron market, and in several branches prices are advancing. The Bohemian rolling mills have raised the price of tinned sheets by 15fl. per ton. Pig iron is in brisk demand. Last week two general meetings of the shareholders of large ironworks have taken place. The first one—that of the Egydy Works—voted the proposed dividend of 3½ per cent.; and the other, of the Manufactory of Arms, a dividend of 27 per cent.

IMPORTS AND EXPORTS.—The value of exports from Austria during the first nine months of the year 1889 has exceeded the value of the exports during the same period of 1888 by 5·8 per cent. The country which has increased most is France. The following table gives a list of exports:—

	1888. Tons.		1889. Tons.
Sugar	96,595	...	142,378
Beer	33,165	...	38,023
Spirits	17,762	...	11,803
Flour	131,135	...	136,637
Iron ore	27,628	...	62,376
Bar iron	7,798	...	6,509
Pig iron	6,555	...	4,667
Waggons	1,972	...	132
Tinplates	1,447	...	1,245
Boilers	46	...	189
Machines	6,785	...	8,303

The imports have increased by 8 per cent. The following table gives the details:—

	1888. Tons.		1889. Tons.
Coal	1,980,590	...	2,327,186
Coke	98,637	...	142,376
Pig iron	48,883	...	67,115
Manufactured iron	4,342	...	7,900
Wood wool	80,452	...	91,091

THE SITUATION OF THE AUSTRIAN MONTAN INDUSTRY IN 1889.—The other day there was a meeting of the Montanverein, when Prince Salm-Reifferscheid was in the chair. The situation of all branches has become better. The perception of mutual interests has rendered the best service to the Austrian Montan iron and machine manufacturers, and it has been also extended this year to some refined iron branches, as, for example, wire nails. Up to the present the syndicate has omitted to increase the prices over the limit. It is a fact that the higher selling prices are balanced by higher production prices. The fixing of the wages was essentially influenced by the strikes. The programme of the Montanverein for the next year contains the solution of two questions: (1) To remove the want of rolling stocks of the railway, which is a steadily increasing hindrance to the trade; and (2) the regulation of the value and its reaction to the industry.

INDUSTRIES IN HUNGARY.—The number of new manufactories in Hungary steadily increases. The new concerns belong to different branches of industry, but in all cases the Hungarian Government has granted extensive favours to the promoters. The number of new factories is not yet exhausted, and many projects are in consideration.

BRUSSELS 31st December, 1889.

THE COAL MARKET.—The coal market continues to be very animated. The prices are continually increasing, and the country is being sought through diligently by foreign buyers for the purpose of finding some coal which has not already been disposed of. The whole production of domestic heating coal is being sold at 25fr. The transport of coal over the iron roads continues to show great activity, and the amount carried by the State Railways compares favourably with that carried this time last year. The strike which has lately been raging has done great harm to industry, particularly in the district of Charleroi.

THE IRON MARKET.—The prices of the finished products are firm, and correspond favourably with those of pig iron and coal. However, it gives the manufacturers some anxiety to see the prices of these raw materials going higher still. The State contracts have given a good deal of work to many shops, but the high price of sheets does not allow of much profit. At a meeting of manufacturers last week sheets and plates were fixed at 21-22fr. as a base. Steel sheets were increased in price by 2fr.

FLAX AND LINEN.—In the principal linen and flax markets there are strong complaints of the stagnation of business. There are several causes for this state of things, chiefly, of course, that the buyers in the Flemish markets, who are principally English and Irish spinners, are at home at present.

NEW TRAMWAYS.—The town authorities of Brussels are about to build a new tramway to connect the Palace Square at the centre of the town with the Luxembourg Station. From the Bourse to the corner of Montagne Street the carriages will be run by electricity, and from there to the end of the journey a steel cable will be employed to help it to mount the rise of 40 metres at a gradient of 20 per cent.

DÜSSELDORF, 31st December, 1889.

COAL.—The report presented to the members of the Düsseldorf Exchange at their ordinary general meeting, held on the 19th inst., at the Hotel Heck, gives some interesting information concerning the state of the coal trade. According to this report, the total production of coal in the Dortmund district, in the first nine months of the year, amounted to 24,515,387 tons, an increase of 1·03 per cent. relatively to the corresponding period of last year. But the number of hands employed had increased 8·6 per cent. Bearing this fact in mind, and taking account of the augmentation in the rate of wages, we see that a large increase has taken place in the cost of production. The small additional output was, however, far from sufficient to meet the growing requirements of consumers; consequently we find a largely augmented import trade. For the first nine months of the year the total imports of foreign coal amounted to 3,342,199 tons, an increase of 50·28 per cent. relatively to the corresponding period of 1888. Of these imports 2,492,143 tons were received from England, a quantity greater by 101·6 per cent. than that of last year. The imports since September have gone on increasing. On the other hand, the exports of German coal to Holland, the chief foreign market for the Westphalian producers, have fallen off considerably. Of course, in a state of things such as is here indicated, prices have risen greatly. What the increase in this direction has been is shown in the report in question by the figures relating to gas coal, dry-burning coal for industrial uses, and blast-furnace coke. In the course of the year the first has risen from 9s. to 16s., the second (roughs) from 6s. 7d. to 12s. 6d., and the third from 10s. to 25s. 6d. a ton. The increase in the cost of coke is remarkable, and it is a fact of great, if not paramount, importance in estimating the situation of the iron trade. At the present moment the tendency is still strongly upward.

IRON.—The year which begins to-morrow will find the iron trade in excellent circumstances, at least in so far as the near future is concerned. The blast-furnace owners have sold nearly the whole of their possible output in 1890. Some of the steel makers have already covered the whole of their requirements for raw material in the coming year, and all manufacturers of finished produce have booked sufficient orders to keep them occupied till the end of June. The upward movement in the prices of pig seems to have come to an end, at least till another considerable advance takes place in the foreign markets. For finished iron there is a rise of 20s. a ton to record in plates and sheets. After this the market is likely to remain steady for some time to come.

RAILWAY SLEEPERS.—The recent order of the Minister of Public Works relative to railway sleepers is one of the many events which have happened of late to promote the interests of the iron manufacturers. According to this order, the length of all sleepers, of wood as well as of iron, is to be henceforward 270 centimetres instead of 240 centimetres as heretofore. The change has been made to give a

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firmer seat to the sleeper. The additional length will increase the weight by some 12½ per cent.

Cost of Growing Corn.—The report of the Commission appointed in 1888 by an order of the Minister of Agriculture to inquire into the methods of corn-growing, and to ascertain the average cost in each of the three principal corn-producing districts of Germany, has recently been published. We learn from this report that the general average is, per ton, as follows:—For wheat, 170s. 7d.; for rye, 151s. 10d.; and for oats, 135s. 5d. The extremes were:—148s. and 180s. for wheat; 141s. and 170s. for rye; and 130s. and 141s. for oats.

LILLE, 31st December, 1889.

Textile Manufactures.—The year ends in favourable circumstances for the linen trade of Armentières. In spite of the interruption of business by the Christmas holidays, the last week has been a period of considerable activity. The turnover is greatly above the average for this season, and augurs well for the business of the new year. The tone of the market is in consequence hopeful and firm. This week will, in the ordinary course of things, be given to the New Year festivities and stock-taking. The Roubaix woollen market has continued active down to the last hours of the year, closing to-day with fair prospects.

Protection for the Linen Industry.—At the annual general meeting of the *Comité linier* of the North of France, held here a few days ago, under the presidency of M. Ed. Faucheur, it was resolved to protest against the renewal of the treaties of commerce, and to set on foot an organised agitation "for the adoption of an economical system conformable to the interests of French industry." This means a vigorous attempt to influence the Government in favour of protection for the linen industry.

AMSTERDAM, 30th December, 1889.

The New Factory and Workshops Legislation.—The new Act, which comes into operation on New Year's Day, is the most important statute upon the subject yet enacted in the Netherlands. It contains numerous exceptions, and work in the following establishments is expressly excluded from its provisions: Restaurants and eating-houses, apothecaries, &c., also craft of every description, although even in all these cases it will be illegal to employ children under twelve years of age, except where skippers have their own children or apprentices with them. Labour in the fields, in orchards and market gardens, in forests and upon peat bogs, is likewise excluded from the stipulations of the Act. In the main it provides that, on and after January 1st, 1890, no child under twelve years of age shall be allowed to work in any factory or workshop scheduled in the Act. In shops, however, children under twelve may perform house duties—such as cleaning, going on errands, &c.—duties that have no connection with ordinary labour in factories or workshops. Young persons between twelve and sixteen years of age, also women, must not commence work in an factory or workshop before 5 a.m., nor labour after 7 p.m. Continual day labour may not exceed eleven hours, and in any case one hour's rest must be given between the hours of 11 and 3. Sunday labour is henceforth forbidden, except in special cases and with Jews, but these must give a holiday on Saturday if their employés work on Sunday. For printing-offices and lithographic establishments exceptional stipulations are made. In newspaper offices boys between fourteen and sixteen years of age may remain at work until 6 a.m. on Sunday, provided they are only employed at printing and folding, and have not worked more than eleven hours in the preceding twenty-four hours. Such boys, under similar circumstances, may work on week-days until 10 at night. In lithographic establishments, lads under sixteen may work until 8 p.m., at "chromos" only, between April and October, but then they must not commence work before 7 a.m. In smelting works boys under sixteen may work until 8 p.m., but only up to July 1st. In fish curing establishments, boys between fourteen and sixteen, and young women above fourteen years of age, may work until 10 p.m. from May to November, if such work be necessary to preserve human food. In the workshops of milliners, dressmakers, &c., girls above fourteen and women may be kept at work until 8 p.m., provided their labour did not commence before 8 a.m. the same day. In bakeries and pastrycook shops, boys between the ages of fourteen and sixteen may commence work at 2 a.m. There are numerous other clauses of a similar nature. In all these exceptional cases, no consecutive labour beyond five hours is allowed without a rest of at least half an hour, whilst the aggregate of working hours in a whole day (twenty-four hours) must not exceed eleven. Employers having in their employ young persons under sixteen years of age must provide themselves with cards from the local authorities, upon which they have to enter the names, years of birth, and all further particulars of these young persons, such cards to be returned to the local authorities within forty-eight hours after the young persons have left the employers' service. The latter shall also cause to be made up a list of all young persons and women in their employ, such list to be verified and certified by the local authorities. These registers should contain not only the persons' names, &c., but also their hours of labour and rest, in full. The penalties are fines and imprisonment. Among the other stipulations in the Act the following have to be noted:—No woman is allowed to work within four weeks of and after her confinement. Rest should not take place in the workshops or labour-rooms themselves, as, in that case, it would not be considered as "rest" within the meaning of the Act. An exception is only made for houses where the work-room is also the family-room. Accidents to the employés must be notified by the employers within forty-eight hours to the local authorities, unless they be of so slight a nature that the workman concerned can resume his duties almost immediately.

COPENHAGEN, 28th December, 1889.

Oiling the Waves.—There can be no doubt that the use of oil for the safety of vessels in stormy weather is becoming more general. A Norwegian engineer has recently drawn attention to the important point of selecting the most suitable oil. A fat, heavy, animal oil, such as train oil, whale oil, &c., is decidedly the best, but as these oils in cold weather become thick, and partly lose their ability to spread, it is advisable to add a thinner mineral oil. Vegetable oils have also proved serviceable. Mineral oils, especially refined ones, are the least effective. Crude petroleum can be used in case of need, but refined petroleum is hardly any good at all.

Telephones in Sweden.—From recent statistics, collected by the Stockholm General Telephone Company, it appears that the company on December 1st, 1888, had 4,493 telephones fixed in Stockholm, which number has increased to 5,172 telephones on December 20th, 1889. In addition to these there are over 300 telephones in Bollnäs and Söderhaum, and about 150 in Jönköping. The Stockholm General Telephone Company, which has left its rival, the Bell Telephone Company, a long way behind, has probably the most perfect telephonic installation in the world.

Textile Industries.—Both in Sweden and Norway, as well as in Denmark, the textile industry appears to be steadily extending. Several large manufactories have recently been started, and a new addition is the Hjelmeland wool spinning mills in Norway, which have been bought by a limited company, and will be transformed into a first-class mill, with machinery, &c.

Reclamation of Land.—The Hjälmaren and Koismarens reclamation undertaking in Sweden is a very large affair, and seems to have been so far attended with satisfactory results. At these reclamation works 14,800 hectares of arable land have been laid dry during the year 1877-1888, at a cost of 3,902,523kr., or about £215,000. Another beneficial result of this work is the facilities it has produced in the means of communication by necessitating dredging and deepening works. During the year 1889 a further link in the waterway has been completed—viz., from Hjälmaren through Hyndevad Sound, past the Nordön, *viâ* Tondlaviken to Hyndevad. Another canal, 5,000 metres long, in the direction of Koismaredalen, is about to be taken in hand, and can apparently, at a small cost, be continued through the Koismare lakes.

MADRID, 30th December, 1889.

Manganese Ores in the North of Spain.—Some four or five years ago I visited the district of Muñas, in Asturias, where the existence of good manganese ore was well known. The workings were in such a state that nothing positive could be assured respecting the importance of the manganese. The samples I took were analysed by Mr. de Pourcel, and he found them good and free from phosphorus, but, whilst I consider the existence of manganese ore proper more or less doubtful, I think there is very little doubt that iron ores of a high yield in manganese are to be met in abundance, and that they can be worked at a good profit.

Commercial Treaties.—The Commission appointed to inquire into the results of the existing treaties, and advise about what is to be done with respect to them in 1892, has now circulated the interrogatory. Opinions are very much divided in Spain on every point connected with the matter, and it is most difficult to say what will be the final decision.

Marble Quarries.—The marble quarries of Fuente Heridos, on the railway from Zafra to Huelva, are now actively working on orders for some of the large and luxurious buildings that are being erected in Madrid. The quality is splendid, and the orders would be still larger if they could be attended to without unreasonable delay.

Electric Light Failure.—A few nights ago the best private installation of electric light in Madrid, that of the Royal Theatre, failed when about two-thirds of the performance had passed. The public were warned that the theatre would be in darkness within a few minutes, and they were invited to leave the place, which they did. The cause of the mishap was an escape of steam in the large main going from the boiler house to the engine room. It is a new proof of the necessity of using accumulators.

Linares to Almeria Railway.—The Company holding this concession tried to place a large amount of debentures, to be paid within a short time. The public have evidently thought the proceeding unusual, and the demand for debentures has been exceedingly small.

Steel Manufacture in the South of Spain.—Spain, famous of yore for its Toledo blades, is destined to become a great steel producing country. Not only in the north, with its famous stores of hematite iron, but in the south also, with its rich deposit of magnetic iron ore, is steel now being manufactured. The old-established iron works at Heredia, on the shores of the Mediterranean Sea, has quite recently been partly converted into a steel plant for producing steel on the open-hearth process. The plant embodies some of the latest improvements of Mr. James Noble, of Middlesbrough and formerly of Consett, and of Mr. B. H. Thwaite, of Liverpool. The plant has been successfully put in operation by Mr. B. D. Healey, C.E. The plant, as designed by Messrs. Noble & Thwaite, was supplied by Messrs. Neville & Co., engineers, Oriel Chambers, Liverpool, Barcelona, and Madrid. The casting arrangement is on the system introduced by Mr. Turner, of Birmingham.

NEW YORK, 20th December, 1889.

The Coal Market.—There is little change in the anthracite trade. Prices are firm at old quotations, but some concessions are given by individual operators. The demand for furnace and steam sizes continues quite heavy. There is little coal at tide water, and owing to the increase in the iron business newly mined coal is being taken by the furnaces as fast as it can be delivered. In domestic sizes the warm weather of the last few days has caused a decided falling off in orders, and the trade will be likely to continue dull until cold weather sets in in earnest. The bituminous trade is dull, owing principally to a lack of cars for delivery. Operators have quite a lot of orders on hand, but no coal to complete them with.

The Iron and Steel Market.—The iron market continues active, with a slight advance in some lines. Anything like a moderate pressure to place orders would be sure to advance prices for both pig and finished iron. Eastern dealers are conservative in their trade, and are in no hurry to advance prices, while in the West there seems to be a strong upward movement. Pig iron is unsettled, and prices are firm, with a decided upward tendency. Inquiries are for much larger quantities than sellers are willing to offer. Consumption is without doubt the heaviest on record, and production is greater than ever before, and constantly increasing. Quite a large amount of this is taking the place of the material that has heretofore been imported. The scarcity of good ores, and the high prices at which they are held, are other factors tending to raise prices. Prices are about the same as last week, but the best grades are a little higher than a week ago. There is little change in manufactured iron. Bars are steady and in good demand. Mills are full of work, and there are some large plate orders that seem to be hard to place. The outlook is considered to be of the most promising character, with plenty of business and probably somewhat higher prices in the near future. The demand for steel rails is fair, with prices firmly maintained at $35 per ton at mill, with every prospect of higher rates before long. Steel in other forms is in good demand, and the mills are crowded with work.

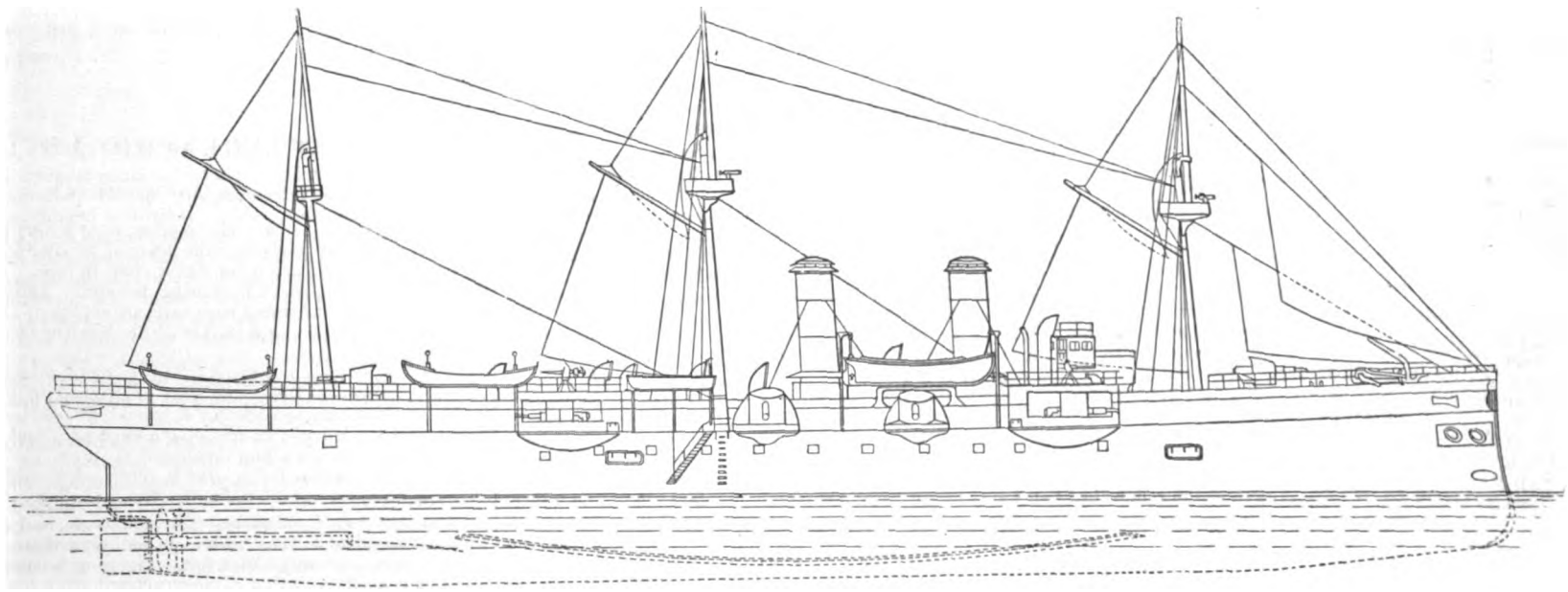
The Metal Markets.—A large quantity of copper has been sold during the past week at prices ranging as high as 14¼c. for Lake. The market has fallen off somewhat towards the end of the week, and quotations are now 13·90c. to 14c. per lb. for December delivery and 12c. to 12¼c. for casting brands. A moderate amount of business is doing in tin at gradually falling prices. Spot is selling at from 21c. to 21·10c., and March delivery at 21·10c. to 21·20c. per lb. There has been little doing in plates, and prices are unchanged. The lead market is quiet; sales have been light at about 3·85c. per lb. The demand for spelter is increasing, the market closing at 5·35c. per lb. Antimony is in active demand, with prices ruling higher.

Telephone *versus* Electric Cars.—Complaint has been filed against the Eau Clair Street Railway Company and the Sprague Motor Company by the attorneys for the Wisconsin Telephone Company, stating that the operation of the electric street railway system has destroyed the utility of the telephone system, and that the street railway is of a dangerous character and without proper safeguards for the protection of the public. It prays for an injunction restraining the Street Railway Company from operating its railway by electricity until its wires are insulated or return wires put in. The trouble is said to arise from the fact that there is an almost constant buzzing and roaring in the telephone caused by induction.

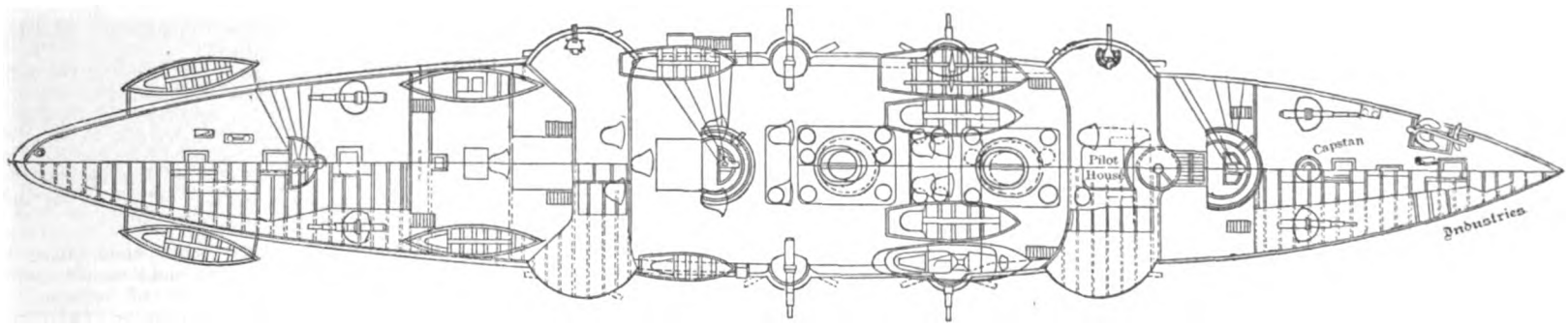
Cotton.—The December cotton report of the Department of Agriculture relates to prices on plantations. Correspondents report late maturity. In the northern belt early frost arrested the development of the bolls and seriously reduced the harvest. In the larger and more southern areas, while killing frosts were reported in some localities, in October losses were neither severe nor general from this cause. In the most productive portion of the belt there was little frost until the last week of November. The season has, therefore, been a long one, counterbalancing the late development of the plant. The top crop is fairly abundant, and general mention is made in the more southern districts of a burden of bolls yet unopened which may open with a continuance of mild weather. Weather for picking has been favourable, and the lint is generally bright and clean, though not everywhere of full length. Prices are little better than those of last December, plantation prices varying from 8·3c. to 8·7c. per pound. The cotton spinners of Fall River are making another attempt to form a federation of cotton operatives, and have sent invitations to operatives in cotton centres in New England and the Atlantic States to be represented at a convention to be held on the 15th prox. Attempts have been made before this one to form a federation, but unsuccessfully, as operatives in other cities have not been so well organised as in Fall River. In view of the eight hour agitation it has been decided to make another attempt.

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THE UNITED STATES CRUISER "SAN FRANCISCO."



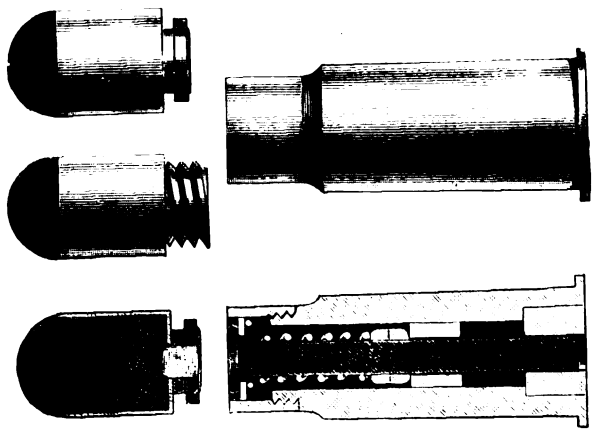
ELEVATION.



PLAN OF POOP DECK.

THE MULLINEUX CARTRIDGE.

We are indebted to the *Admiralty and Horseguards Gazette* for the following account of this cartridge. Our contemporary remarks that what promises to be a most useful invention for the Service, and also a source of amusement to all lovers of the rifle, has just been produced by Mr. M. Mullineux in the shape of a substitute for the Morris tube. It consists of a gun-metal or



steel cartridge case similar in shape to the Martini-Henry cartridge. The case can be unscrewed into three sections. At the end of the case is affixed a small section containing a charge of powder and a bullet, together with a percussion cup fitted in its base in a manner similar to the ordinary cartridge. The remainder of the case contains an elongated striker, which acts on the percussion cap when the main spring of the rifle is released. The bullet used, being of the correct diameter, takes the groove of the rifling. The section containing the bullet and charge of powder is but ¾in. in length, so that any number can be conveniently carried in the pocket, together with the remainder of the case containing the striker. After firing, all that is necessary is to remove the end section which contained the powder and bullet and replace it by a fresh one. The charge of powder is regulated by the distance at which it is desired to fire, and it is possible to use these cartridges at a distance of only ten yards. Although the case is similar in shape to the Martini-Henry cartridge, it can be supplied to fit any rifle, and the sights attached to any rifle can be used with it with accuracy. Being so small, the cartridge has, of course, no effect on the weight of the barrel, and is, in fact, practically the same as the ordinary cartridge except as regards the length and weight of the bullet and the strength of the charge. Sections containing any charge suitable to the distance required can be obtained, and it has been found that the splash from the bullet on impact is in no way dangerous. The cartridges are made in a thoroughly durable manner, and there is no point at which any amount of the roughest wear and tear would be likely to damage them. As regards cost, it is stated that they compare most favourably with other similar inventions. The cartridges are now loaded with smokeless powder, and the result has proved perfectly satisfactory. The rifle will stand any number of rounds being fired without cleaning out.

THE UNITED STATES CRUISER "SAN FRANCISCO."

The "San Francisco" was successfully launched from the Union Iron Works in San Francisco on October 26th last. This ship is the second one built for the Government in the same yard, the "Charleston" having been the first. The contract was let in July, 1887, the construction of the vessel having been authorised by the Act of March in that year. This ship and the "Philadelphia," which is building at Cramp's Yard in Philadelphia, are sister ships, and the contracts were let at the same time, the price for the "Philadelphia" being 1,350,000 dols., and for the "San Francisco" 1,428,000 dols. This ship is a twin-screw cruiser 328ft. long over all, 310ft. on water line, 49½ft. in breadth, 31ft. 6in. depth, 18ft. mean draught, and her displacement, when completed, will be about 4,100 tons. The vessel is not armoured, but carries a heavy protective deck just above the water line, and the machinery is further protected by the arrangement of the coal bunkers. The engines are of triple expansion type, with cylinders 42in., 60in., and 94in. in diameter, and 42in. stroke. The boilers, 15ft. diameter, will carry a working pressure of 135lb. per square inch. The two screws are three-bladed and 14½ft. in diameter. The engines are expected to develop 7,500 h.p. under natural draught, and 9,000 h.p. under forced draught, and the maximum speed is to be 19 knots an hour. The armament is to consist of twelve 6in. guns, with a secondary battery of small rapid-fire and machine guns. We give above two illustrations showing respectively a side elevation and deck plan of this ship. The "San Francisco," the "Philadelphia," and the "Newark" are the largest cruisers yet built for the United States Navy, but will be exceeded in weight, fighting power, and strength of armour by the "Maine," the "Texas," and the new battle-ship for which designs are now being prepared in the Navy Department. We are indebted to our American contemporary, the *Railroad and Engineering Journal*, for the above description of this vessel.

SHIPBUILDING NOTES.

On the 21st ult. Messrs. Richardson, Duck, & Co. launched from their building yard, at South Stockton, a three-masted iron sailing ship of the following dimensions: Length, 315ft.; breadth, 42ft.; depth of hold, 24ft. 7in.; gross tonnage, about 2,400 tons. This vessel has been built to the order of Messrs. W. H. Ross & Co. She has a full poop with accommodation for passengers, captain, and officers, and a deck-house amidships for crew, petty officers, and galley. She has been built under the superintendence of Captain Hamilton, and will be commanded by Captain Steel. As the vessel was leaving the ways she was christened the "Scottish Moors."

On the 21st ult. Messrs. Harland & Wolff, Limited, Belfast, launched the large steel screw steamer "Nizam," for the Asiatic Steam Navigation Company. This vessel is a sister ship of the "Nawab" and "Nadir," also built in this yard for the said company during the past year. Her

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dimensions are: Length, 345ft.; breadth, 42ft.; gross tonnage, 2,970 tons. The boilers and engines are being built by the same firm, and the vessel is expected to be ready for sea in a few weeks.

Notices of Meetings.

THIS WEEK.

GEOLOGISTS' ASSOCIATION.—Friday, January 3rd. Papers to be read: "On the Fossil Fishes of the English Lower Oolites" (illustrated by specimens from the collection of Thos. Jesson, F.G.S.), by A. Smith Woodward, F.G.S., &c.; "A Short Account of the Excursion to the Volcanic Regions of Southern Italy" (illustrated by photographic views), by H. J. Johnston Lavis, M.D., F.G.S., &c.

NEXT WEEK.

ROYAL INSTITUTION.—Saturday, January 4th; Tuesday, January 7th; and Thursday, January 9th, 3 p.m. Christmas Lectures on "Electricity" (adapted to a Juvenile Auditory), by Professor A. W. Rücker.

SOCIETY OF CHEMICAL INDUSTRY.—Monday, January 6th. Mr. C. T. Kingzett, "Peroxide of Hydrogen: Its Preservation and Commercial Uses"; Mr. Lovibond, "An Analytical Tintometer."

CIVIL AND MECHANICAL ENGINEERS' SOCIETY.—Wednesday, January 8th, 7 p.m. Annual General Meeting.

PRICES CURRENT, 1st JANUARY, 1890.

Quotations at per ton, unless otherwise specified.

PIG IRON.

Messrs. Raby, Fell, & Co., Manchester, quote as follows:—

Middlesbro' Warrants, No. 3		61 7½	Cash
Scotch Warrants, m/n		61 2½	"
Hematite Warrants, m/n		74/-	"
Stocks in Stores — Scotch	937,912.—Dec. for week,	7,696	Tons.
Middlesbro'	181,021.—Inc. "	1985	"
Hematite	184,427.—Inc. "	998	"

Exclusive of stocks in makers' yards.

	No. 1.	No. 3.		
Coltness	80/-	70/6	f.o.b.	Glasgow.
Gartsherrie	78/-	70/6	"	"
Dalmellington	70/-	69/-	"	Ardrossan.
Eglinton	65/-	64/-	"	"
Glengarnock	78/6	70/6	"	"
*Derbyshire	—	70/-	f.o.t.	Works.
*Lincolnshire	—	68/-	"	"
*Lancashire	—	70/-	"	"

*Forge quality, about 1s. per ton less.

Market excited, and rising.

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton	80/6	73/-

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best. £ s. d.		
Middlesbro' Bars	8 2 6	.....	8 12 6	f.o.t. wks.	
" Angles	7 17 6	.....	8 7 6	"	
" Plates	8 5 0	.....	8 15 0	"	
Staffordshire Bars	9 7 6	.....	9 17 6	London.	
" Angles	9 7 6	.....	9 17 6	"	
Crown Sheets	9 0 0	.....	9 10 0	"	
" Hoops	8 10 0	.....	9 0 0	"	
"Siemens-Martin" Steel Boiler Plates	10 5 0			"	
" Ship and Girder	9 5 0			"	

Market firm, and advancing.

Messrs. E. S. Ferguson & Co., of Cardiff, report as follows:—Business generally wears a holiday aspect, and there is little new to report this week. The tendency in the steam coal market seems still in the upward direction, and it is with the utmost difficulty that shipowners can get their vessels steamed. The activity in the iron and steel trades is still unabated, but the supply of coke seems far from adequate. Great apprehension is being evinced by consumers as to their supplies of Spanish ores, more particularly those from Bilbao, which are urgently required. As has been anticipated in these columns for the past month or two, it is now reported on the best authority that two or three firms in Bilbao have declared their inability to carry out the contracts made by them at the lower figures, so that to make good these quantities importers on this side have had again to cover themselves at considerably higher prices.

Messrs. Carrick & Brocklbank, Manchester, report as follows:—

COPPER: From the 24th to the 30th ult. there was no London market, owing to Christmas holidays. It is reported that about 1,250 tons of Chili bars changed hands on the 24th, speculatively, in view of a firmer market early this year. On the reopening of the market on Monday Chili bars were firm at the rates ruling on the 24th, viz.—£50 to £50 7s. 6d. cash—and to-day's quotations are the same. Manufactured is still firm at £66 to £69 sheets and bottoms.

TIN: Slightly firmer in tone, with moderate business doing.

LEAD remains unaltered in price.

SPELTER: Still very scarce and slightly dearer, with every prospect of higher rates after the turn of the year.

METALS.

Spelter: Ordinary	£25	2	6	to	£25	5	0
Copper: British Cakes and Ingots	57	0	0	"	58	0	0
" Chili Bars, G.O.B.'s	50	0	0	"	50	7	6
" Other sorts, G.M.B.'s (equal to Chili Bars)	50	0	0	"	50	7	6
" Manufactured (strong)	66	0	0	"	.....		
Lead: Common Pig	15	15	0	"	16	0	0
" English Sheet	16	5	0	"	16	10	0
Tin: Straits	97	0	0	"	97	10	0
" Australian	.....			"	.....		
" English Ingots	102	0	0	"	.....		

OILS.

		£	s.	d.
Cocoanut: Cochin	per tun	26	10	0
" Ceylon	"	23	10	0
Cottonseed	"	21	5	0
Cod	"	19	0	0
Lard	"	37	10	0
Linseed	"	20	10	0
Palm, Lagos	"	25	10	0
Rapeseed: English	"	33	10	0
Seal: Pale	"	26	10	0
" Brown	"	19	0	0
Sperm	"	45	0	0
Whale	"	24	10	0
Turpentine	per cwt.	1	15	9
Coal	per gal.			
Petroleum (Refined)	"	0	0	6⅛
" Spirit	"			

CHEMICALS.

		£	s.	d.		£	s.	d.
Acid: Carbolic Crystals	lb.	0	0	11	---	0	0	11½
" " Liquid	gal.	0	1	2	—	.....		
" Citric	lb.	0	1	7	--	.....		
" Oxalic	"	0	0	4½	to	0	0	4¾
" Sulphuric	ton	1	10	0	—	.....		
" Tartaric	lb.	0	1	4	—	.....		
Alum: Lump (powder 10/- ex.)	ton	4	17	6	—	.....		
Ammonia: Carbonate	lb.	0	0	3½	—	.....		
" Muriate (Grey)	ton	22	5	0	—	.....		
" " (White)	"	26	0	0	—	.....		
" Sulphate	"	12	7	6	—	.....		
" Liquor	lb.	0	0	3⅜	—	.....		
Antimony	ton	.....			—	.....		
Bleaching Powder	"	5	0	0	—	.....		
Bisulphide of Carbon	"	13	10	0	—	.....		
Borax	"	30	0	0	—	.....		
Benzole (90 %)	gal.	0	3	5	—	.....		
" (50/90 %)	"	0	2	7	—	.....		
Copper Sulphate	ton	23	10	0	—	.....		
Copperas	"	2	0	0	—	.....		
Kieserit	"	1	13	0	—	.....		
Lead: Nitrate	"	22	10	0	—	.....		
" White Sugar	"	24	0	0	—	.....		
" Brown "	"	19	0	0	—	.....		
Potash: Bichromate	lb.	0	0	4	—	.....		
" Caustic	ton	22	0	0	—	.....		
" Carbonate	"	19	10	0	—	.....		
" Chlorate	lb.	0	0	4½	—	0	0	4¾
" Prussiate (Yellow)	"	0	0	9½	—	.....		
" Sulphate (Basis 90 %)	ton	9	10	0	—	.....		
Precipitate: Red	lb.	0	3	1	—	.....		
" White	"	0	3	2	—	.....		
Salts: Epsom — Bags	ton	2	15	0	—	.....		
Salts: Epsom — Casks	"	3	10	0	—	.....		
" Glauber	"	1	10	0	—	.....		
Sulphur: Sublimed Flowers	"	9	0	0	—	.....		
" Recovered	"	4	10	0	—	.....		
Soda: Ash	deg.	0	0	1¼	—	.....		
" Caustic (White 70%)	ton	7	2	6	—	.....		
" " (" 60%)	"	6	7	6	—	.....		
" " (Cream 60%)	"	6	0	0	—	.....		
" Crystals	"	2	7	6	—	.....		
" Bicarbonate	"	5	5	0	—	.....		
" Hyposulphite	"	6	5	0	—	.....		
Solvent Naphtha	gal.	0	3	6	—	.....		
Tartar, Cream of	cwt.	5	12	6	—	.....		
Zinc Sulphate	ton	7	10	0	—	.....		

Messrs. S. W. Royse & Co., Manchester, report as follows:—

CHEMICALS.—There is very little news to report, the holidays having made matters quiet. Caustic soda continues firm, and bleaching powder is showing a hardening tendency. Soda ash and soda crystals unchanged. Sulphate of copper is more easily procurable, but price is steady, and the inquiry for green copperas for export has slackened. Yellow prussiate is strong at the advance. Acetates of lime have moved up, and will, probably, advance further. Very large sales of grey have been made from America for 1890, and stocks of all qualities are now firmly held. Carbolic acids continue very dull; other tar products steady.

FOREIGN TELEGRAPHIC ADVICES.

(From our own Correspondents.)

PARIS, Jan. 2.—*Iron.*—The market here is very firm, at 160s. for bars and joists, but the demand is languid. The provincial markets are quiet but strong in tone. Wire in the Haute Marne is in increasing demand. Annealed is quoted 192s. a ton. Steel wire nails are selling at 216s. for the No. 18. The pig iron market of the Meurthe-et-Moselle is very firm.

Metals.—There is not much life in the metal markets this week. Copper remains practically unchanged in price, at £53 for Chili bars and £58 for English best selected. Tin has given way a little, Banca being quoted £107 and Straits £102. Lead is quiet and unaltered in price, at £14 8s. Havre. The market for spelter is more active, and prices have risen to £25 15s. for Silesian brands at Paris.

BERLIN, Jan. 2.—*Bourse.*—The market is fairly active for industrial securities. Shares in colliery companies and in iron and steel works have further risen in price in consequence of the strike of colliers in Belgium, an immediate effect of which must be to restrict Belgian competition.

BRESLAU, Jan. 2.—*Coal.*—The scarcity of coal is keenly felt. Many manufacturing works are running short time, and even domestic consumers complain of a want of fuel. Prices are higher to-day by 1s. a ton. Merchants are buying up all in the market. Colliers are receiving better wages and are more contented.

Iron.—Though we are in the midst of the holiday and stock-taking season, there is considerable activity in the market for iron. Pig iron continues to be briskly dealt in. Forge pig is quoted 80s.; foundry, 85s. to 90s. Magnetic iron ore is being largely imported from Sweden. Business is active in finished iron and steel. Bars are officially quoted 190s. per ton at works, but it is difficult to buy under 200s. Boiler plates are 240s., and sheets 240s.

DÜSSELDORF, Jan. 2.—*Iron.*—Stock-taking has kep buyers out of the market to some extent; nevertheless there is a fairly strong current of business. Ordinary spiegel pig has advanced to 102s. in the official quotations. Forge pig is scarce and very firm in price. The same may be said of foundry pig. The amount of business being done in finished iron and steel is much above the average for the season. Tone very firm.

BRUSSELS, Jan 2.—*Bourse.*—The prices of shares in colliery companies are again bounding upward, but other industrial securities, especially shares in iron and steel works, are flat. Glass works, which will suffer from the higher cost of coal, are less favourably regarded as an investment.

CHARLEROI, Jan. 2.—*Coal.*—The number of colliers out on strike is estimated at 15,000. Many works are stopped for want of fuel. In the present state of things it is impossible to quote prices. Several large consumers have sent agents to England to buy coal. The French colliery owners have agents here briskly booking orders for prompt delivery.

Iron.—The iron market is greatly disturbed by the coal-miners' strike. Brisk buying is taking place in some classes of iron, notably plates, in anticipation of higher prices. The market is, however, not exceptionally firm. Longwy pig is being sold here at 69s.

LILLE, Jan. 2.—*Flax and Yarns.*—The flax and yarn market is but thinly attended as usual at this season. But though business is quiet, prices are firmly maintained. Russian flax is a little more inquired after. Stocks of tows are low. Buyers of yarns are not disposed to operate at this stock-taking period. There is, however, a good demand for jute yarns.

OMNIBUS LICENCES.—It is stated that the Board of Inland Revenue, giving effect to the decision in the Court of Queen's Bench, have now ordered the repayment of all licences paid by omnibus proprietors and tramway companies, and that a hackney carriage licence of 15s. be issued instead. This is a return of 27s. on each licence, and the total repayment by the Board of Inland Revenue will be about £150,000.

THE LONDON CHAMBER OF COMMERCE.—The following circular will shortly be issued by the Electrical Section of the Chamber to the members, on the question of "Blocking Orders":—"The attention of the Electrical Section has been called to the fact that many of the notices which have been given by the local authorities of their intention to apply for provisional orders have been given with a view of blocking the extension of electric lighting, owing to gas interests or other causes. The matter will be brought forward at the next meeting on the 28th inst., and it is hoped that you will communicate to Mr. Trotter, the correspondent, any corroborative evidence of such action as you are able to give, together with as many details as possible."

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HOME INDUSTRIES.

LONDON 2ND JANUARY, 1890.

THE MONEY MARKET.—The year closed rather sensationally in the Money Market, the Bank Directors meeting hurriedly on Monday morning to raise the Bank Rate to 6 per cent. The Bank Return had been very unfavourable, and with an increasing note circulation, due to the expansion of trade, and a continuous though gradual drain of gold from this country, it behoved the Bank to take steps to preserve its stock of gold from further diminution. Curiously enough, the raising of the Bank Rate did not have the usual effect on speculative business on the Stock Exchange, though no doubt the dearness of money must tend to check speculation. Still, a year of high values and good business closed with prices very strong in almost every department. To a certain extent this was not a fair criterion of the state of the market, for with the public quite out of the markets at this season, prices may be put up quite apart from dealings. No doubt the jobbers, wishing to end a good year well, put quotations up all round, a circumstance which might lead the public early into the market again in the hope of repeating the fortunate strokes made by speculators for the rise in 1889.

COMPANIES.—The following companies have been registered since our last report:—The Astracana Sailing Ship Co., Ld., with a capital of £14,700; Witty & Wyatt, Ld., with a capital of £30,000, to carry on the manufacture of asbestos goods; The Gemming & Mining Company of Ceylon, Ld., with a capital of £100,000: Southampton Naval Works, Ld., with a capital of £274,000, to carry on the business of shipbuilders belonging to Messrs. Oswald Mordaunt & Co.; The Audenshaw Paint and Colour Co., Ld.; The Corona Hill (Australia) Silver Mining Co., Ld., with a capital of £150,000.

WOOL.—Messrs. Charles Balme & Co. report as follows:—"The more prosperous character of the period covered by the past twelve months is reflected in the statistics embodying the year's operations in wool, a steady and gradual, though, at times, somewhat halting, movement in the direction of expansion and improvement having marked the progress of the industry upon which our article depends. To this result several circumstances have contributed, and among them we may especially mention (1) increased confidence in regard to the maintenance of European peace; (2) more general and profitable employment among the working classes, and a consequently enlarged purchasing power on the part of the great mass of consumers; and (3) a comparatively moderate increase in the supplies of the raw material. A comparison of the prices ruling at the close of 1888 and 1889 establishes roughly an advance in merino produce ranging from 8 to as much as 15 per cent. in particular descriptions, and in crossbred staple of the coarser types of about 10 per cent., in favour of the later period, the bale average of the year being the highest recorded since 1884."

HEMP.—In Baltic hemp and yarns there is nothing doing for spot, and quotations are unaltered. Last week's arrival business has been quite small, but the prices are firm. The Italian markets are exceedingly firm, and prices have advanced slightly. The quantity of Italian hemp in producers' hands is very small. Nothing has been done in Manilla hemp.

SOCIETY OF ARTS.—The following arrangements have been made for the ordinary meetings of the Society between Christmas and Easter. These meetings are held on Wednesday evenings at eight o'clock:—January 15th, adjourned discussion on Sir Robert Rawlinson's paper on "London Sewage;" January 22nd, R. Brudenell Carter, F.R.C.S., Vice-President of the Society, "Vision-testing for Practical Purposes;" January 29th, Gilbert Redgrave, "The Utilisation of Blast-furnace Slag;" February 5th, Arthur Paget, "High-speed Knitting and Weaving without Weft;" February 12th, George Findlay, General Manager London and North-Western Railway, "Modern Improvements in Facilities for Railway Travelling." The dates for the following papers have not yet been fixed:—Sir Douglas Galton, K.C.B., D.C.L., F.R.S, Vice-President of the Society, "The Chemin de Fer Glissant, or Sliding Railway;" G. N. Hooper, "Carriage Building and Street Traffic in England and France;" J. S. Keltie, "Commercial Geography;" J. Tripplin, "Recent Progress in British Watch and Clock Making;" Arthur Montefiore, "The English in Florida;" Professor Silvanus Thompson, "The Organisation of Secondary and Technical Education in London."

THE "ELECTRICAL REVIEW."—The *Electrical Review* of New York, one of the leading United States electrical journals, has now taken offices at Bridge House, 181, Queen Victoria Street, London, E.C., where in future all editorial communications, advertisements, or subscriptions are to be addressed to the London editor and manager, Mr. Charles ffrench.

CHANGE OF ADDRESS.—On the 1st inst. Messrs. John Birch & Co., engineers and merchants, removed their head offices from 40, Chapel Street, Liverpool, to 10 and 11, Queen Street Place, London, E.C.

MANCHESTER, 2ND JANUARY, 1889.

THE IRON TRADE.—Although in the engineering trades in Lancashire the remainder of this week is generally observed as a holiday, the market on the last day of the old year was a very strong one. In sympathy with the upward movement in the Scotch and Middlesbrough markets the local makers of pig iron are very firm, and are indisposed to book too much new business, although a good deal is offering. It is expected that the forthcoming quarterly meetings will result in an advance of prices, and makers are naturally reluctant to forestall it. Hematite pigs are dear and scarce, with no great quantity offering. Finished iron bars are also very sparely offered, and prices are firm, £8 10s. per ton being the nominal quotation.

CO-OPERATIVE TELEPHONY.—A meeting was held on the 23rd inst., at which a report of the committee appointed to investigate the chances for the establishment of co-operative telephones was received. The report stated that over 1,300 persons had provisionally agreed to become renters, and recommended the formation of a limited liability company to carry the project into effect. The registered capital of this company is to be £100,000 in the first instance, of which £20,000 to be issued first to establish the Manchester business. The co-operative system is to be applied, no greater dividend than six per cent. being payable, but the establishment of a reserve fund is provided for. A committee was formed to carry the suggestions into effect, and it is expected that some steps will shortly be taken.

THIRLMERE AQUEDUCT.—A somewhat unusual occurrence took place at a special meeting of the Manchester City Council on the 23rd ult., when a report was presented by Mr. G. H. Hill, C.E., relative to the state of the works on No. 4 contract for the aqueduct bringing water from Thirlmere. The engineer reported that the contractor was not making the progress expected or according to the terms of his contract, and that the delay arose from causes within his control. He therefore recommended that the Council should exercise their reserved rights and terminate the contract. This the Council unanimously agreed to do, and directed steps to be taken to seize all the plant at present on the works. The contractor has since obtained an injunction to restrain such seizure.

HYDRAULIC POWER MAINS.—A private Bill is to be promoted during the forthcoming session of Parliament to authorise the carrying out of the necessary works to provide a high pressure water supply in a similar manner to that pursued in London and Liverpool. This project was mooted about three years ago, but owing to the opposition of the City Council was then dropped. It is intended, however, to proceed with it this year. The engineers to the promoters are Mr. Corbett Woodall, C.E., of London, and Mr. C. Hopkinson, C.E., of Manchester.

THE LINEN AND JUTE TRADES.—Although the present is a broken week there are signs that the linen trade is about to enter on a period of much greater activity. Stocks are believed to be low in many departments, and, to judge from the contracts entered into by buyers, a large consumption is looked forward to. Prompt deliveries are being insisted on. There is not much to report regarding the current demand, which is, of course, slow, owing to the interruption to business caused by the holidays. Regarding prices, future prospects are not unsatisfactory. It is safe to say that the rates which for some time manufacturers have been accepting scarcely made it worth while to keep their looms running, and, looking at the wretched nature of the Irish flax crop, and the consequent scarcity and dearness of prime qualities, fine goods promise to maintain their present firmness. Linen thread houses would certainly advance their lists again were it not for the fear of driving customers to the use of higher class materials in the shape of silk threads, or lower class ones such as cottons. As it is, they are perforce compelled to be content with the prices established in January of last year. Jute goods are in average demand, and the new fancy varieties promise well. The detailed circulars with reference to the carpet syndicate will, it is expected, be in the hands of those interested on the 10th inst.

GLASGOW, 2ND JANUARY, 1890.

SHIPBUILDING.—Messrs. Holt, of Liverpool, have placed an order with Messrs. Scott & Co., Greenock, for two large steamers. Clyde builders continue to refuse orders, owing to the impossibility of guaranteeing anything like prompt execution of the work. The slipways are nearly all occupied. Messrs. Russell & Co., Port Glasgow, have sold two steel four-masted barques, now building. The vessels are each 2,500 tons, and are sold at about £10 10s. per ton gross register.

NEW BUILDINGS IN GLASGOW.—A proposal has just been placed before the Town Council by the Lord Provost, to the effect that the surplus from the Exhibition of last year, amounting to upwards of £50,000, be supplemented by a public subscription of £150,000, and the sum of £200,000 devoted to the erection of an Art Gallery, on or near the site of the Machinery Section of the Exhibition.

FORTH BRIDGE.—It is announced that the Forth Bridge is to be opened on the 4th March by the Prince of Wales. The plant which has been used in the erection of the bridge has now been sold off, and the staff is rapidly being dispersed. There is no doubt that the permanent way on the bridge, and even the approach railways, will be completed well within the two months that will elapse before the official opening.

PIG IRON.—The pig iron market remained strong till the close of the year, and at midday on Tuesday, when the market ceased for the year, the prices were 64s. for Scotch iron and 62s. 6d. for Middlesbrough. It is reported that the considerable stocks, amounting to about 30,000 tons, of Cleveland iron which had accumulated in Glasgow have been entirely cleared off, and it is suspected that stocks in makers' hands have been reduced to a mere fraction of what they were at the beginning of the year. On Monday the Scottish Pig Iron Trade Association met and decided to boycott the London Metal Exchange, by binding its members to buy and sell and settle only in Glasgow. The production of pig iron during the past year has been 998,928 tons, according to Messrs. Bost & Turner's statistical report, with which we have just been favoured, there being a decrease on the production of the previous year of 28,846 tons. The number of furnaces in blast in both years was the same. The average production per furnace per week has fallen off from 3 per cent., or from 236 tons to 228 tons. The consumption in foundries has increased 48,000 tons, and that in malleable works 125,000 tons. The exports, foreign, have increased 6,000 tons; coastwise, 12,000; and by rail, 4,300. The stocks in Connal's stores have decreased 87,000 tons, and at makers' works have decreased to the startling amount of 121,000 tons, or from 213,000 to 92,000 tons, a total decrease of 208,000 tons. The stock in Connal's stores, at the close of the year, is 4,000 tons less than it was in the end of 1888. Messrs. Bost & Turner give the minimum price of pig iron at 42s. on the 3rd January, and the maximum price 64s. 10d. on the 18th November. They anticipate a very busy year in the pig iron trade, although they point out that, owing to the difficulty of obtaining coal, coke, and ore, and the advance of wages, they do not see much chance of an increase of production. Wages, they say, have been 5s. per day over the year, as against 4s. 3d. last year.

THE YEAR'S TRADE IN GLASGOW.—Everywhere in the manufacturing industries of Glasgow the course of trade has, during the year, been extremely prosperous. Shipbuilding yards and engineering works have been more prosperous than in any year since 1882, and steel works have been busier than ever before. Freights have been good, and thus shipbuilding has been encouraged. The coal trade has been somewhat unsettled, the strikes in Westphalia having affected the shipping trade to a considerable extent. Among the notable incidents of the year have been the strike of dock labourers on the Clyde, strikes of riveters in Glasgow and Greenock, advances in colliers' wages, and advances in wages almost all round. The expansion of the trade of the port has been so considerable as to hasten the Clyde Trustees in the construction of the new docks at Cessnock Park, Govan, and these are now being rapidly pushed forward, the north wall being now completed. Among the notable items in the import trade is the increase in Indian corn. Imports of this article, which stood steadily for some years at about half a million quarters, reached, last year, 850,000 quarters. The most important increase in export items is that in coal, which exhibits an increase over last year of three-quarters of a million tons, or 14 per cent. Among striking import statistics is the increase in the trade in American rosin and tar. The latter seems to be replacing almost altogether Archangel tar, which formerly had a very large market in Glasgow. Boiler-making and general engineering have been steadily prosperous all the year. Large orders for the colonies and for the United States have been in course of execution during the past few months, while home engineering enterprises have also been supplied by Glasgow firms. The shield for the Hudson Tunnel, as well as the bridges for the Manchester Ship Canal and the Tower Bridge, have kept Messrs. Wm. Arrol & Co. busy since the practical completion of the Forth Bridge. The Manchester Ship Canal is being supplied with a powerful dredger by Messrs. Wm. Simons & Co. The tunnel under the Clyde, which a company under the inspiration of Messrs. Baird & Co. has been formed to construct, may be expected to be among the engineering features of next year, as will also the construction of the tunnel under Argyll Street to convey the Caledonian branch railway from East to West Glasgow. The excessive activity in steel manufacture has had naturally an important effect upon the fire-brick trade. Prices have nearly doubled, and at Glenboig, the works of the Glenboig Company and those of Mr. Peter Hurll, newly established, are both very busy.

(From our own Correspondents.)

LIVERPOOL, 1ST JANUARY, 1890.

A LARGE CONSIGNMENT OF BULLION.—One of the largest consignments of silver ever landed in this country arrived in the Cunard Steamer "Umbria" last Sunday. It consisted of 873 bars of solid silver, weighing 24 tons, and valued at £178,000, and was conveyed by special train to London. One half this amount was consigned by Messrs. Zimmermann & Foshay, bankers, Wall Street, New York.

THE MASTER CARTERS.—On account of the great increase and extension of the dock system north and south, and of the revival in trade, the master carters consider they do not receive adequate pay for the increased distances and for the frequent long delays. A large meeting was called last week, when it was unanimously resolved, "that it has now become necessary to seek such advances as may enable cart-owners to make a reasonable profit." It is not their intention to strike, but they hope to be able to convince the traders that their claims are just ones. The present rates are based upon those of twenty years ago, when trade was not at its best, and in the interval, trade arrangements have undoubtedly not been to the advantage of the master carter. One hundred years ago, a load was from 8cwt. 4lb. to 19cwt., and a double load between 19cwt. and 30cwt.; no carman was allowed to load more than one cart or barge—each taking in turn; the working hours were seven hours per day in winter and ten hours per day in summer, while the pay was 7s. 6d. per day for a cart and two horses.

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LEEDS, 1st January, 1890.

The Iron and Steel Trades.—The year which closed yesterday was one of remarkable commercial prosperity. In the beginning of 1889 a great expansion of local trade was predicted, and the prediction was realised to the full. Throughout the year an immense volume of business was done, and 1890 opens with a very rosy prospect indeed. In the first half of 1889 there was not much improvement in prices, but the next six months saw to a large extent the realisation of the hopes of producers. The great advance in raw materials was followed by a proportionate increase in finished iron and steel, and to find a parallel to the state of things existing on the eve of the late holidays in the iron, steel, and engineering branches of Leeds trade, we have to turn to the memorable years 1870 to 1873. During the year a vast amount of overtime was worked, and in some instances the wages of employés were enhanced. A pleasing feature of the heavy industries in the year was the relations between employers and workmen, only one or two disputes, and those not of a serious nature, arising. As in 1888, so in 1889, the steel trade of the district developed to a considerable extent. In two years the production of steel in Leeds alone shows an increase from 200 tons to about 1,200 tons a week. The largest proportion of the recent increased output of steel is from the Leeds Steel Works, while Messrs. Taylor Brothers, the Monkbridge Iron Company, and the Leeds Forge Company have added considerably to their resources. This development of the steel industry did not lessen the production of the best Yorkshire iron trade, which shared the general prosperity in the year. Nothing but success can be written of the engineering trade. The Christmas holidays now being over, all the forges, foundries, and engineering establishments are again in full operation, and the reports on lal hands are of a most hopeful character. Builders of locomotive and stationary engines are busy on home and foreign orders, the execution of which will take considerable time. There is a large demand for machine tools and general machinery, and makers of textile machinery are well off for orders.

The Coal Trade.—The general revival of trade during the past year was more advantageous to the miners than to the coalowners. The latter did not begin to experience the full benefit of the improvement until three months ago, owing to the higher wages they had to pay and the increased cost of colliery material. With the new year the miners receive an advance of 10 per cent., making 30 per cent. in twelve months. As to the present and future prospects, there is a good demand for coal of all classes, and coalowners who hold locomotive orders experience no little difficulty in meeting the demands. Prices have an upward tendency. An increasing proportion of the West Yorkshire coal is being sent to London and the South, and there is also an extensive export business being done.

SHEFFIELD, 1st January, 1890.

The State of Trade.—There is very little business of any kind being done here this week. At most of the works extensive repairs to machinery and plant have been necessary owing to the heavy strain put upon them during the past year. The "Atlas" Works have restarted their large blast engine, and the blast furnaces are again in working order. The iron and steel moulders have succeeded in obtaining from the manufacturers, as a body, an increase of wages amounting to 2s. per week. This will give ordinary moulders 38s., and machine men 40s., for a week of 54 hours. Trade prospects for the coming year are bright. On all hands there appears to be plenty of employment. Colliery owners will, for the first six months, be placed at a slight disadvantage, the miners' wages being 30 per cent. higher than last year, while some of the coal contracts run for six months longer yet.

DERBY, 1st January, 1890.

The Coal Trade.—The demand for all descriptions of engine coal is considerably in excess of the supply, owing in no small measure to the improved condition of the cotton trade, which diverts large quantities of this class of fuel from our immediate district. The increased requirements for house purposes as the season progresses, together with the general prosperity of the iron trades, also contribute to make supplies scarce, so that prices are advancing by leaps and bounds, a quotation hardly holding good for 24 hours. No wonder, then, that notice has been given to the miners at all the chief collieries in Derbyshire that an increase of 10 per cent. in wages will be given on the first making-up day in January. This is the third 10 per cent. advance granted within the last 15 months, and it has been estimated that the total additional payment in wages in this county alone means an increase at the rate of £312,000 per annum to the men.

The Brewing Industry.—Messrs. Acton & Co., Ld., of Derby, have just declared a 10 per cent. dividend on their ordinary capital, with a bonus of 2s. 6d. per share.—At Burton the maltsters recently organised a strike, which has been perfectly successful, although it was quite unnecessarily attended with violence. Some of the men entered the premises of Messrs. Ind, Coope, & Co., and assaulted Mr. Brown, the manager of the malting department, and his son, who came to the defence of his father.—The brewers' labourers are now to the fore, and demand some increase on what they regard as a scanty wage of 17s. per week.—Works are being erected at Burton to dispose of brewers' and distillers' grains in a more profitable manner than is at present practised. This source of food for cattle can be greatly improved by the Passburg process of drying, which will introduce what is practically a new industry into the town.—A ventilating beer-barrel has been brought out by Mr. Woolrich, which is provided with simple mechanism to release the accumulated carbonic acid gas when it attains a certain pressure. By this means, it is asserted, may be prevented the enormous percentage of returned ales, which, in a notable instance this last season, were so great as to completely swamp the dividend of one company.

BARROW-IN-FURNESS, 1st January, 1890.

Another Advance in Iron and Steel.—At variance altogether with anticipation the hematite pig iron market has evinced considerable improvement during the past week or ten days. The demand for hematite pig iron has been strengthened, and makers are in receipt of numerous inquiries for large parcels for forward delivery. Prices have advanced to 79s. and 80s. per ton for parcels of mixed numbers of Bessemer iron net f.o.b.; and hematite warrants, which last week were at 73s., have advanced rapidly to 78s. 6d., and are still buoyant. There is a slight increase to note in the stocks of iron to the extent of over 1,000 tons. They now represent 380,000 tons, but are over 50,000 tons less than they were in January, 1889. In the steel trade there is much life, and the demand shows great strength from both home and foreign sources. Heavy rails are quoted at £7 per ton, light rails at £7 10s., and colliery sections at £7 15s. per ton. There is a heavy and increasing trade being done in steel shipbuilding material, and the mills are very vigorously employed on heavy contracts, which will require several months to complete.

Shipbuilding and Engineering.—There is a very brisk business in shipbuilding and engineering, and the heavy orders on hand are likely to be supplemented with other important contracts, which will make these industries very brisk during the ensuing year. There is some prospect of large orders for putting triple expansion engines into several well-known steamers, and large orders are pending for the highest class of ocean-going vessels.

MIDDLESBROUGH, 1st January, 1890.

Pig Iron.—The market is quiet. The holidays have had their influence, but of course this is the dead season of the year, when quietness reigns. The market, however, is firm, with the prospect of an increasing business as the season advances. No. 3 G.M.B. is quoted at 61s. 6d. to 62s. for prompt delivery, and 62s. 6d. to 63s. for delivery over the first quarter of the year, which figures indicate the conviction that the favourable run of business will be continued. Cleveland warrants range from 61s. to 61s. 6d.

Shipments of Pig Iron.—The shipments of pig iron for the past week are rather better, but still they are very small comparatively. For the week they amount to 11,621 tons, as against 11,329 tons for the previous week. Up to the 30th ult. they amounted to 40,323 tons, as against 75,007 tons to a similar date the previous month, and 70,682 tons last year. Of course there will be an increase in stocks, the only question being how much.

Finished Iron and Steel.—There is no change in finished iron and steel. Most works take advantage of the holidays to lay off for repairs. Prices are firm, with a tendency to rise, but as yet there is no change except in some special brands, which have advanced from 5s. to 10s. per ton. The exports of finished iron and steel are maintained, and compare favourably with those of a similar period last year.

Coal and Coke.—The holidays have interfered with the output, but the demand continues strong. Prices are firm; indeed, they are a little higher for the time being. Gas coals are at 14s. to 15s.; steam coal, 13s. to 14s. Coke is as scarce as ever, as high as 31s. per ton being asked.

SUNDERLAND, 1st January, 1890.

Shipbuilding.—The returns for the shipbuilding of the year are now complete, and show that there has been greater activity in this industry than in any past years. One hundred and two vessels of 217,345 tons have been launched, as compared with 75 vessels of 142,410 tons in 1888, which exceeded each of the three previous years. The present output has only been approached, as far as tonnage is concerned, by that of 1883, when 128 vessels of 212,313 tons were launched. As in last year, thirteen shipbuilding establishments contributed to the result, Messrs. Jos. L. Thompson & Sons, North Sands, again heading the list with 13 vessels of 30,543 tons, which, however, is a decrease of 3 vessels and 4,578 tons, as compared with 1888, due partially, at least, to irregularity of delivery of material and workmen. Messrs. Short Brothers, Pallion, fall from the second position to the fifth, despite of the fact that they launched an additional steamer and had 2,444 tons larger output, the vacated place being occupied by Mr. James Laing, Deptford, who has turned out 11 vessels of 29,160 tons. Messrs. William Doxford & Sons, Pallion, come next with 10 vessels and 24,150 tons; then the Sunderland Shipbuilding Company, Limited, with 11 vessels of 23,565 tons. Messrs. R. Thompson & Sons, Southwick, occupy the sixth position with 8 vessels of 18,174 tons, which is the same place as in the previous year, but with more than double 1888's output. Messrs. Jonn Blumer & Co., North Dock, rank next with 9 vessels of 15,296 tons; then Messrs. Bartram, Haswell, & Co., South Dock, with 5 vessels of 11,917 tons. Messrs. Osbourne, Graham, & Co., North Hylton, have launched 6 vessels of 10,692 tons; Messrs. John Priestman & Co., Southwick, 6 vessels of 8,037 tons; Messrs. W. Pickersgill & Sons, Southwick, 5 vessels of 7,960 tons; the Strand Slipway Company, 4 vessels of 7,481 tons; and Messrs. S. P. Austen & Sons, 4 vessels of 2,550 tons. Ninety-nine of the vessels were screw steamers, and three were sailing vessels.

NEWCASTLE, 1st January, 1890.

The Christmas Holidays.—The recurrence of the Christmas and New Year festivities has temporarily dislocated trade arrangements in the district, work being almost wholly suspended in the shipbuilding, engineering, and other industrial establishments until January 6th. When business is resumed, pressure will, in many cases, be put on to make up for lost time, but it will be found difficult, if not impossible, to make good the losses caused to employers, workpeople, and the general public by such a prolonged stoppage of productive operations.

The Coal Trade.—The prices of all descriptions of coals are very firm, and for households an advance of 1s. per ton is being asked. The whole of the contracts for 1890 have now been allotted by the North Eastern Railway Company. The collieries of Durham, Northumberland, and South Yorkshire will be the sources of supply. The prices are nearly 50 per cent. higher than under the contracts entered into at this time last year, and which are now expiring. It is understood that a settlement of the Northumberland miners' claim for an advance of 15 per cent. in the wages rates will be arrived at on the basis of the employers' offer of 10 per cent. The acceptance of this offer by the miners involves the abandonment of their request to have the number of working days per fortnight reduced from eleven to ten.

Wages Movements.—The shipsmiths employed in the Tyne yard have accepted the arrangement already made with the platers, riveters, &c., by which an advance of 5 per cent. on piece prices, and 1s. per week on time wages, will become payable on the first pay-day in January. The platers' helpers have put in an application for an advance of 10 per cent., to fall due on January 24th. The enginemen, cranemen, cartmen, and general labourers at Messrs. Abbot's works are on strike for an advance of wages, but the firm, having made them a reasonable offer, which was refused, now seem to be determined to dispense with their services, and have already made arrangements which will have the effect of permanently displacing at least one section.

Electric Lighting.—New works for the manufacture of electric lighting apparatus have been erected at Heaton by Messrs. C. A. Parsons & Co., and operations on an extensive scale have been commenced. Among the earliest contracts executed by the firm is that for the whole of the plant required by the Newcastle and District Electric Lighting Co, Ld.

DUNDEE, 1st January, 1890.

Flax and Jute Trades.—Business is at a standstill at present on account of the holidays. The year 1889 has been, on the whole, a prosperous one, so far as the local industries are concerned. Prices close below those which were obtainable at the beginning of the year, but the average of the twelve months has been remunerative. The importation of jute, 214,353 tons, is the largest on record, if we except that of 1883, which reached 233,883 tons. In 1888, there were 188,659 tons imported. Prices have been pretty well maintained, notwithstanding the increased supplies. At the beginning of the year quotations were from £10 10s. to £17; they are now from £11 10s. to £19. Spinners are not believed to be well supplied. In yarns a very good business has been done throughout the year, and there has been a large demand for export as well as for home consumption. Rates do not, however, close so high as at the end of last December. The quotation for 7lb. fine yarns was then from 1s. 8d. to 1s. 9d.; it is now from 1s. 7½d. to 1s. 8d. For the last weeks of the year the demand for manufactured jute goods has not been up to expectation, but makers are hopeful that the spring demand will be brisk. The feature of the year's trade is the increased attention given to carpets and other fancy goods. It is on the development of the manufacture of fancy articles, perhaps, that the permanent improvement of the jute trade largely depends. Prices of Hessians are about ⅜d. under the closing rates of 1888. The linen trade has not been equal in extent to that of that year. Indeed, the importations of flax, tow, and codilla are below the average of the last four years. In 1885 the imports of flax amounted to 28,474 tons; in 1886, to 20,215 tons; in 1887, to 28,570 tons; in 1888, to 31,060 tons; and in 1889, to 25,673 tons. In 1885 the imports of tow and codilla were 4,800 tons; in 1886, 5,388 tons; in 1887, 6,016 tons; in 1888, 7,580 tons; and in 1889, 4,797 tons. Prices of most qualities are from 10s. to £3 under the closing prices of last year. Tows show a decline of from £4 to £5. The prices of yarns are also lower. The price of 2lb. flax is 1s. 4d. to 1s. 4½d., against 1s. 5½d to 1s. 6½d; 3lb. flax is 1s. 7d. to 1s. 7½d., against 1s. 9d. to 1s. 10d.; 3lb. tow is 1s. 5d. to 1s. 6d., against 1s. 6½d. to 1s. 8d.; and 6lb. tow is 2s. to 2s. 1d., against 2s. 4d. to 2s. 6d. The importation of foreign (French) yarns has increased the downward tendency of prices. The business in linen goods has been, on the whole, satisfactory. Merchant navy canvas is quoted at 7½d. to 7¾d., against 7¾d. to 8d. at the corresponding date last year.

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THE FORTH BRIDGE.

(For description see page 17.)

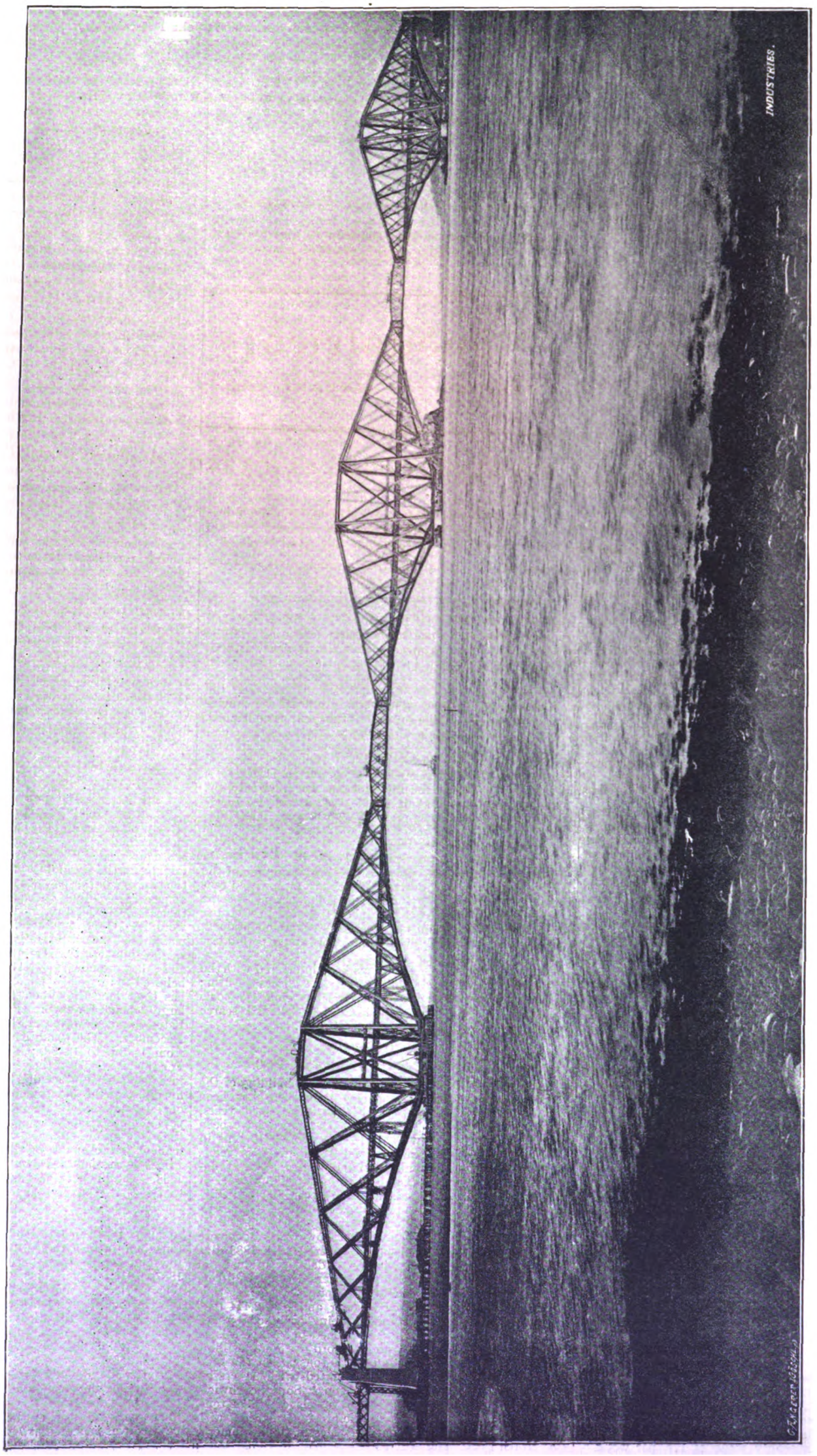


FIG. 1.—GENERAL VIEW OF THE COMPLETED BRIDGE.

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As we go to press early with certain of our advertisement pages, all Alterations to Standing Advertisements should reach the Publisher not later than 2 o'clock on Wednesday afternoon in each week.

All accounts are payable to GEO. CAWLEY, 358, *Strand, London, W.C. Cheques should be crossed Manchester and Liverpool District Banking Co., Limited, 75, Cornhill, London, E.C. Post Office Orders should be made payable at the Post Office, Bedford Street, Strand, London, W.C.*

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

Contents.

	PAGE
Industries and Commerce during 1889	1
Wire Straightening Machine (*Illus.*)	5
Improved Screwing Machine (*Illus.*)	5
Foreign Industries (Corres.)	6-7
The Mullineux Cartridge (*Illus.*)	8
The United States Cruiser "San Francisco" (*Illus.*)	8
Shipbuilding Notes	8
Notices of Meetings	9
Prices Current	9
Foreign Telegraphic Advices (Corres.)	9
Home Industries (Corres.)	10-11
The Trade of the Past Year	13
Profit Sharing	14
An Irish Industrial League	14
Letters to the Editor:—	
The Channel Bridge	15
Machinery for Treating Arrowroot	15
The Gas Stokers' Disputes	15
English *versus* German Torpedo Boats	15
The "Farnley" Boiler Flue (*Illus.*)	15
The Royal Institution Lectures for Juveniles	15
Books Received	16
Reviews	16
The Forth Bridge (*Illus.*)	17
The Construction of Marine Boilers with a View to the Use of Higher Pressures (*Illus.*)	18
Electric Lighting in New York (Corres.)	19
Tests of a Ten-Light Transformer (Corres.)	19
Cellulose and its Constitution	19
Notes	20
"Industries" Patent Record:—	
Applications, Acceptances	21-22
Illustrated Abridgments	22-24

To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

We cannot undertake to return manuscripts or drawings, and must request correspondents to keep copies.

BOUND VOLUMES OF Industries,

In half calf, gilt lettered, may be obtained at our London, Manchester, and Glasgow Offices, Price 20s. each.

Industries:

FRIDAY, 3RD JANUARY, 1890.

THE TRADE OF THE PAST YEAR.

Two years ago, when reviewing the trade of the year 1887, we noticed that the autumn revival of 1886 had been short-lived, but that towards the close of the following year a fresh revival of trade, which bade fair to last long, had begun. This anticipation has been so far justified by events, for since the late autumn of 1887 trade, both foreign and domestic, has been progressing by leaps and bounds. The rumours of Continental imbroglios have been falsified, and even the deposition of an Emperor and the establishment of a Republic in Brazil have passed almost unheeded in the press of business. The trade of the year has been brisk beyond precedent, and, although not improbably some of the production which is being carried on so rapidly is at least premature, there is, for the time at all events, ample margin for capitalists and labourers alike to lay by against the "rainy day" that sooner or later must come. The incidents with which we are familiar in times when the curve of trade tends upwards have been fully manifest during the past year. General wholesale prices, which had been, with a brief check in 1873-82, falling steadily from 1874 till 1886, began to rise towards the close of 1887, and have continued to do so till now. Prices of staple commodities also have in some cases advanced very rapidly. In the beginning of January, Middlesbrough pig iron warrants stood at 33s. 10d., and Scotch warrants at 41s. 7d. The stocks were 250,215 tons and 1,032,123 tons respectively. The year had scarcely begun when orders from abroad came pouring in; the demand for steel-making, consequent upon the rapid revival of the shipbuilding industry on the Tyne, the Clyde, and the Mersey, drew off production, and checked the accumulation of stocks. Soon the stocks were encroached upon; prices rose rapidly all summer and during the autumn. The pig iron ring at Glasgow was in a chronic state of excitement, the Christmas holidays finding prices 61s. 7½d. and 61s. 2½d. for Middlesbrough and Scotch iron respectively, and the stocks reduced to 179,036 tons and 945,608 tons respectively. The aggregate decrease in stocks was thus upwards of 158,000 tons, and the advance in prices 80 per cent. in Cleveland iron and 50 per cent. in Scotch iron. This rapid advance was fostered by speculative outsiders, who rushed into the market and contributed an element of uncertainty and insecurity. It was even rumoured for a time that a syndicate contemplated a "corner" in Cleveland warrants, and transactions lent some colour to this rumour. One of the chief financial events of the year was the collapse in March of the Copper Syndicate, and the consequent ruin of the Comptoir d'Escompte of Paris. The financial crisis in France which followed affected to a considerable extent financiers in London and Glasgow who were involved in copper speculations; but the state of trade was too stable at the time for even such an untoward circumstance having any very widespread or lasting effects. Shipping was among the earliest of trades to feel the impetus of revival. The enormous expansion of the railway system in the United States and in Canada, the development of the South American Republics—especially the Argentine—and the rapid increase of Indian external commerce brought demands for ships which the existing tonnage could not cope with. Then shipbuilding, marine engineering, steel smelting, and the numerous complementary industries of these groups shared the expansion, and during the whole year every resource of these trades was taxed to the utmost. On the shipbuilding rivers, as the year closed, yards which had been disused during the depression had been reopened, new firms had been established, and every slipway was occupied. General wholesale trade, not so readily followed in detail as those great staples which bulk largely in the public eye, has benefited also. Increased work, increased wages, and increased spending power has enabled the great body of consumers to increase effective demand, and has thus reacted upon production, accelerating the rate of revival and tending to make it more lasting. These industrial impulses have, as was to have been expected, strained the resources of the companies in whose hands are the means of inland transit. Not only have the railway companies benefited very largely by the increase in the volume of trade—so largely indeed that they have been paying, for them, large dividends, and have been able to make permanent reductions in their expenditure, by effecting favourable financial changes—but they have been compelled, as well as enabled, to increase their power of meeting the large demands upon their resources. The ensuing session of Parliament will witness what may well be called a railway mania, for not since the memorable days of forty years ago will so many railway bills have been brought before it. In the near future also there lies the enormous possibilities opened up by the prospect of supplying China with railways. A momentary hitch seems to have taken place, owing to the reluctance of the Chinese to admit the foreigner to the share in administration which would be demanded if foreign capital were used in the construction of railways. But this difficulty will doubtless be got over, either by the capital being found in China itself—for the Chinese are born speculators, and a Chinese railway mania which should draw the cash from the pockets of the small Celestial investor is by no means beyond the bounds of probability—or by the Chinese Government borrowing the money in London on its own credit. The latter it could easily do, for the last China loan was quickly placed, the total indebtedness of the country being rather less than its annual customs revenue. Though the exploitation of the transit system of China by European capitalists would be more rapidly carried out than would be the case if it were left to native administrative sagacity, with its dignified Oriental deliberation, there is a good deal to be said for the latter course, from the point of view of its effect upon European trade. Two important incidents of the year, in connection with international commercial relations, are the prolongation of the contest between Germany and England for the trade of the Eastern Coast of Africa, and between Portugal and England for the trade of the West Coast. Both cases illustrate the circumstance that the explorer as plenipotentiary and administrator is not always a success, since the qualities of physical endurance and braggadocio which are indispensable in the rôle of the first are generally secondary at least in the rôle of the second.

The most considerable industrial phenomenon of the year has been the prevalence of strikes. The rise of prices which brings increased profit to the employer, provided the rise in the prices of raw materials is not out of proportion to that in the prices of the finished product, brings increased expenditure upon the workman, and thus, from the Ricar-

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dian view of the law of wages, a rise of wages is an inevitable result. Such direct relation between cause and effect is understood well enough by many employers, and thus in some industries advances were, with much foresight, spontaneously offered. Whether or not the claims of the men were just claims, in those cases where the demand for increased wages was not granted, need not be discussed here, but the *rationale* of these claims is not far to seek. Advance of prices all round, rise in wages in many trades, a general feeling that wealth was being produced in which the smallness of their share was only too manifest—these were considered quite sufficient grounds upon which to demand advances. Perhaps if one had been asked to mention a case in which an effective demand for increased wages could not be made unless the employers were entirely agreeable to grant it, the case of the dock labourers in London would have been most unhesitatingly given. Yet the dockers struck, remained out five weeks, their committee meanwhile supporting nearly all the waifs and strays of the London streets, and then the dockers went in with an advance of wages. It would be futile to omit to draw the obvious conclusion from this and from other similar cases. Depression of trade and falling off in prices inevitably result in the forcing down of wages. Revival in trade and advance in prices just as inevitably result in advance in wages. But the strikes convey another practical lesson. Without in the least criticising the conduct of the dock directors, or others who may now be placed in similar circumstances, the conviction has forced itself upon the public mind that such disputes must not be allowed to go too far. That, when a dispute about wages results in the stoppage of a great industry, in interference with the means of transit, or in curtailing the supply of such essentials to life, under modern conditions, as gas or water, it is time for some one in the public interest to step between masters and men, and say: "We cannot permit this war." This conviction has been growing. The success of the small committee of arbiters which met at the Mansion House and settled the dock strike has encouraged the London Chamber of Commerce, as indicated in our columns last week, to suggest the formation of a permanent Board of Conciliation. This cannot be too strongly commended. It has been the fashion to sneer at such attempts as being praiseworthy, but sentimental and unpractical. They are really intensely practical and far-seeing. The evil day when prices go down, and wages must go down, cannot be very far a-head. Strikes will hasten its coming, for every strike means cessation of spending power and crippling of industry—a strike of one trade means a lock-out of another. Arbitration, therefore, as a means of settling wages without stopping production is not an expedient of sentiment; but a definite attempt to introduce order and system into what has hitherto been disastrously anarchic. The year 1889 must, from the point of view of industrial organisation, be regarded as the starting point of a new epoch, for, if it has seen the largest strike on record in this country, it has also seen a most successful effort on the largest scale to reconcile the conflicting interests of labour and capital.

The probable future of trade is a topic upon which we would rather avoid entering. To prophesy correctly we must know, and there is no knowing. There are, however, some elements of danger in the offing. Are we producing too much for use as fixed capital? Are the South American Republics not over-railwaying themselves? Are America and Canada not calculating too much on the continuance of grain and cattle shipments to Europe on the present large scale? A collapse in America would certainly affect us very seriously, since a large part of our increased trade has been with the United States and Canada. Are we not also, as indicated above, going with our eyes open into a new railway mania, in which immense sums will be locked up in an unrealisable form? There is besides an element of danger in the immense nominal increase of capital invested in joint-stock companies, amounting, during the past year, to upwards of two hundred millions. A large part of this is really due to enhanced valuation on the properties in question; yet interest is expected upon these inflated sums by the investors, and, if it be not earned, there will be corresponding hardship. To the large capitalist this is a matter of comparatively slight importance, but to small holders restriction of dividends means proportionally a much larger restriction of spending power. Thus, the increase of the number of stockholders involves increase of sensibility in the commercial balance. There is besides another danger, which is almost always left out of account in purely commercial forecasts—that is, the rate of increase of the population. It goes without saying that sudden bursts of prosperity result in an increase of marriages, and the offspring of these marriages pass their non-productive years generally in the periods of depression that follows the periods of inflation. They are thus a charge upon their parents and upon the community at a time when both are least able to bear extra burdens. Thus periods of depression are inevitably lengthened, and their intensity deepened, by legacies from the periods of inflation which preceded them. The circumstance that the revival has been in progress only two years, that it has slowly emerged from a period of depression, and that meantime all looks prosperous, encourages us to hope that a wild spirit of speculation may be avoided, and that the normal result of a moderately increasing population and a greatly increasing power of production will be brought about—viz., increasing comfort among all classes of the people.

PROFIT SHARING.

Mr. David F. Schloss has contributed a thoughtful and interesting article on the above subject to the *Charity Organisation Review* for the present month. After describing several instances of profit sharing, Mr. Schloss goes on to say: "The price of the craftsman's labour is its wage. Profits are the price of another kind of labour. Profits are the piece-work wages of management. The main test of the fairness and efficiency of any method of industrial remuneration is that it succeeds in securing a just proportion between the price of labour on the one hand, and the quantity and quality of that labour on the other, including in the elements which go to make up the quality, not alone careful workmanship, but also the avoidance of waste. What we want, in fact, is payment by results. Now, all forms of piece-wage involve payment by results, the remuneration of the workman being proportionate to the quantity of the work performed, and also to its quality, so far as this quality can be ascertained by the critical inspection of an experienced foreman. The avoidance of waste can be promoted by prizes for economy (as, for instance, those paid to engine-drivers on many railways for economy fn the consumption of coal and of oil). These methods are applicable in the case of men working single-handed; in that of men working in groups advantage is taken, under a variety of appropriate methods, of the well-known fact that six men, working together with the prospect of a joint reward of a given amount, will render services more than six times as valuable as each would render if working separately with the promise of a reward equivalent to one-sixth part of that amount; every man acting, in effect, as a foreman in relation to the labour of the other five, and stimulating them to display the utmost possible degree of carefulness and zeal for the common good. Now, while it is to this fact that the system of profit sharing owes a great part of its economic value as a means of inducing the exhibition of special assiduity by the employés, all these types of collective piece-wage possess, from the point of view of equity, this marked superiority over profit sharing, that by them the remuneration of the labour of the employés is made wholly independent of the ultimate financial results of the business—results which depend, in the main, on the skill and industry, not of the workmen, but of their master.

"On the other hand, there are certain cases in which the profit sharing method, in respect both of fairness and of economic efficiency, undoubtedly surpasses any form of the wage system. In particular instances it may be impossible to measure the extra value of special zeal and of special care otherwise than by the figures of the profit and loss account of the firm: in these instances, accordingly, the system of industrial partnership may, in the true interests of both the employés and the employer, reasonably be preferred to any other.

"So much as to the logic of profit sharing. But the consideration of the claims of this method would be incomplete if we ignored the high practical value which it derives, not from its fulfilment of the demands of reason, but from the satisfaction which it affords to popular prejudice. The working classes in general object to the scale of the remuneration which they receive as unduly low; but still more does a considerable section of the working classes object to the form of this remuneration as inconsistent with the dignity of labour. What these men yearn for is, not so much a rise in wages, as a radical alteration in the position of the working man, which shall convert him from a 'mere wage-earner' into an 'associate' entitled to participate in that coveted fund, hitherto monopolised by the middle-class capitalist—'the profits of industry.' To persons imbued with an ambition of this character the benefits—shadowy as they may turn out to be—promised by this novel and elaborate method of industrial partnership, especially when coupled with the constitution of some sort of consultative committee of the employés (which, of course, is never allowed to possess any but a nominal influence in the management of the concern), will appear infinitely more attractive than any advantages, however substantial, which might be secured for the workers by any form, however equitable, of the simple, old-fashioned, well-tried, but despised and detested, wage system. Outside the world of the working classes the conversion of the profit-making *entrepreneur* into a salaried official is a matter of more and more frequent occurrence, the small shopkeeper being turned into the manager of a department in the service of 'the Stores' or of a Universal Provider, and the owners of the big breweries, and so on, becoming the managing directors of the limited companies to which they have sold their concerns. Nor do the persons thus degraded into 'mere wage-earners' appear to feel any very acute degree of humiliation. But the love of independence which characterises the industrial classes not unrarely causes them to chafe under the yoke of 'service,' and to embrace with avidity the opportunity of posing as partners with their masters, which is afforded to them by this ingenious system of profit sharing."

AN IRISH INDUSTRIAL LEAGUE.

An influential Provisional Committee has been formed to promote an Irish Industrial League, and, having regard to the non-political and non-sectarian character of the undertaking—which is well shown by the list of members of the Provisional Committee—we heartily wish this latest attempt to give life to Irish industry every success. A general meeting of subscribers and members will be held in Dublin during the first week in February for the appointment of central offices, district committees, and officers. The Rev. Canon Bagot, of Kildare, is one of the hon. secretaries, and also provisional treasurer.

The following prospectus has been issued by the Provisional Committee:—

The Irish Industrial League is formed to better promote the development of the material resources of Ireland, hoping thereby to provide remunerative employment for our artisans and labourers. The League is formed on a strictly non-sectarian and non-political basis, and in order that all may join, 5s. per annum is fixed as the subscription. The Executive of the League will consist of a Central Council and committees in every district in Ireland. The duties of the Council will include receiving reports from the various committees on the industries which can be profitably introduced, as well as on those which from one cause or another are languishing or dormant, but are capable of being established on a sound financial basis; also as to the water-power available in their respective districts, and what railway and other communications are at present in existence, and how far these can be improved. On receiving these reports the Council after due and careful investigation will make their report to the public, and suggest the best means of carrying out their recommendations, having regard to such industries only as can be profitably promoted. Special committees will be formed from time to time of members of the League who are known to be more or less experts on particular industries.

The following, among others, are the industries that will receive the special attention of the Council, viz.:—

Textile manufactures,
Minerals and mining,
Quarries and clays,
Milk and dairy produce,
Development of dead meat traffic,
Fruit and vegetable farming,
Agricultural development,
Fisheries, internal and seaboard,
Poultry farming,
Forestry,
Osier-growing and basket-making, &c., &c., &c.

The League also hopes to take up the question of industrial education in primary schools.

The Committee trust that the ramifications of the League will

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extend throughout every district in Ireland, and as their sole object is to increase the material wealth and prosperity of the country, they hope it will receive universal support. As soon as the League is fully organised public meetings will be held throughout the country to explain more fully its objects, and also to receive suggestions from those who attend. Applications for membership will be received by any of the hon. secretaries, and until the appointment of treasurer the Rev. Canon Bagot, Kildare, will receive and acknowledge subscriptions.

Letters to the Editor.

THE CHANNEL BRIDGE.

To the Editor of "Industries."

Sir,—Your article on the subject of the means of communication between England and France is extremely interesting, as it affords a history of the various schemes which have been brought forward for crossing the Channel by other than the ordinary mode of conveyance, but those of a superstitious frame of mind will deduce a moral therefrom injurious to the latest project, as the whole of the previous proposals, with the exception of the "Calais-Douvres," have either proved abortive or else failures. I do not assert that this is any logical reason that the Channel bridge will come to nothing, but it may affect the investing class, which is an important matter.

One point upon which you have not touched, but which would have an important bearing if the project ever reaches the Parliamentary stage, is the effect upon the shipping of the Channel. The shipping interest has enormous influence in this country, and it may be expected that it will vigorously oppose the obstruction of navigation which will result from the formation of 120 islets between England and France. The knowledge, in thick weather, that this obstacle is ahead, will not have a reassuring effect on the mind of the average mariner. The matter has been pithily expressed—I forget where—in the statement that had there been a natural obstruction of a similar nature, engineers would have busied themselves long ago in devising a method of getting rid of it. Another question to be considered is whether the bridge would pay. You give the estimated cost at £34,000,000. As estimated costs and actual cost go in such matters, it may be taken that £50,000,000 will be near the mark, and it is exceedingly doubtful whether, after allowing for cost of maintenance and working expenses, the traffic would give a return which would pay a reasonable rate of interest even on the lower of these sums. As an engineering exploit the bridge would be a desirable monument, but as a commercial speculation I think it is less to be wished for.

Yours, &c.,

Speculator.

London, 30th December, 1839.

THE GAS STOKERS' DISPUTES.

To the Editor of "Industries."

Sir,—The letter of Mr. Charles W. Rausch, in your issue of the 20th inst., is interesting, because it is written from a point of view of the relations between capital and labour which is falling into abeyance, or even, perhaps, becoming obsolete. This point of view, though hitherto common enough, is essentially one-sided. It goes without saying that the perfectly fair objection to the importation of sentiment into the discussion of such problems cuts both ways. The plea that employers should be permitted to "conduct their business" as they please—that is, without regard to their employés or to anyone else—is simply a sentimental plea. No one is independent of the obligations of contract, or of law, or of public opinion. Wages imply a contract between employer and employed, and a wages question is not exclusively the employer's business, but is of necessity a business in which the other party to the contract must have something to say. The course of events in this case seems to have been something like this:—The men were employed on certain terms; afterwards the directors of the Gas Company announced that they were about to alter those terms, adding that if the men did not agree to this alteration they might go. The men did not accept the terms, and they went. This is not a strike; it is, in effect, a lock-out. The men may win, or the company may win; but either way it is not a foregone conclusion that the company were right, any more than that the men were right either morally or as a matter of policy. If a public company, or indeed a private individual, may do as they please, then justification of any action of theirs is unnecessary; but the Gas Company do seek to justify themselves, and thus they voluntarily place themselves before the bar of public opinion. An employer may justly or unjustly dismiss a single employé without incurring almost any risk of attracting public attention; but he cannot lock out several hundreds without the fact becoming notorious, and the importunate question being put, Why?

In this case, the Why? is answered apparently truthfully, by the statement that the men had formed a union which the employers were desirous of breaking up. Here, then, on the face of it, is an interference by the employers in what is an affair of the men. If they choose to form a union, they were simply acting within their legal rights, and were only following the example of almost all tradesmen, skilled and unskilled. Suppose, for a moment, that the case had been reversed: that the company had elected to combine with other gas companies in order to form a gas syndicate, would they have consulted the men or would they have submitted to the imposition of the men's dictation of conditions which would infallibly break up the proposed union?

This anti-combination idea cuts both ways. It is too late in the day to oppose the principle of trades unions, just as it is too late to object to the development of joint-stock enterprise. These two examples of combination have together brought about a great change in the markets. At a particular moment the combination of capital secures the buyer or the seller, as the case may be, in a strong position. So far as labour is concerned, the trade union has undoubtedly made labour a stronger seller than before. Employers may not like this, but it is a patent fact. "Platitudes about peace," then, must come in; the arbitrator must take the place of the strike committee. Wages questions must, for the sake of both sides, be discussed quietly, and not with strife, and arbitrary and unreasonable action on either side avoided because it is against the best interests of both. To plead that it is illegal or immoral for the union "to order what men shall or shall not be employed by the Gas Company" is quite beside the question. The men may or may not be acting wisely in rejecting Mr. Livesey's proposal, but they see, what he must have seen when he made it, that its acceptance involved the breaking up of their union, and, having just formed this union, they determined to resist this attempt to smash it. Their position is a perfectly tenable one; whether, however, the balance of advantages was on the side of striking or on that of submission I am not prepared to say.

Yours, &c.,

T. M.

Glasgow, 27th December, 1889.

MACHINERY FOR TREATING ARROWROOT.

To the Editor of "Industries."

Sir,—If any of your readers could tell us to whom to apply for particulars of machinery for grating and treating arrowroot and cassava, we should be very much obliged.

Yours &c.,

W. R. Dell & Son.

26, Mark Lane, London, E.C.,
January 1st, 1890.

ENGLISH *VERSUS* GERMAN TORPEDO BOATS.

To the Editor of "Industries."

Sir,—I have read with great interest what has appeared in your issue of the 27th inst. in reference to English and German torpedo boats. I am myself of German extraction, was educated in that country, and, besides, employed there for many years as an engineer. I am now interested in the study of torpedo boat design in this country, and consequently feel myself very unbiassed in this discussion, as my sentiments in some respects lean toward the Germans, and in other respects toward the English. I am very well acquainted with the torpedo boats built both in this country, Germany, and France.

What I believe to be the case is that the German constructors are far more clever than the English in pushing their business, and they are also powerfully supported by their Government, which has constituted itself a gigantic agency for promoting by any means in its power German industry. To these two causes must be mainly attributed the recent successes of German manufacturers, and no doubt the cheaper labour obtainable in Germany enables them to construct at lower prices: but in point of quality the English undoubtedly maintain the lead.

Regarding the question of speed, I do not believe there is much to choose between Thornycroft, Yarrow, Schichau, and Normand. That is, on a given length. We all know that with the larger, or longer boat, if the power is proportionate to its displacement, it will, as a matter of course, have a higher speed than the shorter one, and in the table which you give on p. 609 this fact is simply confirmed by the figures. The Schichau boat appears to be the fastest, but it is at the same time the longest. The slowest boat, which is also German, is the shortest, and the other ones have intermediate speeds and intermediate lengths. The real point in regard to speed, so far as the credit of the builder is concerned, is to obtain the highest speed for a given length, because length determines speed with similar model and proportionate power. I believe I am correct in saying that all the builders named above are practically on the same level, provided the speeds are tested over runs of long duration.

There are, however, many other things besides speed to consider. There is the question of rapidity of manœuvring, and in this respect Yarrow & White are far ahead of all others. In the last boats built for the British Government by Yarrow, which are 130ft. in length, the speeds varied from 22½ knots to 23 knots, carrying a load of 20 tons on a run of three hours' duration, and the boats were capable of turning in a circle having a diameter of twice the length of the vessel. This combination of speed and manœuvring power has never, to my knowledge, been surpassed or even equalled before in a boat of these dimensions.

Touching the question of stability, which seems of late to have come prominently before the public, no doubt Schichau and Yarrow come first. The French boats are notoriously very deficient in beam—in fact, too narrow to be thoroughly safe under all conditions. One remarkable point in the Yarrow boats is the fact that the rudder and stern is so designed that, when turning, the action of the rudder on the hull has a tendency to keep it upright and to counteract the centrifugal force which otherwise would cause the vessel to heel outward, which is one of the sources of danger other builders have taken no steps to remedy.

In point of durability and success in continuous working, the two English builders and M. Normand undoubtedly come before the German firms. Not very long ago (referring to the boats built for the Italian Government by Messrs. Schichau) I saw two torpedo boats in Dover Harbour, and one of them had broken down. After being repaired they proceeded on their voyage, and they again broke down near Portsmouth, and had to apply to the English Government for permission to go into Portsmouth and get repaired in the dry dock, at which time the construction of the hull was severely criticised by the English authorities, some things having been made in cast steel which in English practice would have to be made of forged steel. The plating and riveting of the hulls were far from good. At any rate, they did not produce a favourable impression; also the skin plating of the hulls was not galvanised, while that of all English boats is always galvanised. I simply mention these points, but there are many others in which the German boats are defective.

Another fact is interesting, and adds to the reputation of the British builders (Thornycroft and Yarrow), and that is, they have never incurred any penalties for failure to get their contract speed, although they have built, as is well known, a very large number of torpedo boats, while Schichau has failed. I would particularly refer to their contract with the Austrian Government, on the trial of which some doubts had arisen in the mind of the Austrian authorities as to the accuracy of the trials, and a special commission was appointed for the purpose of verifying the same, when it was found that the speed obtained was considerably below that contracted for, and heavy penalties were incurred by the contractors. Failure to obtain the contract speed certainly cannot be considered a feather in the cap of the German builders.

The excessively fine entrance lines adopted by Messrs. Schichau may possibly avoid the conspicuousness of the bow wave, and is therefore a good point; but as regards speed and comfort I do not for a moment believe these to be any gain, and the accommodation for the crew, being forward, is thereby very much reduced.

I trust you will consider these few lines worthy of publication.

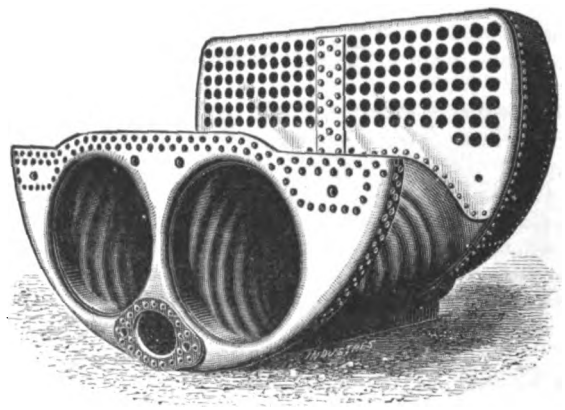
Yours, &c.,

F. W. Crohn.

London, December 31st, 1889.

THE "FARNLEY" BOILER FLUE.

The illustration below represents one of the latest designs of corrugated furnaces, and one in which the corrugations have a spiral arrangement around the flue. This furnace is made by the Farnley Iron Company, Ld., near Leeds, and the design is very neatly worked out, with the view of forming a flue which shall have maximum



strength, both radially and longitudinally. Now that the normal pressure in marine boilers is 160lb. per square inch, and much higher pressures are being recommended for marine purposes, the question of a reliable furnace becomes one of prime importance. We therefore anticipate that the furnace we illustrate will be extensively adopted, especially in connection with the higher steam pressures which now obtain in the best engineering practice.

THE ROYAL INSTITUTION LECTURES FOR JUVENILES.

On Saturday, the 28th ult., Professor Rücker, F.R.S., gave the first of a series of lectures on "Electricity," at the Royal Institution. The lectures were specially adapted to a juvenile audience, but there were also present a number of leading men of science. The lecturer, after a few introductory historical remarks on electricity, made several experiments to show how bodies charged with electricity attracted and repelled one another. He then demonstrated the conducting and non-conducting powers of various bodies. With regard to the question, What is electricity? the lecturer confessed that if he were asked this apparently simple question he could not give a satisfactory answer, although much was known about its action. Professor Rücker next brought before the consideration of his audience the question how it was that two bodies charged with electricity, yet being several inches apart, should attract or repel each other. What was the invisible connection between these two bodies? Some might think that air was the all-important medium, but by means of an experiment with Dr. Crook's radiometer he showed that this was not the case. The state of the space surrounding the electrified bodies was next considered, and by various experiments this space was shown to contain lines of force in certain defined directions. Professor Rücker concluded his first lecture by showing his own investigations on electrical stress. By means of the Nicol prism, he showed that the physical conditions and arrangements of liquids were changed by passing through them a strong electrical current, the electrical stress on the liquid having a similar result to that of the introduction of a crystal into a ray of polarised light.

In the second lecture, on the 31st ult., Professor Rücker proceeded to show the distribution of electricity on conductors. He charged a metal cylinder, and on testing showed electricity to be on the outside, not on the inside, of the cylinder. An experiment with a soap bubble and a pith ball inside demonstrated the same principle. So long

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as the bubble remained unbroken no effect was produced upon the pith ball by electrical influences from outside. On the bubble being broken the pith ball was affected. When a body is electrified, he said, it depends on the shape of the body whether the electricity spreads uniformly all over it. In a sphere it is found to be uniform, but in a body of irregular shape the electricity was found to accumulate in those parts which are the most pointed. A series of experiments was then shown to demonstrate the effect which an electrified body had on the air and surrounding liquids by causing repulsion and setting up streams. The lecturer concluded by pointing out the different results which experiments of this kind would have if performed in very rare gases—the electrified particles of air causing phosphorescence. He referred with admiration to the investigation of the late Mr. Warren de la Rue on this subject, who had recently bequeathed the actual apparatus employed to the Royal Institution.

Books Received.

Eleventh Annual Report of the Transactions of the National Association of British and Irish Millers. London: J. H. Chatterton, 61, Mark-lane.

A Treatise on the Metallurgy of Iron. By H. Bauerman, F.G.S. London: Crosby Lockwood & Co.

Reviews.

Practical Electrical Notes and Definitions. By W. Perren Maycock. London: E. & F. N. Spon. 1889.

This little work possesses the merit of clearly defining its scope by its title. It contains notes on, and definitions of a nearly all matters connected with the elements of electrotechnics, and should be, we think, of great use to practical men and young electrical engineers. The definitions are all as accurate as can be expected without entering into mathematical detail, except, perhaps, the definition of the joule, which, though scientifically accurate (since heat and work are mutually convertible), is expressed in a way which might lead the uninitiated to believe that the *values numerical* of the units are identical. The average current required by an incandescent lamp is given as one ampere. It might, perhaps, be wiser to give the watts per candle-power, as then the current for any incandescent lamp running at any e.m.f., could easily be deduced approximately. The book also contains a useful table giving several quantities connected with conductors. We think that possibly the value of this table might be enhanced if the figures in columns IV., V., VI., and VII. referred to column III., and also if it were stated for which size of conductor the value of the fusing current applies. Further, something appears to have gone wrong with column VIII. But no doubt all such oversights will disappear in the next edition. The work contains clear and instructive diagrams of the various systems of arranging conductors for supplying current to lamps of the various types of dynamo, an epitome of the recent investigations in the theory of lightning conductors, the "fire-rules" of the Institution of Electrical Engineers and of the Phœnix Fire Office, and many other important data.

Society of Engineers. Transactions for 1888. Edited by G. A. Pryce Cuxson. London: E. & F. N. Spon. 1889.

The question is sometimes suggested by thoughtless critics, "What is the *raison d'être* in London of an institution like the Society of Engineers, in view of such gigantic competitors—if such they can be called—as the Institutions of Civil and Mechanical Engineers?" The answer is that there is plenty of room for the co-existence of all these bodies, and that they fulfil to a great extent different functions. The Institution of Civil Engineers, as a rule, accepts only papers recording work actually carried out, and the same remark applies, under somewhat different conditions, to the Institution of Mechanical Engineers. It by no means, however, follows that, because a paper does not comply with the requirements of these societies, that it is on this account undeserving of publication; and, besides this, it is very desirable that opportunities should be given for the discussion of schemes and inventions before they are crystallised into accomplished facts. Such opportunities are provided by the Society of Engineers, of whose Transactions a volume is now before us. The inaugural address of the President, Mr. Arthur Thomas Walmisley, was in the main a general survey of recent engineering practice in various branches, introduced by a short account of the origin and progress of the Society, which was originally started in the year 1854, as the Putney Club. This Putney Club was formed out of the former students of the "College for Civil Engineers and of General Scientific and Practical Education," and subsequently developed into the Society of Engineers, which at the beginning of 1888 had a total of 382 corporate members.

The first paper is by Mr. Henry Faija, M.Inst.C.E., on "The Effect of Sea Water on Portland Cement," and was suggested by the failure of concrete work at Aberdeen, this failure having been attributed to the chemical action of the sea water. The author disputes the correctness of this view, and maintains that the magnesia, admitted to have been left in the concrete by the sea water, was already hydrated and perfectly harmless and inert, and that the failure was due to quite other causes. The other papers published are the following:—"Wimbledon Main Drainage and Sewage Disposal Works," by Mr. W. Santo Crimp; "Filtration by Machinery," by Mr. Edward Perrett; "Acton Main Drainage Works," by Mr. C. Nicholson Lailey; "Light Railways," by Mr. William Lawford; "Practice of Foundry Work," by Mr. H. Ross Hooper; and "High Pressure Steam and Steam Engine Efficiency," by Mr. W. Worby Beaumont.

The Development of the Philosophy of the Steam Engine. By Robert H. Thurston. New York: John Wiley & Sons. London: Trubner & Co. 1889.

Professor Thurston has done well to publish in separate form his interesting sketch of the history of the theory of the steam engine which was presented to the British Association for the Advancement of Science when holding its session of 1884 at Montreal. The paper was given a very favourable reception, and was selected for incorporation in full in the "Transactions" of that year. It has now been revised, and, with slight modifications and some additional matter, is now reprinted for more general circulation. Every treatise on the steam engine should have a chapter similar in design to Professor Thurston's paper, for the purpose of showing its readers the present position of the subject and its connection with its past development, for the only real way to have a clear understanding of any matter is to consider how it came to be what it is. We have very often pointed out the defects of the ordinary methods of treating the theory of the steam engine, and we think Professor Thurston has done good service in putting his paper in a convenient form, and thus made it accessible to students of the subject, who, in the meantime, may use it as a supplement to the ordinary treatises.

The author begins by pointing out that a complete history of the development of the steam engine would include—first, the history of the mechanical theory of heat; secondly, of the history of the science of thermodynamics, which has been an outgrowth of that theory; thirdly, the history of the application of the science of heat-transformation to the case of the steam engine; and fourthly, an account of the completion of the theory of losses by the more or less avoidable forms of waste, as distinguished from those necessary and unavoidable wastes indicated by the pure theory of thermodynamics; and the object of the paper is to collect into a condensed form, and in proper relations, those several branches of the subject. An interesting sketch is given of the development of the science of thermodynamics, which deals impartially with the different distinguished men who have helped that development, and has avoided all personal or party feeling—for there are scientific as well as political parties. For instance, while giving full credit to Joule for his distinguished work, he has not overlooked the merits of Mayer, and naturally he gives prominence to the investigations of Rankine, Clausius, and Sir W. Thomson. In the application of thermodynamics to heat engines he points out that the germ of the science of the steam engine is to be found in the work of Sadi Carnot, published in 1824, and traces its growth through De Pambour and Tate to Clausius and Rankine. He gives an outline of the work of the latter, and points out its neglected elements and the difficulty of arriving at any exact theory about them. Since Rankine's time the thermodynamic theory of the steam engine has received no important modifications, and the work of later engineers, and of physicists working on the general subject, has been confined to the study, experimental or other, of the limitations set to the application of this theory by the influence of other physical phenomena. Professor Thurston points out the share taken in the investigation of the nature of these limitations by Hirn, Clark, Isherwood, Cotterill, and others, and this part of the paper will be found most interesting and instructive; and the conclusion he comes to is that he agrees with Hirn that, in the present state of our knowledge, a complete theory of the steam engine is impossible, and that all that can be given is an experimental theory. A beginning has, however, been made in the final researches necessary for a complete theory in the experimental investigations which have been and are being made by many workers, and Professor Thurston says that it is to be hoped, if not expected, that an exact theory of steam engine economy may at some early date be produced, and that thus the engineer may be enabled to obtain solutions of all such problems as arise in steam engine design with all the precision that can ever be desired. He thinks that its final shape will probably be given by some such master of mathematical and physical science as was Rankine or Clausius. In the meantime, care should be taken that the results of experiments are put in such a shape that they can be successfully used by such a master when he appears. Professor Thurston's paper will be most useful in showing the steps which have already been taken, and indicating those which are necessary for future progress.

A Text-book of Assaying for the Use of Those Connected with Mines. By C. Beringer and J. J. Beringer. London: C. Griffin & Co.

Of all the branches of chemical analysis practised for the control of industrial processes none is of greater importance than assaying. The modern literature of the subject is, however, very unsatisfactory, for, besides Mitchell's treatise, which is too voluminous for the ordinary mine assayer, and the chapters given in Percy's works and in Phillips' "Elements of Metallurgy," there is no concise work that can be unhesitatingly recommended. The recent revival in the mining industry, which has given rise to a clamour for metallurgical literature, has no doubt led Messrs. C. and J. J. Beringer to attempt to provide a practical text-book for the assayer. Of their fitness for the task they have undertaken there can be no question, for Mr. J. J. Beringer, besides being a graduate of the Royal School of Mines, is public analyst to the county of Cornwall and lecturer at the Camborne Mining School, whilst Mr. C. Beringer has filled the post of chief assayer to the most important copper mining company in the world. Their book admirably fulfils its purpose. It is not confined to methods of estimating a particular metal by the agency of heat, but deals fully with wet gravimetric and volumetric processes. Indeed, it gives considerably more information of use to the assayer than is included under the strict meaning of the term "assaying." For example, cognisance is taken of the rarer metals, since their presence occasionally affect the accuracy of the assay. The work covers four hundred pages, the first eighty-six being devoted to an account of the principles on which assaying is based and the manipulation required, whilst the remainder of the work deals with the methods of estimating the various elements. Throughout the book the metric system of weights and measures is adhered to. This is undoubtedly a step in the right direction. The metric system must eventually be used in all analytical work, as is now the case in volumetric analysis. Many assayers still adhere to the English weights and measures in dry gravimetric methods, and in assays for commercial purposes it will always be necessary to compute in ounces per ton. Those who prefer to work with grains and grain-measures can use the figures given by the authors multiplied by ten. One feature of the book is of special value. Under the more important methods, the authors give the results of an exhaustive series of experiments they have made, showing the effects of varying conditions on the accuracy of the method. Such results are of the utmost importance, for the assayer has hitherto been apt to accept vague generalisations, or to deduce from analogy what the effect of an interfering substance will be. The authors insist that the record that the assayer makes of his work should be clear and neat, so that reference, even after an interval of years, is certain and easy. Their instructions as to the keeping of laboratory books and the filling-in of report forms will be found of great interest. At the end of each section practical exercises are given for the benefit of the student. The work must, however, in no sense be regarded as a cram book. The requirements of the assayer in industrial practice are kept in view throughout. We note, for example, useful information on the valuation of copper ores, on sampling a mass of material, and on approximately estimating with rapidity the proportion of carbonic acid in the air of mines. The electrolytic method of copper assaying, as practised at large works, is described at considerable length. It is gratifying to learn that it is rapidly taking the place of the inaccurate method of dry assay for the commercial valuation of copper ores. The Cornish method of assaying tin ore, of which an interesting description has been furnished by Mr. A. K. Barnett, one of the leading authorities of the Cornish tin industry, is shown to be by no means so imperfect as some writers would have us believe. It is certainly the most expeditious method of determining the commercial value of a parcel of ore, and this, after all, is the main object of all assaying operations. The only fault we have to find with the book is that there seems to be some uncertainty as to the amount of chemical knowledge expected from the reader. Thus, the statement that hydrogen is a gas (page 62) will certainly be unnecessary to anyone who has been capable of understanding the information given in the preceding pages. The book is well printed and bound, and the

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THE FORTH BRIDGE.

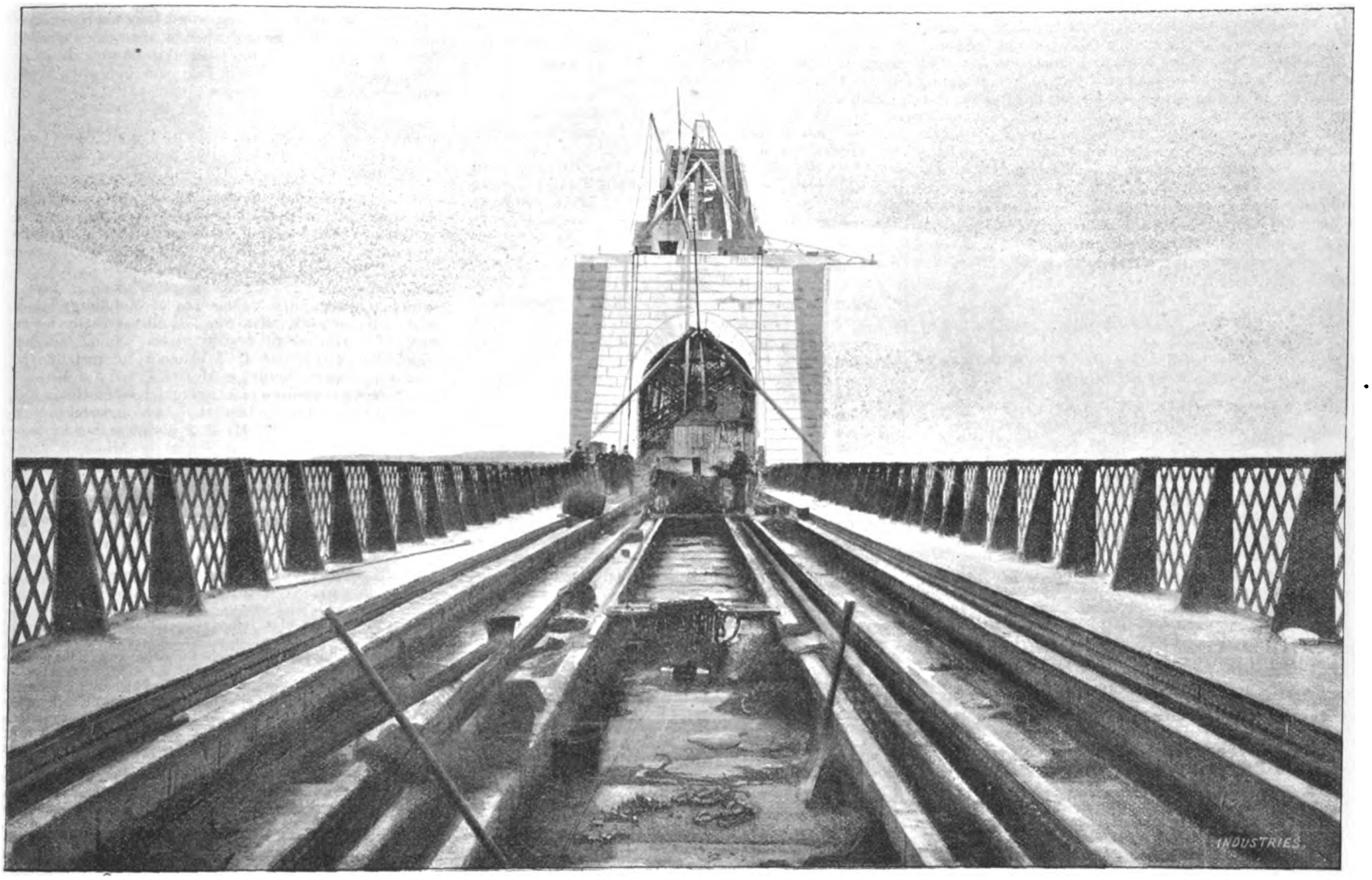


Fig. 2.—View on the South Approach Viaduct.

illustrations are numerous and carefully drawn in bold outline in vertical projection, the absence of unnecessary shading and perspective being greatly conducive to clearness. On the whole we can cordially recommend the book. The subject is treated in a practical and authoritative manner, and the work bears internal evidence of not being composed of mere extracts from other books. It conveys trustworthy information to the student, and, at the same time, contains a large amount of matter of interest and value to the practised assayer.

THE FORTH BRIDGE

In a recent number (see *Industries*, Vol. VII., page 357) we published an account of the central girders of the Forth Bridge, and the methods adopted in erecting them in position, and at the same time we reproduced some diagrams of exceptional interest, giving the exact longitudinal and transverse alterations of position made by the Queensferry cantilevers, so long as the end was free to move, pointing out at the same time that the figures were drawn by a giant arm, 670ft. in length, and weighing about 5,000 tons.

Since that time the bridge has been successfully completed, connection having been made on both north and south central girders; and we are now enabled, through the courtesy of the engineers, Sir John Fowler, K.C.M.G., and Mr. B. Baker, to place before our readers an illustration of the great work as an accomplished fact (see Fig. 1, page 12).

It is not to be supposed that a structure so widely known, and so conspicuous in the annals of engineering, should escape some criticism, if only on the score of its appearance. Accordingly, we find Mr. William Morris, at the recent Art Congress in Edinburgh, attacking the bridge on the grounds of ugliness. "There could never be," says Mr. Morris, "an architecture in iron, every improvement in machinery being uglier and uglier, until they reached that supremest specimen of all ugliness—the Forth Bridge." To such attacks on the part of the æsthetic school, Mr. Baker replied in his lecture delivered on the 27th November, before the Edinburgh Literary Institute, by pointing out that, in relation to the question of beauty, both size and fitness for intended requirements must have all possible weight. "The great Pyramids," said Mr. Baker, "would be regarded with deserved contempt if no bigger than haystacks." Aristotle held that great magnitude is, as such, an element of beauty, whilst Socrates regarded no object as in itself inherently beautiful, but that the attribute depended upon the impression made upon the mind receiving it. Mr. Baker passed on to point out that minds which had no conception of the duties which the great structure has to perform were utterly incompetent of judging what impression such knowledge had on those which did possess it and could appreciate the direction of the lines of stress and the fitness of the several members to resist forces. "I contend," said Mr. Baker, "that critics must first study the work to be done by both the piers and superstructure of the Forth Bridge, and the materials employed, before they can be properly qualified to settle the question of its beauty or ugliness."

This contention is supported, Mr. Baker concluded by remarking, by so eminent an authority on such questions as Ruskin, who says on the subject: "Of all the various principles of art, none are more indisputable, and few of more practical importance, than this. All art working with given materials must propose to itself the objects which with those materials are most perfectly attainable. Thus, great slenderness, lightness, or intricacy of structure—as in the ramifications of trees—is easily and perfectly expressible in metal work. The workman has not done his duty, and is not working on safe principles, unless he can so far humour the materials with which he is working as to exalt as far as he can their peculiar properties. If he is working in iron he should insist upon and exhibit its strength and tenacity, and he will invariably find the material grateful, and that his work is all the nobler for being eulogistic of the substance of which it is made."

Fig. 2 above shows the south approach viaduct, looking northwards. It will be noted that the rails appear in the foreground, the laying of which on teak sleepers inside guard troughs is being rapidly pushed forward. The rails are of the bridge type, 120lb. to the yard, a solid section, 146lb. to the yard, being used for making the expansion and contraction joints, which have received very careful consideration at the hands of the engineers. The rails were rolled by The Steel Company of Scotland, Limited, at their Heaston works, and the majority of them are now delivered at the Forth. Our illustration portrays the wind fence on each side of the viaduct girders, the teak handrails of which are being expeditiously fitted; and in the background will be noted the south cantilever end pier, the top cornice of which, of dressed granite, has yet to be built into position. Glancing at the approach railways, completion may be said to be seen very near. On the south approach railway, both the station at Rosshill and the Dalmeny bridge are nearly finished; whilst on the north approach railway the covered way and tunnels leave little further to be done, and the laying of the permanent way is well in hand. The direct line from Corstorphine to Dalmeny is well advanced, and the Carrickburgh branch is being pushed on with all possible speed.

In concluding, we may say that everything at South Queensferry is foreshadowing the end—as shown by the gradual dispersion of the men, the sales of plant, and the dismantlement of the workshops. The ancient and royal burgh of South Queensferry, after seven years of unwonted activity and prosperity, is gradually relapsing into its former placid slumbers. In a short time now little will remain to mark the busy toil and incessant labour carried on here since the beginning of 1883, save the gigantic structure to eastward, the fruit of so much skill, patience, and work—a triumph for all time of engineering progress in the nineteenth century.

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IMPROVED HIGH PRESSURE MARINE BOILER.

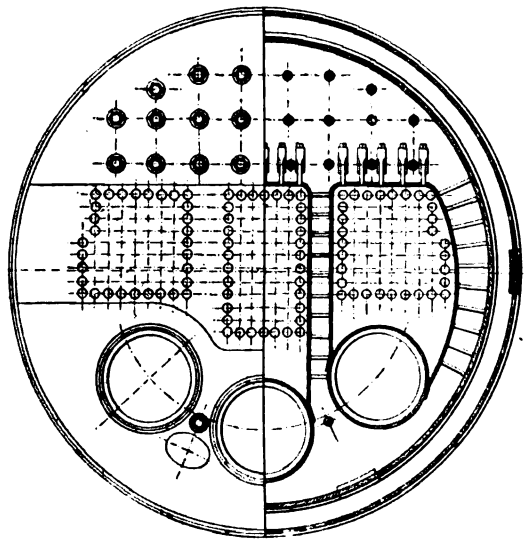


Fig. 1.—End Elevation—Half in Section.

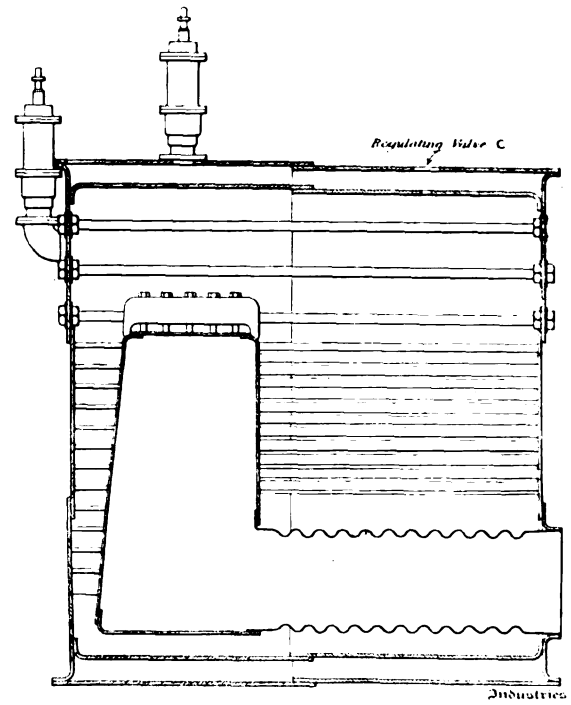


Fig. 2.—Longitudinal Section.

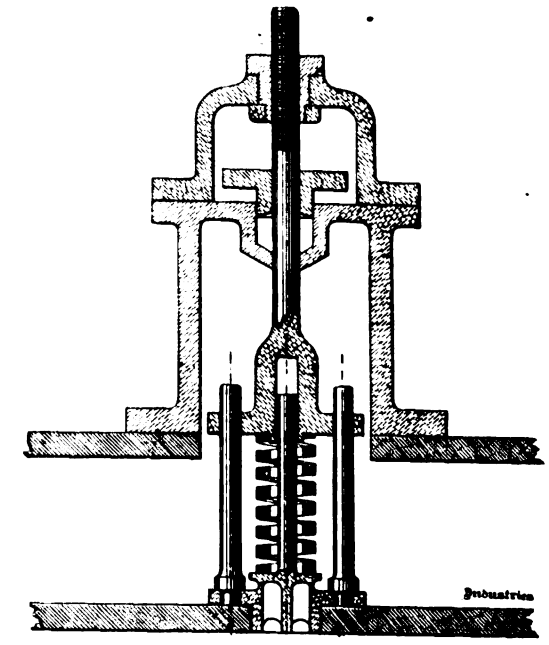


Fig. 3.—Transverse Section of Regulating Valve.

THE CONSTRUCTION OF MARINE BOILERS WITH A VIEW TO THE USE OF HIGHER PRESSURES.*

In placing before the members of this Institution a design of a new form of boiler suitable for higher pressures of steam than those now in general use, it would be as well for the writer, before explaining the design, to point out the many advantages, in his opinion, that would accrue from the use of higher pressures. During the last four or five years the struggle for economy has been marked by the extensive adoption of the triple expansion or tri-compound engine, working at pressures from 140lb. to 180lb. This type of engine has been almost exclusively adopted in new vessels, and in many instances compound engines have been converted into triple expansion by the addition of a third cylinder and higher pressure boilers. The well-known Trevithick was the first engineer to introduce steam of high pressure; and although his engines were non-condensing and his boilers of poor construction, yet he successfully proved their superiority in economy of fuel over the low-pressure engine, thus showing that steam of high pressure could be used advantageously; and when he and Woolf joined together in introducing the compound engine, it is said they used steam of 60lb. pressure. Steam of higher pressure than he ever anticipated is now being used, both with land and marine engines, and the object of this paper is to attempt to prove that steam of still greater pressures than those now generally adopted may be used with economical results, and that with few alterations the present type of marine boiler may be adapted to safely withstand these higher pressures.

The superiority of the triple expansion engines over the compound is due to the following causes:—To the higher pressure of steam used, and the higher rate of expansion consequent. Great variation of temperature in the cylinders, great initial strains, and sudden "drops" in the receivers are thereby avoided. These apply also to quadruple expansion engines. Increased pressure of steam is easily obtained by a very slight addition in the consumption of fuel, and the efficiency of steam rapidly increases with the increased pressure.

This may be proved thus:

1. The total heat of evaporation of 1lb. water from 100° Fahr. and at 312° Fahr. (80lb. absolute) is 1108·6° Fahr.
2. The total heat of evaporation of 1lb. water from 100° Fahr. and at 358° Fahr. (150lb. absolute) is 1122·4° Fahr.
3. The total heat of evaporation of 1lb. water from 100° Fahr. and at 401·1° Fahr. (250lb. absolute) is 1135·3° Fahr.

If in each case the steam be expanded to a terminal pressure of 10lb. absolute, the ratios of expansion will be (1) 8, (2) 15, (3) 25, and the mean pressures corresponding to these initial pressures and rates of expansion will be (1) 30·7, (2) 37·08, (3) 45. If the volume of steam varied exactly as the inverse ratio of the pressure, then these figures would give the comparative values of the steam at the pressures indicated. But as the volume of steam does not vary exactly as the inverse ratio of the pressures, the following will be found to be the more exact relative values in whole numbers: (1) 31, (2) 39, (3) 47. From this it will be seen that steam of 250lb. is capable of doing 20 per cent. more work than steam of 150lb., and steam of 150lb. 25 per cent. more work than steam of 80lb. The latter has been proved by actual practice, and is now an acknowledged fact. To use steam of 150lb. pressure with a compound engine would be very little more economical than to employ steam of 80lb., and the same may be said in the case of using any higher pressure than 160lb. for triple expansion engines. Yet when 160lb. pressure is used in the case of triple expansion engines, it may be said that there is a saving of 25 per cent. over the ordinary compound; and supposing a boiler was adopted with 250lb. pressure it might be anticipated with some certainty that a saving of 20 per cent. would be effected over the triple expansion engine. At the present time quadruple expansion engines are working at a pressure of 180lb. only. This is accounted for by the fact that hitherto it has not been found possible to construct a marine boiler capable of withstanding a higher pressure without either considerably reducing the diameter or increasing the thickness of the shell plates. With respect to the reduction of the diameter, it may be generally known that boilers of the locomotive type have frequently been tried, and many engineers are looking to this class of boiler as offering some advantages in point of weight in comparison to marine boilers, as well as their adaptability for higher pressures. Their performances have, however, not been found satisfactory, and in many instances where large boilers of this type have been in use they have had to be taken out and replaced by the ordinary type of marine boiler.

Two of the principal objections to the locomotive boiler for marine purposes are:—Firstly: That they require the purest of water, as from their construction they are much more difficult to clean and scale than an ordinary marine boiler. Secondly: They are apt to prime, owing to the small diameter and limited steam space, whenever the vessel is rolling and pitching in a seaway. Again, the writer questions very much whether this type of boiler, if required for a certain horse-power, could be made to occupy the same space of boiler room as a marine boiler of the same horse-power.

In a paper read before the Institution of Naval Architects by Mr. W. Parker, March 27th, 1885, he says:—"I have conferred with the principal steel makers in the kingdom on this subject, and am able to say that they agree with me, and are decidedly of opinion that steel shell plates of over an inch in thickness, and having a tenacity of over 30 tons, must contain so much carbon as to render them unsuitable for boiler-making purposes, although they may possess the necessary tenacity and ductility to withstand the usual tensile and cold bending tests." Since this paper was read, the uniform quality of steel plates for boiler making has considerably improved, and they are now able to turn out plates up to 1¼in. and 1⅜in. thick, but this is about the limit. Mr. J. T. Milton also remarks, in a paper read before the same Institution, March 30th, 1882:—"That these pressures of 140lb. and 180lb. are not likely to be increased for some time to come, unless some type of boiler is introduced which will not necessitate the present style of casing for containing the steam and water, nor the present method of internal firing, as with the obtaining pressures the thickness of plates for these portions have reached the maximum capable of being worked on the one hand, and of being used for the transmission of heat on the other." Taking these matters into consideration, it would appear that before higher pressures can be adopted some improved type of boiler is necessary to withstand these higher pressures, which must be so constructed that shell plates of excessive thickness are not required, nor has the diameter of boiler to be reduced.

Having regard to these requirements the writer ventures to introduce to your notice a form of boiler which will bear the strain of these higher pressures without increasing the thickness of shell plates, or reducing the diameter. In the accompanying illustrations Figs. 1 and 2 represent views of a boiler having two shells, which will hereafter be named as "outer" and "inner" shells. The space enclosed between the shells is termed a "jacket," so that the whole may be termed a "jacketed" boiler. The object of providing a double shell is to charge the enclosed space with steam of a lower temperature than that generated within the inner shell, which is thus relieved of the full pressure of steam within, and is only subjected to the excess of the pressure of steam within over the pressure of the steam between the two shells. As for example—in the illustrations we have a boiler with a shell calculated to stand a working pressure of 150lb. to the square inch, employed as the inner shell of a boiler in which steam is generated to a working pressure of 250lb., the extra 100lb. being neutralised or balanced by an external pressure of the same amount exerted by the steam enclosed between the two shells or jacket. As the object of providing a space between the two shells is to provide a means of applying a neutralising or balancing pressure to the inner shell, any fluid or gaseous body may be used, but for many obvious reasons steam is the most convenient for the purpose. It is at once evident that the pressure in the jacket must be constantly and regularly maintained, and in order to provide for this it is necessary to have one or more regulating valves between the two shells. These are constructed on the principle of an ordinary spring-loaded safety valve mounted on valve seats in the inner shell, and so regulated that when the pressure in the jacket falls below that required to be maintained the valve lifts, admitting steam from the boiler until the required pressure is reached, when the valve again closes. The valve in Fig. 3 is loaded to 150lb., and is externally adjustable. This is effected by having a screwed spindle passing through the cover by means of which the spring may be compressed or released as desired. A valve similar to Fig. 3 would be necessary to provide against collapse of inner shell, should the pressure in boiler from any cause be suddenly reduced. Safety valves of ordinary construction would have to be provided for both boiler and jacket. Condensed water would be drawn away from bottom of jacket to feed pumps. Tubes would have to be thicker, but not much more so than those required for 150lb. pressure, as their diameter could be slightly reduced. The same may be said of furnaces. These could be used of a thickness of ⅜in. and diameter of 3ft., and of a thickness of ⅞in. and diameter of 2ft. 6in., of Fox's patent corrugated type. Longitudinal stays would have to be pitched closer together, and of rather larger diameter, but they need not be of less pitch than 14in., which would afford ample room for examination and cleaning inside of boiler. Combustion chamber stays would have to be pitched closer together and of rather larger diameter. Tube plates need not be of any excessive thickness, if more screwed stay-tubes are put in. In fact, there seems to have been plenty of room for adapting the present style of marine boiler to higher pressures in all directions with the exception of the shell, and the writer is of opinion that a double form of shell, as shown in Figs. 1 and 2, would overcome this difficulty. Although a boiler with two shells will naturally weigh more than a boiler with one, yet the extra weight will not be so much as might at first be supposed, for by using steam of higher pressure a boiler of smaller diameter is possible, the weight of water evaporated being less. In this boiler there are two forms of riveted circumferential seams employed—one the ordinary lapped joint double riveted, and the other a flanged joint flanged externally in the case of the "outer" shell and internally in the case of the "inner" shell. The latter form of joint has been suggested in event of any difficulty being experienced in repairing an ordinary lap joint should occasion rise. It has been previously mentioned that this type of boiler is specially adaptable for steam of 250lb. for quadruple expansion engines which are at present only using steam of 180lb. This class of engine is becoming more popular every day, and may in time supersede the present triple expansion, even as the latter has taken the place of compound engines. The writer has not thought it necessary in this paper to go into all the minor details of a new design of boiler, but is anxious to have an expression of opinion from the engineering members of the Institution as to the feasibility of constructing a marine boiler with a double shell to stand much higher pressures than those now in actual use.

* Paper read before the North-East Coast Institution of Engineers and Shipbuilders, by Mr. Charles Bastow Casebourne, on the 16th ult.

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ELECTRIC LIGHTING IN NEW YORK.

(From our New York Correspondent.)

UNDER the protection of the injunction granted by Judge Andrews against the interference with their wires by the Department of Public Works and the Board of Health, the electric light companies of the city used every effort to replace their old conductors with wire having more perfect insulation, in order to comply with the standard of the Board of Electrical Control. Having done this, the machinery was again started up; but all the regulations of the Board had not been complied with. Among others are the requirements that arc lamps shall be suspended at least nine feet above the sidewalk, and that all parts of the lamp with which a person is liable to come in contact shall be insulated. The neglect of these precautions led to the death of Henry Harris, on the night of November 30th. He and a fellow salesman were carrying a show-case from the sidewalk into a shop at 675, Eighth Avenue. The metal case of the frame came in contact with the protruding lower carbon of an arc lamp hanging but 100 inches above the walk. Harris had his left hand on the corner of the case, his left foot was on an iron plate in the walk, a nail in his shoe protruded through the sole inside—the contact was completed, and he was instantly killed. A few days later, lineman Clausen was killed while upon a pole in a similar manner to that of Feeks a few weeks ago.

These later accidents may have influenced the action of the Judges of the General Term, who, on December 13th, overthrew the injunction of Judge Andrews, as Judge Van Brunt said that "Human life is more sacred than the forms of legal procedure." On the following day the Commissioner of Public Works organised gangs of men, who, under the direction of Inspectors from the Board of Electrical Control, proceeded to cut down poles and remove wires wherever it was found that the regulations of the Board had been violated. This destruction of lines has now been going on for a week, and is likely to continue for a month longer. The confusion into which the circuits have been thrown by the reckless work of those who were unfamiliar with the systems, has led to a practical abandonment of arc lighting in the city, and the companies are discharging a portion of their force. The Westinghouse Company, which controls the two leading arc lighting systems in the city, has decided to abandon the direct system of arc lamps, and will introduce a new lamp supplied from transformers, with subterranean high tension conductors. These lamps will require renewals of carbon but once in three days, instead of daily. Meanwhile the streets of the city have been in comparative darkness at night. Fog and rain have prevailed, the holiday trade has added immensely to the local traffic, and the situation has been decidedly unpleasant for the public as well as the companies. The Brush Company had just expended 50,000 dols. for new wire, most of which is ruined, while customers have vainly offered 2 dols., or even 3 dols., per night for lamps for which they had previously paid but 50 cents. The unusual demand for gas lamps has exceeded the immediate supply, and they have been borrowed from neighbouring cities and transferred from unimportant districts.

The newspapers are just learning that although low tension currents may not be fatal to human life they may cause fires, and thus there is a probability that the general scare which has been so carefully nursed will finally react against the very interests which have advocated the suppression by law of high tension currents. As between the loss of life on one hand, and the loss by fire on the other, the electrical interests of the country will suffer tremendously, unless an immediate reform is begun, and every possible precaution taken to prevent these frequent accidents.

TESTS OF A TEN-LIGHT TRANSFORMER.

(From our New York Correspondent.)

PROFESSOR HARRIS J. RYAN, of Cornell University, read a paper, on December 17th, before the American Institute of Electrical Engineers, at New York, on "Transformers," in which a detailed description was given of the methods employed. It was illustrated with diagrams of the apparatus used. The transformer was operated under the same impressed electromotive force from the plant in which it had been supplying incandescent lamps commercially. It was tested with the secondary open, and also closed, through one, five, and ten lamps. The following are the data of the transformer used:—

Number of turns in the primary coil, 675; number of turns in the secondary coil, 35; resistance of the primary, 21·8 ohms; resistance of the secondary, ·04 ohms.

The iron discs of the magnetic circuit were one-half millimetre in thickness, the surfaces merely oxidised, so that no special insulating material was provided between the laminations. The total volume of laminated iron used was 2,050 cubic centimetres. The mean cross-section of the magnetic circuit was 63·3 square centimetres, and the mean length of the magnetic circuit 30·8 centimetres.

	Primary e.m.f.	Current.	Secondary e.m.f.	Mean of Ammeter Readings.
Observed $\sqrt{\text{mean}^2}$ with secondary on open circuit	1,025	·14	51·5	—
With secondary closed through one lamp	1,053	·196	52·3	1·26
With secondary closed through five lamps	1,050	·390	51·0	5·83
With secondary closed through ten lamps	1,040	·631	49·3	10·65

Curves plotted from the observations clearly showed the rate at which energy was given to the transformer, or that the transformer restored to the circuit at all points of a complete alternation for the several conditions under which it was operated. The following are the percentages of the work given to the transformer that is restored to the circuit by it under the foregoing conditions:—Open circuit, 6·8 per cent. One lamp, 3·9 per cent.; five lamps, 0·96 per cent.; ten lamps, 0·36 per cent. The above observations and data were sufficient for the computation of the various losses of energy that take place in the transformer under the several loads and under no load, and the deduction of the corresponding efficiencies as given in the following table:—

	*Secondary e.m.f. (Primary 1,020.)	Primary Watts.	Secondary Watts.	Efficiency per Cent.	Total loss in Watts.	Hysteresis Loss in Watts.	Heating Loss.	
							Primary Watts.	Secondary Watts.
Secondary open	52·3	96·1	0·0	0·0	96·1	95·7	0·4	0·0
One lamp	52·3	159·1	64·3	41·1	94·8	93·9	0·9	0·0
Five lamps.	50·1	388·6	300·9	77·5	87·7	83·1	3·3	1·3
Ten lamps.	47·5	607·9	525·0	86·6	82·9	69·7	8·7	4·5

It is interesting to note that this transformer might be loaded to twice its rated capacity, and the heating of the coils would still be less than that of the iron, although the heat produced by the iron grows less as the load comes on. Likewise that its efficiency would not yet have reached its maximum, and that it would have a value of 92 per cent. It was shown by the curves that the energy wasted by the eddy currents was small.

The assumption made by Mr. Swinburne, in his valuable paper on the "Design of Transformers," appears to have been fully substantiated. Mr. Mordey's experiments, in which hysteresis and Foucault current losses producing a common loss were determined, were performed by cycles of magnetisation produced by rotation in which the degree of magnetisation did not vary in amount, but direction, and cannot be said to throw light on the correctness of Mr. Swinburne's assumption. Commenting on this paper, some have used Mr. Mordey's results as evidence that these assumptions are wrong. By a knowledge of the magnetic properties of the iron with which a given transformer is to be built, and the methods made use of by Mr. Swinburne, its efficiency is something that can be correctly predetermined. The importance of making a transformer produce the same e.m.f. at the terminals of the secondary under all loads asserts itself when it is used for incandescent lighting. In the transformer under consideration the magnetisation produced through the secondary and the magnetisation set up about the primary in its own air space are determined. This leakage of magnetism amounted to about 1·2 per cent. When the transformer worked on full load 4·5 times as much current passed through the primary, and the leakage of the primary in its own space was 4·5 times as much as on open circuit, and became 5·4 per cent. This value, together with the small drop due to the actual resistances of the transformer coils, accounts for the fall of 3·5 volts that was observed by turning on all of the ten lamps. A similar leakage in magnetism takes place in the secondary circuit, producing a self-induction proportional to the secondary current. The rate of change of this quantity is then proportional to the e.m.f. that it produces. This e.m.f. is therefore a quarter of a period behind the secondary current, and results in producing a small lag in primary and secondary currents and secondary e.m.f. One peculiarity of this transformer remains to be explained; that is, the considerable decrease in the loss by hysteresis, as it is loaded down, that is not to be accounted for by rise of temperature or the falling off of the magnetisation due to the increased leakage about the primary in its own air space. Mr. Ryan made the following suggestion as to the reason for this:—Mechanical shock has been shown to greatly reduce loss by hysteresis when iron is passed through cycles of magnetisation. Since the currents are at all times opposite each other in the two coils of a transformer, strong repulsion occurs when these currents are at a maximum, and no force is exerted when they pass through zero. So it follows that they continually keep thrusting each other apart when at work, and add to the disturbance of the laminated iron that already exists on account of its changing magnetisation. This increasing of the mechanical vibration of the iron may, therefore, account for the above-mentioned phenomenon. On open circuit the maximum magnetisation of the iron per square centimetre was 3,850 c.g.s.; loss by hysteresis per cycle per cubic centimetre, neglecting Foucault currents, ·046 Joule at 138 per second, coercive force per centimetre of the iron 2·76 c.g.s. The conclusion of Mr. Ryan was that the data given show clearly the advisability of providing some practical means for breaking the primary circuit of the transformer when not in use, as insisted upon by Mr. Swinburne. The paper was discussed at length by Messrs. Kennelly, Tesla, Mailloux, Stillwell, Professor Geyer, and others.

* The values given in this column have not been corrected for the two lamps in series with the primary for the first three conditions, and the one lamp that was used for the last. With ten lamps, where one lamp was used in the primary, this correction amounts to an increase of the secondary e.m.f. of 3 per cent. On open circuit and one lamp it is negligeable, and 3 per cent. increase for five lamps. When this correction is applied, the drop of 3·5 volts obtained is what was observed by direct measurement on the secondary.

CELLULOSE AND ITS CONSTITUTION.

MESSRS. CROSS AND BEVAN have recently shown that the principal constituent of the jute fibre substance is a complex molecule, which yields, under different methods of attack, marcogallol, furfural, and acetic acid, thereby proving that the compound is one containing closed chains or rings of carbon atoms, and that its oxygen is of an aldehydic or ketonic nature. They have also further shown that the more inert cellulose, which constitutes the framework of the jute fibre cells as of other plant cells, is capable of forming, by the action of acetic anhydride in the presence of zinc chloride, an "acetate," which seems to be the penta-derivative, whence it appears that all the oxygen of cellulose behaves as hydroxyl oxygen, and that its molecule contains neither aldehydic nor ketonic oxygen. Hitherto the tri-acetate and tri-nitrate were the highest substitution products known. It is certain that this view of its constitution is conformable with the deductions to be drawn from the industrial aspects of the chemistry of cellulose, as shown by the sulphurous acid and bisulphite methods of isolating it, and the methods of the dyer and printer, which depend upon its weak combining affinities. The same authors have also published the results of their researches into the nature of the constituents of flax undertaken in connection with the introduction of a new system of linen bleaching into the Belfast district. The flax fibre contains in its commercial forms a large percentage (3–4) of constituents soluble in alcohol, which are associated with chlorophyll residues, and are separable into two main groups—(a) a resin wax containing the ceryl ether of cerotic acid; and (b) an oil wax which resolves into oily ketones. These constituents are obviously derived from the cuticular tissues of the plant, and play an important part in the wet spinning process peculiar to this fibre, the temperature of the water through which the roving passes preparatory to the drawing and twisting being such as to bring them into complete fusion. The removal of these wax constituents in the process of linen bleaching is the main source of the difficulties and complications of the process. These compounds are characterised by reducing a boiling neutral solution of silver nitrate, whereas pure flax cellulose does not affect this reagent. The non-cellulose constituent of the fibre substance—*i.e.*, the cast cell, free from cuticular and wood residues—yields pectic acids by alkaline hydrolysis and mucic acid on oxidation with nitric acid.

It is also interesting to note, in connection with the history of cellulose, that during the past year works have been established at Hartlepool for the manufacture of wood pulp by the sulphite process. This is practically a new industry in England, and it is proposed to import wood from Scandinavia and Russia for treatment in this country, and subsequent conversion into paper, instead of, as heretofore, allowing this industry to be a monopoly of the wood-growing countries.

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Notes.

PATENT ABSTRACTS.

EVERYONE who wishes to keep his knowledge of electrical inventions up to date reads the *Electrical World* and the *Centralblatt für Elektrotechnik*. Some people cut out abstracts of any patents that seem good, and mount them under their subjects in a scrap book. May we suggest that the *Electrical World* would make it easier for its readers if it placed each illustration with its abstract, instead of one or two columns away from it?

THE EDINBURGH EXHIBITION.

WE hear that the French Government has recognised this Exhibition, and other countries will very likely do so too. Foreign exhibitors may apply for space till the 1st of February. For this country the date given is the 15th inst. The cost of buildings and grounds will be covered by the proceeds of refreshment contracts and concessions, so that the proceeds of admission go to cover working expenses. The Exhibition of 1886 began with £20,000 to the bad; that of 1890 looks very much more promising.

A UNIPOLAR DYNAMO.

OUR esteemed contemporary, *La Lumière Electrique*, describes a unipolar machine which gives enough electromotive force for incandescent lighting. From the description, we should have said offhand that the fallacy is obvious, and the machine would not work; but the output of an actual machine is given. The only thing to do is to apply David Hume's treatment for alleged miracles. Is it easier to believe the unipolar machine works, or that *La Lumière Electrique* is in this instance misinformed?

PRESENTATION TO MR. THOMAS PARKER.

ON the 21st ult., those employed by Messrs. Elwell-Parker & Co., or rather by the Electrical Construction Company, at Wolverhampton, presented Mr. T. Parker with a tea service and an illuminated address, as a token of their esteem. Few could be more deserving of the appreciation of his men than Mr. Parker. He is noted, not only for his extraordinary energy and "go," but for his carefully balanced knowledge of practical electrical engineering and business management. There seems to be much more kindly feeling between masters and men in the electric light trade than in others. This may be partly due to novelty, which leaves room for enthusiasm, but is also due to the masters themselves.

PROPOSED BRIDGE ACROSS THE BOSPHORUS.

THE most recent proposal for a huge bridge is for one across the Bosphorus, a project for which has been made out by a French engineering company. The historic and picturesque channel between the shores of Europe and Asia, which connects the sea of Marmora with the Euxine, is 872 yards broad, and it is proposed that the bridge to span it should be of one arch only. In these days of huge bridges this should not offer very serious difficulties from an engineering point of view, if the financial ones can be got over. Various projects have been put forward to the same effect during the past twenty years, but it was not considered that the bridge would be useful enough to justify the enormous expense which it would entail. Railways have, however, developed very much during recent years, and it is now thought that, if constructed, it would act as a link in the local railway system, and eventually pay a fair return on the money invested in it.

GLASGOW UNIVERSITY AND THE TECHNICAL COLLEGE.

AN important step has been taken towards making a closer connection between the University of Glasgow and the Glasgow and West of Scotland Technical College than has hitherto existed. The Senate of the University has resolved that the possession of a diploma of the Glasgow and West of Scotland Technical College shall be reckoned to the holder as equivalent to the first two years at the University for the degree of B.Sc. As this degree can be taken after three years' attendance at the University, it follows that those who hold the diploma of the Technical College may proceed to after one year's attendance at the University The diploma of the Technical College can be obtained by attending the day classes for three years, or completing the evening class course (which can be done during apprenticeship) and then taking one year at the day classes, so that, with a comparatively small exertion, those who wish to proceed to a degree will be able to do so. There are now four grades of study and examination. That for the junior certificate may be taken by all ordinary apprentices, while the senior certificate course may be taken by those who have had better opportunities or have greater abilities, and thus the diploma and the degree courses will allow some of the best students to pursue their studies as far as they please. The higher as well as the lower grades of those required in industrial works are thus provided for, and we consider that the former is even more important than the latter, for, as we have often pointed out, the men who will in the future create new industries or revolutionise old ones will be men who have received the most thorough training in the principles of science and in their applications to practical work.

THE COTTON TRADE.

THE following results of the quarterly stocktakings of joint-stock companies have just been announced, viz.:—

Mills.	Spindles.		Profit.
Albert	23,810	...	£578
Duke	70,380	...	1,360
Hathershaw	77,400	...	468
Ivy	34,600	...	437
Parkside	48,700	...	1,160
Royton	67,600	...	1,260
New Earth	44,000	...	470
Hope	66,700	...	900
Ridgefield	69,000	...	879
Hollinwood	75,000	...	1,052
Equitable	78,700	...	1,000
Stanley	48,400	...	104
Lees Union	63,000	...	250
Dowry	66,760	...	1,248
Rochdale	70,600	...	1,001
Staleybridge	75,400	...	1,245
Lees Brook	85,900	...	1,020

THE ACTION OF WATER ON WOOD AT HIGH TEMPERATURES.

TAUSS, in *Dingler's Journal*, has described some interesting experiments on the action of water on cellulose and wood at high temperatures. Cellulose, when boiled with water at ordinary pressures, yields traces of a sugar which reduces Fehling's solution and gives a red colour with phloroglucol. Pine wood behaves similarly, but gives a smaller quantity of sugar. Under 5 atmospheres pressure, cellulose, beech, and pine wood all give indications of the formation of sugar; and phloroglucol and hydrochloric acid give a violet coloration with the exhaust of the last two. Under 10 atmospheres phloroglucol gives the dextrose reaction distinctly with the cellulose extract, and beech and pine wood react similarly to the extract obtained at 5 atmospheres pressure. Under 20 atmospheres cellulose is completely changed into a jelly, which dries to a powder, and which appears to be a hydrocellulose $C_{12}H_{22}O_{11}$, burning red on the addition of phloroglucol. No vanillin was formed in any of experiments.

SAFETY APPARATUS FOR TRANSFORMERS.

MR. DRAKE has recently written to the *Standard* to point out that customers can be protected from danger by electrostatic cut-outs in the houses. Is it not very much safer to earth the middle of the secondary? It is better to remove a danger completely than to put some automatic arrangement to prevent its coming. Any automatic cut-out should be at the central station, where it can be looked after. Besides, the average customer already has a transformer, a pair of fuses, a meter, and probably a switch in his basement. He scarcely requires to have an extensive installation in his lower regions. Major Cardew's apparatus is not only very simple and ingenious, but it does not require an earth contact on its own account, which is a great advantage, but it is doubtful whether it is efficient. If it does not burn out both fuses, for instance, it is useless. Again, suppose an installation in perfect order. The primary electromotive force is 2,000 volts. If the installation is equally good on both sides, each main varies between + 1,100 and − 1,100 volts, the average potential of the system being zero. The average potential of all the secondaries will also be zero. Suppose some of the secondaries become earthed at one point each. There is nothing to show this, so no notice is taken of it. Suppose in one of these cases one primary lead now begins to leak to the secondary. That cut-out does not act, as the secondary is already earthed. If one of the other insulated transformers is cut off from its lamps, or if its lamp circuit has very little capacity, its cut-out may go, though there is nothing wrong there, for the potential of the primary system now varies from 0 to 2,200 volts, and will tend to bring the transformer secondary to 1,100 volts above the potential of the earth, and this will operate the cut-out. Moreover, if two or more houses have their secondaries partially earthed, and the different primary wires leaking to the secondaries, it depends on the resistances of the leaks whether a fire is caused or whether a cut-out goes. An automatic cut-out at the station also saves the main leads. If the primary system is earthed at the middle the maximum stress on the leads is 1,100 volts. If not, a minute leak on one side keeps the other lead under a stress of 2,200 volts. The same reasoning applies to earthing the secondary in the middle.

AN EXHIBITION AT JAMAICA.

THERE will be opened early in 1891, at Kingston, Jamaica, an Exhibition of island products and manufactures, and exhibits of machinery, &c., from Great Britain and elsewhere. The arrangements are being carried out by a commission, of which the Governor is the head, and a committee has been formed in London to co-operate with them. The chairman of the latter is Mr. C. Washington Eves, 1, Fen Court, E.C. No rent is payable by exhibitors, and no duties will be levied on goods not intended for sale. The attention of merchants and manufacturers in the United Kingdom is specially invited, and, as it is desired to show the advance of science in manufacturing tropical products, engineering firms are requested to give their aid by exhibiting plans, drawings, models, and specimens of actual machinery connected with such manufactures. As there is little doubt that one of the causes of complaints from the West Indies as to the unremunerative nature of sugar planting is due to the fact that in many cases the sugar making machinery is of an obsolete type, the opportunity may prove favourable for engineers in this line of business to find a market for their wares.

THE RECENT FLOODS IN JAPAN.

THE full accounts of the recent floods in Japan show some of the difficulties of carrying on engineering works in that country, especially those connected with roads and bridges, railways and telegraphs. Between April and September the country was visited by a succession of storms and floods almost without intermission. In Yezo many houses and cattle were destroyed, and other parts of the country were inundated, during the latter half of April. In June, frightful rainstorms took place along the west coast, and the rivers filled, while a strong westerly wind forced the sea up their mouths, so that the water spread all over the country and crops were ruined and houses destroyed to a very great extent. In July, in the island of Kiushiu, the Chikugo river overflowed its banks and wrought havoc in the Oita prefecture, about 4,000 acres of cultivated land being devastated, over twenty miles of embankments swept away; roads were rendered impassible, and business had to be suspended everywhere. In August, however, the floods were worse than all the others put together, and especially in South-Eastern Japan the calamity was great and widespread. In Kiushiu the Chikugo river again flooded a huge tract of country, the water rising 28½ft. above its usual level, and this it did twice in succession in three weeks. Thirty-three thousand three hundred and seventy-two houses were submerged, 2,741 bridges were swept away, 130 miles of embankment destroyed, and 73,694 persons were thrown on the world without adequate sustenance. In the south-eastern part of the main island 1,247 persons were killed or drowned. In September a terrible gale swept over Northern Japan, and the sea was forced over the embankments in various places along the coast and covered the surrounding country. The totals of the official returns, so far as they have been given in, are:—12 prefectures devastated, 2,419 persons killed, 155 wounded, over 90,000 deprived of the means of subsistence, over 50,000 houses swept away or submerged, 150,000 acres of crops destroyed, about 6,000 bridges washed away, and hundreds of miles of roads broken up. For thirty years no such calamity, or succession of calamities, has overtaken Japan.

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Patent Record.

(*Compiled from "The Illustrated Official Journal (Patents)."*)

APPLICATIONS FOR PATENTS.

(*The names in italics within parentheses are those of Communicators of Inventions.*)

ENGINEERING.

16th December, 1889.

20178. Carette & Platt..... Pulleys for cable-driving.
20180 Nenninger, R. F. ..... Smelting furnace.
20185. Rhodes & Lee ..... Friction brake.
20190. Britton, W. ..... Cutting machinery.
20191. Stubley, C. H..... Bolting machines.
20192. Hedderwick, P. ..... Collapsible boats.
20196. Barber, W. ..... Boot-making machine.
20198. Pocock & Johnson ..... Discharge and measurement of liquids.
20205. Jackson, W. ..... Sewing machines.
20215. Baillie, R. A. ..... Upsetting ends of metal bars.
20216. Resch & Grand ..... Sounding apparatus.
20220. Tower, B..... Maintaining a constant plane in a floating vessel.
20222. Trocmé, A. L. J..... Pile fabric looms.
20223. Taussig, E. ..... Casting.
20227. Lake, H. H. ..... Projectiles (*Wood*).
20229. Aunay, V. M. H..... Looms.
20230. Noble & Murray ..... Recoil presses.

17th December, 1889.

20245. Ireland, J. ..... Securing rails.
20249. Crist & Covert ..... Gas engines.
20252. Whiteley, B. ..... Ordnance and projectiles.
20256. Conlong & Horsfall... Looms.
20261. Gutensohn, A..... Annealing metal plates.
20265. List & Dick ..... Screw propellers.
20267. Berry & Gilbert ..... Steam pumps.
20271. Venables & Jones ..... Washing machines.
20272. Lake, H. H. ..... Railway wheels (*Cramer, Lindermuth, & Danstedter*).
20277. Melling, J. ..... Propelling tramcars.
20280. Cropper, Cropper, & Birks ..... Twist lace machinery.
20283. Browne, N. ..... Valves (*Vater*).
20287. Hansell, R. B..... Manufacture of springs.
20291. Schmidt, C. ..... Washing machines.
20293. Imray, H. ..... Breechloading firearm (*Sneider*).
20294. Imray, O. ..... Metallic fireproof structures (*Kensett*).
20297. Wise, W. L. ..... Quick-firing guns (*Von Skoda*).
20299. Liebing, B. ..... Rotating engine.
20300. Ricker, J. H..... Steam generators.
20305. Lake, H. H. ..... Separating machines (*Holt*).
20306. Amstetter, C. ..... Rotary motors.
20308. Boult, A. J. ..... Sewing machines (*Von Pittler*).
20310. Boult, A. J. ..... Steam engines (*Stanwood*).
20320. Neave, W. A. ..... Machine for grading wheat.

18th December, 1889.

20321. Green, E. C..... Revolvers.
20325. Clegg, J. ..... Mules.
20327. Ingham & Ingham ..... Looms.
20330. Barnes, H..... Warp beaming machines.
20333. Lewinsohn, H..... Printing machines.
20340. Irvine, J. D'A..... Projectiles.
20342. Wright & Gillott..... Flooring for bridges.
20343. Spiers, J. ..... Welding tubes.
20346. Matthews, A. ..... Coupling for railway carriages.
20353. Meldrum & Meldrum Furnaces.
20355. Stensland, C. ..... Regulating speed of propellers.
20361. Paul, A..... Railway brake.
20365. Duesberg-Bosson, H.... Carding textile materials.
20368. Wise, W. L. ..... Coke ovens (*Semet*).
20375. Kitt, A. ..... Apparatus for transferring coal.
20376. Cutlan, J..... Sewing machine.
20380. Bott, J. E..... Compound armour plates.
20386. Pilard, A. J..... Spinning wool.
20389. Kenoyer, B. ..... Propelling boats.
20395. Brady, Powers, Quinn, & Maher..... Casting ingots.
20398. Cawston & Scott ..... Screw propellers.
20405. Liardet, J. E. ..... Utilising tidal power.

19th December, 1889.

20415. Avery, W. B. ..... Weighing apparatus.
20416. Critchley & Lancaster Looms.
20422. Walton, W..... Grinding card clothing.
20423. Walton, W..... Wiredrawers' benches.
20425. Drury, R. F..... Animal clipping machines.
20430. Harris, H..... Machine for manufacturing ropes.
20435. Watson, T. ..... Spinning frames.
20439. Edward, G. ..... Punching and shearing machines.
20441. Sivewright, G. W..... Anchors.
20442. Betham & Woolnough Disengaging ships' boats.
20443. Wallis, A. H. ..... Compound engines.
20444. Wells, C. ..... Furnaces.
20445. Smith, J. W..... Washing machinery (*Robbie*).
20453. Boult, A. J. ..... Magazine firearms (*Luigi & Peraldi*).
20455. Decollogne, E. ..... Automatic distributors.
20456. Bracher, P. H..... Screening apparatus.
20459. Barnes, D. L. ..... Railway car frames. (21st May, 1889.)

20th December, 1889.

20462. Fletcher, J. M. ..... Projectile.
20467. Tattersall, W. ..... Air propellers.
20470. Campbell, J..... Drying kilns.
20475. Dougill, J. ..... Gas engines.
20476. Dunlop, M. ..... Stuffing boxes.
20477. Wilkinson, R. ..... Looms.
20482. Atkinson, J..... Heat engines.
20498. Grant, T. B..... Steam boilers.
20500. Blackburn & Davenport ..... Coupling waggons.
20507. Matthews & Laidman Framing and plating ships.
20512. Clark, A. M..... Throttle valves (*Barclay*).
20514. Davies, E. ..... Projectiles.
20519. Geiersbach, F..... Automatic brakes.
20522. Brasseur, V. ..... Valve gear.
20525. Clay, C. ..... Horse rakes.

21st December, 1889.

20527. Sharp, J. W..... Machinery for manufacture of boots.
20529. Gallon & Chapman ... Hydraulic valves.
20530. Tervet & Reid..... Filter presses.
20537. Clarke & Clarke ..... Glove machinery.
20540. Warren, F. P..... Internal casing of iron ships.
20543. England & Hughes ... Milling machines.
20545. Robson, J. M. ..... Stuffing boxes.
20549. Garstang & Bancroft Warping machines.
20550. Newall, G. W. ..... Valves for engines.
20551. West, J..... Machinery for charging gas retorts.
20566. Wallis & Longden ... Lace machines.
20567. Wakefield, C. C. ..... Sight feed lubricators. (10th September, 1889.)
20570. Fisher & Russell ..... Level crossing gates of railways.
20576. MacIlwraith, W. ..... Open shed jacquard.
20579. Crow, S..... Wringing machinery.
20581. Barre, C. A. A. ..... Sliding railways operated by hydraulic propulsion.
20585. Tafel, P. A..... Bolting apparatus.
20586. Darby, J. H..... Manufacture of steel.
20592. Horn, W. W. ..... Chain propeller for ships (*French*).

ELECTRICITY.

16th December, 1889.

20186. Wilson, H. W..... Measuring currents.
20210. Hobson, J..... Separating particles of iron.
20217. Marx, F..... Metallic electrodes.
20218. Morison, D. B..... Telephone transmitters.
20235. Correns, E. ..... Accumulators.
20236. Horn, W. W. ..... Electric igniting device (*Carranza, Tinoco, & Altozano*).

17th December, 1889.

20244. Holmes, J. H. ..... Electric lighting of trains.
20260-1. Stitzel, Weinedel, Reutlinger, Schwartz, Egelhoff, & Krieger, Sen. Electric semaphores.
20266. Lake, H. H. ..... Electric spark-rupturing appliances (*Thomson*).
20288. Tatham & Tatham..... Conduits.
20302. Lovegrove & Pechin... Electric alarms.
20311. Thompson, W. P..... Lightning arresters (*Westinghouse Electric Company*).
20318. Reckenzaun, A. ..... Electric clocks.

18th December, 1889.

20326. Kapp, G..... Dynamo-electric machines.
20387. Andrews, J. D. F. ..... Electric switch.
20391. Gisborne, C. A. ..... Multiplex telegraphy (*Keeley*).
20393. Jenkin, C. F..... Lighting trains by electricity.
20400. Murday, T. J. ..... Obtaining a record of the movements of indicators by means of electricity.

19th December, 1889.

20451. Hedges, K. W..... Electric safety plugs.

20th December, 1889.

20486. Pritchett & Low ..... Distributing electricity.
20516. Philippart, G..... Secondary batteries.

21st December, 1889.

20538. Soll, J. H. F. ..... Rotary engine and dynamo.
20582. Einstein & Kornprobst Electric meters.

CHEMISTRY.

16th December, 1889.

20174. Robins & Shakespeare Gas retorts.
20181. Young, T. ..... Treating ores.
20214. Pearson & Pratt ..... Alloys of aluminium.
20219. Imray, J. ..... Colouring matters (*Société Anonyme des Matières Colorantes et produits Chimiques de St. Denis*).
20237. Rödiger, W. ..... Soap.

17th December, 1889.

20292. Imray, J. ..... Colouring matters (*Société Anonyme des Matières Colorantes et produits Chimiques de St. Denis*).
20301. Cowan, J. ..... Indigo printing.
20313. Thompson, W. P. ..... Separating gold dust (*Brown*).

18th December, 1889.

20392. Kendall, J. A..... Hypophosphites.
20403. Hutchings & Hutchings Extracting tannin.

19th December, 1889.

20432. Gray & Bromhead ..... Coal gas.
20434. Hoff & Frommel..... Rectifying spirits.

20th December, 1889.

20497. Imray, O. ..... Non-plumbiferous lakes (*Farbwerke vormals Meister, Lucius, & Brüning*).

21st December, 1889.

20587. Lysaght, J. ..... Galvanising apparatus.

MISCELLANEOUS.

16th December, 1889.

20193. Sykes & Sykes..... Spindle bearings.
20194. Danks, A. T. ..... Gas meters.

17th December, 1889.

20257. Jacques, W. W..... Phonographs.
20263. Jay, R. C. ..... Waterproofing iron plates.
20307. Lorrain, J. G. ..... Ventilating.

18th December, 1889.

20323. Meredith, J..... Fire escape.
20339. Gorton, T. W. ..... Loom shuttles.
20341. Latham, H. ..... Fire escape.
20378. Preece, T..... Packing for pistons, &c.
20381. Summerskill, C. W. ... Fire alarm.

19th December, 1889.

20421. Lynde, J. H..... Automatic sprinklers.
20429. Smith & Maynard ..... Fire escapes.
20433. Holmes, P. H. ..... Lubricating.
20447. Engert, A. C. ..... Mechanical telephones.
20450. Adams & Say ..... Fog signalling.
20452. Hayes, G. ..... Metallic lathing.

20th December, 1889.

20506. Sax & Donohoe ..... Fire alarm.
20510. Shapland, R. A. ..... Timber drying.

21st December, 1889.

20544. Hibbert & Hibbert ... Shuttles.
20561. Sheppard, W. A. ..... Washing and refining substances.
20568. White, J. W. ..... Lock nuts.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form, of such opposition.

Year 1888.

16559. Allin.
17048. Parkin.
18244. Martyn.
18304. Brooks.
18496. Munro.
18741. Goodridge.
18781. Lake (*Douds*).
18902. Grimes.
18924. Murphy.
16852. Goolden, Atkinson, & Gold.
18276. Barron.
18461. Sowter.
18709. Edwards (*Standaert Brothers*).
18812. Yorke.
18915. Good.
18973. Frampton & Dumper.

1889.

50. Claus.
301. Bawden.
499. Danchell.
620. Smith.
716. Bingham.
814. Edmondson.
1325. Godfrey.
1439. Turner.
1471. Ancill.
1538. Keizer & Keighley.
1567. Greener.
1631. Lancaster.
1791. Archbutt & Deeley.
1814. Popplewell (*Schroeder*).
1940. Guthrie.
2003. Shepard.
2160. Mond.
2205. Lancaster.
2312. Lawrence.
2464. Bird.
2553. Mewburn (*Von Szabel*).
2575. Mond.
2631. Michaud.
2668. Walker & Carver.
2692. Poole & McDonald.
2708. Turner & Asbury.
2714. Knowles.
2718. Ponton, Moseley, & Chambers.
2741. Newman.
2749. Joberns.
2760. Hartley.
2776. Thorne.
2796. Darby.
2802. Scott.
2816. Camm.
2818. Roadhouse.
2825. Corsham.
2837. Baron of Bechtolsheim.
2866. Reisert.
2873. Oliver.
2883. Harries & Dougall.
2889. McQueen.
2929. Peberdy, Earp, & Parr.
2937. Robinson, Robinson, & Robinson.
2959. Cane.
234. Illidge.
480. Gare.
515. Day & Green.
654. Hughes & Chapman.
776. Boothroyd & Renouf.
1321. Borland.
1420. King.
1445. Kinsella.
1490. Hutton & Sorley.
1543. Lancaster.
1588. Rowland & Moor.
1757. Mason.
1806. Mowll.
1862. Curtis & Carey.
1955. Wells.
2043. Hackett & Kempe.
2202. Jucker.
2306. Ballardie.
2345. Ellington.
2485. Bower.
2572. Kent.
2629. Adams.
2666. Booth.
2689. Craven.
2701. Kelly.
2710. Wilder, Wilder, & Wilder.
2734. Dawson.
2735. Blackburn.
2742. Wagg & Hudson.
2757. Dewrance (*Pratt*).
2772. Kent & Price.
2786. Muspratt & Eschellmann.
2811. Dorman.
2817. Laycock.
2823. Goodall (*De Connick*).
2835. Edge.
2855. Sainsbury.
2865. Lion, Lion, & Cutlan.
2872. Booth.
2877. Sellers.
2886. Nolan.
2917. Tynan.
2933. Thompson (*Kellogg*).
2946. Lake (*Morhard*).
2955. Amaron.
2984. Ingham.

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2993. Mathieson, Mathieson, Mathieson, & Turnbull.
3044. Smith & Pearson.
3072. MacArthur.
3083. Dunnett.
3102. Furnival, Tudor, & Byway.
3125. Mather.
3146. Hamblet.
3185. Miller & Finlayson.
3190. Dickison & Brodie.
3235. Bourne.
3244. Rogers.
3255. Taylor & Dawson.
3340. Lavender.
3525. Pinkney.
3812. Munro.
4312. Burroughes.
4676. Shaw.
4825. Imray (*La Société Anonyme des Matières Colorantes et produits Chimiques de St. Denis, Poirrier, & Rosenstiehl*).
5564. Thompson (*La Société Générale de Maltose*).
7109. Rammage.
7529. Smith.
8059. Leigh (*Carpenter*).
9175. Chambers.
9287. Aiken.
9466. Appletree.
10857. Moncrieff.
11488. Mills.
12005. Lilwall.
12136. Von Schmidt.
12270. Peddie.
12276. Brown
13404. Humphries.
13761. Wach.
14005. Brown.
14879. Lake (*Keyes*).
15182. Willis.
15190. Rohrbeck.
15711. Kendal & Laval.
16209. Boult (*Heinrich*).
16342. Simpson.
17069. Speed.
17103. Van Valkenburg.
17278. De Bournonville.
17376. Anderson.
17559. Adams.
17624. Bangs.
17691. Kerry & Kerry.
17765. Haddan (*Williams*).
17766. Taylor & Povey. (25th May, 1889.)
17965. Ellis.
18031. Thompson.
18072. Krasky & Kuepfer.
18114. Macmeikan.
18144. Ryland.
18186. Cheesbrough (*Felton*).
18322. Cumming.
18347. Thompson (*Braun & Sons*).
18425. Howard.
18437. Lasar.
18440. Lasar.
18165. Lake (*Tripp*).
18488. Shedlock.
18496. Lake (*Wiman*).
18503. Johnson.
18513. Fell (*Lott*).
18585. Samuels.
18631. Humphries.
18652. Edwards (*Georgi & Bartsch*).
2996. Brownhill & Benfield.
3007. Inskip.
3071. MacArthur.
3082. Hall.
3096. Webster.
3123. Lorenz.
3124. Appleby.
3135. Nunan.
3152. Rouse & Rouse.
3187. Justice (*Gibson*).
3220. Henson.
3239. Grime & Atkinson.
3248. Johnson.
3292. Lorenz.
3351. Mewburn (*Nacke*).
3585. Thomson.
4087. Lane.
4430. Whiting.
4702. Bower.
5032. Imray (*La Société Anonyme des Matières Colorantes et produits Chimiques de St. Denis*).
5101. Stokes.
6090. Briggs.
6329. Adair (*Adair & Cruikshank*).
7539. Ellis.
8583. Parsons.
9196. Lake (*Chapin*).
9438. Wittmann.
10569. Diesseldorff.
11418. Barnes.
11795. Leigh (*Williams*).
12051. Thompson (*The Ranken & McDonald Spinning Company*).
12482. Gresty.
13433. Eade.
13781. Hille.
14294. Leigh (*Williams*).
14991. Blathy.
15189. Konka.
15539. Alzugaray.
15925. Porter.
16244. Miller & Troy.
16486. Coze.
17085. Blanchard.
17199. Mersing.
17362. Ratcliff & Garvey.
17506. Kuhl (4th April, 1889.)
17573. Smart.
17641. Thompson (*Killing*).
17708. Dalbeyer & Beauchamp.
17842. Chapman & Ingram.
17942. Wale & Wale.
18016. Haddan (*Favre*).
18052. Blackburn.
18090. Appletree.
18121. Edwards, Keizer, Keighley, & Wright
18293. Webster. (22nd April, 1889.)
18365. Entz & Phillips.
18419. Schilling.
18430. Jensen (*Krag & Jörgensen*).
18462. Beatty.
18486. Stone.
18495. Wilcox.
18502. Fales.
18507. De Nottbeck.
18582. Hagelberg.
18592. Johnson (*Genevois*).
18635. Bennett & Simson.
18655. Fiedler.
18671. Gösser.
18674. Reed (*Abadie*).

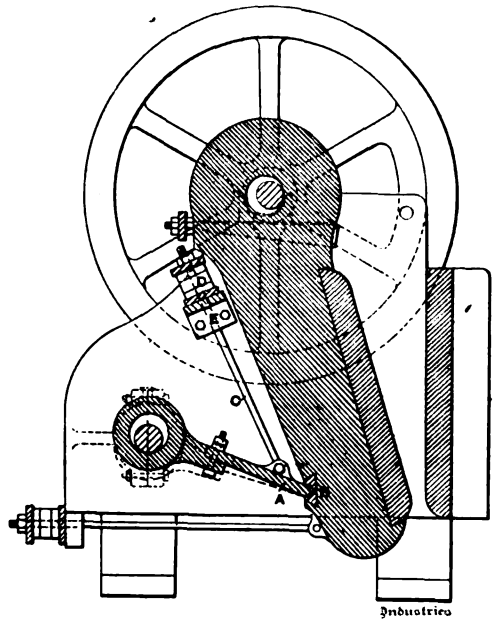
ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

Looms.—*I. Hillas, Morley, Yorkshire.*—The object of this invention is to save the wear and tear of neck bands in double lift harness, and to use one only where hitherto two have been employed. Use is made of a sliding metallic double loop or union, through which pass the two upright or vertical wires or rods connected to the lifting motion of the dobby. A hook or link is preferably attached to the centre of each double loop. This hook carries one neck band, which as usual carries the leashes or heads attached to the healds. When the dobby lifts one of the vertical wires the loop slides up the other and takes the neck band with it. Claims: (1) Connecting the two upright or vertical wires in any manner so that half the number of neck bands are dispensed with; (2) the combination of the vertical wires and double loop with or without the link.—No. 8326. May 20th, 1889. 6*d*.

Slide Valves.—*W. J. Thompson, Liverpool. (H. D. Haverkamp, Derember, Holland).*—The slide valve is constructed so as to reduce the "port clearances" of the engine cylinder. The port surfaces are step-like in form. The part surrounding the exhaust ports is raised to permit the coring out of the exhaust passage as usual. The inlet ports are reduced at each end so as to make the "port clearance" as small as possible. Two slides are employed, one at each end of the cylinder, and they are connected to one rod, which is worked in the usual manner. Each valve has two working faces, one for the inlet port and the other for the exhaust. Claim: A slide valve for steam engines, in which the face or faces adapted to control the admission of steam are placed in a different plane from those adapted to control the exhaust.—No. 16666. October 22nd, 1889. 6*d*.

Stone Breaking Machinery.—*A. Hill, Leicester.*—This invention relates to stone breakers, in which the motion of the jaw is obtained direct from the eccentric shaft. The weight of the jaw upon the eccentric shaft causes undue friction and wear, which is here obviated by the following means. On the front of the rocking lever is fixed a nose piece A, which enters a recess



B in the swing jaw. To the nose piece A is attached the rod C, which is pulled upwards by the springs D upon the support E. By this means a self-lifting motion is given to the swinging jaw. Claim: The self-lifting motion to the stock or swing jaw, by the novel mode of coupling the toggles—nose piece, or rocking lever—to the top of frame or brackets in the manner mentioned.—No. 666. January 14th, 1889. 6*d*.

Covers for Drain Openings, &c.—*J. Jones, London.*—An improved form of cover is here described for man-holes and similar openings of drains to prevent the passage of vapours from them. The frame of the man-hole is constructed with a small channel round the inner side of its lower edge. Into this channel the edge of a dome-shaped plate rests, the dome-shaped plate being either separate or connected to the under part of the flat surface plate. As the vapour rises from the drain it comes into contact with the cold surface of the dome plate and condenses, running down its sloping sides to the channel, and ultimately forming a water seal. Claims: (1) In a man-hole, or similar cover, the utilisation of the liquid formed by condensation on the man-hole cover for automatically making a gas-tight seal around its edges; (2) in a man-hole, or similar cover, the combination with a frame provided a channel of a domed or similar plate, the edges of which rest in or enter the said channel for the purpose described,—No. 16455. October 18th, 1889. 6*d*.

Wool-combing Machines.—*D. P. Norris, Methuen, U.S.A.*—The improvements are made in combing machines of the Noble class. The large and small circular combs and carrying aprons are combined with guides, which take the sliver from the aprons and deliver them directly to the delivery tube. The delivery tube is shaped to compress the sliver and deliver it clear of the

FIG. 1.

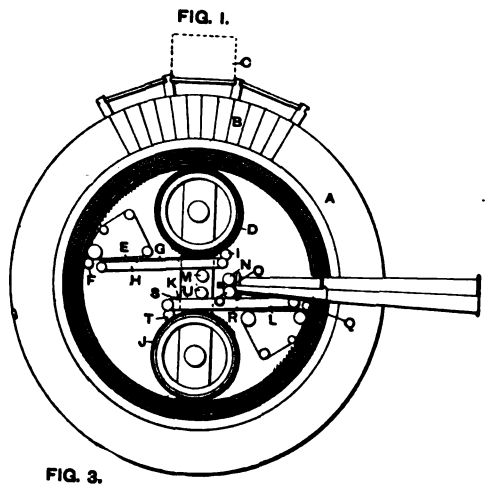
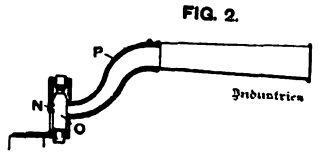


FIG. 3.



FIG. 2.



machine. In the drawings Fig. 1 is a plan of a portion of a wool-combing machine, showing part of the delivery tube in section. Fig. 2 is a vertical section upon the side elevation of the delivery tube and co-operating devices. A is the arge circular combs; J, D the smaller ones; E and L are endless aprons, which take the sliver off the large comb; I T are the rolls for taking the sliver off the small combs. The sliver is taken off the large comb and conveyed by the aprons H S to the points where the sliver is taken off the small combs; here it combines, and is carried forward by the rolls M U. The sliver from the two different sets of aprons unite upon the roller U, and are then passed into the bite of the calender rolls O N, Fig. 2, which compress and feed them to the delivery tube. The delivery tube is bent to carry the fibre clear of the machine and slightly compress it before delivery. Claims: (1) The combination of the large and small combs and drawing off rolls and aprons of a wool-combing machine, with a single delivery tube, having its receiving ends substantially at the level of the aprons, and guides, by which the fibre from the aprons taken from all the combs is directed without twist into the said tube, substantially as described; (2) the combination of the large and small combs and drawing off rolls and aprons of a wool-combing machine, with a single stationary guide tube, into which the united fibre from both aprons is carried, and calender rolls and a delivery tube having its mouth opposite the said guide tube, into which delivery tube the sliver is carried from the guide tube by the calender rolls, substantially as described; (3) the combination of the large and small combs and drawing off rolls and aprons with a single delivery tube that receives the united sliver from both aprons and has its receiving end at the level of said combs, and is curved upward and extends laterally to its delivery end, which is at a higher level than its receiving end substantially as and for the purpose described; (4) the combination of the large and small combs and drawing off rolls and aprons of a wool-combing machine, with a stationary delivery tube having its receiving end substantially at the level of the aprons and adjustable binders, by which the fibre from the aprons is directed into the said tube, substantially as described; (5) the combination of the large and small combs and drawing off rolls and aprons of a wool-combing machine, with a delivery tube having its receiving end near enough to said aprons to admit of the combined sliver from said large and small combs being carried from the aprons to the delivery tube without twist, substantially as described.—No. 14681. September 17th, 1889. 8*d*.

Compound Locomotives.—*F. W. Webb, Crewe.*—An improvement is here introduced in the reversing gear of a class of compound locomotive engines, for which the inventor was granted a patent, No. 1128 of 1881. The compound locomotives are of that class in which the wheels driven by the high pressure cylinders are uncoupled from those driven by the low pressure cylinder or cylinders, and the improvement consists in using an automatic

FIG. 1

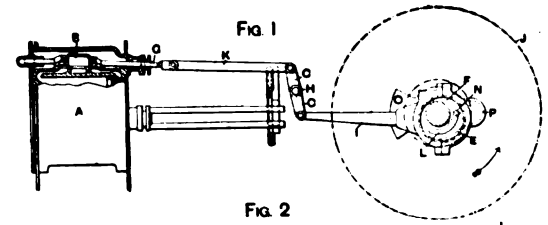
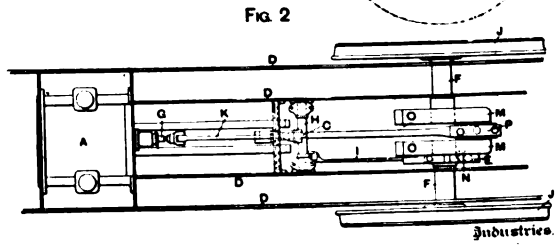


FIG. 2



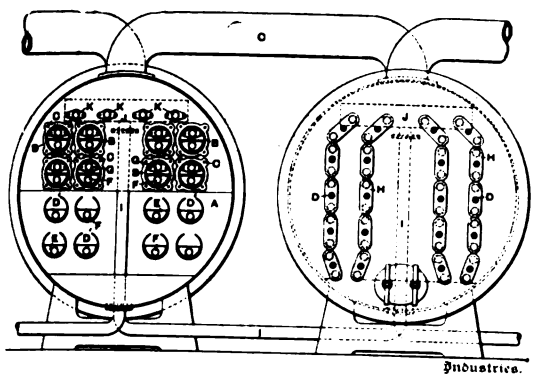
reversible valve gear, such as a single eccentric, which can rotate to a certain extent on the driven axle, and thus change its position automatically. The illustrations give a side elevation and plan of an engine cylinder and valve with the automatic reversible gear. B is the slide valve of the cylinder A, connected to the rocking lever C, which is worked by the eccentric E. The eccentric is loose upon the shaft F, yet made to revolve with it by a pin N in the slot L. When the engine is started, and the wheels J rotate in the direction of the arrow, the pin N will come against one end of the slot and carry the eccentric round with it in the right position for that direction. If the engine be now reversed the pin will come against the other end of the slot, and carry the eccentric in the right position for the direction it now travels. Claims: (1) In compound locomotives, where a pair of cylinders drive one axle, and a single cylinder, or pair of low pressure cylinders, drive another axle, uncoupled with the axle driven by the other pair of cylinders, the combination therewith of automatic reversing gear for the valve or valves of the low pressure cylinder or cylinders; (2) the combination and arrangement of automatic reversing gear for the valve or valves of the low pressure cylinder or cylinders of compound locomotive engines, acting independently of the high pressure cylinders.—No. 701. January 14th, 1889. 8*d*.

Evaporating Apparatus.—*T. Slaiter, London.*—The inventor introduces an improved construction of the apparatus described in a previous patent, No. 10493 of 1888. In the apparatus the liquid is evaporated and concentrated by flowing over open trays or gutters, which are heated by steam, and contained in a vacuum chamber. In the illustrations Fig. 1 is an end elevation of two chambers arranged in series, one being partly in section, and Fig. 2 is a longitudinal section of the chamber. In the figures A is the vacuum or evaporating chamber, B a steam or vapour chamber at one end, C the exhaust pipe connecting the vacuum or evaporating chamber of one vessel with the steam or vapour chamber of the next vessel or to an air pump, D removable evaporating tubes containing the gutters E for conveying the heating steam, and F pipes for the circulation of concentrating water. G are short pipes forming continuations of the trays through the steam chambers, and connected by the elbows H to the return pipes F. I are closing caps at the other end of the tube. The steam chamber ends of the tubes D are closed except to the pipes G. The first vessel receives its steam from the exhaust of the air pump engine. The second vessel derives its heat from the vapour arising from the fluids in course of concentration in the

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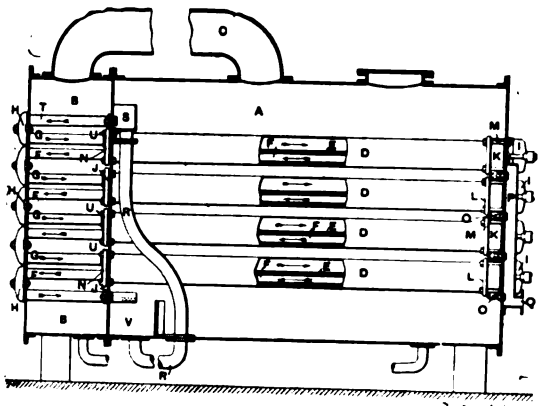
first vessel; the third from the second, and so on. The fluid to be evaporated is drawn through a pipe R into a box or tank S; from here the fluid passes through pipes T to the pipes G, which lead to the trays of the uppermost tubes D. After passing along these trays it returns by the return pipes F, and from them descends to the next layer of trays, and so on. Claims:

FIG. 1.



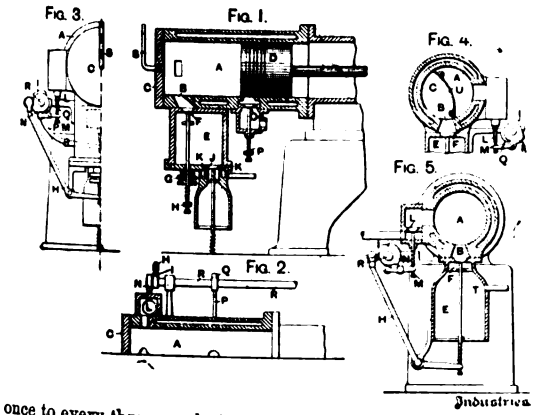
(1) The combination of the vacuum chamber, the readily removable tubes passing through both ends thereof, each tube having a tray or gutter within and across it, and open at the top where it is within the vacuum chamber, and means for supplying the tubes below the trays or gutters with steam or heated fluid, and for passing liquid to be evaporated over the surface of the trays

FIG. 2.



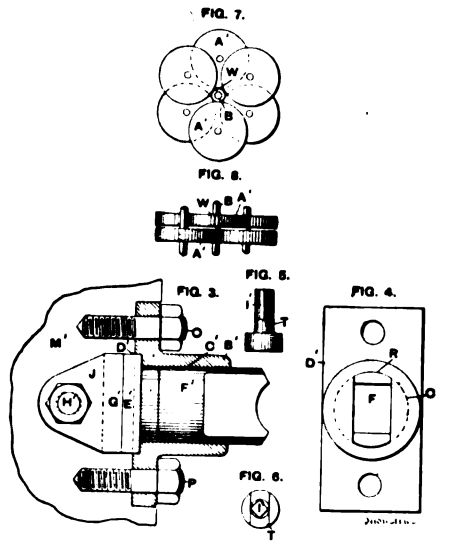
or gutters; (2) the combination of the vacuum chamber, the steam chamber at one end thereof, the readily removable tubes passing through both ends of the vacuum chamber, each tube having a tray or gutter within and across it, and open at the top where it is within the vacuum chamber—the return pipes passing back through the steam spaces below the gutters and through the steam chamber, and means for leading the liquid under concentration over the upper trays or gutters, then through the return pipes below them, and on to the trays or gutters below them, and so on; (3) the construction of evaporating apparatus substantially as described.—No. 34. January 1st, 1889. 11*d*.

Gas Engines.—*J. Roots, London.*—The inventor describes a method of obtaining double expansion of the gaseous charge. Fig. 1 is a side elevation; Fig. 2 a half sectional plan; Fig. 3 a half end elevation of the engine; Fig. 4 shows a modification; Fig. 5 shows a one-to-two arrangement giving the double expansion. A is the cylinder, D the piston, E a chamber for receiving half the charge, H is a lever which opens or raises the valve F by means of the cam I. J is the inlet valve to the chamber, which also covers the gas orifices K. L is the first exhaust valve opened by the lever M and cam N. O is the second exhaust valve opened by the lever P and cam Q. The exhaust valve shaft R is revolved

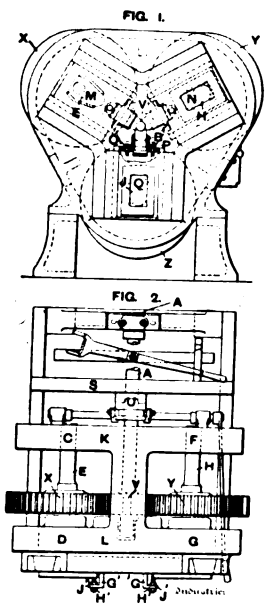


once to every three revolutions of the crank shaft. S is the usual igniting pipe kept at a red heat. At the commencement of the compression instroke the valve J closes, the valve F being kept open by the cam during a part of the instroke; a portion of the charge is returned to and compressed into the chamber E, as well as in the cylinder and clearance space. When the valve F is closed the half charge in the cylinder is further compressed and exploded doing a full working stroke. The chamber E has about half the cubic space of the whole piston stroke. Close to the working stroke end, the exhaust valve O is opened and a part of the exhaust let out. Near the dead point the valve F opens by its cam or by the pressure of the charge in the chamber E, and the half charge then pours into the cylinder, displacing more of the exhaust during the instroke until the piston has covered the exhaust valve O. During the remainder of the instroke the second half charge is compressed together with the remaining products, and fired, performing the second working stroke with double expansion. At the end of the second stroke the first exhaust valve L is opened by its cam, and the cylinder is completely exhausted on the instroke. Claims: (1) The combination and arrangement of mechanism whereby the cylinder inlet valve placed between the cylinder and the chamber E is retained open during about half the instroke following the suction outstroke, so that about half the charge only is fired at each time, thus allowing it double the expansion; (2) the chamber E for receiving about half the charge drawn in the cylinder during the suction stroke, and this portion of the charge being compressed in the chamber E assists in displacing the exhaust products in the cylinder; (3) the method of working with two working strokes in three revolutions, each allowing double expansion; (4) the combination and arrangement of mechanism for producing two working strokes in three revolutions; (5) the modified arrangement, as described with reference to Fig. 4; (6) the chamber E open to the air for receiving uncompressed the portion of the charge displaced by the piston on its instroke, there being a working stroke every other revolution; (7) the method of working and arrangement of parts, as described and shown in Fig. 5.—No. 16220. November 9th, 1888. 8*d*.

Power Presses.—*J. S. Taylor & S. W. Challen, Birmingham.*—The press is constructed to operate upon such objects as cartridge shells. The improvements enable pressure to be given in different places at the same time, and a complete circle of pressure can, if so desired, be given by means of the different tools attached to the press. In the illustrations Fig. 1 is a front elevation of the press, Fig. 2 a plan, and Figs. 3, 4, 5, 6, 7, and 8 details.

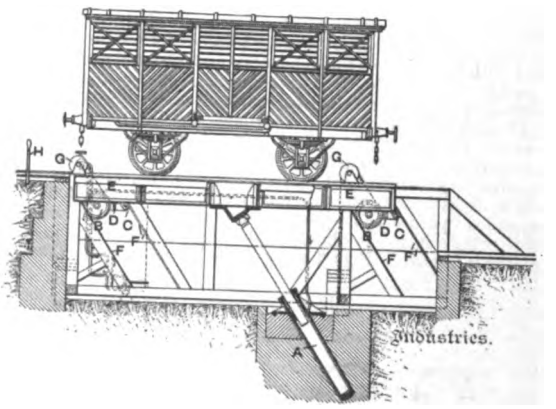


Instead of, as in the ordinary press, the tools operating in one plane and in one direction, a number of tools are arranged radially about a given centre to work in different directions. In the apparatus illustrated three tool holders B^1, C, and P are shown arranged radially to the centre V. The tool holders are fixed to the ends of suitable slides in the frame of the machine, and are actuated by eccentrics upon the three shafts E, H, and J. A central shaft A drives the three shafts E, H, and J by suitable gear wheels, and is itself driven from pulleys upon one end. A suitable fly wheel S and clutch arrangement U are also applied to the shaft A. Figs 3 and 4 give an enlarged view of the tool holder B^1. A central circular hole C^1 has a rectangular space D^1 formed at the base, and a slotted hole R at the front. Within the hole C^1 is a

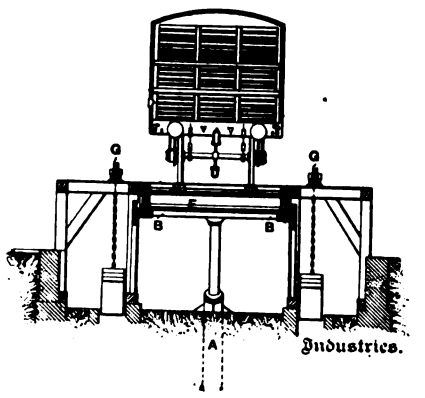


cap E^1, which serves to hold the tool in position. The tool is also shaped to fit the oblong hole in front of the holder. The tool is adjusted by a wedge G^1, whose bent head receives a screw H^1 for the purpose of shifting the wedge. Figs. 7 and 8 show the arrangement for driving a number of radial slides by means of a long pinion W working in sets of toothed wheels. Claims: (1) The combination of a central shaft with pinion driving three other shafts by means of toothed wheels, which shafts actuate radial slides carrying dies for the purpose of compressing copper bands on steel projectiles; (2) the combination and arrangement of a press or machine, whereby radial punches or tools are caused to operate upon an object simultaneously; (3) the construction of a tool holder with an adjusting sliding wedge and block; (4) the combination of sets of toothed wheels placed one set behind the other, driven from a single long pinion, or a number of shorter pinions, upon a central shaft, whereby a number of radial slides are simultaneously operated from shafts rotated by the toothed wheels.—No. 14,261. September 10th, 1889. 6*d*.

Hydraulic Lifts.—*A. A. Vingner, Paris.*—The principal novelty of this lift is in the raising of the platform in an inclined instead of vertical direction. The weight of the platform and of the load is carried by the hydraulic cylinder and four wheels which travel upon inclined guides and are fixed to the corners of



the platform. When the centre of specific gravity of the load is not central upon the platform unequal weights are thrown upon the pulleys, but no stress is made upon the platform, which remains horizontal. In the illustrations, A is the hydraulic ram constructed to work upon the centre of the platform E, B are



the wheels working upon the guides F. The weight of the platform E is counterbalanced by weights attached to chains passing over the pulleys G. Spring slides C work upon the guides F^1 to prevent the platform lifting at one end when the load is not central. Claims: (1) The improved construction of lift or hoist, wherein a horizontal platform is moved in an inclined direction by means of one or more inclined hydraulic cylinders or equivalent appliances, the platform being guided in its motion by means of inclined guide rails arranged parallel to the hydraulic cylinder, against which rails the platform is made to bear either by means of wheels or slides, or both combined; (2) the construction of hydraulic lift or hoist with platform travelling in an inclined direction arranged and operating as described.—No. 198. January 4th, 1889. 8*d*.

Boiler Furnaces.—*E. Dobson, Jarrow-on-Tyne.*—The object of this invention is to encourage the consumption of the smoke, and to utilise the increased heat evolved without diminishing the draught of the fire. The inventor places at the rear of the bridge, and preferably on the same level as the dead place, an air chamber the width of the furnace; into this chamber air is admitted from the ash pit through an opening at the under side of the chamber, the admission of the air being regulated or cut off by means of a valve or damper operated by any suitable means, such as by a rod carried to the front of the furnace. From this chamber the air passes by a large number of small openings in the top of the chamber. This top plate is preferably inclined, the inclination being downwards from the back of the bridge. Through the bridge over the dead plate passages are made coinciding with openings in the front of the air chamber, so that hot gases from the fuel can enter into the air chamber. By the foregoing means hot air passes from the ash pit into the air chamber, and passes therefrom through the perforations in the top, and so is brought in a number of small streams into contact with the smoke directly they have passed over the bridge. Claims: (1) In steam boiler and other furnaces an air chamber, situated close behind the fire bridge and communicating at the bottom with the ash pit, and having the top perforated with a great number of small holes, through which heated air passes from the interior of the chamber to mingle with the products of combustion passing over the bridge; (2) in steam boiler and other furnaces an air chamber, situated close behind the fire bridge and communicating with the ash pit, the top and one side of the chamber being perforated, the perforations in the side coinciding with perforations or passages in the fire bridge; (3) the combination with the subject matter of either of the preceding claiming clauses of means substantially as hereinbefore described for automatically admitting air from the ash pit to the flue behind the fire bridge when the furnace door is being closed, and for gradually cutting off the supply of air after the furnace door is closed; (4) the general combination and arrangement of parts constituting means for effecting the burning or consumption of smoke in furnaces.—No. 19057. December 31st, 1888. 8*d*.

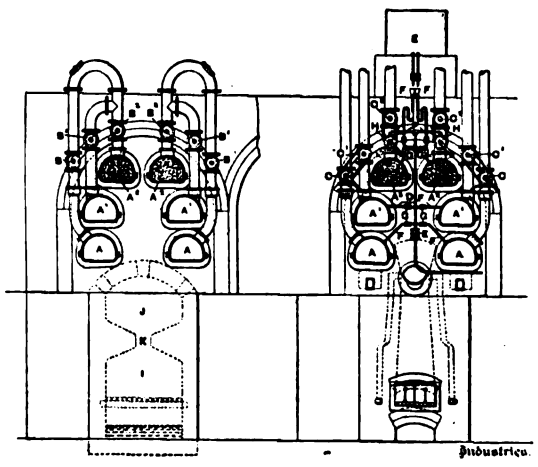
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STEAM ENGINES.—*E. P. de Soveral, London.*—The object of this invention is to lessen the friction of the slides of piston rods by substituting for the sliding faces rollers or wheels which can be arranged to work in the existing guides of steam engines. To prevent lateral shifting of such rollers, they may have flanges on their periphery to project over the sides of the guides, or they may be made to work in grooves in the guides. The body of the crosshead may have several rollers attached to take the bearing on the guides, or one large wheel may be used. Four claims are made.—No. 6680. April 18th, 1889. 8*d.*

CHEMISTRY.

PRODUCTION OF COMBUSTIBLE GASES.—*B. H. Thwaite, Liverpool.*—In this improved method use is made of the ordinary coal gas retorts, the mode of proceeding being as follows:—A retort is filled with broken pieces of refractory material, and connected to a second in which is distilled carbonaceous fuel. Both are heated to a high temperature, and the hydrocarbons evolved from the second retort passed by the connection through the first retort, and from there to the hydraulic main. After the evolution of all the hydrocarbons, steam is passed through the first retort filled with the refractory material, which has collected suspended pieces of solid hydrocarbons in the previous action, and scours it of these suspended hydrocarbon. The steam is then passed to the second retort, where it meets the incandescent fuel and becomes dissociated into gases. Figs. 1 and 2 show the method of connecting

FIG. 1. FIG. 2.



the retorts, Fig. 1 being a back view of the retort, and Fig. 2 a front view. In Fig. 1, A, A^1, A^2 are the retorts; B, B^1, B^2 the valves by which the connections are made. In Fig. 2, C, C^1, C^2 are valves in the ascension pipe, and E, F, and G are tanks, pipes, and valves for admitting into the retorts, &c., tar, naphtha, or other hydrocarbon for the purpose of enriching the gases. Claims: (1) The cycle of operations producing combustible gases as applied to gas retorts of the ordinary kind; (2) the arrangements for connecting the retorts to each other and the gas and steam valves connected therewith; (3) the arrangement of converting one retort into a superheater in connection with a second or third coal or cannel charged retort; (4) the arrangements for simultaneously effecting the reversal of the steam and gas valves.—No. 16970. November 22nd, 1888. 8*d.*

RECTIFYING ALCOHOL.—*A. de Meritens, Paris.*—The present invention has reference to Patent No. 13293 of 1888, according to which an alternating current of electricity is employed in treating and rectifying or aging alcohols. An alternating current is essentially a current causing combinations, whilst a continuous current is a current causing dissociations. The object of the present invention is to provide substances capable of combining immediately with the aldehydes under the action of an alternating electric current, and of forming stable combinations indestructible by heat even at temperatures as high as 100° C. The substances which give the best results are ammonia, aniline, the phenylene-diamines, such as meta-phenylene-diamine, and their salts. These substances are capable of combining directly with the aldehydes when brought in contact therewith at temperatures from about 80° to 100° C. Under the action of an alternating current the combination takes place without any perceptible rise in the temperature, and as this combination cannot be destroyed by heating even to about 100° C. the employment of the above mentioned substances enables the process to be conducted under most favourable conditions. To the impure alcohol to be treated with an alternate current the inventor adds two equivalents, for example, of ammonia or aniline, or of a salt of meta-phenylene-diamine to one equivalent of aldehyde. Claim: In the treatment or rectification or aging of alcohol or alcoholic liquors and the like by electrical action the employment of substances such as ammonia or aniline or phenylene-diamines or their salts.—No. 16,947. October 26th, 1888. 4*d.*

COLOURING MATTERS.—*C. D. Abel, London.* (*Actiengesellschaft für Anilinfabrikation, Berlin*).—The inventors have discovered a new set of colouring matters which are prepared by acting on the sulphurated bases which are formed by heating m-xylidine or pseudo-cumidine with sulphur by nitrous acid and then mixing the diazo products thus formed with phenol, &c. Claims: (1) For the manufacture of dyestuffs, the production of sulphurated bases by heating m-xylidine or pseudo-cumidine with sulphur; (2) the production of azo dyestuffs from the sulphurated bases mentioned in the first claim by the reaction of nitrous acid upon the sulphurated bases and by the combination of the diazo compounds thus obtained with phenol, its homologues, resorcine, resorcine ethers, orcine naphthol, dioxynaphthalene, phenylene-diamine, toluylen-diamine, chrysoidines, Bismarck-Brown naphthylamine and its alkyle derivates, or with their sulphonic or carbonic acids; (3) for the production of azo dyestuffs the conversion of the sulphurated bases mentioned in the first claim into their sulphonic acids, the reaction of nitrous acid upon these acids, and the combination of the diazo compounds thus obtained with the substances mentioned in the second claim; (4) as a new manufacture the orange, yellow, brown, and red dyestuffs produced as described.—No. 17333. November 28th, 1888. 6*d.*

WHITE LEAD.—*H. B. Condy, London.*—The inventor describes a method of producing white lead from lead by first generating acetate of lead, and then converting it into the carbonate. Metallic lead is carefully granulated by melting and pouring it into water, and a vat is filled. Above the level of the vat is another vat in which dilute acetic acid is placed, the proportion being about 55lb. of acetic acid, containing 40 per cent. of hydrated acetic acid, to about 625lb. of water. This vat is connected to the former vat by pipes provided with cocks so that the liquor may be run on to the metallic lead and turned on and off at will. After allowing the acid to run on to the lead and remain in contact with it for a period of from four to six hours, the liquor is run off into a vat placed at a lower level, so that the lead is left exposed to the atmospheric air and oxidised. The liquor which has run through the lead is pumped up into another vat above the level of the lead, and after the lead has become sufficiently oxidised the same liquor is again run on to the lead and the coating of oxide is dissolved and removed. This operation of alternate oxidisation of the lead by atmospheric air and solution of the oxidised lead is repeated until the specific gravity of the liquor reaches 1·145 or thereabouts. At this stage the liquor is pumped into a closed tank, fitted with an agitator. Carbonic acid gas is driven into this vat until it is found that the contents have become neutral; at this stage the white lead must be separated from the liquor in which it has been precipitated. The liquor thus separated is again treated with carbonic acid until it appears, upon testing a small sample drawn from the bulk, to give no further precipitate, or only a slight cloudiness with further treatment by carbonic acid.—No. 18705. December 21st, 1888. 6*d.*

EXTRACTION OF GOLD.—*M. H. Simpson, London.*—This invention relates more especially to the extraction of gold by the wet processes, from such auriferous materials as pyrites, or tailings, obtained in the ordinary gold washing processes. In such processes the use of bromine is very effective, but the difficulty of safely conveying and keeping the bromine in a liquid form is an objection. This invention has for its object a novel method of preparing and treating bromine so that it is obtained in a form easily transported and stored. The inventor takes a strong solution of a caustic base such as caustic soda, potash, or ammonia, or the carbonates of these bases, or employs the oxide, hydrate, or carbonate of any other suitable base, and saturates it with bromine, thereby forming a hypobromate or a mixture of bromide and bromate of the base. The solution is evaporated to dryness, and a dry powdery material is obtained, capable of being carried or transported in boxes or barrels or other suitable vessels. Of the several bases capable of being employed in the way described, the caustic soda is preferable. In order to obtain the bromine from this salt or mixture of salts, all that is required is to dissolve the material in water and add to the solution an acid such as sulphuric acid, when the bromine is at once set free. The soda-bromine material is easy of transport and without danger, unlike liquid bromine, whilst from it liquid bromine may be obtained at any time as already described. In order to obtain an acid material likewise easy of transport for the purpose of liberating the bromine from the soda-bromine material, the inventor takes sodic or potassic sulphate, and treats it with sufficient sulphuric acid to form an acid sulphate, heating the mixture to expel all water. The mass is allowed to cool, when it solidifies and may be broken up and packed in suitable boxes or barrels. When the bromine is to be used for the extraction of gold, the auriferous material to be treated is placed in barrels or other suitable vessels capable of being hermetically sealed, and is then moistened with the requisite amount of a solution of the soda-bromine compound described. A solution of the acid sulphate is next added in quantity sufficient to liberate the bromine, and the containing vessel is closed and agitated occasionally for a few hours. The auriferous material is then washed, and any excess of bromine present volatised and condensed, and the solution containing the gold subjected to any known method for the precipitation of the gold. Claims: (1) The method of combining bromine with caustic bases, or with the carbonate of such bases, or with the oxide, hydrate, or carbonate of other suitable bases, evaporating the mixture to dryness, so as to obtain a material containing bromine capable of being readily transported, and from which the bromine can be set free when required; (2) in order to set free the bromine from such salt, or mixture of salts, when required, the addition of an acid such as sulphuric acid; (3) in order to obtain an acid material, in a convenient form for carriage, for the purpose described, the treatment of sodic or potassic sulphate with sulphuric acid to form an acid sulphate, heating the mixture to expel all water, allowing the mass to cool and solidify, and breaking it up into pieces convenient for packing; (4) the addition to the bromine compound of a suitable carbonate in order to obtain pressure in the vessel in which the bromine is used for the extraction of gold.—No. 17930. December 7th, 1888. 6*d.*

MISCELLANEOUS.

OBTAINING MOTIVE POWER FROM TIDAL WATERS.—*C. Hussmant & I. Dramant, Melbourne.*—The method consists in the employment of two large suitably constructed reservoirs adapted to be filled and emptied alternately by the rise and fall of the tide. Each reservoir is connected with one or several turbines in any convenient manner, and these turbines are arranged to be operated by the water passing in and out of the reservoirs. The system is worked preferably as follows:—Assuming the total rise and fall of the tide to be twenty-four feet, and that one of the reservoirs is full whilst the other is empty, then as soon as the tide has fallen a certain extent, say eight feet, the turbine connected with the full reservoir is set to work by allowing the water to pass through it to the sea until the tide by its again rising reaches the height of the water in the reservoir, say at sixteen feet. The turbine connected to the empty reservoir is inoperative until the tide has reached a height of about eight feet above low water, when the water is allowed to flow in past the turbine until the level of the water in this reservoir is equal to that of the sea by its again falling. Effective power is thus obtained from each reservoir for about seven and a half hours in each tide, thus giving fifteen hours effective working per day for each turbine. Claim: The improved method for obtaining motive power from the action of the tides, said method consisting essentially in allowing water to flow into and out of a pair of reservoirs, through a water motor or motors in such a manner as to obtain a source of continuous power.—No. 12454. August 6th, 1889. 8*d.*

REGENERATIVE GAS LAMPS.—*L. Somzée, Brussels.*—This improved regenerative lamp is designed to stand a higher temperature than those of other systems, and consequently give a better light. Fig. 1 is a sectional view of the lamp; Fig. 2 a plan view of the top of the regenerator; and Fig. 3 an elevation of the regenerator. The lamp comprises heater M with walls I, on which the products of combustion play before passing to the chimney. The heater terminates below in a cylindrical pipe D^1. On the lower end of the heater is an enamelled plate H, forming a reflector, and provided around its periphery with a series of small holes O by which part of the air passes into the globe G. A dome E integral with the chimney C covers the heater; it rests on the plate H and against the annular support N near the base of the chimney. The gas feed-pipe T passes down the centre, and is provided with the sleeve M^1 for preventing passage of water, &c., into the burner. It terminates below in a burner B of lance form, as shown in the drawing. The flame projector D cast with the

FIG. 1.

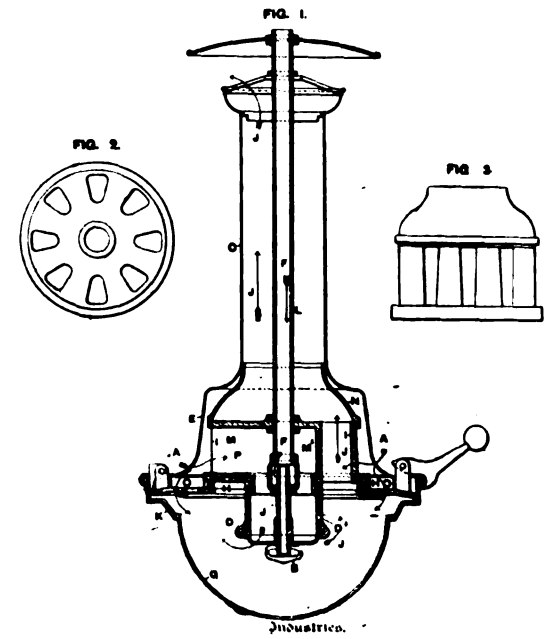


FIG. 2.

FIG. 3.

cylinder D^1 is fed with heated air and is ring shaped. The flame receives therefore the advantage of the radiation of heat from the projector, so that the whole surface of the flame is rendered active and the light thrown out in a horizontal plane. Claims: (1) A regenerator with inclined walls terminating in a cylindrical tube integral therewith, said tube having cast thereon an annular projector or guide for the flame for circulation of heated air, said tube being closed by a double metallic gauze projecting from the orifice; (2) the combination with a regenerator of a plate of enamelled iron having a series of holes in its periphery for passage of air into the globe, and carrying an exterior casing or dome integral with the chimney and leaning on an annular support on said regenerator, whereby the hot air is prevented from passing direct into the chimney; (3) a gas feed-pipe cut in two parts connected by a sleeve, the upper part terminating below in a hollow conical enlargement, the lower part provided above with a projecting nozzle; (4) the method of constructing the essential parts of the lamp subject to heat or exterior influence of cast iron enamelled within and without.—No. 16,379. November 12th, 1888. 6*d.*

MAKING GRINDING ROLLERS.—*J. E. Platt & J. Fidler, Oldham.*—The inventors cover the roller to be used as a grinding roller with a coating of glue or cement and emery. They then place the roller in a lathe and cause it to revolve in contact with another roller having a plain smooth surface, until the emery surface of the roller becomes level and circular and of the diameter required. They form a mould of suitable length, with the internal diameter formed of the same size as that of the grinding roller to be constructed, and in the interior of the mould there is a series of ridges and grooves, each of which is formed of a zig-zag or wave-like form. They cut the mould lengthwise into two or more portions. Instead of the mould being formed of one piece, having grooves and ridges on its inner surface and afterwards cut or divided into two or more portions or segments, the mould may in the first instance be formed in two or more portions which are held together in any suitable manner whilst the ridges and grooves are formed on its inner surface. The roller to be used as a grinding roller having been covered, and whilst the glue or cement and emery with which the roller has been covered is sufficiently plastic, the inventors enclose the roller in the mould by placing round it the portions into which it is divided, and enclose the whole by a ring or tube, and then compress the mould in any suitable manner upon the roller so as to impart to the surface of the glue or cement and emery a form corresponding to that of the interior of the mould. In order that the mould may be readily forced upon the roller, they form the outside of the mould of a taper form, and provide a ring or tube, the interior of which ring or tube is also formed taper. After the roller to be used as a grinding roller has been placed within the mould, and the tube or ring has been placed upon the outside of the mould, the whole is placed in a suitable press and the ring or tube is then forced upon the mould. Two claims are made.—No. 1373. January 25th. 8*d.*

Copies of the British specifications may be obtained on application to H. READER LACK, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at* ½*d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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ENGINEERING PROGRESS IN 1889.

GENERAL MECHANICAL ENGINEERING.

During the past year, although there has been no striking discovery or invention in the department of mechanical engineering, still there has been a steady development all along the line. It is to Americans that we owe almost all the most recent developments in the steam engine. Novel boilers, valve gears, and framings are all of American origin. There has not been much change in the manner of using the steam in the cylinders of steam engines during the year, although there has been a general tendency to the use of higher pressures. In land engines, the compound system is becoming more common, as the steam users are beginning to feel the necessity for economising fuel, and if the price of coal continues to rise, no doubt there will be greater attention paid to such matters. Triple and quadruple expansion is for the most part confined to marine engines. In marine engines, for pressures varying from 160lb. to 200lb. per square inch, quadruple expansion engines are now used, and of very various designs, the most usual being double tandem. One of the most ingenious designs which has come into use during the year is the quadruple expansion engine of Messrs. Fleming & Ferguson, of Paisley, in which the cylinders are all in the same plane, and the piston rods connected by a triangular crosshead to the two cranks. A considerable number of these engines have been made during the past year, and for the smaller sizes of vessels they have many advantages. The normal type of marine engine, however, is the triple expansion engine with the cylinders side by side, and each piston rod working on a separate crank, and for the usual pressures of steam this type is very suitable in every way. The engines of the steamers of the Inman and International line, the "City of New York" and the "City of Paris," may be mentioned as examples of the latest developments of marine engineering. These vessels have twin-screws, worked by two complete sets of engines in separate compartments. The engines are of the triple expansion type, working with a pressure of 150lb. per square inch. The boilers are worked under forced draught on what is known as the closed stoke-hold system. The new steamer of the White Star Line has also done some excellent performances, although somewhat below those of the "City of New York." Modifications are, however, being made in the propellers of the former, which may bring up her speed considerably. The excellent performances of these ships have, of course, raised speculations as to the future of the marine engine and of the marine boiler. The models of the hulls are excellent, and the engines are far ahead of the boilers. Attention is, therefore, being directed to the latter, and probably some form of water-tube boiler will be the next great step in advance in marine engines.

The machinery of our ships of war is as deserving of attention as that of the mercantile marine, and it involves many more difficult conditions, especially those regarding space and irregularity of employment. Whatever the reason may be, the engines of ships of war do not give the same satisfaction as those of the mercantile marine. Too often they break down when put to anything like a severe test, which would be a very serious matter if that test were actual warfare. The weakest part of the fleet has always been the boilers, and since the introduction of forced draught that weakness has been much increased, and therefore to this point the attention of engineers ought to be directed. In the matter of speed again, the ships of the navy very often fall behind what was expected of them. The subject of forced draught has been receiving considerable attention both in the navy and the mercantile marine during the past year.

We have hitherto known little of the efficiencies of marine engines, the consumption of coal in a given time being the only test applied. During the past year, however, the Institution of Mechanical Engineers published the results of a series of experiments on a marine engine, under the superintendence of its Research Committee, Professor Kennedy being the reporter. The experiments are useful, not so much for their results, for the engine under trial did not belong to the highest class, but rather for showing how experiments could be carried out without interfering to any great extent with the work of the ship.

Turning to locomotive engines, we find also considerable progress in several points. The President of the Institution of Mechanical Engineers in his address directed attention to the improvement made in getting rid of the exhaust steam to prevent the choking of the outlet, a condition which threatened to prevent the further development of speed on railways. During the year a considerable number of compound locomotives have been built, both in this country and on the Continent, and their use seems to be steadily gaining ground. A gain in economy of from 12 to 14 per cent. is said to be the result. In Russia, petroleum refuse is employed on some of the railways with fairly satisfactory results, but in this country it has not yet been practically applied. When coal becomes dearer, engineers will no doubt have some cause for trying a change.

The application of electricity to tramways and to locomotives is steadily gaining ground. The endless rope system of propelling tramcars is also being extended. Any one who has observed the great development of the system in America may well be surprised that greater advantage is not taken of it in this country.

Gas engines have attracted a considerable amount of attention during the year. The trials made by the Society of Arts, and the valuable report by the judges, gave us some accurate data and independent information as to their performances. There can be no doubt, however, that in spite of certain drawbacks gas engines have become a most important element in our industrial system, and are destined to have a still wider application. Hot-air engines are receiving more attention now than they did some years ago after the continued disappointments which inventors experienced, and for small sizes they are found useful and economical. That brought out by MM. Benier Brothers, Paris, contains several novel points, and gives fairly satisfactory results as regards economy. The spirit vapour motors introduced by Mr. Yarrow promise to be very useful for torpedo boats and work with good efficiency. They embody remarkable qualities for sea-going purposes, as might be expected from the lightness of the machinery, and they possess the great advantage of being able to get into action in two minutes.

The distribution of power by means of compressed air has been fairly successfully carried out in Paris by means of the Popp system, and during the past year it has received a great extension. The general problem of the distribution of power is likely to afford a wide field for ingenuity, as there is a growing demand for small motors for all kinds of purposes.

The various advances have led to the design of a great variety of special tools.

SHIPBUILDING AND MARINE ENGINEERING.

England and Wales.

The year which has just closed will long be remembered in shipbuilding, marine engineering, and allied industries, the aggregate output having beaten the record by about 100,000 tons of shipping. The prospects for the present year are, generally speaking, favourable, and it would be safe to prognosticate another output exceeding one million tons. In the accompanying tables we show a summary of the work in England and Wales, from which it will be seen the Tyne carries off the palm as the busiest shipbuilding river, having an increased output of over 68,000 tons over the previous year. The Wear, a good second, has, however, an increase of nearly 75,000 tons, and the Tees has also a very substantial increase of about 50,000 tons. Some marine engineering establishments have also been engaged in reboilering and converting compound into triple expansion engines, but the latter class of work has not been so plentiful as was anticipated in some quarters. Two reasons for this may be fairly advanced: (1) freights have been remunerative for old steamers with compound engines, and (2) the prices asked for altering engines to triple, and supplying boilers of higher pressures have necessarily been high, owing to the increased cost of material and labour.

Times of great activity do not usually appear to be very favourable to departures from everyday practice. However, quadruple expansion engines have been supplied to five steamers, four by Messrs. Wm. Allan & Co., Scotia Engine Works, Sunderland, and one of Tweedy's quadruple engines by Messrs. Wigham Richardson & Co., Walker-on-Tyne. For the converting of existing triple expansion engines into quadruple, as well as constructing new engines of the latter type, Mr. Thomas Mudd, the manager of the Central Marine Engineering Works of Messrs. William Gray & Co., of West Hartlepool, has recently patented a design, in which the high pressure cylinder is placed tandem fashion on the high intermediate, the low intermediate being placed forward and the low pressure abaft the high pressure cylinders.

Six of the shipbuilding centres in England may be considered of sufficient moment to justify the publication of tabular returns showing each shipbuilding firm's output for the last year:—

TABLE I.

Shipbuilding in England and Wales.

Rivers or Ports.	No. of Vessels.	Tonnage of Sailing Vessels.	Tonnage of Steamers.	Total Tonnage.	I.H.P.
The Tyne	153	505	281,205	281,710	202,111
The Wear	102	3,367	213,978	217,345	106,370
The Tees	53	4,810	105,616	110,426	49,085
West Hartlepool	41	—	85,875	85,875	41,050
The Mersey	21	14,248	21,459	35,707	27,550
Barrow	10	—	26,847	26,847	26,835
The Humber	41	184	21,530	21,714	27,770
Whitby	7	—	13,146	13,146	5,375
Blyth	10	—	10,972	10,972	5,450
The Thames	25	805	2,802	3,607	5,254
Whitehaven	5	8,297	1,744	10,041	840
Workington	3	4,403	300	4,703	450
Milford Haven	2	—	1,402	1,402	1,150
Bristol	2	150	260	410	40
Rye	4	302	—	302	—
Preston	2	—	250	250	850
Yarmouth	1	154	—	154	—
Ipswich	1	79	—	79	—
	483	37,304	787,386	824,690	500,180

TABLE II.

The Tyne.

Shipbuilders.	No. of Vessels.	Tonnage of Sailing Vessels.	Tonnage of Steamers.	Total Tonnage.	I.H.P.
Palmers' Shipbuilding and Iron Co., Ld.	28	—	64,669	64,669	43,270
Sir W. G. Armstrong, Mitchell, & Co., Ld.	15	—	34,415	34,415	39,710
C. S. Swan & Hunter	12	—	28,312	28,312	15,610
J. Readhead & Co.	12	—	26,182	26,182	15,236
R. & W. Hawthorn, Leslie, & Co., Ld.	8	—	22,536	22,536	20,700
R. Stephenson & Co., Ld.	7	—	20,517	20,517	9,000
Wigham Richardson & Co.	10	55	20,298	20,353	20,750
Tyne Iron Shipbuilding Co., Ld.	8	—	15,547	15,547	9,400
Schlesinger, Davis, & Co.	9	—	13,029	13,029	6,100
W. Dobson & Co.	8	—	12,501	12,501	6,730
Wood, Skinner, & Co.	7	—	8,892	8,892	5,080
T. & W. Smith	7	—	7,101	7,101	3,195
Edwards' Shipbuilding Co., Ld.	6	450	5,550	6,000	2,900
Jos. T. Eltringham & Co.	8	—	947	947	2,610
Hepple & Co.	5	—	536	536	1,380
Tyne General Ferry Co.	2	—	169	169	400
Northern Marine Engineering Co.	1	—	4	4	40
	153	505	281,205	281,710	208,111

TABLE III.

The Wear.

Shipbuilders.	No. of Vessels.	Tonnage of Sailing Vessels.	Tonnage of Steamers.	Total Tonnage.	I.H.P.
Jos. L. Thompson & Sons	13	—	30,543	30,543	15,350
James Laing	11	—	29,160	29,160	18,500
Wm. Doxford & Sons	10	—	24,150	24,150	11,650
Sunderland Shipbuilding Co., Ld.	11	—	23,565	23,565	11,870
Short Bros.	10	—	23,419	23,419	10,200
R. Thompson & Sons	8	—	18,174	18,174	8,500
John Blumer & Co.	9	—	15,296	15,296	6,700
Bartram, Haswell, & Co.	5	—	11,917	11,917	6,350
Osbourne, Graham, & Co.	6	—	10,692	10,692	4,550
John Priestman & Co.	6	—	8,037	8,037	3,900
W. Pickersgill & Sons	5	1,914	6,046	7,960	2,900
Strand Slipway Co.	4	—	7,481	7,481	3,350
S. P. Austen & Sons	4	1,453	5,498	6,951	2,550
	102	3,367	213,978	217,345	106,370

TABLE IV.

The Tees.

Shipbuilders.	No. of Vessels.	Tonnage of Sailing Vessels.	Tonnage of Steamers	Total Tonnage.	I.H.P.
Raylton, Dixon, & Co.	18	—	40,689	40,689	18,675
Ropner & Son	12	—	29,441	29,441	14,125
Richardson, Duck, & Co.	10	4,810	16,775	21,585	8,145
Craig, Taylor, & Co.	5	—	10,450	10,450	4,250
R. Craggs & Sons	5	—	5,561	5,561	2,700
W. Harkess & Son	3	—	2,700	2,700	1,190
	53	4,810	105,616	110,426	49,085

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TABLE V.
WEST HARTLEPOOL.

Shipbuilders.	No. of Vessels	Tonnage of Sailing Vessels.	Tonnage of Steamers.	Total Tonnage.	I.H.P.
W. Gray & Co., Ld.	28	—	58,731	58,731	29,350
Edward Withy & Co.	9	—	21,015	21,015	9,200
Irvine & Co.	4	—	6,129	6,129	2,500
	41	—	85,875	85,875	41,050

TABLE VI.
THE MERSEY.

Shipbuilders.	No. of Vessels.	Tonnage of Sailing Vessels.	Tonnage of Steamers.	Total Tonnage.	I.H.P.
Laird Bros.	6	—	13,478	13,478	23,050
Thos. Royden & Sons	3	2,673	6,561	9,234	3,000
W. H. Potter & Sons	6	7,698	—	7,698	—
R. & J. Evans & Co.	2	3,406	—	3,406	—
John Jones & Co.	4	—	949	949	1,000
Cochrane & Co.	16	471	471	942	500
	37	14,248	21,459	35,707	27,550

TABLE VII.
THE HUMBER.

Shipbuilders.	No. of Vessels.	Tonnage of Sailing Vessels.	Tonnage of Steamers.	Total Tonnage.	I.H.P.
Earle's S. & E. Co., Ld.	17	—	18,455	18,455	22,395
Cook, Wilton, & Gemmell	12	—	1,725	1,725	3,200
Smith & Stephenson	3	184	—	184	—
Cochrane, Cooper, & Schofield	9	—	1,350	1,350	2,175
	41	184	21,530	21,714	27,770

SCOTLAND.

During the past year there has been nothing very startling either in the way of the design or methods of construction of ships. There has, however, been a continuous development as regards dimensions, speed, safety, and strength of hull. The largest vessel built on the Clyde was the Red Star Liner "Friesland," over 7,000 tons, which was launched by Messrs. J. & G. Thomson, of Clydebank. Messrs. Napier & Son, of Govan, built for the Royal Mail Steam Packet Company, Southampton, two steamers, the "Thames" and the "Magdalena," both over 5,000 tons; Messrs. Denny, of Dumbarton, two of about 5,000 tons, one being the Pacific Mail Company's steamer "China," and the other the "Monte Video," for the Compania Transatlantica of Barcelona; the Fairfield Company, three steamers of about the same size, for the North German Lloyd. Large sailing vessels seem to be coming more into use, several of over 3,000 tons having been constructed during the year. The following table shows the sizes and numbers for the two past years:—

	1889.	1888.
Under 50 tons	49	27
100 ,,	27	18
500 ,,	48	58
1,000 ,,	20	34
1,500 ,,	13	17
2,000 ,,	27	22
2,500 ,,	25	17
3,000 ,,	16	17
4,000 ,,	24	12
Above 4,000 tons	10	9

from which it will be seen that the number of vessels built between 2,000 and 4,000 tons has considerably increased. The most important improvement carried out in the largest passenger ships is that they are made practically unsinkable by being divided into a sufficient number of water-tight compartments, and they have two complete sets of engines and boilers quite independent of each other. The use of steel has now become almost universal in the construction of ships, even sailing vessels being now almost all made of that material. On the Clyde for last year there was built of the total tonnage 97·2 per cent. of steel, so that for all practical purposes we may now speak of steel instead of iron shipbuilding.

Table I. shows the output at the most important ports in Scotland during the past six years:—

TABLE I.

	1889.	1888.	1887.	1886.	1885.	1884.
Clyde	335,201	280,037	185,362	172,440	193,453	296,854
Dundee	17,568	11,197	14,246	3,347	7,358	12,071
Leith	17,776	6,000	4,167	5,340	7,769	5,000
Aberdeen	9,380	6,640	1,842	1,550	6,246	7,626
Grangemouth and Alloa	11,017	4,556	1,730	2,627	1,153	1,563
Kirkcaldy	1,006	1,455	1,920	—	—	—

Table II. shows the output in the Clyde district during the past thirty years, and gives some idea of the great and rapid rise of the shipbuilding industry.

TABLE II.

1889	335,201	1873	232,926
1888	280,037	1872	230,347
1887	185,362	1871	196,229
1886	172,440	1870	180,401
1885	193,453	1869	192,310
1884	296,854	1868	169,571
1883	419,664	1867	108,024
1882	391,934	1866	124,513
1881	341,022	1865	153,932
1880	241,114	1864	178,505
1879	171,750	1863	123,262
1878	222,353	1862	69,967
1877	169,710	1861	66,801
1876	174,824	1860	47,833
1875	211,824	1859	35,709
1874	262,430		

TABLE III.

Name of Firm.	No. of Vessels.	Tonnage of Steamers.	Tonnage of Sailing Vessels.	Total Tonnage.	I.H.P.
Russell & Co.	21	16,653	29,847	46,500	—
W. Denny & Bros.	20	25,230	—	25,230	22,730
Fairfield Co.	8	23,830	—	23,830	29,750
Scott & Co. (Greenock)	12	20,094	536	20,630	23,200
Alex. Stephen & Son	8	14,688	3,746	18,430	9,000
Caird & Co. (Greenock)	7	16,461	—	16,461	15,500
Charles Connell & Co.	8	8,252	6,768	15,020	—
Barclay, Curle, & Co.	6	323	12,437	12,760	1,000
John Reid & Co.	7	7,045	5,709	12,754	—
Jas. & Geo. Thomson	3	12,316	—	12,316	20,000
D. & W. Henderson	17	11,362	444	11,806	8,250
R. Napier & Sons	3	11,640	—	11,640	16,500
R. Duncan & Co.	7	4,472	6,785	11,257	—
A. M'Millan & Son	7	4,939	5,505	10,344	—
London and Glasgow Co.	3	8,666	—	8,666	6,700
A. & J. Inglis	3	8,294	10	8,304	6,700
Aitken & Mansel	3	8,140	—	8,140	—
Lobnitz & Co.	8	6,507	—	6,507	5,450
David J. Dunlop & Co.	5	4,900	800	5,700	3,600
Wm. Hamilton & Co.	3	1,800	3,512	5,312	—
Murdoch & Murray	3	5,269	—	5,269	—
Napier, Shanks, & Bell	4	3,051	2,115	5,166	—
M'Knight & Co.	5	4,558	—	4,558	—
Campbeltown Co.	3	4,484	—	4,484	—
Ailsa Co.	7	3,771	—	3,771	—
Fleming & Ferguson	5	3,620	—	3,620	8,600
Simons & Co.	10	3,150	225	3,375	3,100
Mackie & Thomson	5	2,215	—	2,215	—
Birrell, Stenhouse, & Co.	1	—	2,160	2,160	—
Scott & Co. (Bowling)	5	2,054	—	2,054	—
Alley & M'Lellan	—	1,517	—	1,517	7,420
John Fullarton & Co.	4	965	—	965	—
Blackwood & Gordon	2	800	—	800	500
M'Arthur & Co.	5	752	—	752	—
Mechan & Son	—	675	—	675	—
T. B. Seath & Co.	7	167	360	527	400
David M'Gill & Co.	3	326	—	326	—
Marshall & Co.	2	140	—	140	—
W. Fyfe & Son	12	—	91	91	—
J. & J. Hay	1	90	—	90	—
Hanna, Donald, & Wilson	1	86	—	86	1,000
D. M. Cumming	3	34	—	34	56
Ardrossan Co.	2	38	—	38	—
Several yacht and boat-builders	—	—	—	881	—
Total	249	253,374	80,946	335,201	199,256

The great activity which prevailed in the industry last year had a very important effect on all the cognate industries, and prices and wages have accordingly risen to a very great extent. In steel and iron there has been a rise of at least £2 10s. per ton, which on the prices current at the beginning of the year was about 20 per cent., while malleable iron has risen almost 30 per cent. during the past six months. Part of this is, no doubt, due to the speculation which has taken place, but the greater part is due to increased demand. The same remarks apply to all the materials of construction. Wages have, of course, increased, and, although there have been a few disputes, there has been an absence of long strikes. It is becoming increasingly evident that both employers and employed are beginning to see the evils of strikes and lock-outs. The latter, of course, have long had their trades unions, and during last year the Clyde Employers' Association has developed into a National Federation.

It is interesting to note the nationality of the ships which have been built on the Clyde during last year, as we thereby have an index of the probable amount we may expect in the future. Out of a total of 80 built for foreign countries, Germany heads the list with 14, which shows that, notwithstanding the progress that country has made in shipbuilding, it finds its wants can be better supplied, at least for the larger ships, in this country than anywhere else. The same number were built for countries in South America, a continent which is capable of immense development, and which is well deserving the attention of our capitalists, engineers, shipbuilders, and manufacturers. Then we have for Australia 7, a number which is very small compared with what is likely to be required in the not very distant future; for Portugal 6, Spain 5, France 2, Japan 2, China 2, Canada 4, United States 1, Belgium 1, South Africa 1, and India and other countries 14, giving for the 80 vessels a tonnage of 115,272 tons. For Scotch owners there were built 67 vessels with a tonnage of 104,977 tons. For owners in London there were built 20 vessels with a total tonnage of 44,599, in Liverpool 19 vessels with a tonnage of 43,975, and in other ports 59 vessels with a tonnage of 19,878. The British Government had 4 vessels with a tonnage of 6,810.

The returns we give in Table III. have been published as the output of the respective yards, and of the horse-power of the engines in the cases where the shipbuilder also constructed the machinery.

In addition to the engines of which the horse-power is given in the annexed table, a great many more have been built by makers who are not shipbuilders. Table IV. gives an abstract of the work of such makers during the two past years.

TABLE IV.

Name of Firm.	1889. No. of Eng.	1889. I.H.P.	1888. No. of Eng.	1888. I.H.P.
J. & J. Thomson	7	17,350	7	14,100
Dunsmuir & Jackson	14	16,431	11	11,730
Hutson & Corbett	14	12,350	14	10,800
Jas. Howden & Co.	18	9,900	6	7,600
Muir & Houston	16	9,150	12	6,725
D. Rowan & Sons	8	7,750	8	6,170
Bow & M'Lachlan	14	7,145	18	2,790
Rankin & Blackmore	5	6,400	4	3,840
Ross & Duncan	24	4,575	26	5,245
Kincaid & Co.	5	4,230	2	4,000
Wm. Kemp	4	2,680	4	2,530
A. & J. Inglis	1	1,800	1	1,800
Hanna, Donald, & Wilson	3	900	—	—
Robert Harvey & Co.	1	900	—	—
Duncan Stewart & Co.	1	850	3	4,000
Wm. King & Co.	3	240	4	4,040

During the past year no steamer built on the Clyde has had the engines made elsewhere, and in addition to those required for Clyde-built ships, the engineers have constructed 24 sets of machinery of 20,880 i.h.p. for vessels built in other ports, and have also refitted 10 steamers with triple expansion instead of the ordinary compound engines of 15,275 i.h.p.

The estimated value of the ships built on the Clyde during the past year may be put down at about £7,500,000, compared with £5,600,000 in 1888, £4,400,000 in 1887, £4,100,000 in 1886, £4,000,000 in 1885, £7,000,000 in 1884, and £10,000,000 in 1883. In the last-named year the tonnage was 419,664 and the horse-power about 315,000, and prices were even higher than they are at present.

The prospects for the present year on the Clyde are very good, there being now in the various yards, and in different stages of construction, 166 vessels, aggregating 300,629 tons, the whole of which will be launched during the year, and in itself represents a good average year's output.

In Dundee, from which shipbuilding had almost disappeared during the depression of 1885-87, there has been a great improvement. In 1888 there were 8 vessels, with a tonnage of 11,197, launched. Last year there were launched 13 vessels of 17,668 tons, and about the same amount remains on hand.

In Leith the past year has been one of the best in the history of the trade, there having been constructed 17 vessels, with an aggregate of 17,776 tons; and one of these, by Messrs. Ramage & Ferguson, was the largest vessel yet built in the port, being of 3,300 tons, and fitted with engines of 1,800 i.h.p. She was built to the order of Messrs. Money Wigram & Co., of London.

In Aberdeen there were launched 11 vessels, of 9,380 tons, the largest number and the greatest tonnage turned out at the port since 1883. At some of the smaller ports a considerable number of smaller craft were built, but nothing calling for special notice.

IRELAND.

In Ireland, Messrs. Harland & Wolff, of Belfast, launched 12 vessels, of an aggregate tonnage of 56,430, and 51,800 i.h.p. The two most important of these were the White Star liners, "Teutonic" and "Majestic." Of the 12 vessels built by this firm, it is remarkable that they were all above 3,000 tons, which shows that there is a tendency for the sizes of ordinary merchant steamers to increase. Messrs. Workman, Clark, & Co., of Belfast, constructed 6 vessels, 1 sail and 5 steam, the tonnage being 21,112 and the horse-power 9,800: while the new firm of Messrs. MacIlwaine & Maccoll, also of Belfast, made a fair start with 4 steamers of moderate size, 2 small sailing vessels, besides reboilering and compounding 2 vessels. At Londonderry Mr. Charles J. Biggar, Foyle Shipyard, launched 5 vessels, aggregating 7,268 tons.

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CIVIL ENGINEERING.

First among the engineering works completed during the year 1889, both as regards magnitude and skill in design and execution, stands the Eiffel Tower. As to its utility, there may, from the general point of view, be some question, but there can be no doubt whatever that it constitutes one of the most remarkable monuments of constructive ingenuity ever achieved. To its promoters, too, it has proved an extremely useful instrument for the transfer of wealth from the pockets of the French and cosmopolitan public visiting Paris to their own; whether, while being instrumental in redistributing wealth, it has tended to equalise it, is quite another matter. To the Eiffel Tower it also seems probable that the sincerest form of flattery will be accorded, as both in this country and in America designs for rival towers have been or are being prepared. While it is probable that these will exceed their prototype in mere size, it is extremely unlikely that they will excel it in elegance of form or constructive skill, and at the best will take a second rank as mere imitations without the same excuse for their existence as the original. Of the Eiffel Tower such a full account has appeared in our columns that any recapitulation of the leading particulars is here unnecessary. As is our usual practice, we shall review under their respective headings the various branches of civil engineering.

Bridges.

The Forth Bridge is now approaching final completion, and as yet no rival undertaking of a similar kind has any prospect of being carried out in the immediate future. We have kept our readers so fully informed of the progress of this great work that any further reference here is unnecessary.

In England, no large bridges of any importance have been completed within the year now coming to a close, and the only new topic of interest in connection with this branch of engineering is the proposed Channel Bridge. Whether this gigantic scheme ever gets beyond the paper stage is a matter on which we should not care to commit ourselves to a definite prophecy. There certainly are some objections to the execution of such a project, quite apart from the engineering difficulties, which, given time and money, would probably not be insuperable. We think those interested in shipping may protest against the construction across a crowded water-way of a series of obstructions at intervals of less than a third of a mile. It has, we believe, still to be shown how, when constructed, the money necessary to realise a reasonable profit on the capital expended and pay interest during construction is to be earned. The estimated cost of the bridge is £34,000,000; to pay 3 per cent. only on this would require £1,020,000 per annum, in addition to the cost of maintenance and working expenses, which latter would probably have to include those necessary for keeping powerful lights burning on each of the piers.

A scheme for a new bridge across the Clyde at Glasgow has for some time been under the consideration of the authorities. Various suggestions have been made, but a proposal of a definite character has recently been placed before the Clyde Trustees by Mr. Wm. Arrol, the contractor for the Forth Bridge. According to this proposal, the river is to be crossed, at Finnieston, by a single span of 430ft., with a roadway 100ft. above the top of the quay wall. The approach would be by an incline 2,000ft. in length, with a gradient of 1 in 20. The width of the roadway would be 40ft. and that of the footpath 10ft. Under this bridge large vessels could pass by lowering their topmasts.

The Manchester, Sheffield, and Lincolnshire Railway Company have built a new bridge over the Dee at Connah's Quay. It consists of two spans of 120ft. each and a swing girder giving a clear waterway of 140ft. on one side and 80ft. on the other.

Among large bridges recently completed abroad may be mentioned the Sibley Bridge, over the Missouri, on the Chicago, Sante Fé, and California Railway. This structure includes three spans of 400ft. each and one of 250ft., while the total length of iron bridge is 3,900ft. The main spans of 400ft. are chiefly of mild steel and the remainder of wrought iron.

Over the River Hudson at Peekskill a bridge is being built, the foundations of which are now nearly ready. This bridge will have a span of 1,620ft., and be of the suspension type, with cables of crucible steel, without joints, welds, or tucks.

Canals.

Many of the projected canals to which we referred in our review of civil engineering for last year still await inception, while in the United Kingdom no new work of this description has been commenced. The Manchester Ship Canal progresses steadily, and to this great work we devote a special article. To the list of proposed new waterways must now be added the canal from the Forth to the Clyde. Two alternative schemes for this have been brought forward; one for deepening and widening the existing canal, the other for an entirely new canal which would include part of Loch Lomond, and utilise the river Leven from its junction with the Clyde to the Loch, deepening it where required. The former suggestion finds most favour. In Canada the ship channel from Montreal to Quebec was opened on November 7th, 1888, and has during the present year come into use. This work has been in progress for about fifty years, the channel having been from time to time deepened to meet the requirements of vessels of increasing tonnage. The depth is now 27½ft., and the minimum width 300ft. A very large proportion of the work has been through the marshes and shallows of the Lake of St. Peter. Another canal in progress is the Kootenay Canal, connecting the south end of the Columbia Lake with the Kootenay River. When completed this will establish communication by steamer between the Columbia River and the fertile Kootenay valley, which has hitherto been shut off from the rest of the world by the absence of adequate means of transport. The length of the channel will be about 1¼ miles, with a lock between the Kootenay River and the lake, the latter being 11ft. lower than the former. In Japan, a canal is being constructed to supply Kioto, the ancient capital of Japan, with water from Lake Biwa, about seven miles distant. The water is intended mainly for irrigation and manufacturing purposes, but there is no reason against its being used for drinking. Lake Biwa lies about 140ft. above Kioto. In the first instance the main canal will be employed for supplying the existing canals in the city, but subsequently a reservoir is to be made, from which water will be carried into Kioto by mains. Among other projected water channels may be mentioned one to unite the Kattegat with lake Venern. The length will be about 12 miles, including 4 miles of lakes, and the depth 21ft., allowing the passage of vessels of 3,000 tons. The scheme for making Paris a seaport has not, we believe, so far assumed any very definite shape.

Work has recently been commenced on the Nicaragua Canal, of which we quite recently gave an account.

Dock and Harbour Works.

On the 18th of July last the Barry Docks at Cardiff were formally opened. In our review last year we gave a brief account of the leading features of this important work, and more detailed particulars in connection with the account of the opening in our issue of July 26th, 1889. The total area open is 557 acres, and at low tide vessels of 16ft. to 17ft. draught can enter through the gates. At Glasgow new docks are in course of construction, the present accommodation for vessels having been found insufficient. These new docks comprise three parallel basins, each 200ft. in width; the length of the water area is 2,000ft., the extreme width 1,100ft. For Ardrossan Harbour, an additional wet dock, 9 acres in extent, is being constructed, which at high water will have a depth of 27ft. Outside this is formed a tidal basin of 5 acres area, with 18ft. of water at low and 27ft. at high tide. Besides these, a new breakwater is being built for protection against the north-west gales; this will have a length of 2,000ft., is 28ft. wide at the bottom, and is composed entirely of concrete. New quays and quay walls are being added, and the entrance channel deepened. The old wet docks have an area of only 4 acres, with a depth of water of 18ft. At Hartlepool the new marine promenade and headland protection works were lately opened. They were built to protect the cliff against the action of the sea, by which it was being rapidly undermined. The works consist of a concrete wall formed along the face of the cliff, to a height of 17ft. 8in. above the high water mark of ordinary spring tides. The length is 3,400ft., the minimum width 20ft. Among harbour improvements abroad, those now approaching completion in Calais Harbour deserve notice. This work was commenced in 1876, and has ever since then been in progress. The chief improvements consist in a new outer harbour basin of about 15 acres, a floating basin of about 30 acres connected by locks with the former, and a sluicing reservoir with a present area of 35 acres at ordinary high tides. By dredging and sluicing a minimum depth of 10ft. is maintained at the lowest tides, while at high tide the corresponding depth is 36ft. For a distance of 1,300ft. beyond the jetties the outer channel has been deepened by about 12ft. For this purpose, between January, 1883, and December, 1888, about 1,152,000 cubic metres of sand were removed. Throughout the harbour hydraulic machinery is employed for working sluices, lock-gates, swing-bridges, capstans, &c., the power being supplied from a central station on the quay. The entrance to the locks connecting the outer harbour basin with the floating basin is crossed by four swing-bridges; two with spans of 91ft. 10in. each, and two with spans of 68ft. 10in. each. For the improvement of the port of Havre very extensive works are contemplated, the chief of which will be a new entrance in deep water and an extension of the dykes in the Seine, together with breakwaters to protect the entrance from the violence of the waves.

Railways.

In this country no railway enterprises of any magnitude are now to be expected, and any work of this kind that may be carried out is chiefly in the nature of improvements or short branch lines. Nevertheless, it seems not improbable that there is a greater scope for new undertakings in this direction than is generally imagined, more particularly in the matter of providing cheap mineral and goods transport by special lines equipped with rolling stock of great individual carrying capacity. With this, however, we cannot at present concern ourselves, but must return to the consideration of work accomplished. The Lancashire and Yorkshire Railway Company have in the present year completed an extension which enables them to have a fast express service between Liverpool and Manchester by avoiding the detour through Wigan and Bolton. The new line passes through Pemberton and Pendleton, at which latter place it departs from the previously existing railway system. On this length of railway there are no steep gradients or sharp curves, but it involved in other respects some rather heavy work, including ninety-three substantial bridges. The work was commenced in April, 1885. The cost has been about £750,000. Early in last June the new Fulham and Wimbledon Railway, forming part of the South-Western Railway Company's system, was opened for traffic. The total length is about four and a half miles, and includes a fine trellis girder bridge over the Thames, besides other heavy work in the shape of cutting tunnels and embankments. The Metropolitan District Railway Company has running powers over the new line.

Turning our attention from the mother country to her colonies and foreign possessions, we find that in Canada the Grand Trunk Railway has doubled its main line between Montreal and Toronto at a cost of £41,410, while a short new branch, the South Norfolk Railway, 17 miles in length, has been constructed from Simcoe to Port Rowan on Lake Erie. The Northern Pacific Railway from Tacoma on Paget Sound to Duluth on Lake Superior has already commenced the construction of a series of railways in Canada to form an outlet from the wheat-growing country in the North-West to the Atlantic, thus competing seriously with the Canadian Pacific Railway. This activity on the part of the Northern Pacific Railway Company gave rise to the dispute which occurred not long since in Manitoba, which was decided against the Canadian Pacific Railway. Three lines are either finished or in course of construction in Manitoba: one from Winnipeg City due south to the international boundary, 65 miles in length; a second branching off from this south of the Assiniboine River, and then running due west to join at Portage the Manitoba and North-Western Railway, length 65 miles; and, thirdly, a line commencing 20 miles north of the frontier, and establishing communication with the North-West Central Railway now being built. This new line, 130 miles long, will cross the Canadian Pacific, taking generally a north-westerly direction. In British North America, including Novia Scotia, about 400 miles of railway have been laid in 1889.

In the United States over 3,000 miles of track were constructed during the period from January to October of 1889.

In India, the largest piece of railway work now in hand is the Bengal Nagpur line, which, when completed, will very materially shorten the journey from Bombay to Calcutta. Another line, which is rapidly progressing, is the Villupuram-Dharmavaram State Railway, 301 miles in length. Besides these numerous short extensions are in hand. In Burmah a survey is being carried out for a railway up the Mu Valley from Sagoing, 10 miles below Mandalay on the right bank of the Irrawaddy, to Mogaung, with branch line to Bhamo.

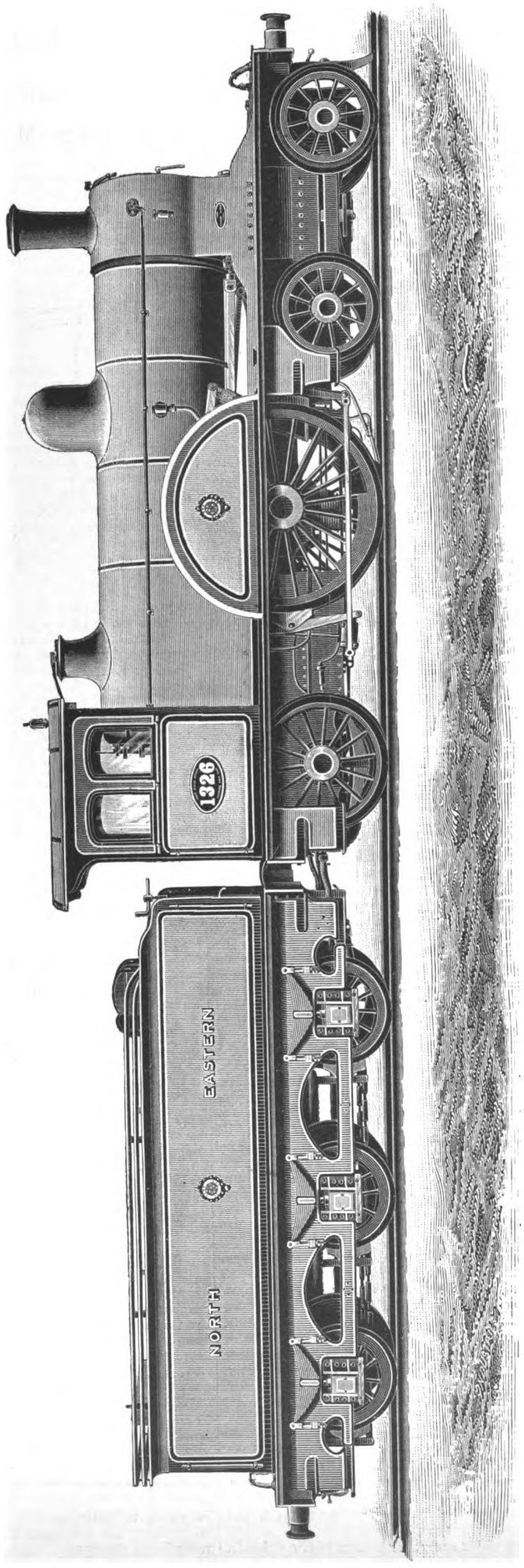
Throughout the Argentine Republic, railway construction has been prosecuted with great energy during the present year, and numerous new concessions have been granted. The Government refuses, however, to give further guarantees, but in spite of this new enterprises are taken up. An extension of the Northern Central has been opened beyond Tucuman as far as Chilias, and branches to Chilicito and Catamarca are in course of construction. The line from Mendoza towards Valparaiso continues to make progress.

In Japan the whole of the railway system connecting Tokio, Yokohama, Kioto, and Osaka, has been opened for traffic for a length of 278 miles. In the mountainous district near Fusigama the works are heavy, comprising numerous tunnels and many bridges. The largest and most important of the bridges is the Tenriugawa bridge, which has 19 spans of 200 feet each. The total length of the railways now open in Japan is 752 miles, while there are 455 miles under construction and 216 miles being surveyed.

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COMPOUND PASSENGER LOCOMOTIVE.

BUILT BY THE NORTH EASTERN RAILWAY COMPANY, FROM THE DESIGNS OF MR. T. W. WORSDELL, M.I.C.E., LOCOMOTIVE SUPERINTENDENT.



The detail plans are now ready for a new Alpine railway up the Säntis in the canton of Appenzell, in Switzerland. This line will rise from 2,600ft. to 6,700ft. above the sea level, will have a length of 9¼ miles, and a maximum gradient of 24 per cent. The first portion of it, for about four miles, will follow the valley, and on this section ordinary locomotives, working by adhesion, will be used, but on the remaining portion a rack locomotive will be required. A proposal for a railway up the Säntis was brought forward many years ago, but the concession was only granted in 1887. The latest project for a mountain railway is the scheme for the ascent of the Jungfrau, the audacity of which we are compelled to admire, whatever may be our opinion as to its æsthetic aspects or necessity.

COMPOUND PASSENGER LOCOMOTIVE.

DURING the meeting of the members of the British Association last year at Newcastle various excursions were made, and one of the most interesting was that to the North Eastern Railway Works at Gateshead. We referred to this excursion in our issue of the 4th October last, and promised to give an illustrated description of the largest and most recently built compound express passenger engine, as made from the patented designs of Mr. T. W. Worsdell, M.I.C.E., the locomotive superintendent.

This we are now enabled to do through the courtesy of Mr. Worsdell, and in our two-page supplement this week we show a sectional elevation and plan of this engine, while on this and the next page we give a general view and a transverse section of the engine respectively. The general particulars are tabulated below:—

	Ft.	In.
High-pressure Cylinder:		
Diameter of cylinder	1	6
Stroke of piston	2	0
Length of ports	0	11¾
Width of steam ports	0	1¾
„ exhaust ports	0	3½
Distance from centre line of cylinder to valve face	1	1
Slide valve, Trick pattern, ports ½in. wide	0	0½
Lap of slide valve	0	1⅛
Maximum travel of valve	0	5¼
Lead of slide valve	0	0 3/16
Inside clearance of valve	0	0¼
Distance apart of cylinders, centre to centre	2	0
Distance apart of slide spindles, centre to centre	2	0
Low-pressure Cylinder:		
Diameter of cylinder	2	2
Stroke of piston	2	0
Length of ports	1	5
Width of steam ports	0	2
„ exhaust ports	0	3½
Centre line of cylinder to valve face	1	5
Lap of slide valve	0	1⅛
Maximum travel of valve	0	5¼
Lead of slide valve	0	0 3/16
Inside clearance of valve	0	0⅛
Motion:		
Diameter of piston rods	0	3
Length of slide blocks	1	3
„ connecting rods between centres	6	1
Wheels (cast steel):		
Diameter on tread (bogie)	3	7¼
„ „ (driving)	7	1¼
„ „ (trailing)	4	7¼
Thickness of tyres on tread	0	3
Width	0	5½
Crank Axle (steel):		
Diameter at wheel seats	0	9
„ bearings	0	8
„ centre	0	7¾
Distance between centres of bearings	3	10
Length of wheel seats	0	7 7/16
„ bearings	0	9
Diameter of crank bearings	0	8¼
Length „	0	5
Distance between centres of cranks	2	0
Bogie Axle (steel):		
Diameter at wheel seats	0	7½
„ bearings	0	6
„ centre	0	5¾
Length of wheel seats	0	7¼
„ bearings	0	9
Distance between centres of bearings	3	7
Trailing Axle (steel):		
Diameter at wheel seats	0	8⅓
„ bearings	0	7
„ centre	0	6¾
Length of wheel seats	0	7⅜
„ bearings	0	11
Distance between centres of bearings	3	8

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COMPOUND PASSENGER LOCOMOTIVE.

Built by the North Eastern Railway Company, from the Designs of Mr. T. W. Worsdell, M.I.C.E.

	Ft.	In.
Frames (steel):		
Front centre of bogie to front buffer beam	5	3
Centres of bogie wheels	6	6
From centre of bogie to centre of driving wheels	10	0
From centre of driving wheels to centre of trailing wheels	8	8
From centre of trailing wheels to back end of frame	3	3
Distance apart of frames	4	0
Thickness of frame	0	1
Distance apart of bogie frames	2	8
Thickness of bogie frames	0	0¾
Boiler (steel):		
Height of centre of barrel from rails	7	8
Length of barrel	10	7
Diameter of barrel outside	4	3
Thickness of plates	0	0½
„ smoke-box tube plate	0	0⅝
Pitch of rivets	0	1⅞
Diameter of rivets	0	0⅞
Fire-box Shell (steel):		
Length, outside	6	0
Breadth, outside at bottom	3	11
Depth below centre line of boiler	5	0
Thickness of throat plate	0	0⅝
„ sides and top plate	0	0 9/16
„ back plate	0	0 9/16
Pitch of copper stays	0	4
Diameter of copper stays	0	1
Roof stays, cast-steel, girder section		
Inside Fire-box (copper):		
Length of bottom, inside	5	3⅝
Breadth „ „	3	3
Top of box to inside of shell	1	3½
Depth of box inside	5	9½
Tubes (brass):		
Number of tubes, 203		
Length between tube-plates	10	11⅛
Diameter, outside	0	1¾
Thickness, No. 11 and No. 13 B.W.G.		
Height of chimney from rail	13	0

	Sq. ft.
Heating surface of tubes	1026·12
„ firebox	110·00
Total	1136·12
Grate area	17·23

Working pressure, 175lb. per square inch.

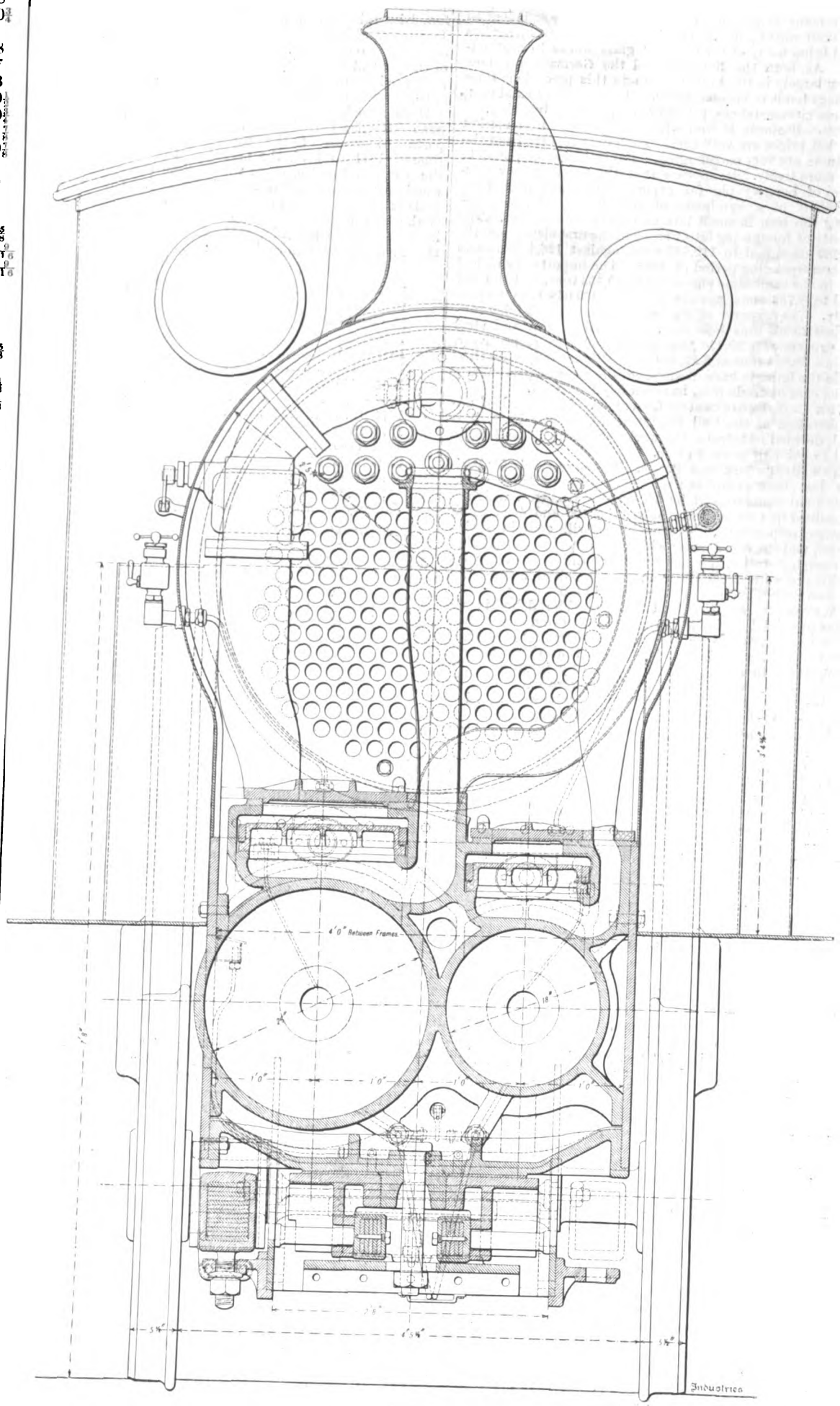
Weight of engine (empty):	Ton.	cwt.	qr.
Bogie wheels	13	14	0
Driving „	16	6	2
Trailing „	9	10	2
Total weight	39	11	0
Weight of engine (full):			
Bogie wheels	14	12	0
Driving „	18	0	0
Trailing „	10	5	2
Total weight	42	17	2

Tender.

Wheel base:	Ft.	In.
From front buffer beam to centre of leading wheels	4	2
From centre of leading to centre of middle wheels	6	4
From centre of middle to centre of trailing wheels	6	4
From centre of trailing wheels to back buffer beam	4	2
Wheels:		
Diameter of wheels on tread	3	9¼
Thickness of tyre on tread	0	3
Axles:		
Diameter of bearings	0	5
Length of bearings	0	10
Distance between centres of bearings	6	10
Frames:		
Distance between inside frames	4	1
Distance between outside frames	6	2¾

Capacity of tank, 3,038 galls.
Coal capacity, 4 tons.

Weight of tender (empty):	Ton.	cwt.	qr.
On leading wheels	6	8	3
On middle wheels	5	10	2
On trailing wheels	5	17	0
Total	17	16	1
Weight (full):			
On leading wheels	12	0	0
On middle wheels	10	0	0
On trailing wheels	11	16	0
Total	33	16	0



Transverse Section through Cylinders.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

(FOR LATEST TELEGRAPHIC DESPATCHES SEE PAGE 33.)

PARIS, 7TH JANUARY, 1890.

COAL.—The state of the coal market is giving rise to much anxiety. From all quarters we hear of a short supply. Here in Paris there is a serious scarcity, and in the provinces many large consumers have only just sufficient to keep their works going. The least interruption by strikes would bring many of the iron and glass works to a standstill. As both the Belgians and the Germans are now buying largely in the French markets this precarious state of things tends to become worse. It is needless to add that, in these circumstances, prices are constantly advancing.

IRON.—Business is somewhat slack in the iron market here, but prices are very firm. The latest reports from the provinces are very encouraging. Buyers seem disposed to deal more freely. It appears that the recent heavy purchases of Longwy pig for export to Germany were made on behalf of a syndicate of speculators, who are now selling the iron in small lots to German consumers. The imports of foreign pig into France in the first eleven months of 1889 amounted to 110,692 tons, against 126,401 tons in the corresponding period of 1888. The imports of finished iron in the same time amounted to 25,453 tons, and those of steel to 8,752 tons, against 32,100 and 9,038 tons respectively. The exports of pig iron amounted to 91,699 tons against 23,968 tons last year. Of finished iron and steel the exports were 59,220 tons and 29,759 tons respectively, against 30,034 tons and 13,359 tons. Hence it appears that, while the imports have diminished, the exports, particularly in the case of crude iron, have notably increased.

THE CAIL ENGINEERING COMPANY.—The board of administration of the Cail Engineering Company have, it is said, decided to transfer the works at Grenelle to Denain and Douai, half to each place.

NEW RESERVOIR FOR PARIS.—A new reservoir for Paris has just been completed on the heights of Montmartre, The total contents will be 11,000 cubic metres, which is contained in two separate bulks of 6,200 and 4,800 cubic metres respectively. One reservoir will contain spring water, and the other water which is pumped from the Seine. A pumping station is being erected at the base of the hill to lift the water from the Seine, the installation consisting of two Corliss engines of a total of 140 h.p.

ACCIDENTS WITH STEAM PLANT.—The delay in the issue of official statistics is proverbial. From the returns of boiler and steam engine accidents during 1888, which have just been published, it appears that there were 17 explosions, 19 persons killed, 9 seriously injured, and 12 slightly hurt. Of the 17 explosions, 9 were caused by defective construction, 5 by negligence or imprudence, 2 by unpreventible accidents, and 1 by an unknown cause.

A NEW SUBMARINE BOAT.—Further particulars are to hand regarding M. Apostoloff's new submarine boat. The boat is 28m. long and 3·25m. in diameter, and it has accommodation for 20 to 25 persons. It consists of two shells. It can descend to a depth of 22 metres, and the supply of air will allow of a submersion of 38 hours. At a depth of 20 metres the speed is 12 knots per hour. A new electromotor has been specially designed for the boat, but no information is obtainable regarding its construction.

BERLIN, 6TH JANUARY, 1890.

GERMAN IRON ABROAD.—The German export trade in iron was fairly active in the month of November, the total, as shown by the Customs returns, being fully up to the average for the season. The following classified record shows the quantities for the month, and also for the eleven months of 1889 ending with November: Pig iron, 11,962 (147,155) tons; old iron and scrap, 1,746 (31,544) tons; half-wrought iron and steel, 1,950 (19,194) tons; finished iron and steel, 20,780 (261,912) tons; wire, 13,118 (146,195) tons; wire nails, 3,479 (42,724) tons; rails, 11,920 (101,593) tons; other railway iron, 3,991 (48,133) tons; heavy castings, except ordnance, 1,800 (17,541) tons; other manufactured goods, except machinery, 10,607 (110,488) tons. Total, 81,353 (926,479) tons. The quantity of iron and steel wire shipped to great Britain in November amounted to 2,941 tons, making 31,284 tons for the eleven months. The shipments of wire nails to great Britain in the same period amounted to 810 tons and 11,518 tons respectively. Of the wire-nail exports, 8,938 tons were sent to Japan.

PRICES OF PHOSPHORIC SLAG.—As the value of phosphoric slag as a manure becomes known the demand increases and prices advance. The best possible evidence of the growing importance of the trade in this substance, formerly a waste product of the iron industry, is afforded by the rapid advance in prices in the year 1889. At the beginning of that year 38s. per ton was the quoted price. From this the price rose to 42s., 46s., 48s., 50s., and 51s. At the present time the market is firm at 51s.

PHOTOGRAPHIC EXHIBITION.—In the course of the present month an important national exhibition of photographs will be held in Breslau, in which it is expected that English and American photographers will take a large part. Instantaneous photography is to be made a feature of this Exhibition. The papers to be read are likely to be of a very interesting character.

VIENNA, 6TH JANUARY, 1890.

THE COAL MARKET.—Circumstances have not changed, and the markets are in the same position as last week. The continued strike in the Westphalian collieries has had an important influence on the Western Bohemian district, where a strong activity is displayed. During the last week 17,629 waggons of Bohemian brown coal have been exported to Saxony.

THE IRON MARKET.—The feature of the iron market at the present moment is a scarcity which has not been equalled for many years. The animation is still sustained, and prices continue to tend upwards. The Bohemian foundries raised their prices by 25 per cent. on the 1st of January, and in other branches of the market a steady tendency is observable. It may be mentioned as indicative of the present prosperity that Messrs Ganz & Co., of Budapest, are intending to pay a dividend of 17 per cent.

RETROSPECT OF THE AUSTRO-HUNGARIAN COAL TRADE.—During the last thirty years the export trade of coals has gone through a period of steady increase. The most important increase of the export took place during the time of 1871 to 1875, the period of the establishment of the German Empire, since which time there has been a wonderful evolution of German industries. The import of coals has also increased considerably, a circumstance which is the best testimony of the amelioration of our home industries. The following table shows the development of the Austro-Hungarian coal trade:—

	Import. Tons (= 1000kg.)	Export. Tons (= 1000kg.)
1831–1835	14,285·7	2,219·6
1836–1840	20,442·5	14,123·7
1840–1845	32,551	37,141·6
1846–1850	47,470	54,201
1851–1855	102,363	85,523
1856–1860	183,227·8	184,393·5
1861–1865	325,673	342,516·8
1866–1870	576,412·7	753,415·7
1871–1875	1,598,467·8	1,751,796
1876–1880	1,858,498	3,285,307
1881–1885	2,407,612	3,902,687·5
Jan. 1886	2,721,279	4,504,509·7
„ 1887	2,874,756	4,747,988
„ 1888	3,150,936	6,120,542
January to August, 1889	2,195,408	3,607.742·5

ELECTRICAL ENGINEERING.—The electric lighting of Vienna progresses very slowly, and it meets with a great deal of influential opposition in all quarters. For instance, the project of the central station at Neubad, from which 60,000 lamps were to be supplied, has been before the public for six years, but up to the present time M. Fischer and Siemens & Halske have only been able to complete sufficient plant to feed 5,000 lamps. The project of Professor Engländer has not fared any better. It took him three years to persuade the authorities and the public in general as to the advantages of having a central station in Copernicus-Gasse. At present 12,000 glow lamps are being supplied from the station by means of five vertical high-pressure steam-engines and ten dynamos of various types. Accumulators are employed to equalise the day and night duties of the machinery. The whole installation is erected on very good lines, and it supplies a large number of important buildings. The International Electricitäts Gesellschaft are pushing on their central station. During the past year Messrs. Ganz & Co. have brought out an alternating current motor, a wattmeter, a new transformer for their high-power wattmeter, and an electric railway.

TELEPHONE TRUNK LINES IN AUSTRO-HUNGARY.—At the beginning of the year the telephone line was opened between Vienna and Budapest, a distance of 282 kilometres. This is the fourth line which has been erected between towns in the Austrian Empire, the others being between Vienna and Brünn, 177 kilometres; between Vienna and Reichenau, 115 kilometres; and between Vienna and Prague, 310 kilometres.

BRUSSELS, 7TH JANUARY, 1890.

THE COAL MARKET.—In spite of the great activity in the transport of coal over the Belgian railways, the consumers complain most bitterly of the irregularity of the supplies, and of the poor qualities of the coal and coke which is sent to them. Work at the rolling mills, the blast furnaces, and the glass works is thoroughly disorganised. If anyone wants a quick delivery of coal or coke he has to pay a tremendous price, varying widely at different collieries. During the past week the State Railways have transported 28,957 waggon-loads as compared with 28,409 during the same week of 1888. The position of the trade is much the same. The strike continues, and there does not appear to be any likelihood of an immediate resumption of work. The coal owners are determined to resist, and work will therefore be suspended until the men come round. There is no coal-getting being done in the Charleroi district, and English and German coal is therefore being imported, thus making it possible for some of the manufactories to be carried on. The strike is equally persistent in Liège, and the coal owners are very anxious. The collieries of the Société Cockerill have a great many strikers, but the directors rather than give in have ordered large amounts of coal from England and Germany, in order to keep their steel works going. Two vessels laden with American coal have arrived to supply the Charleroi district, but it is taxed very heavily.

THE IRON MARKET.—The scarcity of fuel has thrown the iron trade into a state of great perturbation, for many manufactories have been forced to cease work in the absence of coal and coke. The demands for iron are therefore beginning to be transferred to other quarters. The prices of all kinds of products are firm. Pig iron is well held; red short is quoted at 80fr., and good brands at 90–100fr. The sellers are trying to force the prices up still further, but it would be wiser to try to establish the present prices on a firmer basis.

GLASS WORKS.—No business has been done during the past week owing to holidays and strikes. If the coal strikes continue much longer the glass makers will have to cease work altogether, and so bring upon themselves an enormous loss. They are taking as many precautions as possible by ordering supplies of foreign coal, and are thus encouraging industries which have long been rivals to Belgian coal workers.

ELECTRIC LIGHTING IN BRUSSELS.—The municipal authorities of Brussels have determined not to grant the contract for lighting the city to the German firms, but they have not decided yet who is to have the contract. The solution of this problem, which gives so much trouble to the city fathers, is really very simple. Here there are two native electric supply companies—La Société l'Electrique and M. Rysselberghe—both of them of good reputation, and both capable and willing to do the work at advantageous terms for the public. Why the Council cannot decide the question is an enigma to reasonable beings.

THE BELGIAN EXHIBITION IN LONDON.—Arrangements are mostly completed regarding the Belgian Exhibition to be held in London during the coming summer. The private and public guarantee funds amount in all to 600,000fr. The Belgian committee have settled all the points of dispute with the English executive, and are able to include the transport charges from Belgium to London in the fee for letting the space in the Exhibition.

DÜSSELDORF, 7TH JANUARY, 1890.

COAL.—The course of events tends to increase the scarcity of coal in this district. Consumers of Belgian coal are buying German produce now that the output of the Belgian pits is interrupted by the strike, and the influenza has diminished the production of the German pits fully 20 per cent. The effect on prices has shown itself in a rise of 6d. a ton for coal and 1s. for coke. The coalowners in the Halle district have raised the price of briquettes to 14s. a ton. The new wharfs for Westphalian coal at Hamburg were opened to-day. The reduction of 5s. per 10-ton truck load to Hamburg came into operation on January 2nd. These are matters of great importance to the English trade in coal with Hamburg.

IRON.—The iron market is active again, and the prospects of trade in 1890 appear most encouraging. The Rhenish-Westphalian syndicate of rolled iron manufacturers have begun the year with an advance in prices, bars being now quoted 200s. a ton. The progress of the pig iron market in 1889 is set out in the following figures, which represent the price in shillings per ton on the last day of each month:—Spiegel, of 10 to 12 per cent manganese, 59, 62, 63, 63, 66, 66, 67, 70, 76, 77, 85, 102; Rhenish-Westphalian forge, 52, 54, 54, 57, 58, 62, 62, 64, 69, 72, 80, 92; Bessemer, 55, 55, 56, 59, 58, 58, 58, 59, 68, 72, 80, 95; Thomas, 46, 46, 47, 47, 47, 48, 48, 53, 58, 62, 69, 78; foundry No. 1, 61, 61, 63, 63, 64, 66, 66, 68, 72, 75, 85, 101.

HIGH PRICES FOR SALT.—The salt syndicate of Rhineland, Westphalia, and Alsace-Lorraine has advanced the price of salt 40 pfennigs (4¾d.) per sack.

COLLIERY COMPANIES.—The owners of collieries are taking advantage of the present state of the coal market to sell their properties to share companies. Several such companies are now being floated in this district. Changes of this sort must affect in an important degree the future of the coal mining industry.

LILLE, 7TH JANUARY, 1890.

IRON.—Though nominally bars are quoted 144s., few if any transactions take place at that price. The current rates are from 148s. to 152s. a ton, and the market is firm at that level. It is long since manufacturers' order books have been so well filled as they are now. In all cases there is work in hand for at least four months to come. A serious retardation of the production of the iron and steel works is, however, caused by the short supply of coal. Most works are running short time from this cause, and as there are no stocks at the pits the prospect is disquieting.

TEXTILE MANUFACTURES.—Brisk business at this season is not to be expected, but the turnover in linen goods in the last week is in some degree disappointing, inasmuch as it compares unfavourably with that of the corresponding week of last year. There are, however, plenty of indications of greater activity after the middle of the current month. The reports last to hand from Roubaix describe the situation of the woollen goods trade as exceptionally good, and manufacturers begin the year with bright prospects. The Calais tulle industry continues in a languid state, but the spring trade is expected to be good. Those who are in the best position to form a sound judgment regard the future with confidence.

COTTON AND JUTE.—The Customs returns indicate greater manufacturing activity in the cotton and the jute industries in 1889 than in the previous year. The declared value of the raw cotton imported in the first eleven months of 1889 amounted to £6,370,200, against £5,651,480 in

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1888. That of raw jute for the same periods is recorded in the returns as £833,840, against £649,040. The jute market is now very active, and exhibits a tendency to yet more vigorous life.

AMSTERDAM, 6TH JANUARY, 1890.

THE LABOUR QUESTION.—The first Chamber of the States-General will shortly discuss the Government proposal to prolong the inquiry by Royal Commission into the state of the working clssses in Holland, preparatory to special legislation on the subject. Upon the whole, the proposal has been well received by a Grand Committee of the House, although several members doubted the wisdom of making special legislation for the labouring classes, seeing that the evils complained of are not to be cured in that way. Others remarked that, if special legislation to benefit the working classes were the outcome of the proposed continued inquiry, it would be necessary also to pass an Act for the special protection of employers against the combination of workmen. Some members deplored the exclusion of field labour from the scope of the Commission's inquiry, although they knew that the Royal Commission on Agriculture is already inquiring into that class of work.

THE NEW WATERWAY AT ROTTERDAM.—In the year 1889, 4,271 steamers and 567 sailing vessels entered the new waterway at the Hock van Holland, whilst 4,246 steamers aud 563 sailing vessels were cleared outwards. This does not include fishing craft nor foreign tugs.

THE NORTH SEA CANAL.—During the past year 210 sailing vessels and 1,363 steamers entered Amsterdam from foreign ports, against 213 sailing vessels and 1,353 steamers in 1888.

NEW WATERWORKS FOR AMSTERDAM.—The summer season of 1889 was remarkable in the Dutch capital for its dearth of water for domestic purposes. This water is brought into town from the dunes around Haarlem, by a company, which, partly with English capital, started in 1855, and has been extending its reservoirs and water-pipes ever since, in order to keep pace with the wants of a city that has doubled the number of its inhabitants in the last twenty-five or thirty years. The company has a monopoly, in virtue of an exclusive concession, but its charter is now very stringent, and, when the water supply failed in the summer, and the management could give no satisfactory explanation, a committee of experts was appointed to make inquiry and report to the urban authorities. The committee has just issued its report. It finds that the company has not complied with the terms of its charter, that the collecting of water in the dunes is defective, because the pipes are not laid at a level to ensure the proper interception of all the available water; and, further, the committee states that the conduits between the dunes and Amsterdam are insufficient to carry all the water required, and that the proper supply has been kept down by the Hill Water Company by using a low pressure in the dunes. The committee proposes certain provisional measures, which will cost some £15,000, and which will tend to increase the water supply of Amsterdam. The report, however, points out that permanent measures are necessary, that the Hill Water Company must be compelled to carry out its contract in accordance with the concession, and that such cannot be done without giving the town authorities of Amsterdam the power to control the necessary pressure in the dunes, and see that it is maintained.

CO-OPERATIVE MARINE INSURANCE.—Four leading Dutch steamship companies have combined in the formation of a co-operative marine insurance fund, out of which all losses arising at sea for any of them shall hereafter be made good. This decision has been come to after the serious disasters that have befallen our steamboat undertakings lately, the Netherland American and the West Indian Steamship Companies both losing their finest vessels, almost simultaneously, by collisions in the Channel. These losses have proved very heavy. The former undertaking has since replaced the "Leerdam," gone down, by purchasing the steel-built steamship "Arabic" of the Oceanic Steam Navigation Company, Limited, in Liverpool. She was constructed in the year 1881, at Harland & Wolff's, in Belfast. Her future name will be "Spaarndam," and she is intended for the North American mail service.

METHYL SACCHARINE.—What is methyl saccharine? The Dutch Government does not pretend to know the secret of its manufacture. It only knows that it resembles saccharine, and that its sweetening powers are even greater. Consequently the Minister of Finance has drawn the attention of his Custom-house officers to the existence of methyl saccharine, and given instructions to tax its import as a drug or spice, with an *ad valorem* duty of 5 per cent., keeping a strict watch on the quantities imported, and noting the country it comes from, the makers, and the names of the senders and addressees.

TELEPHONIC COMMUNICATION IN HOLLAND.—In the course of the month the Dutch Bell Telephone Company will give a great extension to the system in different provinces after laying special new lines between Amsterdam and Haarlem, Amsterdam and Zaandam, Rotterdam and Dordrecht, &c., in accordance with the Government regulations regarding their construction. After the completion of these supplementary lines, towns not hitherto in telephonic communication will be brought into direct contact, and Dordrecht will be able to converse with Haarlem, and Zaandam with Rotterdam and the Hague. The uniform charge for the use of these telephones is to be 50 Dutch cents, or 10d., for three minutes' talk on the instrument.

TELEPHONES AT AMSTERDAM.—On the 1st of January 1888 the telephonic system at Amsterdam had 1,490 subscribers, against 1,368 on the 1st of January, 1889. About 53,500 communications were booked there in the past year, and 41,000 telegrams forwarded by telephone.

TELEGRAPHS AT AMSTERDAM.—In 1889 the chief telegraph office at Amsterdam received and forwarded 412,343 messages, delivered 523,219 messages, retransmitted 1,633,655 messages, whilst 393,751 messages went, viâ Amsterdam, from England to Germany and from Germany to England. Fourteen sub-offices treated 438,445 messages besides.

OMNIBUS WAR AT AMSTERDAM.—The two rival omnibus and tram companies of Amsterdam are now waging an open war. The public is the gainer, as the price of tickets has fallen to a little over a penny for any distance in town, including a change of cars, as in Paris; but those that do not buy their tickets beforehand have to pay 2½d. in cash.

COPENHAGEN, 4TH JANUARY, 1890.

PUBLIC WORKS IN SWEDEN.—The Department for Roads, &c., in Sweden will soon have been in existence for fifty years. Several interesting particulars about its work have recently appeared. On new roads they have expended about £1,000,000 in wages, and no less than 878 different roads have thus been made or improved. The area of land reclaimed or otherwise improved amounts to 302,738 hectares, divided into 1,102 different undertakings, and entailing a cost of labour of £1,100,000. Of other land, arable or forests, 28,081 hectares have been treated, at a calculated cost of £300,000. During the same period 58 bridges have been built and 21 canals have been made, as well as 88 harbour works, 7 docks, and one river extension for the floating down of timber.

ELECTRICITY AND GAS.—The question of gas and electric light in Stockholm has now advanced another step, inasmuch as the Corporation, without the slightest hesitation, have voted the two grants for £30,000 each for the commencement of a new gasworks and a new electric central station. In Gothenburg a large new gasworks is in the course of erection; the calculated cost is £50,000.

ICE BREAKING STEAMERS.—Ice breaking steamers are coming into extensive use. The Motala Engineering Company, Sweden, has received a new order from the Aalborg harbour authorities, Denmark, for an ice breaker to be used over the Limfjord. She is to be 90ft. long, 19½ft. broad, and 8ft. deep, and the engines are to indicate 260 h.p. She is to be fitted with powerful pumps, &c., so that she can be used also for tug and salvage service. The same firm have just secured another order for a 1,400 tons cargo steamer from Messrs. Anderson & Lindholm, Gothenburg. She is to have triple expansion engines, and will be built of Motala plates.

SWEDISH BREWERIES.—The Stockholm Brewery, St. Erik, which has been much coveted both by English and German capitalists, has now passed into the possession of a Swedish company, Svenska Brijggeriaktiebolaget. The selling price is 4,050,000kr., but this does not include outstanding accounts, &c. In Copenhagen an amalgamation of a number of breweries is understood to be under contemplation, and the shares of the less successful ones have accordingly improved somewhat in their quotation. Nothing reliable has, however, transpired, and there would no doubt be several difficulties in the way of completing the plan in its full extent, the more so as the majority of Danish breweries are doing very well.

DANISH BREWERIES.—Danish breweries vary greatly as to their financial results. While some do exceedingly well, others are by no means in such flourishing condition. The Marstrands Breweries, Copenhagen, held their annual meeting a week or two ago, when no dividend was declared. The expenditure for coal and other raw materials was about 60,000kr. in excess of the previous year, and the sale of "Bavarian beer" considerably smaller. Export had taken place to Brazil and the Argentine Republic. The gross profits amounted to 170,573kr., besides 8,343kr. for rents, but after deducting the various expenses, only a balance of 2,787kr. was left, which was carried forward to next year's account. As a somewhat larger balance had been carried forward from the previous year, the last year has given an actual loss.

TEXTILE INDUSTRIES IN SWEDEN.—A large new manufactory for zephyr and tricot wools is approaching completion at Boras, Sweden. It is, to a great extent, built on the German system. The main hall is 44ft. long and 35ft. broad. The chimney is 152ft. high. The special machinery is from the German firm of N. Schumberger & Co. The manufactory is the first of its kind in Sweden, and belongs to the Göta Company,

LAND RECLAMATION. — Another land reclamation scheme is contemplated in connection with the Helgea River, Sweden, where 4,000 hectares of land will be drained through the medium of extensive dams, pumpings, and dredgings. This will probably necessitate the Helgea River being made deeper for a distance of some 34 kilometres, and a committee has been formed for the purpose of thoroughly investigating the matter.

THE COPENHAGEN WATERWORKS.—These works are about to be considerably extended, and tenders for the machinery, engines, boilers, pumps, &c., were invited some time ago. Danish engineering circles have naturally been considerably interested in the result of this competition, and general satisfaction is evinced at the bulk of the large orders going to the leading Danish engineering establishment—viz., Burmeister & Wain's Engineering and Shipbuilding Company, Copenhagen. This firm has secured the order for all engines, &c., in spite of severe competition from several large foreign firms. The firm of Babcock & Wilcox have got the order for the boilers, no Danish firm being in a position to comply with the conditions of the tenders in this respect.

NEW YORK, 27TH DECEMBER, 1889.

THE COAL MARKET.—There has been no improvement in the anthracite coal trade. The yards are full of coal and the weather is as mild as spring, so that there is little prospect of improvement. The situation is gloomier than at any time this winter. The Reading Company, after holding out as long as possible, has been forced to work only three-quarter time. A discouraged feeling pervades official circles, and predictions of worse times are heard among the less enthusiastic. Among the dealers the situation is about the same. There are few orders and no immediate prospect of more. Shipments to the East are small, and those to the West are no better. The only demand anywhere in the trade is for furnace and steam coal, and notices that these grades are to be advanced in price have caused large consumers to put in big orders ahead.

THE IRON AND STEEL MARKETS.—The iron trade is in about as good a condition as could be desired. Prices continue firm, with indications towards higher prices; the demand is fully up to the supply, and all the concerns have as many orders on hand as they care to book. There is no definite opinion as to the probable course of the market, and each firm engaged in the business seems to be acting on their own opinion as to the future of the trade. If the present demand continues, prices are pretty sure to advance, as the cost of materials has been steadily advancing. The general course of action seems to be to buy what is needed, or sell what is ready for the market, but to place or take no orders that would place the operator at a disadvantage on a sudden change of the market either way. The pig iron market is strong, with prices practically the same as for the last three weeks. The demand for foundry purposes is not quite so heavy, and millowners are pretty well supplied for the present, but there are still some heavy orders to be placed that sellers do not care particularly for unless at high figures. In manufactured iron but little business has been entered during the past couple of weeks. This does not mean that the demand has fallen off, but that sellers are inclined to ask higher prices than buyers are willing to pay unless they are satisfied they cannot to better. All early needs seem to be provided for, and the market is a waiting one. Bars are steadier, and prices are 1·95c. per lb. in carload lots. Plates are firmer, but not much in the way of orders have been booked. Prices are 2·3c. for iron and 2·5c. for steel. Steel rails are firm at $35 per ton at mill for large lots, and $36 for smaller ones. Sales for delivery during 1890 amount now to about 750,000 tons. There is a good demand for billets, with sales at about $37 per ton.

STEEL SHIPS ON THE LAKES.—The project of a great shipbuilding industry on the banks of the Calamut has at last taken definite shape, notwithstanding the denials of the officials of the Illinois Steel Company that they had in contemplation such a project. The Globe Iron Works of Cleveland, Ohio, the most extensive builders of steel ships on the great lakes, have joined hands with the Illinois Steel Company in the organisation of a company to build steel ships in Chicago. The new corporation is to be known as the Chicago Shipbuilding Company, and six steel steamers will be on the stocks in its yards within a few months. The yards will be on the east side of the Calamut river in South Chicago. It is not intended to put in boiler and machine shops immediately, but this will be done before long, as also a dry dock.

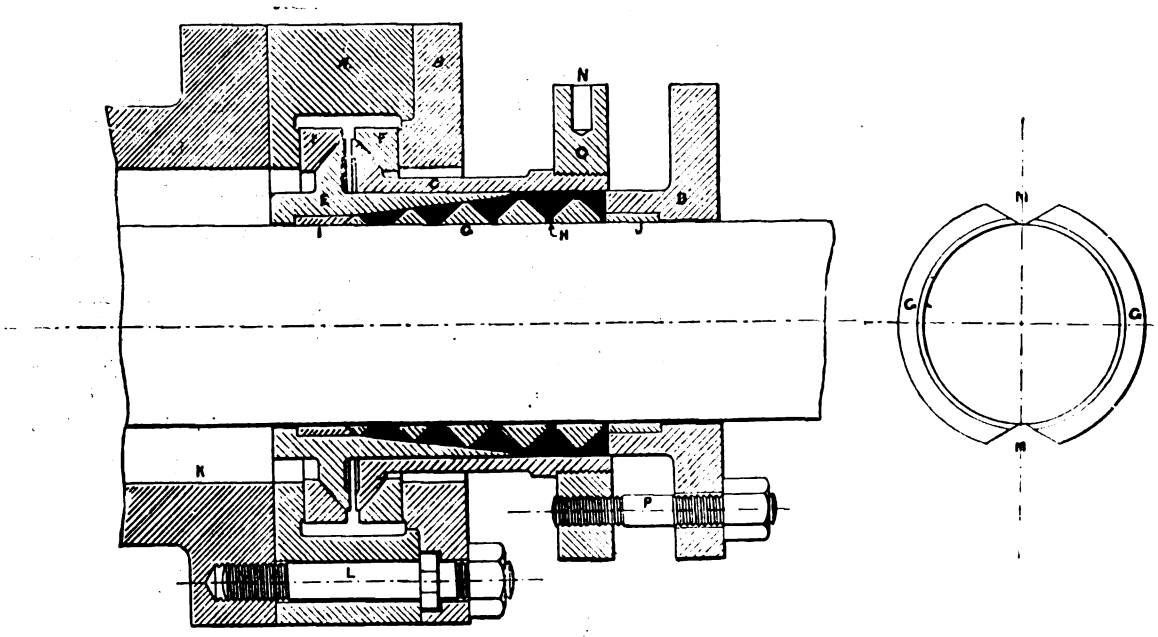
ALASKA SEAL FISHERIES.—Secretary Windom has decided not to renew the lease of the Alaska Commercial Company of San Francisco, which has had the monopoly of the Alaska seal fisheries for twenty years. The Secretary has taken steps to give any responsible bidders an opportunity to obtain the lease, and will advertise for bids. The advertisements will be issued in a few days, after the form of contract is made up and approved. It will be substantially the same as that under which the present lessees have been operating, there being a limit as to the number of seals which can be killed during the season.

SUGAR.—Offerings of raw sugars have been greater than current needs, and prices have ruled easy in consequence. Refined is quiet and ⅛c. lower per pound. The report that the sugar trust has prepared to transfer its assets to a new corporation if the Court of Appeals pronounces the trust illegal seems to mean that it will take advantage of the charter of the Commonwealth Refining Company, of Hartford, which is broad enough to cover any sort of business the trust might want to engage in. This company has the right to own and conduct sugar factories and refineries, and to transact business of all kinds appertaining to sugar, including the "holding of stock of corporations having relating to sugar refining for parties interested therein, with all the rights of owners, and certificates of interest therein to issue to parties entitled thereto, and to acquire, purchase, receive, in trust or otherwise; hold, grant, sell, mortgage, lease, and otherwise dispose of all kinds of property, real, personal and mixed, whether in the State of Connecticut or elsewhere."

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CONSTRUCTED BY MESSRS. J. & E. WOOD, ENGINEERS, BOLTON.



LONGITUDINAL SECTION. END VIEW OF RING.

THE PROGRESS OF THE MANCHESTER SHIP CANAL DURING 1889.

THE progress of the construction of this great work during the last twelve months has been very marked, and it bears ample testimony of the indomitable energy, perseverance, and practically illimitable resources of the eminent contractor whose death it was our painful duty to record a few weeks ago. Throughout the whole length of the works—35 miles in extent—everything is in a very forward state; and, while the contractor has been vigorously pushing forward the work, he has not been unmindful of the needs and comforts of his men; for along the line of work places of worship, reading and recreation rooms, hospitals, stores, &c., have been erected for the special use of the men and their families.

The amount of plant has been considerably increased during the last twelvemonth, and now consists of 163 locomotives, nearly 6,000 waggons, 96 steam navvies of English, French, and German make, 148 steam cranes, 250 pumping and other engines, and about 34 steam pile drivers; about 210 miles of temporary railway have been laid, and there are over 12,000 men and boys, and 180 horses employed upon the works. In addition to the above, concrete mixing machines are used for the formation of the concrete walls of the various lock pits, the machines being Carey & Latham's patent, made by Messrs. J. H. Wilson & Co., Sandhills, Liverpool, each machine being capable of mixing 20 cubic yards of concrete per hour.

The work on No. 1 section, from Eastham to Ellesmere Port, has made rapid progress, and the locks and the lock gates are very far advanced; a shed 200ft. long has been erected for the construction of the latter and lighted with electric light. There will be three locks at Eastham, one 600ft. by 80ft., one 350ft. by 50ft., and a small one next the river 150ft. by 30ft. In addition to the ordinary lock gates, storm gates will be provided. All the gates are made of greenheart. A very heavy cutting through the red sandstone has been made on this section, and where the stone was sound it was carefully quarried and used on various portions of the works. A large pumping engine has been at work on the lock pit excavation, and is one that was used on the Severn Tunnel works; the cylinder is 60in. diameter and has a stroke of 9ft., and actuates a pump 31in. diameter capable of lifting 300 gallons per stroke to a height of 85ft. In section No. 2, from Ellesmere Port to Ince, there is another very heavy cutting made through the red sandstone, which provides a much harder stone than that found in No. 1 section; the cutting is also the deepest in the whole length of the canal. An interesting feature in the Eastham section is the wall across Port Hall Bay, about one mile in length, and which has been the cause of litigation between the Mersey Docks and Harbour Board and the Ship Canal Company. According to the provisions of the Act it is necessary to have a number of openings left in the bank to enable the tidal water to flow in and out of the enclosed portion of the estuary during construction. The contractor, however—no doubt with the object of facilitating the construction of the bank and of the excavation for the canal inside—made the bank continuous, and so kept out the water. An injunction was applied for in the Court of Chancery to restrain the contractors from making a continuous bank, and after a long hearing it was granted. Still the opening was not made, and the Dock Board have again applied to the Court. The Ship Canal Company have also applied to Parliament for further powers to alter the construction of the works. It appears, therefore, likely that the important and interesting question of the *régime* of the estuary will be again fought out in the committee room. The piling across the foreshore from Stanlow Point to past the entrance to the port, a length of more than a mile, is steadily progressing. The important work of constructing the syphon to conduct the Gowy under the canal has been a difficult undertaking, and is now well advanced. The syphon consists of iron pipes 12ft diameter. In Section No. 3, from Ince to Weston Point, the important sluice works for regulating the waters of the River Weaver are far advanced, and consist of ten sluices having an opening of 30ft. width each. All the steel piers for carrying the sluice gates are erected, and the latter are now being riveted up. At Weston Marsh lock the fender course is being put in, and the excavations on the north side are making rapid progress. Over 1,300 permanent piles have been driven at Weston Point during the last nine months. In Section No. 4, from Weston Point to Norton, the progress of the work has not been so marked as in the other sections. A railway has been laid in the cutting for the convenience of the traffic to Messrs. Wigg Bros. & Steele's works—which was formerly carried on the Runcorn and Latchford Canal—so that this canal will no longer interfere with the construction of the work. A small portion of the concreting of the sea wall has been done, but the works on the Widnes side of the river have been stopped. At the Old Quay the work at the tidal openings is steadily progressing. In Section No. 5, from Norton to Latchford, the cuttings have proceeded satisfactorily, and a large quantity of stone is obtained from the Lower Walton and Acton Grange cuttings. The excavation of the Grappenhall Road, close to Latchford station, has commenced, and a substantial temporary bridge spans the cutting. In Section No. 6, from Latchford to Warburton, the point of interest is the Latchford locks and sluices, where the work is progressing rapidly. The pier foundations of the bridges to carry the London and North Western Railway deviation are nearly completed; the stone for these piers is obtained from a quarry near Chester, and is a light-coloured sandstone. The bridge over Bradshaw's Lane is completed, and several other road bridges are far advanced. Most of the canal in this section has been excavated its entire width and depth. Section No. 7, from Warburton to Barton, is in a forward state; the lock walls at Irlam are rising gradually, and the cutting of the canal is proceeding rapidly. The piers for the railway deviation bridges at Irlam and at Cadishead are in an advanced stage, some of them being several feet above the ground. The Warburton cutting passing through the Keuper marls is of interest to geologists, and was the scene of a disastrous landslip early in the year. Section No. 8, from Barton to Mode Wheel, is an important one, and the Barton locks on Sticken's Island are progressing rapidly. Near Hulme's lock a temporary river diversion is being made during the cutting of the canal through the site of the lock; when the cutting is completed the water will run in the old channel, and the diversion filled up. At Salteye the pitching of the banks has proceeded slowly, and the south bank of the river has been strengthened with piles. Most of the cutting is completed, and interest is centred upon the construction of the new bridges to replace the Barton and other bridges. Section No. 9, the terminal section, contains some of the most important works in the whole undertaking, and all of them are in a very forward state. The Mode Wheel locks are far advanced, and the Salford and Pomona Docks are so far ahead that the granite coping is being laid on some lengths of one of the docks which has been nearly excavated to its full depth—the excavations being made after the construction of the wall. A coffer dam is being constructed in the river at the entrance to the Pomona Docks. A large shed has been erected at Salford, in which the dock gates are constructed, and one large pair is nearly completed. The swing bridges which cross the canal at various points are in hand, and are being constructed by Messrs. Arrol Bros., of Glasgow.

The work from beginning to end is being pushed forward rapidly, and it appears very probable that it will be completed within the specified time, and the universal opinion of competent authorities is that the work is also being well and substantially done.

IMPROVED "UNIVERSAL" STUFFING BOX.

OUR illustration shows a cylinder stuffing box made by Messrs. J. & E. Wood, engineers, Bolton, the main feature of which is the perfect freedom which is given to the body of the box to adjust itself while at the same allowing no escape of steam. The construction is as follows:—The cast iron box A is bolted to the cylinder cover K, the joint being made by cement in the ordinary way. The cylindrical case or box C is formed with a ring at its lower end, the upper edge of which is bevelled to correspond with the upper ring F. An inner case E is similarly formed with a bevel surface engaging with the lower ring F. The cover B is used to keep the rings in position, and their surfaces, which are in contact respectively with those of A, B, C, and E, are ground to a steam-tight fit. It should be specially noted that the cases C and E, although fitting each other, are distinct, and it will be easy to see how important this is. The inner surface of E is tapered as shown, so that as the packing is pushed downwards the wear is taken up until the rings are quite worn away. The effect of screwing up the gland D is twofold. It tends, by the pressure put upon the packing, to push E upon its seat on F, while, in consequence of the upward pull on the case C, it is in like manner drawn on to its seat on F. As a corollary, the rings F are pressed on to their seats on A and B. It follows that a perfect joint is made without the use of any springs, which in such a situation must be objectionable. All these results are obtained without destroying the freedom of movement of the box, which can adjust itself as required. It is, indeed, found that in most cases the box has, during the working of the engine, a slow rotary motion round the rod, thus leading to an even wear of the packing. We inspected one of these boxes which had been in work for two years on an engine making 85 revolutions per minute, the piston rod being 3½in. diameter, and it was quite tight, although during work it was slowly rotating.

SHIPBUILDING NOTES.

ON the 24th ult. Messrs. Harland & Wolff, Limited, Belfast, launched a steel screw steamer, named "Gaekwar," for Messrs. Thomas & John Brocklebank, Liverpool. This vessel is a sister ship of the "Ameer," launched by the same firm in August last, and, like her, is intended for the Eastern trade. Her dimensions are: Length, 400ft.; breadth, 45ft.; gross tonnage, 4,014 tons. The boilers and engines, which are triple expansion of 1,600 h p., are being built by the same firm, and the vessel is expected to be ready for sea early in the new year.

ON the 27th ult. Messrs. Scott & Co., Bowling, launched the s.s. "Sard." The vessel was built to the order of Mr. Wm. Robertson, Glasgow, and was supplied with engines by Messrs. Muir & Houston, Harbour Engine Works, Kinning Park, Glasgow. The engines are of the triple expansion type, with cylinders 13in., 21½in. by 34in., by 27in. stroke. The

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"Sard" went on her trial trip on the 28th, when she attained a mean speed of 11¼ knots, which was considered highly satisfactory.

On the 30th ult. the "Abbotshall," built by Messrs. Jno. Scott & Co., Kinghorn, went on her trial trip. On a trial of speed; she accomplished 13 knots an hour, or a knot more than was expected. The "Abbotshall" was built for the Kirkaldy and London Steam Shipping Company.

TRIPLE EXPANSION ENGINES OF THE S.S. "FRIESLAND."

In *Industries*, Vol. VI. (19th July, 1889), we illustrated in a two-page supplement the triple expansion engines of the s.s. "Friesland," which was built and engined by Messrs. James & George Thomson, Clyde Bank, for the Red Star Line, and now we give an end view of the same engines. The diameters of the cylinders are respectively 35½in., 56in., and 89in., and the stroke is 4ft. 6in. We shall give further particulars, with the results of trials, in an early issue.

Notices of Meetings.

NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, January 14th, 8 p.m. Paper to be read: "Recent Dock Extensions at Liverpool," by George Fosbery Lyster, M.Inst.C.E.

INSTITUTE OF MARINE ENGINEERS.—Monday, January 13th, 7.30 p.m. Paper to be read: "The Marine Engine Considered as a Machine," by Mr. J. G. Hawthorn.

UNIVERSITY COLLEGE, GOWER STREET, LONDON, W.C. Wednesday, January 15th, 8 p.m. Dr. W. S. Squire, on "Some Considerations in Connection with the Economical Use of Fuel."

ROYAL METEOROLOGICAL SOCIETY.—Wednesday, January 15th, 7.15 p.m. Annual General Meeting. Dr. W. Marcet, F.R.S., will deliver an Address on "Atmospheric Dust."

PHYSICAL SOCIETY.—Friday, January 17th, 5 p.m. Papers to be read: "On a Carbon Deposit in a Blake Telephone Transmitter," by F. B. Hawes; "On Electric Splashes," by Prof. S. P. Thompson, D.Sc.; "On Galvanometers," by Prof. W. E. Ayrton, F.R.S., T. Mather, and W. E. Sumpner.

SOCIETY OF ARTS.—Wednesday, January 15th, 8 p.m. Adjourned discussion on Sir Robert Rawlinson's paper on "London Sewerage and Sewage." Friday, January 17th, 5 p.m. "The India Office Records." By F. C. Danvers.

PRICES CURRENT, 8TH JANUARY, 1890.

Quotations at per ton, unless otherwise specified.

PIG IRON.

Messrs. Raby, Fell, & Co., Manchester, quote as follows:—

Middlesbro' Warrants, No. 3		64/7½	Cash
Scotch Warrants, m/n		65/4½	"
Hematite Warrants, m/n		81/7½	"
Stocks in Stores: Scotch	932,501.—Dec. for week,	5,111	Tons.
Middlesbro'	188,783.—Inc. "	2,762	"
Hematite	185,360.—Inc. "	933	"

Exclusive of stocks in makers' yards.

	No. 1.		No. 3.		
Coltness	80/-	.....	70/-	f.o.b.	Glasgow.
Gartsherrie	78/-	.....	70/-	"	"
Dalmellington	70/-	.....	69/-	"	Ardrossan.
Eglinton	68/-	.....	67/-	"	"
Glengarnock	77/6	.....	69/6	"	"
*Derbyshire	—	.....	82/6	f.o.t.	Works.
*Lincolnshire	—	.....	71/-	"	"
*Lancashire	—	.....	71/-	"	"

*Forge quality, about 1s. per ton less.

Market improving.

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

Prices, per ton ...	No. 1. 80/6	No. 3. 73/-

F.O.B. Grangemouth or F.C.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

Delivery at	Per Ton Extra.
Leith or Granton	1/9
Broomielaw, Glasgow	2/-
London (over ship's side in Thames)	6/-
Liverpool (alongside export vessel)	—
do. (traders' dock)	—
Hull (on quay)	5/-

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	8 2 6	.....	8 12 6	f.o.t. wks.
" Angles	7 17 6	.....	8 7 6	"
" Plates	8 5 0	.....	8 15 0	"
Staffordshire Bars	9 5 0	.....	9 15 0	London.
" Angles	9 5 0	.....	9 15 0	"
Crown Sheets	9 0 0	.....	9 10 0	"
" Hoops	8 10 0	.....	9 0 6	"
"Siemens-Martin" Steel Boiler Plates			9 5 0	"
" Ship and Girder			10 5 0	"

Market very firm, and moving up.

METALS.

Spelter: Ordinary	£25	10	0	to	£25	12	6
Copper: British Cakes and Ingots	59	0	0	"	60	0	0
" Chili Bars, G.O.B.'s	51	10	0	"	52	0	0
" Other sorts, G.M.B.'s (equal to Chili Bars)	51	10	0	"	52	0	0
" Manufactured (strong)	66	0	0	"	67	0	0
Lead: Common Pig	16	0	0	"	16	10	0
" English Sheet	16	10	0	"	17	0	0
Tin: Straits	95	12	6	"	96	2	6
" Australian	.....			"	.....		
" English Ingots	101	0	0	"	.....		

Messrs. Carrick & Brockbank, Manchester, report as follows:—

COPPER: Stocks of copper decreased but slightly during the second half of December, which was doubtless owing to the holiday period and the stock-taking at the end of the year.

The total visible supply on Dec. 15th was	.....	99,156 tons.
" " " 31st	.....	98,847 "
Decrease for second fortnight	.....	309 "

Chili bars have been very firm since the beginning of the year, and the high rates paid for three months' metal indicate firmness in the future. On the opening day, the 2nd inst., quotations were £50 15s. to £51 for cash, and £50 12s. 6d. to £51 for three months. To-day's prices are £51 10s. to £52 for cash, and £51 15s. to £52 2s. 6d. for three months. The Rio Tinto Company advanced their price for ingot copper £2 per ton yesterday. Manufactured is very firm at £66 to £67 sheets, and £69 to £70 bottoms.

TIN: Somewhat unsettled, with only moderate business doing.

LEAD has improved steadily during the week, and promises to be considerably dearer again, as there is not much offering.

SPELTER: Considerably firmer, with a good demand. Some of the Continental firms are unable to quote, being fully sold. There is a strong market, with every probability of higher prices.

CHEMICALS.

		£ s. d.		£ s. d.
Acid: Carbolic Crystals	lb.	0 0 11	to	0 0 11½
" " Liquid	gal.	0 1 2	—	.....
" Citric	lb.	0 1 7	—	.....
" Oxalic	"	0 0 3½	—	.....
" Sulphuric	ton	1 10 0	—	.....
" Tartaric	lb.	0 1 4	—	.....
Alum: Lump (powder 10/- ex.)	ton	4 17 6	—	.....
Ammonia: Carbonate	lb.	0 0 3½	—	.....
" Muriate (Grey)	ton	22 5 0	—	.....
" " (White)	"	26 0 0	—	.....
" Sulphate	"	12 7 6	—	.....
" Liquor	lb.	0 0 3⅜	—	.....
Antimony	ton	.....	—	.....
Bleaching Powder	"	5 5 0	—	.....
Bisulphide of Carbon	"	13 10 0	—	.....
Borax	"	30 0 0	—	.....
Benzole (90 %)	gal.	0 3 5	—	.....
" (50/90 %)	"	0 2 7	—	.....
Copper Sulphate	ton	23 10 0	—	.....
Copperas	"	2 0 0	—	.....
Kieserit	"	1 13 0	—	.....
Lead: Nitrate	"	22 10 0	—	.....
" White Sugar	"	24 0 0	—	.....
" Brown "	"	19 0 0	—	.....
Potash: Bichromate	lb.	0 0 4	—	.....
" Caustic	ton	22 0 0	—	.....
" Carbonate	"	19 10 0	—	.....
" Chlorate	lb.	0 0 4½	—	0 0 4¾
" Prussiate (Yellow)	"	0 0 10½	—	.....
" Sulphate (Basis 90 %)	ton	9 10 0	—	.....
Precipitate: Red	lb.	0 3 1	—	.....
" White	"	0 3 2	—	.....
Salts: Epsom Bags	ton	3 0 0	—	.....
Salts: Epsom Casks	"	3 15 0	—	.....
" Glauber	"	1 10 0	—	.....
Sulphur: Sublimed Flowers	"	9 0 0	—	.....
" Recovered	"	4 10 0	—	.....
Soda: Ash	deg.	0 0 1¼	—	.....
" Caustic (White 70%)	ton	7 10 0	—	7 12 6
" " " 60%	"	6 15 0	—	6 17 6
" " (Cream 60%)	"	6 5 0	—	6 7 6
" Crystals	"	2 7 6	—	.....
" Bicarbonate	"	5 5 0	—	.....
" Hyposulphite	"	6 5 0	—	.....
Solvent Naphtha	gal.	0 3 6	—	.....
Tartar, Cream of	cwt.	5 12 6	—	.....
Zinc Sulphate	ton	7 10 0	—	.....

Messrs. S. W. Royse & Co., Manchester, report as follows:—

CHEMICALS.—The new year has opened under very favourable conditions in the chemical trade, most articles being in good demand, and prices firm. In the alkali branch matters have considerably improved since the opening of the year. Bleaching powder is dearer, some of the larger makers holding off the market. Caustic soda of all grades is scarce at much higher prices, and soda ash also has advanced. Soda crystals steady. Acetates of lime are again dearer, and tending further upwards. Sulphate of copper is scarce on spot. Yellow prussiate of potash advanced to 10½d. Epsom salts advanced 5s. per ton. A good business is being done in recovered sulphur. Liquid carbolic is rather more active, but crystals continue flat.

OILS.

		£ s. d.
Cocoanut: Cochin	per ton	26 10 0
" Ceylon	"	23 10 0
Cottonseed	"	21 5 0
Cod	"	19 0 0
Lard	"	37 10 0
Linseed	"	20 10 0
Palm, Lagos	"	25 10 0
Rapeseed: English	"	33 10 0
Seal: Pale	"	26 10 0
" Brown	"	19 0 0
Sperm	"	45 0 0
Whale	"	24 10 0
Turpentine	per cwt.	1 15 9
Coal	per gal.	
Petroleum (Refined)	"	0 0 6⅛
" Spirit	"	

FOREIGN TELEGRAPHIC ADVICES.

(From our own Correspondents.)

PARIS, Jan. 9.—*Coal.*—An agent of the Belgian Government is in the Pas-de-Calais district, buying coal for the State Railways. German consumers are buying largely of French coal. Several heavy trains, laden with French coal for German customers, have passed through Charleroi within the last two or three days.

Iron.—Some of the merchants have advanced the price of bars and joists to 176s., but the large firms do not appear disposed to follow. In the Nord the price has risen to 158s. The markets everywhere are active; but sellers are cautious, fears being entertained of a dearth of coal. Already many works in the Haute Marne and the Meurthe-et-Moselle are greatly hindered in their production. The demand for wire is brisk.

Metals.—The metal market is buoyant all round. Copper has further risen in price, Chili bars being £54 10s., and best selected £60. Tin has recovered the loss recorded last week. Banca is quoted £108, and Straits £103. Lead is active, and has advanced to £14 12s. delivered at Havre. Spelter continues its upward movement. Silesian is quoted £26 Havre.

BERLIN, Jan. 9.—*Bourse.*—Industrial securities are somewhat flat to-day, sellers predominating. The uncertainty arising out of the doubtful attitude of the coal miners has made investors cautious, and speculators have turned the circumstance to account to "bear" the market.

Jute Industry.—The market for jute goods is very active, and the animation tends to increase. Prices are steadily rising. As the demand is likely to be heavier next month, still higher prices may be expected. Jute yarns are much sought after, the supply being short of the demand.

BRESLAU, Jan. 9.—*Coal.*—Since January 1st the prices of coal have been advanced 1s. a ton at the pits, and from 2s. to 3s. for the household sorts delivered by the merchants. Production is far below the demand. The short supply is affecting injuriously the industries of this locality. A large proportion of the output of the Silesian pits is being exported to Austria.

Iron.—There is a strong and steady current of business in iron. The supply of pig falls short of the demand. Prices are unaltered, and for the first business week of the new year are as follows: Good forge pig, 75s. to 80s.; foundry, 80s. to 85s.; bars, 190s.; profile iron, 200s. to 210s.; boiler plates, 235s. to 240s.; thin sheets, 240s. a ton. The demand for finished iron and steel is brisk for all classes. Export business with Russia and Austria-Hungary is increasing.

Zinc.—The zinc market is very active, and prices are firm for delivery in the first quarter of the year. For later delivery slightly lower prices are accepted. Spelter of the W. H. brand is quoted £25; ordinary sorts, £24 for February and £23 12s. for the second quarter.

CHARLEROI, Jan. 9.—*Coal.*—The number of colliers now on strike is officially declared to be about 19,500. Industry is paralysed. Iron works and glass works are partially stopped for want of fuel. The railways are without coal. Agents have been sent into France, Germany, and England to buy coal and coke for immediate delivery. The situation is rapidly becoming serious.

Iron.—The market is greatly disturbed by the colliers' strike. Manufacturers are refusing fresh orders till the situation becomes clearer. Most of the business being done is in ships' plates for export to England and Russia. Ordinary forge pig is quoted 72s. to 75s.; Longwy forge is being sold at 70s. delivered; No. 2 bars are firm at 152s.; joists are quoted 144s. at works and 148s. f.o.b. Antwerp; ships' angles are 158s.; No. 2 plates, 176s.; steel plates, 208s.; and steel rails f.o.b. Antwerp, 140s.

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HOME INDUSTRIES.

LONDON 9th January, 1890.

The Money Market.—Though the outside market has got a fuller supply of loanable money at its command than last week, the money market continues very tight. Rates for loans and discounts have been maintained, there being less disposition on the part of Continental bill brokers to discount bills at lower rates than those exacted by London brokers. As this competition has largely tended to render ineffective the precautionary measures taken by the Bank to preserve its reserve, the cessation of it is a welcome feature. The state of the money market has taken all the spirit out of the Stock Exchange, and prices have fallen all round. Consols and home railways are always adversely affected by scarcity and dearness of money, and the other departments, though less sensitive to this influence, have had other troubles to contend with. American railways have been a rather shaky market, and the announcement of a short dividend on the First Income Bonds of the Philadelphia and Reading Railway, pulled down the whole American list. Canadian Pacifics have been in fair request, but Grand Trunks and the Mexican Railway's securities have had a further fall, the traffic returns still being unfavourable. Foreign shares have not been in request, but copper shares have been bought freely.

Companies.—The following companies have been registered since our last report:—Salter & Co., Ld., with a capital of £21,100, to carry on the business of brewers and maltsters; The Automatic Tap Syndicate, Ld., with a capital of £2,000, to acquire a certain patent; The Mount Morgan Gold Mining Co., Ld., with a capital of £10,000; Cooper's Patent Glass-lined Metal Piping Co., Ld., with a capital of £15,000; Cochrane & Co., Ld., with a capital of £350,000, to conduct the business of colliery proprietors, miners, &c.; Strout's Brewery Co., Ld., with a capital of £80,000, to carry on business as brewers; Ralphs & Preston, Ld., with a capital of £15,000, to carry on the business of engineers and machinists; The African General Exploring Co., Ld., with a capital of £20,000, to carry on mining operations; Ellis, Drew, & Co, Ld., with a capital of £10,000, to carry on business as brewers, &c.; The Atlantic Steam Shipping Co., Ld., with a capital of £100,000; The Golden Leaf, Ld., with a capital of £350,000, to acquire lands and mining rights, &c.; The Gold Koppe Mining Co., Ld., with a capital of £333,007, to acquire mining rights in Austria; The Electrical Standardising, Testing, and Training Institute, Ld., with a capital of £10,000, to establish institutions where electric instruments can be tested.

Hemp.—In Baltic hemp the spot business is slow, and consists mostly of retail transactions. There has been a better inquiry for arrival, but business is checked by the firmness of shippers. The Italian markets are very strong, and there appears to be no prospect of any reaction at present. The week's transactions have consequently been very small. Since the new year the demand for Manilla hemp has improved, but very little business has been done yet.

Shipping.—During the past fortnight freights have been inactive, with the exception of American. The holidays have been more general and longer in extent than before. Coal prices have further advanced, and quotations are difficult to obtain at all. Prices of steamers are firm, and good second-hand tonnage meets with a fair sale.

Institution of Mechanical Engineers.—The forty-third annual general meeting of this institution will be held on Wednesday, Thursday, and Friday, the 29th, 30th, and 31st inst. In addition to the ordinary routine business, Mr. Joseph Tomlinson will be elected president in place of Mr. Charles Cochrane, and the following papers will be read:—"On the Compounding of Locomotives Burning Petroleum Refuse in Russia," by Mr. Thos. Urquhart; "On the Burning of Colonial Coal in the Locomotives of the Cape Government Railways," by Mr. Michael Stephens; and "On the Mechanical Appliances Employed in the Manufacture and Storage of Oxygen," by Mr. K. S. Murray.

The Institution of Civil Engineers.—The seventy-second anniversary of the Institution of Civil Engineers occurred on the 2nd inst., when a revised list of the members of all classes showed that the numbers now on the books amounted to 5,804, representing an increase of 3¼ per cent. in the past twelve months.

Blocking Orders.—The attention of the electrical section of the London Chamber of Commerce has been called to the fact that many of the notices which have been given by the local authorities of their intention to apply for provisional orders have been done with a view of blocking the extension of electric lighting owing to gas interests or other causes. The matter will be brought forward at the meeting of the section on the 28th inst., and it is hoped that corroborative evidence will be communicated to Mr. Trotter, the correspondent, with as many details as possible.

Electric Lighting in St. Pancras.—The St. Pancras Vestry held a special meeting on the 1st inst., to consider the unanimous recommendation of its Lighting Committee to carry out an installation of electric lighting under their provisional order obtained in 1883. The vestry, by a large majority, adopted the recommendation, and instructed their engineer, Prof. Henry Robinson, to prepare the necessary plans and specifications for a first installation of 10,000 private lights and 90 public lights, involving an outlay of about £60,000.

Brush Electrical Engineering Company.—The chairman and directors of the Brush Electrical Engineering Company celebrated the tenth year of a prosperous existence by inviting the leading electrical engineers to dinner at the Hôtel Métropôle on Monday night. About a hundred and fifty guests, representing all branches of the industry, and including most of the company's more formidable trade rivals, joined in well-wishes to the continued success of the company. Lord Thurlow, the chairman, proposed the conventional toasts, and succumbed to the temptation which no electrician has ever been known to resist, and "talked shop" even in connection with her Majesty. Speeches were also made by Sir F. Bramwell, Viscount Bury, Mr. J. S. Sellon, Sir F. Abel, and Sir J. Pender.

MANCHESTER, 9th January, 1890.

The Iron Trade.—There is an extremely strong feeling still pervading the iron market, and the free buying which was expected is actually going on. Makers are comparatively indifferent as to orders, and in some cases, especially in hematites, good brands are almost unobtainable. The price of pig iron ranges from 3s. to 5s. per ton over the quoted prices for warrants, which are very deceptive as a guide to actual values. Although the quarterly meetings take place this week, many merchants and consumers have anticipated them, and have placed their contracts already. This course has been pursued because it was felt that much more satisfactory arrangements could be made than is possible amidst the excitement of the actual meetings. Bar iron is very firm in all qualities, and is very bad to buy. The price for local bars is not less than £8 10s. per ton, and one large transaction has been concluded for Yorkshire bars at £9 2s. 6d., delivered Leeds. These prices are, it is anticipated, likely to be almost at once increased, and buyers are very anxious to purchase. There is a large trade being done in other metals, such as copper and brass, and full rates are obtained. The volume of business at this time of the year is remarkable, and has not been exceeded.

The Engineering Trades.—There is a very buoyant feeling among engineers in this district. Not only have they ample work booked, but there is a large volume of fresh business being offered. Stationary engine builders are full of work, and although there are not many new large jobs being offered for the home market, there are several being negotiated for India and the Continent. Boilermakers are full of work, and are very stiff in their prices, the quotations for boiler plates being very much firmer. Locomotive engineers are busy, as are also machine tool makers, who are mostly working overtime. Amongst the novelties may be mentioned a machine for boring dynamo frames, which is being constructed by Messrs. Cunliffe & Croom. Brassfounders and coppersmiths are well employed and have a full supply of orders. There is a good deal of activity in textile machines, India and Japan taking a fair quantity of spinning and weaving machines. There is a rather better tone in the cotton trade owing to the more satisfactory results of the past quarter, and orders for replacements are coming to hand. Most machinists are unable to give quick delivery, and are finding this more difficult weekly, owing to the press of orders. Loom makers keep fairly employed, but there is not the pressure in this department which exists in the spinning machine trade.

Miners' Wages.—The annual report of one of the local miners' associations deals with the question of the advance of wages, and shows that, while these are nearly 30 per cent., the price of coal has increased 35 to 45 per cent. It was stated that the membership of this association, which includes the districts of Haydock, Little Lever, and Burnley, had increased from 4,500 to 9,000, the income being thus doubled. It is also stated that £1,800 had been expended in strikes, some of which were against the use of roburite. The prejudice against the latter is, however, dying away.

The Manchester Linen and Jute Trades.—There has not been time as yet for a real commencement of the season's trade, but orders have nevertheless been received in satisfactory volume. Jute apron cloths have been in extensive request, and an increasing trade is now passing in these goods. The consumption of flaxen and other fabrics made from that class of yarns has fallen off, owing to the popularity of cotton roughs. The latter, however, are now falling off, and a return to the linen article is looked forward to. Linen goods are purchasable to-day at as low a level as they are likely to reach for some time to come. Damask table-covers for table-cloths are used much more extensively than formerly, and this has encouraged designers to put forth greater efforts. A leaning has been noticed of late towards floral as opposed to geometrical patterns, which for a considerable period have occupied the front position in the estimation of buyers. Irish bleachers are said to have been devoting their energies to the pushing of their trade with Scotch manufacturers, and have offered to do work at prices which many Scotch bleachers say they cannot touch. Agents here are pointing out to buyers that with the rise in fuel (amounting in the case of some firms in Fife to 55 per cent.) it is impossible to continue at the rates which have hitherto been current. This action helps to make the tone of the market a good deal firmer than would otherwise be the case.

GLASGOW, 9th January, 1890.

Pig Iron.—Some uncertainty prevails in the iron ring, regarding the near prospects of trade. A few dealers express the opinion that at the present rate of production, and with smaller shipments from here and from Middlesbrough, the present high prices cannot be maintained without injuring business. Others again say that the trade for months to come will continue to absorb all the available production, and to make heavy inroads into the stocks. So far as this year has gone, the deliveries out of store have been on a large scale. Speculation has gone chiefly upon hematite warrants, which are now about 17s. above Scotch. The opening price of warrants was 64s. 6d. to 65s., and at to-day's close was 65s. 6d. cash. The commencement of pig iron business on the London Metal Exchange threatens to make an important alteration in the warrant trade. The change is being stoutly resisted by the Pig Iron Association in the interests of the Scotch brokers. It is hard to say whether the traditional localisation of the iron market in Glasgow will suffice to prevent the innovation having any serious effects.

General.—The holidays at most of the shipyards and engineering works lasted until Tuesday of this week, when the works were opened.

Clyde Trust.—Owing to the retirement and subsequent death of the general manager, Mr. George Keith, the Trust advertised for a successor. There were sixty-seven applicants for the post; but it has been decided not to appoint anyone in the meantime to occupy the position of general manager, but to consider the advisability of appointing a secretary simply. In this case fresh advertisement will necessarily be made. The trustees will this session promote in Parliament a Bill authorising them to effect an important alteration in the plan of the new Cessnock Dock. The opposition of the Commissioners of Govan to the proposal to cross the entrance to the dock by means of a swing bridge has led the engineer of the Trust to carry a road round the dock in such a way as to avoid the necessity of constructing a swing bridge. The traffic would by these means be enabled to go on without interruption.

Proposed Public Safe Deposit.—A company lately established in London, by Mr. Charles W. Milne, formerly of Glasgow, purposes establishing a public strong room in Glasgow. The arrangements will be similar to those of the well-known strong room in Chancery-lane. The chairman of the Security Company is Mr. Howard Vincent, and Sir G. H. Chubb is deputy-chairman. Mr. Milne is managing director. Fidelity guarantee is also a branch of the business of the company. The capital is to be £125,000 in shares of £5 each. Public strong rooms are to be provided in London and in Birmingham, as well as in Glasgow.

Shipbuilding.—New orders are being booked at advanced prices. A good deal of tonnage is changing hands in the market. £5 to £7 per ton dead-weight is the ruling rate.

(From our own Correspondents.)

LIVERPOOL, 8th January, 1890.

The Timber Trade.—The import season has now practically closed, leaving the stocks far heavier than desirable, and within the past month prices have with difficulty been maintained, and in some cases have declined. In furniture woods there has been an active demand for all descriptions of mahogany; stocks are light, and prices firm. The stock of Honduras, Tabasco, and Minatitlan wood is exhausted, and one cargo of Tecolutla has been imported and will be brought to auction early this month. The import of St. Domingo has been limited; curls are in active demand and command good prices. Cuba mahogany is in request, and the market is bare. There is little demand for either Honduras or Mexican cedar, and at reduced prices; there is, however, a good stock. South American finds no sale even at low prices. The stock of American walnut is ample, and Italian and Circassian is seldom asked for. There has been a fair demand for whitewood at improved prices. The market is bare of satinwood, and new supplies would command good prices. Prime lignum vitæ is in great request, and realises very high prices. Lancewood spars are also in good demand, and prices rule high on account of the limited supplies.

Increase of Cartage Rates.—In consequence of the representation made to the different merchants by the master carters, in many cases advances have been granted. The higher rates have not been asked for in anticipation of a carters' strike, for, although there is a question as to whether the men are entitled to overtime when working in the stable, the relations between masters and men are amicable and satisfactory. The carters work 13 hours a day with their horses in gear, and receive 6d. per hour for overtime.

The Live Stock and Fresh Meat Trade.—The imports for the last year are much in excess of those for the previous year, the total amounts being: 166,227 cattle, 34,369 sheep, 685,318 quarters of beef, and 613 carcases of mutton, showing an increase of 76,073 cattle, 5,995 sheep, and 274,965 quarters of beef. The arrivals during the past week amount to 3,210 cattle, 17,407 quarters of beef, and 75 carcases of mutton.

SHEFFIELD, 8th January, 1890.

Coal and Coke.—Business has now been resumed after the holidays; the collieries and coke ovens are in full operation. There is a very good demand for fuel of all kinds; in fact, the demand is in excess of the supply. The advance in miners' wages has naturally caused an increase in the price of fuel, which is now quoted as follows: Best

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engine slack, 9s. to 11s; house coal, according to quality, 14s. to 17s.; best Barnsley coal, 13s. Smudge is now making from 3s. to 5s. 6d. per ton; coke for steel melting, 23s. to 27s. per ton; other qualities at proportionate rates.

IRON AND STEEL.—Makers commence the year with their books well filled with orders, and do not care to book any more owing to the prospect of further advances in value. Common forge iron, Derbyshire and Lincolnshire, is quoted at 70s. to 72s.; hoops, £8 to £9; hematites, 88s. to 90s; marked bars, £9 to £10; Staffordshire bars, £11; hematite pig, £5 per ton. All grades of steel have advanced in prices with the new year, and have still an upward tendency. Bessemer steel is quoted at from £8 to £9. The Bessemer steel works have orders now on their books to last far into the year.

ENGINEERING.—Now that the usual annual repairs and alterations are finished, engineers are again turning their attention to new work, of which there is at present plenty, although it is almost entirely of local requirement. Special machines for labour saving are now being largely adopted. Punching and shearing machines and small steam hammers are in much request.

NORTH STAFFORDSHIRE, 8TH JANUARY, 1890.

THE IRON TRADE.—Operations have been generally resumed after the Christmas and New Year holidays. Makers find a good demand for new work and specifications on old contracts are coming in freely. The quarterly meeting of the local Coal and Ironmasters' Association was held at Stoke-on-Trent on Monday, but business was generally deferred till the meeting at Birmingham on Thursday. The demand for pig iron continues to exceed the capacity of supply, and prices are moving upwards rapidly.

THE POTTERY TRADE.—As the result of many meetings held during the last few months, manufacturers have now come to an arrangement to put up the price of China goods 12½ per cent. There is little doubt that a similar advance will shortly be declared on earthenware. Nevertheless, it is a fact that considerable competition for orders prevails, and unless a healthier demand springs up buyers will still be able to buy goods at pretty much their own values.

LEICESTER, 8TH JANUARY, 1890.

WOOL SPINNING AND YARN TRADES.—The year has opened cheerfully, with a buoyant tone generally pervading the wool market. The tendency downward of prices has disappeared, and staplers are holding their stocks firmly and do not press sales. The late highest rates are fully maintained, and the prospect points to a probability of a further small advance. Spinners are generally running their stocks down and hesitate to come into the market, but with the continuance of the present heavy consumption they will soon have to make large purchases. Spinners recommenced business with a good supply of orders on hand and the mills are mostly fully employed. They are chary of accepting new business at late rates, and some considerable contracts have been declined. Yarn merchants are becoming busier, and though cashmeres were 3d. to 6d. per lb. dearer at the close of last year than the beginning, they are not eager to book at the late rates.

HOSIERY TRADE.—Business has not yet got into working order after the holidays, but there is a fair amount doing, and the prospect of the spring trade is cheerful. Some large buyers are now in the market, and orders are being booked freely. As stocks are low the trade will soon revive under the new commissions.

BOOT AND SHOE TRADE.—Most of the houses are now in full work and with some good orders on hand. The business of the year has opened well, and a very cheerful feeling pervades the trade. It appears certain that a very good trade will be done in the next few months. Leather merchants are doing a good business with new contracts. There is a tendency to harden the price of some descriptions.

SWANSEA, 8TH JANUARY, 1890.

TINPLATES.—The continued increase in the cost of raw materials, and the difficulty of obtaining steel bars, render it almost certain that much higher prices will rule after next Thursday's quarterly meeting of the trade at Birmingham. Quotations, which still remain on the basis of 16s. 6d. for Bessemer cokes, are purely nominal. The Raglan Bay Tinplate Company, registered with a capital of £25,000, intend commencing operations with three mills, and have taken four acres of land at Briton Ferry, upon which they are about to erect works. The warehouse accommodation in Swansea has recently been tried to its utmost, and will soon prove inadequate for the growing requirements of the trade. We may therefore look for extensions in the immediate future.

THE LABOUR MARKET.—The coal miners have as yet been unable to come to any agreement with the masters on the subject of the standard upon which to found the new sliding scale, and the 7,000 workmen employed at the Ocean Collieries demand a 10 per cent. advance. The Cape Copper Company's smelters at Neath have also organised an agitation for an increase of wages, and take pride in being the first body of men engaged in this industry who have adopted the principle of trades unionism. A strike occurred at the Briton Ferry Chemical Works owing to a section of the men seeking an increase of wages. The difficulties encountered by the Mannesmann Tube Company arose from a different cause. Friction at these works was created by the introduction of a number of German workmen, ostensibly to start the manufacture and instruct the Welsh hands, who, however, have looked upon the movement as one calculated to take the bread out of their mouths. Pleasanter is it to record that from the beginning of the new year the directors of the Alexandra Docks, Newport, have raised the wages of traffic men 10 per cent., and have so arranged work that there are three shifts of eight hours each. The men engaged in the engineering trades at Newport are fully employed, the Uskside Engineering Company especially being very full of orders for mining plant of every kind.

BARRY DOCK AND RAILWAY.—Although only opened for traffic on the 18th of last July, 1,088,457 tons of coal and coke had been exported by the end of 1889. This, together with 14,745 tons of imports will suffice, notwithstanding the recent war of rates, to pay the interest on the debentures and on the preference stocks of the company, leaving besides something for the ordinary shareholders, which it is estimated will not be much short of 3 per cent. per annum on their holding.

BARROW-IN-FURNESS, 8TH JANUARY, 1890.

IRON AND STEEL.—There is again a very marked upward tendency in the hematite pig iron trade, and it comes all the more significantly after the few weeks of a lull towards the close of the year. Mixed parcels of Bessemer iron are quoted at 82s. 6d. per ton net f.o.b., and No. 3 forge and foundry iron is quoted at 81s. 6d. per ton, the highest prices touched for many years. There is a large delivery of pig iron, and this is likely to be fully maintained both by rail and by sea. The stocks of iron held in warrants have fallen during the week by 500 tons, but they still stand at 380,847 tons, while the pig iron held by makers will bring this figure up to about 450,000 tons. The pig iron shipments during the week were 12,877 tons, and the shipments of steel 7,214 tons. In the steel trade there has also been an improvement, not so much in the demand as in prices. Rails, which are in full inquiry, especially from the Colonies, have advanced in price to £7 5s. per ton for ordinary sections and £8 5s. to £8 10s. per ton for colliery sections. Ship plates and angles are in full demand, the former at £8 15s., and the latter at £7 15s. per ton. Spiegeleisen has gone up in price to an alarming extent, being now quoted at £6 10s. per ton for 20 per cent qualities.

SHIPBUILDING AND ENGINEERING.—The prospects in these trades are very bright, and as the price of material has advanced to so marked an extent it is not surprising to find that owners of steamships are directing their attention to the re-engining of their old vessels with triple expansion engines in preference to the building of new ships at the present necessarily heavy cost. It is probable that much of this class of work will come to Barrow during the present year.

THE TIMBER TRADE.—Very large supplies of timber have come to hand during the past few months, and stocks are therefore higher than they have been for many years past. There is, however, a large demand for all classes of building, shipbuilding, and mining timber, and good prices are ruling.

MIDDLESBROUGH, 8TH JANUARY, 1890.

PIG IRON.—The market is strong, and prices are advancing. No. 3 G.M.B. cannot be got under 64s. 6d., and some merchants and makers are holding out for 65s., prompt delivery. There is a greater inquiry for forward delivery, for which 66s. is quoted. Warrants are eagerly bought up by a few strong holders, who have every confidence that, as the season advances, the prices will rise. Cleveland warrants are quoted at 65s. 4d., and makers' hematite mixed numbers at 80s. Connal's store is increasing. On Monday, the 6th inst., the amount of stocks was 183,248 tons.

EXPORTS OF PIG IRON.—The exports of pig iron have fallen away very much, chiefly owing to the season of the year, and not to the want of demand. For the current month, up to the 6th, they amounted to 8,595 tons, against 10,685 tons to a similar date last year. The exports for the past year have been very good, having amounted, as a whole, to 959,520 tons, 409,783 of which went coastwise and 549,737 abroad. Scotland, Germany, and Holland have been the best customers.

DECEMBER STATISTICS OF THE CLEVELAND IRON TRADE.—There was a total make of Cleveland iron amounting to 134,760 tons. These were disposed of thus:—38,080 tons were shipped from Middlesbrough, and 74,183 tons were consumed locally or sent off by rail. The total stocks, which at the end of November stood at 239,888 tons, at the end of December amounted to 262,385 tons, having increased by 22,497 tons. The average market price of No. 3 G.M.B. for the month was 62s. as against 64s. for November.

SUNDERLAND, 8TH JANUARY, 1890.

MARINE ENGINEERING.—Although there are five marine engineering establishments at this port as compared with four in 1888, the local output of engines and boilers has not kept pace with the increased number of vessels launched, only about 68 out of the 99 steamers built being engined in the port. Several vessels have obtained their engines from West Hartlepool, and other places even as far away as Glasgow. Mr. John Dickinson, Palmer's Hill Engine Works, has the best return—viz, twenty-two new steamers fitted with triple expansion engines and boilers, and one vessel with "converted engines," besides supplying over one hundred of his patent crankshafts. Mr. George Clark, Southwick Engine Works, and the North Eastern Marine Engineering Company, South Dock, have each turned out 16 or 17 sets of triple expansion engines, and Messrs. Doxford & Son similarly fitted eight of the vessels built in their shipbuilding yard, besides carrying out a number of alterations. At the Scotia Engine Works Messrs. Wm. Allan & Co. have quadrupled four vessels' compound engines, and constructed besides two new sets of quadruple expansions, one set of "triples," and re-boilered the steamer "Eagle." So far as we can ascertain, there has not thus been much actual increase in the work executed on this river in this department, the North-Eastern Marine Engineering Company and Mr. George Clark having had decreased outputs. As Messrs. Wm. Allan & Co. completed their first engine about the middle of the year, their returns are not unsatisfactory. The prospects for the coming year appear to be good in each of the establishments.

NEWCASTLE, 8TH JANUARY, 1890.

SHIPBUILDING.—Although many employers were desirous that the stoppage for the New Year holidays should terminate on the 2nd inst., they very generally found themselves unable to give effect to the wish, and it was not till the beginning of this week that the whole of the yards were again opened for work and the normal state of things was restored. Now, however, there will be some pressure put on for a few weeks, as all concerned will be interested in making up for lost time. The year opens with excellent prospects for the industry, as, in spite of the fact that orders enough have been placed to keep the yards busy over the whole of the twelvemonths, more contracts could now be obtained if builders cared to accept them. The only possibility that seems likely to hinder the smooth run of business prosperity this year is the occurrence of wages disputes, and in view of the unfortunate results which usually accrue from these contests, it would be well if the parties interested would begin the year by taking steps for the establishment of a Board of Arbitration and Conciliation for the amicable settlement of such matters. Such a board has been in existence on the Wear for some years, and has been found effectual for the purpose indicated.

ENGINEERING.—In the engineering establishments the year commences well, work being plentiful and the relations of employers and employed unusually good. Among the engineering firms that have shown exceptional briskness during last year is Messrs. Hawthorn, Leslie, & Co., who have had Government orders and other work of a special class to deal with, and who, in the execution of the more important contracts, have achieved conspicuous success. This firm have now several special orders in hand, and the operations of the year will doubtless be even more important than those of last. For a firm who do not exclusively devote themselves to marine work, Messrs. Black, Hawthorn, & Co. accomplished a remarkable feat last year, supplying fifteen vessels with their machinery, the aggregate indicated horse-power of which amounted to nearly 15,000. In the case of this firm, also, the prospect for the present year is excellent.

WAGES MOVEMENTS.—The stonemasons of Newcastle have given notice for an advance equivalent to 2s. per week in the wages rate. An advance of 15 per cent. has been asked for on behalf of the labourers in shipyards and engine works.

THE COAL TRADE.—The shipments of coal and coke at Tyne Dock for the week ending January 4th amounted to 75,924 tons, being a decrease of 10,670 tons as compared with the shipments for the corresponding week last year.

BELFAST, 8TH JANUARY, 1890.

LINEN TRADE.—On the 3rd inst. the reelers in the employment of the Bessbrook Spinning and Weaving Company refused to resume work unless they were granted a rise of wages. This has been refused, and, the strikers not returning, the entire works have been closed, and over 4,000 hands thrown idle. Owing to the holidays the business done during the past fortnight has been rather small, but, on the whole, there is a very good tone over all, and a considerable improvement is now confidently looked for. The number of looms is increasing.

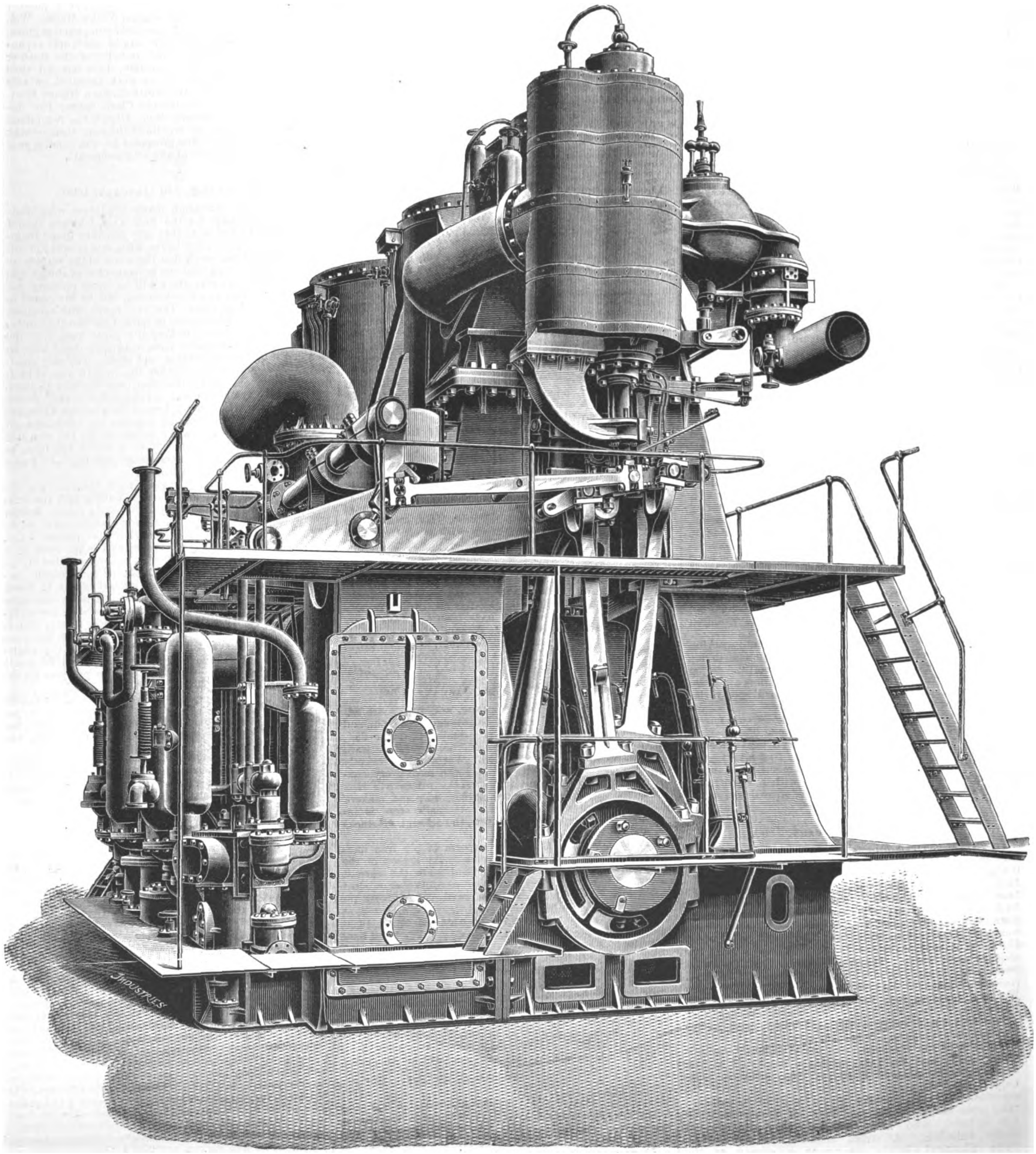
SHIPBUILDING AND ENGINEERING.—Since the holidays very little work has been done, especially in the shipyards, owing to the bad weather. It was not until the beginning of the present week that anything like a fair start was made. Work continues plentiful. All the stocks are full, and there are several steamers of large tonnage in the water being finished. Irish shipbuilders have every reason to be satisfied with their turn out of tonnage during the past year, and are looking forward to another equally good one. Messrs. McIlwaine & McColl, Limited, sustained a severe loss by fire on the 3rd inst., when the drawing office and pattern shop of their engine works were destroyed. The fire is supposed to have originated in the adjoining copper works of Messrs. Cleland & Thorburn, which were entirely destroyed. Machine and tool makers are very actively employed, and in some cases large foreign orders are in hand.

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END VIEW OF THE TRIPLE EXPANSION ENGINES OF THE S.S. "FRIESLAND."

CONSTRUCTED BY MESSRS. J. & G. THOMSON, ENGINEERS AND SHIPBUILDERS, CLYDEBANK, GLASGOW.

(*For description see page* 33.)



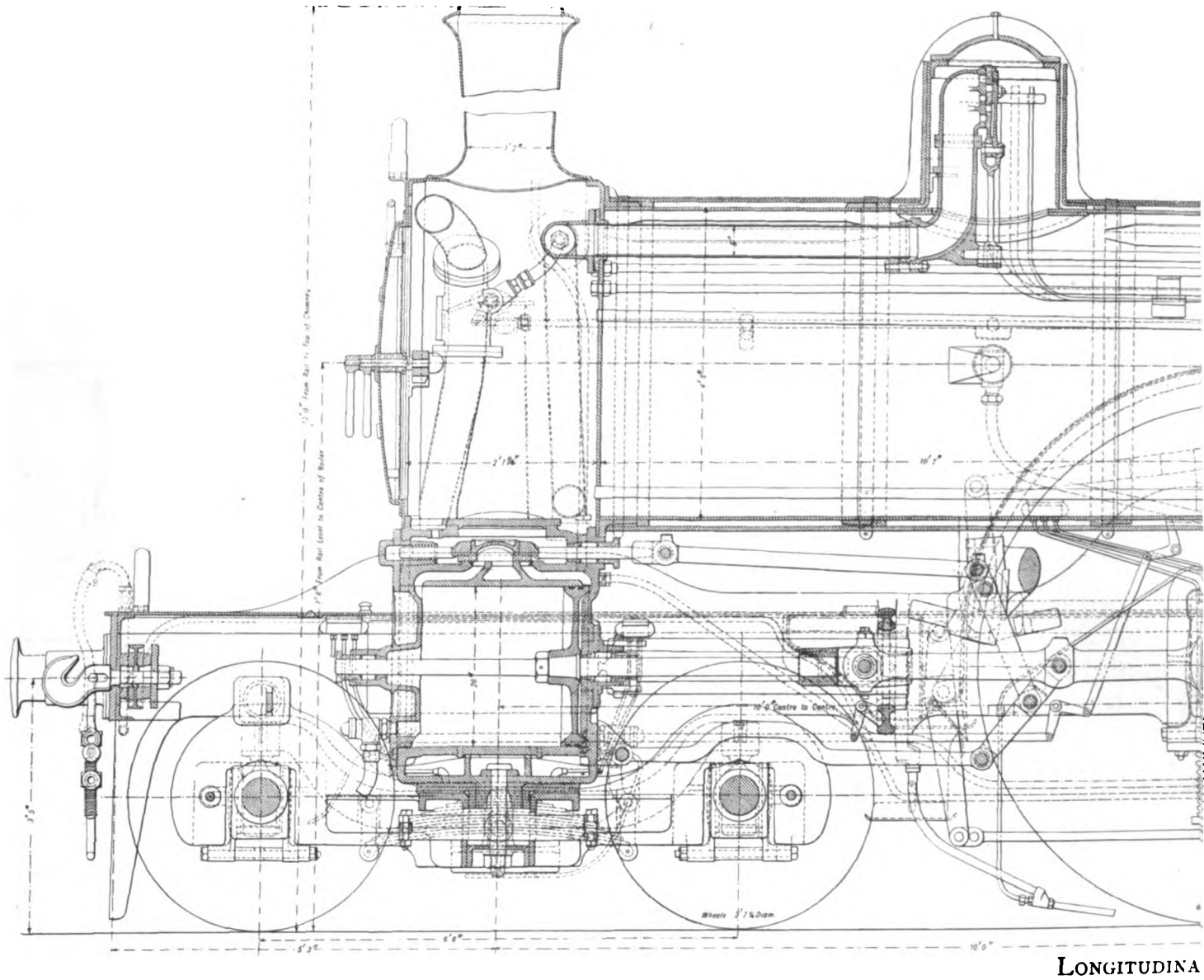
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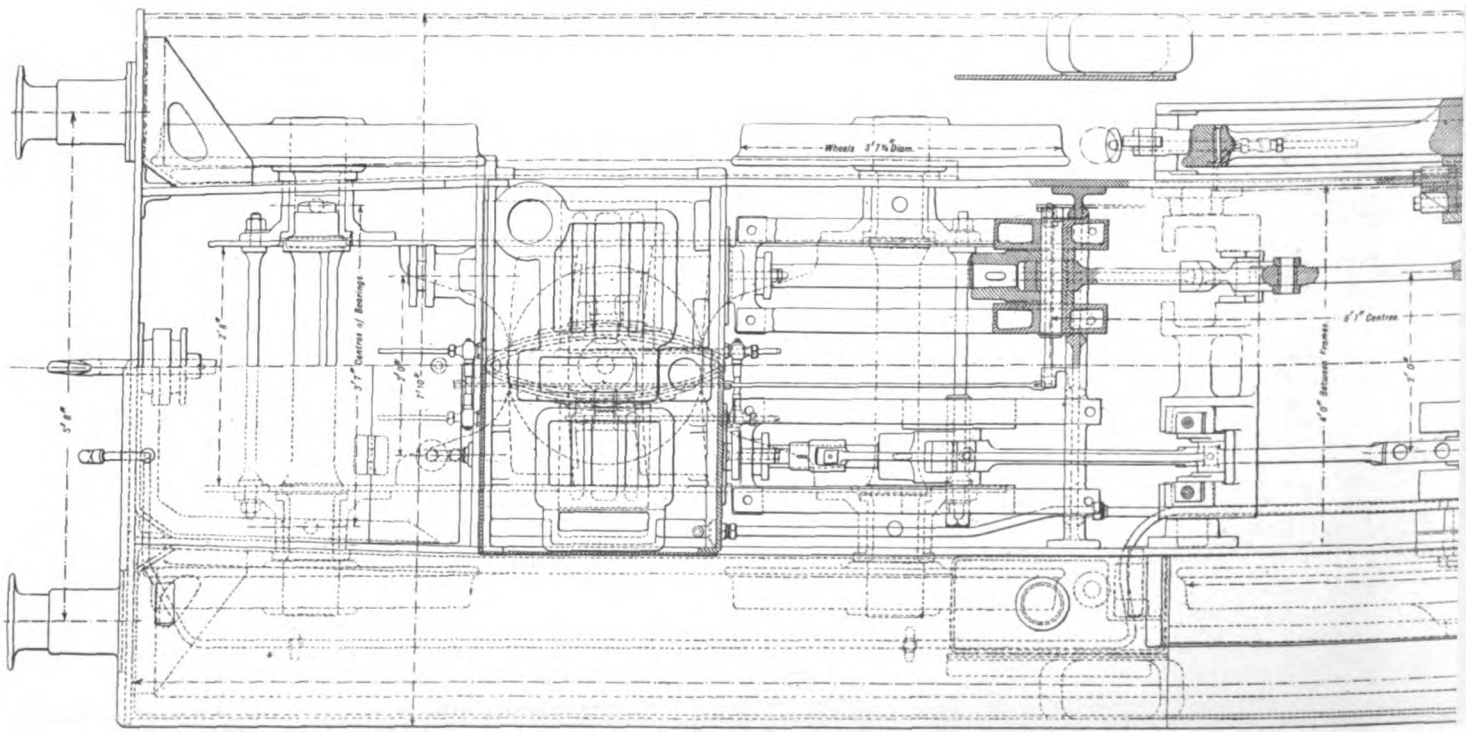
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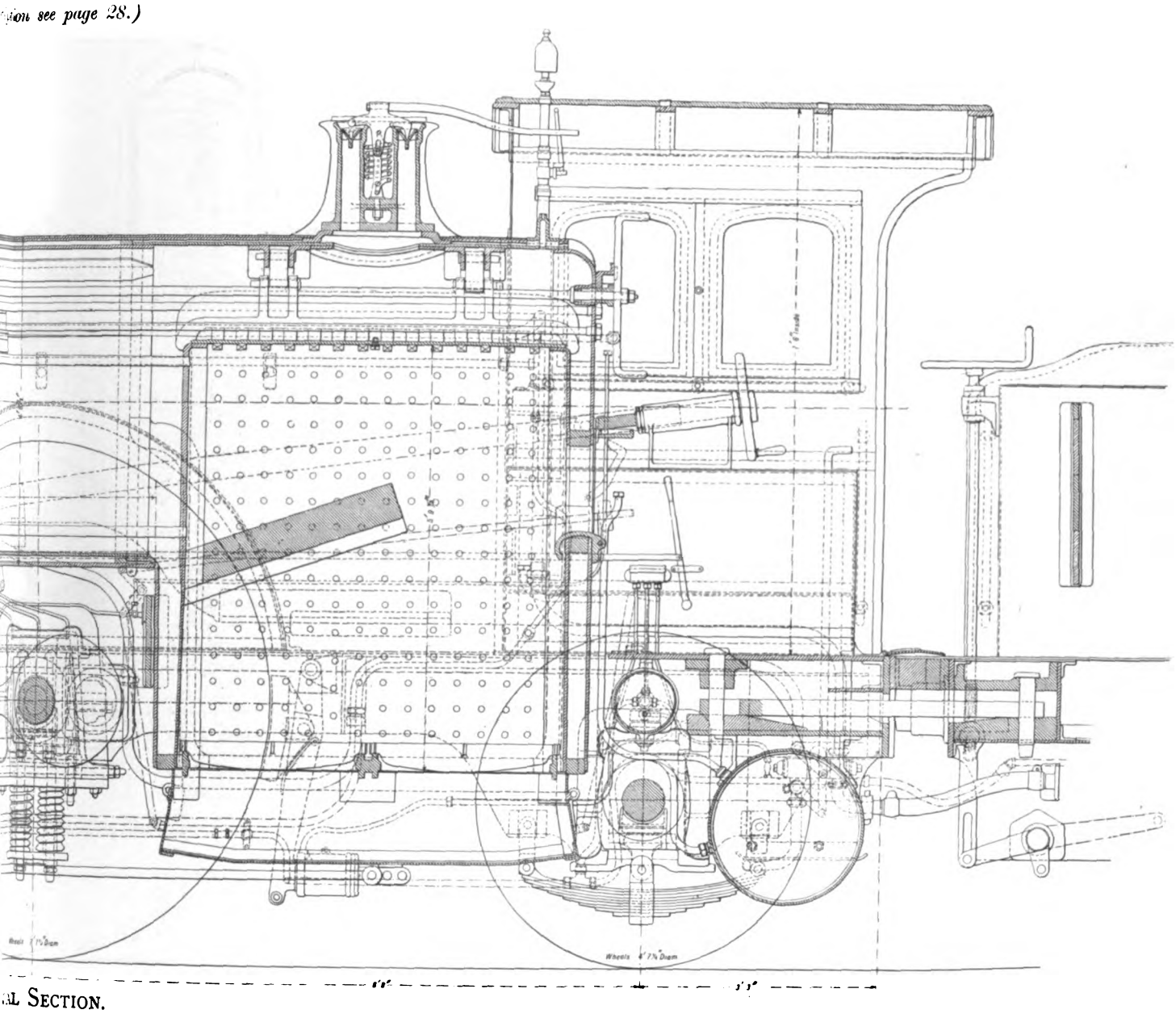
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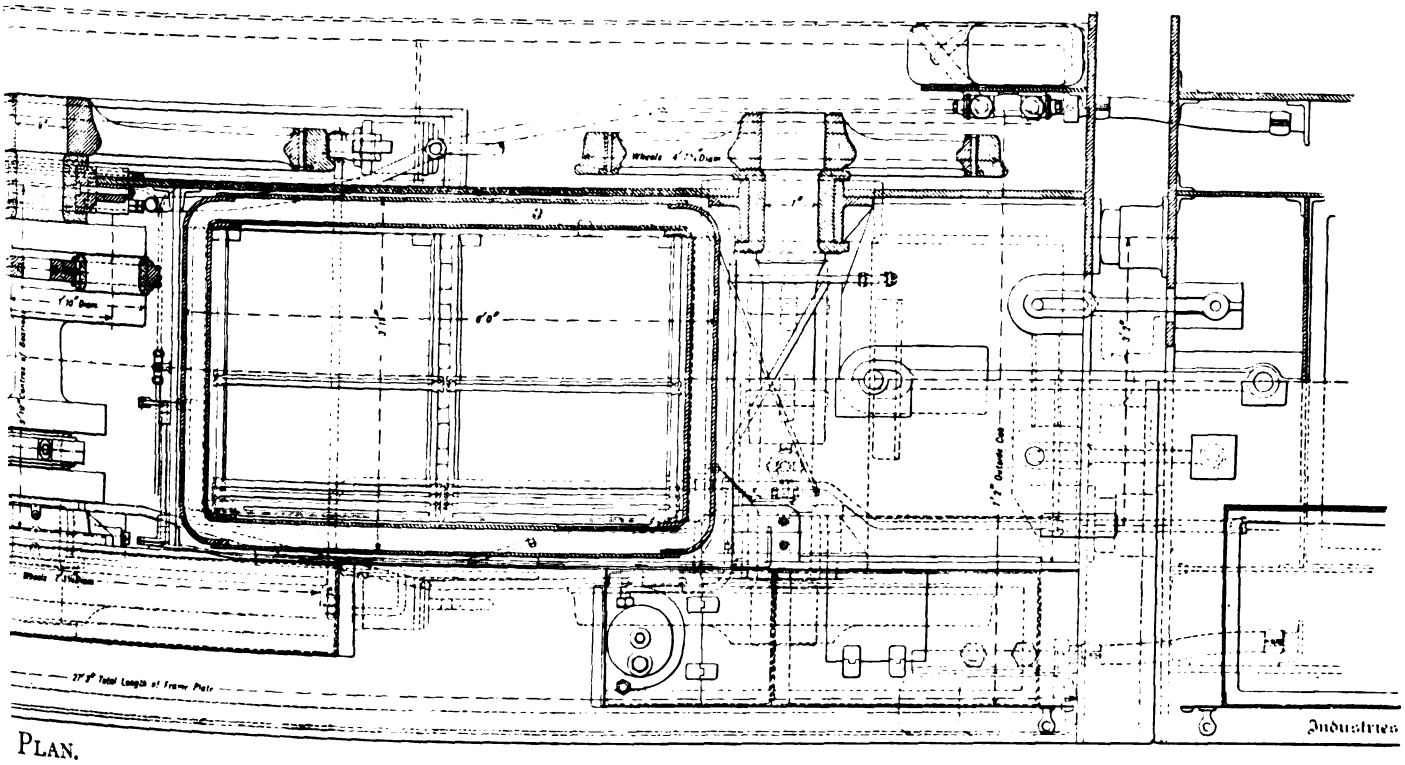
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...NS OF MR. T. W. WORSDELL, M.I.C.E., LOCOMOTIVE SUPERINTENDENT.

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

Contents.

	PAGE
Engineering Progress in 1889	25
Compound Passenger Locomotive (*Illus.*)	28
Foreign Industries (Corres.)	30-31
The Progress of the Manchester Ship Canal during 1889	32
Improved "Universal" Stuffing Box (*Illus.*)	32
Shipbuilding Notes	32
Triple Expansion Engines of the s.s. "Friesland" (*Illus.*)	33
Notices of Meetings	33
Prices Current	33
Foreign Telegraphic Advices (Corres.)	33
Home Industries (Corres.)	34-35
Steam Boiler Legislation	37
The Speed of Vessels in Our Navy	38
The Railway Rates Inquiry	38
Difficulties of Foreign Enterprise in China	39
Proposed Glasgow and District Subway	39
Industrial Wills of 1889	39
The Royal Institution Lectures for Juveniles	39
Letters to the Editor:—	
The Gas Stokers' Disputes	39
Communication between England and France	40
Safety Apparatus for Transformers	40
Reviews	40
The Forth Bridge	40
Improved Sleeper for Railways (*Illus.*)	41
Mining Engineering in 1889	41
The "Exact" Governor (*Illus.*)	42
Graphic Constructions for Dynamos and Motors—I. (*Illus.*)	42
The Edinburgh Exhibition, 1890 (*Illus.*)	44
The Society of Chemical Industry	44
Notes	44
"Industries" Patent Record:—	
Applications	46
Illustrated Abridgments	46-48

Twelve-page Supplement: INDEX FOR "INDUSTRIES," July to December, 1889.

Double-page Supplement showing COMPOUND EXPRESS LOCOMOTIVE.

To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

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Industries:

FRIDAY, 10TH JANUARY, 1890.

STEAM BOILER LEGISLATION.

THE inquiry into the unfortunate Charlesworth boiler explosion case, which was held on the 18th ult., has raised anew the question of boiler legislation. Briefly, the evidence went to show that a second-hand boiler was purchased by Messrs. George Booth & Sons in 1874; that this boiler was supposed to be about a year old, had cost £41, and was worked for several years, for heating purposes simply, at a pressure of 20lb. per square inch. In 1884, however, additional work was required from the boiler, and the working pressure was raised from 20lb. to 40lb. In 1882 and in 1887 some repairs were executed, but in the fifteen years during which the boiler was in the possession of the owners they admitted it was never once "thoroughly examined or tested." One of the partners, who had charge of the boiler, and who lost his life by the explosion, "had had no experience of steam boilers, though he had some idea of stoking and keeping up steam. It would not have paid to have employed a regular attendant." In May, 1889, the boiler was insured with the Engine Boiler and Employers' Liability Insurance Company for £300, at an annual premium of £1 10s. After a preliminary inspection while the boiler was working, a policy was issued, and in August a further examination was made by the inspector of the company. The report, which was submitted to the owners two days after the inspection, showed that the plates below the water-line were pitted by corrosion to the depth of an eighth of an inch, and the company in consequence of the defective plates recommended that the boiler, being of great age, should be subjected to a "thorough examination." This report was not acted upon. The owners resolved to wait till Christmas, and the boiler exploded on November 1st, killing Mr. R. Booth and his manager. The examination of witnesses at the inquiry turned chiefly upon the following points:—Whether or not the owners took measures, between the date of the purchase of boiler in 1874 and the date of insurance in 1889, to satisfy themselves that the boiler was in a safe condition; whether the boiler was at any time under competent management; why the boiler was insured; and the circumstances under which the owner neglected to give effect to the recommendations of the insurance company. It was pointed out in the course of the evidence that the usual clause in boiler insurance policies—viz., the clause which intimates that the insured are under no obligation to adopt any suggestions in the insurance company's report—was present in the policy issued in this case, and also in the report of the company upon this boiler. The finding of the Commissioners was in effect that the owners were to blame in that for fifteen years no "thorough examination" was made of the boiler. As regards the position of the insurance company, the Commissioners did not find blame attachable to them, but thought that companies ought not to insure boilers unless they were convinced of their safety. They directed that the surviving owner should pay £75 towards the cost of the inquiry, and refused the application of the counsel for the Board of Trade that costs should lie against the insurance company. The Commissioners, while appropriately regretting the circumstance that the chief owner had lost his life by the explosion, stated in set terms that they considered the case "the most disgraceful that had come under their notice." This case, along with another which involved an explosion at Northwich, on October 19th, through a "gagged" safety valve, has been made the occasion of an article in the columns of a contemporary, which renews the clamour for compulsory boiler inspection. It appears to us that on any calm view neither of these cases affords any justification for drastic legislation at present. One was due to the culpable recklessness of the attendant, and the other to the procrastination of the owner. It must be remembered, in the first instance, that the Board of Trade has been singularly inert in the matter of boiler investigations. The law as it stands gives the Board very ample powers of punishing, as it has done in both the cases referred to, culpable recklessness in the management of boilers. Yet only three "formal investigations" have been held under the Act of 1882. The careless boiler owner has therefore had every encouragement to slumber in fancied security. Those who object to further legislation most strenuously assert that the law as it stands should be carried out, and that carelessness should be punished severely in the public interest. If the provisions of the Act of 1882 were consistently carried out, and an investigation ordered in all explosions where culpable carelessness was *prima facie* in evidence, the result of it would be, not only that inspection would be universal, but, what is quite as important, efficient management of boilers would become universal also. If owners are so easily lulled into security as to be satisfied that the magic process of insuring can make a twenty-year-old boiler as good as a new one, how would they regard a Board of Trade certificate otherwise than as a virtual indulgence to do what they pleased with their boilers? Thus, the effect of compulsory inspection by the Board of Trade would be hopelessly to demoralise boiler owners. Some capital has been made out of the statement, extracted from Mr. Michael Longridge in cross-examination, that "the issuing of a policy was no guarantee for its safe condition. It simply meant that the insurance company took it as a good risk." So long as human nature and other conditions affecting boilers and their use are variable, no other statement could very well be made. Would anyone assert for a moment that a Board of Trade certificate, by an inspector never so competent, would be a guarantee that the boiler "was in a safe condition"? Would a Board of Trade certificate have prevented the engineman from "gagging" the safety valve, as in the "Development" case, or Mr. Booth from imprudently raising the pressure on his boiler from 20lb. to 40lb.? The fact that in the Charlesworth case the owner paid the penalty of his blunder with his life will surely be taken as a warning by those who undertake the charge of managing boilers with no better qualification than that they had "some idea of stoking and of keeping up steam." Within certain limits the risks in boiler insurance can be reduced by the adoption of precautions, but there remains, and would inevitably remain under the most drastic legislation conceivable, an element of uncertainty such as that which exists in the case of fire and of life insurance. The Board of Trade guarantee, by whomsoever it might be granted, would be worth nothing more than the guarantee of an insurance company, and might besides limit the responsibility of the boiler owner to mere conformance with the minimum requirements of the Board of Trade. At present, as we have pointed out, the owner is responsible before the law for the condition and for the management of his boiler; he cannot, as has been shown distinctly

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in the finding of the Commissioners in the Charlesworth case, shift the responsibility from his own shoulders to that of the insurance company; and our contention is, that he ought not to be allowed to shift it on to the shoulders of any one. One important amendment ought, however, to be made in the Bill of 1882—that is, to make the registration of boilers compulsory, so that it may be known to all concerned where boilers are working. Further than this we do not conceive it would be wise to go on adding to the already considerable powers given by boiler legislation. The Commissioners which the Board of Trade may appoint under the 1882 Act have all the powers of a court of summary jurisdiction, and the exercise of these powers, when the court is set in motion in any particular case, would do more to show the need of scrupulous care in the management of boilers than would any apparently direct, but really roundabout, and inevitably arbitrary, legislation. The often-repeated but altogether unwarranted assertion, that it pays the insurance companies better to run the risk of explosions than to give thorough inspection, has been recently stated, but it bears its refutation on its face. An explosion which could be proved to be due to dereliction of duty on the part of an insurance company would most seriously affect that company's position. In the Charlesworth case, for example, had the company not shown that they had reported adversely upon the condition of the boiler, there is no doubt that they would, and justly, have been mulcted in costs and would have suffered in prestige. It cannot be too strenuously insisted upon that the use of the boiler is as absolutely important an element as its construction and foundation. In the hands of one man a boiler may remain in good condition for years, while in the hands of another, or in certain situations, it may be corroded to a dangerous extent in a few months. This makes it all the more necessary that the onus of the safety of the boiler should rest upon the owner and upon no one else, and also that safety should not be defined to be a certain thickness of plate in construction, or in the compulsory use of certain special boiler fittings in preference to others, but that the owner should be compelled to secure, so far as is humanly possible, that his boiler shall be soundly constructed for his requirements, whatever they may be, and also carefully used.

Among the results which would naturally follow from the arbitrary dictation by the Board of Trade of a certain thickness of plate and certain fittings, would be inevitaby the stultification of invention. All the exasperating incidents of obtaining approval of inventions by the Board of Trade would be extended into a new sphere. Our public departments already sit, like the "Old Man of the Sea," upon many branches of industry. It is well to resist further encroachments of this kind. The Electric Lighting Act, passed in a burst of enthusiasm for State control of industry, has retarded the progress of electric lighting quite sufficiently obviously to convince the most sceptical. To saddle boiler insurance with similar legislative disabilities would be a parallel mistake, which steam users would deplore. No one desires more than we do, that the loss of life from boiler explosions should be mimimised; but we contend that the imposition of a few sharp punishments, such as were meted out in the "Charlesworth" and "Development" cases, would do more to make careless boiler owners careful, than legislation, which would hamper everybody, with only a slender likelihood of doing anything else. In face of some disposition to promote legislation for compulsory inspection on the part of a section of the public, who have not the opportunity of seeing all round the matter, the companies would certainly do well to adopt the recommendations of the Commissioners in the "Charlesworth" case, and refuse to insure boilers which they did not consider safe. The existence of the 1882 Act really meets all practical requirements. It goes without saying, that while the law may be used as an engine for compelling the recalcitrant, it ought not to be used to impede the development of industry, or to relieve people from the responsibilities they voluntarily undertake.

Much of our legislation is manœuvred into existence by sheer fuss; and no branch has suffered more from this than industrial legislation. Pseudo-philanthropy imposes both upon Parliament and upon the public with so marvellous facility, that it is necessary to counteract this influence by the infusion of some steady common sense into industrial politics. What people want is not a mechanism which will compel them to do right; but a principle which will prevent them from doing wrong. This must be definitely taken account of by projectors of boiler bills. Their method of achieving a result, unquestionably desirable in itself, is after all a happy-go-lucky method. Whether or not the Board of Trade intend to act through insurance companies, compulsory inspection would involve an addition to our already considerable bureaucracy.

THE SPEED OF VESSELS IN OUR NAVY.

In recent years naval officers have made themselves heard as regards the constructive details of our war ships viewed as fighting machines, and in none have they been more emphatic than in that relating to speed. The purport of their argument has been that, if a vessel has not a preponderating influence in armour and guns to enable her to give battle with some chance of success, she should certainly be provided with a high speed to show a clean pair of heels if desirable. It was no easy task to move aside the antiquated notions of the Admiralty in this respect. Other Powers were, however, so pronounceably ahead of us on this question, that example and argument at length prevailed. Fast cruisers of 18 knots and higher speeds were built, and have met with all the success that was to be expected from them. Why this important factor of naval construction was neglected for so long was, and is still, a mystery to outsiders. Yet, when put to the test, we out-distance our competitors, and probably possess to-day the fastest ships of any navy. Premising, then, that speed is the first element of safety that an unarmoured man-of-war can possess in a critical moment, and ranks before roominess, sail-carrying power, or handiness, of which we used to hear so much in the past, how comes it that several small vessels have been built lately to crawl along at a top rate of 12 knots on a trial trip? True, these vessels are small—800 to 1,000 tons only; but they would seem to have been designed for peace purposes, fishery duties, river work, and for being kept on show instead of use were war to break out. Do the responsible authorities think enough has been done for the national honour, with all the confidence reposed in them, when attention is paid only to the leviathans in the service, and are the small craft beneath their notice? The great success that torpedo boats have had proves that moderate-sized vessels may be made to travel at a pace unknown to us twenty years ago. There is, therefore, no doubt that vessels of, say 180ft. long, can be driven at much higher speeds than that quoted—in fact, there are examples to prove this in foreign navies. How comes this apparent retrograde step, then, at a time when the country has been so lavish in its expenditure on its fighting fleet? We are very much afraid the answer is the old one for which public departments are noted in every country—viz., red-tape. This word may be said to embrace everything that may be included with love of tradition, circumlocution, and general desire how not to achieve results. Perhaps the British Government excels all others in the capacity of requiring to be goaded before it can make perceptible progress.

Let us consider for a moment what low speed in an unarmoured man of war really signifies. Take, as an extreme case, an ordinary cargo boat, with no protection and no propelling power. In the presence of an enemy's cruiser she would be inevitably captured at once. It would seem to the uninitiated mind that a ship without armour is very much in the same category as the merchantman, and to be of any value as a guard she ought to have the power for a surplus speed and the latest ordnance. It will be seen that this rule applies more to the cruiser type than to line-of-battle ships. In the former case we have a class that would be employed in time of necessity as patrols and convoys, and thus our merchant navy would be relying on a myth were the question of speed left out of consideration. That swiftness in a scout is a *sine qua non* goes without saying. What, then, with no want of funds at our disposal, can be the object of putting our officers and men at a disadvantage if they should be called upon to do their duty to the country? It is difficult to find any answer except the one we have given. To attack or defend at will, to keep the sea for a length of time, to overcome bad weather, and be an efficient protection to commerce, means, in a few words, large engine power; but our Board of Admiralty reverse the ruling of the saying "that to be at peace we must be prepared for war," and send to sea warships prepared for peace only, as far as speed is concerned. Officialdom reigns supreme, and the public is hoodwinked. Even a tyro at marine design will know that, as we have torpedo boats of 120ft. long steaming at over 20 knots, vessels of a substantial build may be propelled at more than 11 to 12 knots with ordinary draught. If the type taken be that which has obtained in the service in the past, the result is inevitable, but, with the experience that has come to us during recent years, most of the shipbuilding firms of the country would readily make themselves answerable, on a displacement of 1,000 tons, for a speed of 16 or 18 knots. The remark that such a vessel would be all engines and ordnance is beside the mark, for a vessel of this kind is a weapon of offence and defence, and it is absurd, if nothing else, to furnish a warship worthy of the name with anything short in either of these necessary vital elements. It may be said that our constructors do not have the direction of the leading features of a design in their hands. If this be the case, why does not a protest go forth against unnecessary interference? The public look to be well served, and will, if a catastrophe occur, not be slow to fix the responsibility on the shoulders of individuals. It can be easily understood that a catastrophe is within the bounds of probability if, in the present state of marine engineering, a man-of-war can only take her place in the line of battle having a speed of 12 knots as developed on a trial trip.

THE RAILWAY RATES INQUIRY.

Between the 15th of October, the date on which the inquiry before the Board of Trade commenced, and the 18th December, when an adjournment was made for the Christmas holidays, nineteen sittings were held. Verbatim minutes of the proceedings have been regularly issued to those desiring them, at a cost of 3s. per day, but it is more than probable that very few, other than those exceptionally engrossed in the inquiry, have waded through this mass of literary work. And, indeed, but little profit could result from such a course. The question presents itself, then, as to how far the inquiry has tended towards an agreement between the railway companies and the traders on the questions at issue, for that is the primary object of the arbitration. And the answer is not of a reassuring character. The main points in dispute relate to the maximum and actual charges to be made by the railway companies, these being dependent on the classifications, and the incidence of terminals. The railway companies appear to claim that there is no reason why the existing maximum powers should be reduced, as the actual rates charged are made dependent partly on the requirements of the districts concerned and partly on the cost of conveyance and working. The traders maintain that actual working rates should be arranged, and the classifications should be so scheduled as to afford substantial relief to the industries of the country. With regard to terminals the companies hold that the charges allowed should be determined by the amount of accommodation afforded and the cost of the construction and maintenance of station properties. Some of the traders protest against the imposition of terminal charges under any circumstances whatever, contending that the costs of station and siding accommodation are expenses incidental to the "conveyance of goods," and not to the duties of a "carrier." Others, from the force of circumstances, admitting the claim, have joined issue as to the assessable value of the services in question. These appear, briefly stated, to be the two main points round which the battle is being waged, but they open out innumerable avenues of minor issues of a complicated character. So far, three or four of the general managers of the largest railway companies have been examined, cross-examined, and re-examined, and this is all the progress which has been made. It has been decided to appoint an expert to check the figures produced by the railway companies as to the cost of sixteen of what are alleged to be fairly typical stations, in connection with the question of terminals; but no matter in which a principle is involved is to be referred to him. The traders have been hard pressed to declare their objections in detail and to submit alternative constructive propositions.

The enormous cost of the arbitrament to the railway companies and to the traders must strike the most casual observer who has attended any of the sittings, and it appears to those who have the question at heart, and have watched the proceedings, that there is but the faintest prospect of any benefit being derived therefrom. The inquiry is yet in an initial stage, progress is slow, and a vista of almost interminable longevity presents itself. Whether the Railway and Canal Traffic Act, 1888, is likely to prove of any commercial benefit to trade during the present century seems questionable indeed.

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DIFFICULTIES OF FOREIGN ENTERPRISE IN CHINA.

As illustrating the difficulties which foreign enterprise may for some time be expected to encounter in China, we may instance the scheme for the navigation of the Upper Yangtse to the port of Chung King, with which the name of Mr. Archibald Little has been associated. By the Cheefoo Convention of 1877 this port was to be opened to foreign trade whenever a steamer ascended the rapids to it. Taking advantage of this clause, in 1885 Mr. Little applied for a permit to do this, but the Chinese Government told him to first get his steamer and then he would get the permit. Mr. Little accordingly got up a small company, and built a steamer, which was sent out to China in 1887. When, however, he applied for the permit, he was bandied about from the Imperial to the local authorities, and without any satisfactory result, until at last the company's funds were exhausted, for all this time the crew was being maintained at considerable expense. When the Chinese thought they had sufficiently exhausted the resources of the company, they made an offer to purchase the steamer, provided Mr. Little and his company should abandon all attempts to ascend the river and all demands for a permit for ten years. This offer was declined, and Mr. Little returned to London during last summer to try to induce the Foreign Office to put pressure on the Chinese Government to grant a permit, and also to claim compensation for loss caused by the delay. Recently negotiations were reopened in London by the representatives of the Chinese Government, and an agreement was come to whereby Mr. Little's steamer was purchased and a liberal allowance made for all expenses incurred, and no stipulation made as to the future. The treaty rights of British subjects thus remain the same as before, and, no doubt, encouraged by the example of Mr. Little, another attempt will be made to supply ships for a department of navigation which, when developed, will be of great importance. In the meantime the Chinese have got a steamer which has been specially designed for ascending the rapids, but which is of little use for ordinary navigation, and they must either make the attempt themselves or be content to allow their money to be practically lost. The whole affair may be useful to foreigners, as showing them the disappointments which they, for some time at least, may expect when they attempt to take the initiative in any work in China.

PROPOSED GLASGOW AND DISTRICT SUBWAY.

The promoters of the proposed subway in Glasgow and district have not been discouraged by their want of success on their first attempt, and, with the guidance of their engineers, Messrs. Simpson & Wilson, have brought out an improved scheme, for which they propose to ask powers in the next session of Parliament to construct. The route commences in St. Enoch Square, and includes in its circuit the north and west parts of the city, as well as the most populous parts on the south side of the river, which necessitates it passing twice underneath the river. There are to be two tunnels, each 12ft. diameter, along the whole course of the line, to be formed of cast iron segments 1in. thick. They will be 35ft. under low water level, or 55ft. below quay level. The total length of the line will be 6¼ miles, and on the route fifteen or sixteen stations are to be constructed. At the stations the two tunnels will be joined by an arch rising 11ft. above the platform, which will be formed between the two lines, and in each case will measure 10ft. wide and 130ft. long. The waiting-rooms, &c., are to be on the street level, stairs and hydraulic hoists being provided, but, as it is arranged that no passenger will require to wait more than two minutes for a train, there will not be much occasion to use the waiting-rooms. The trains are to be drawn by the endless wire-rope system, so that a continuous service will be provided, and all inconveniences of defective ventilation will be avoided. The method of construction to be adopted is the pneumatic process which has been recently adopted in several important engineering works, and which will allow the whole work to be executed entirely under ground, with only one or two shafts for raising the material to the street level, a method which will, of course, greatly increase the expense, but will not interfere with the traffic in the streets. The diameter of each tunnel, as already mentioned, will be 12ft., with a clear height of 10ft. above the level of the rails. The distance between the two tunnels is 6ft. The level of the top of the arch below the street varies from 21ft. to 122ft., while each station will be from 30ft. to 40ft. below the street level. The line does not interfere with any of the Clyde shipbuilding yards, and as the chief objections to the former scheme have been avoided, or at least modified, it is very probable that the present proposals will be confirmed by Parliament, and if they are carried out they will add immensely to the travelling conveniences of Glasgow, especially in connecting the west and south parts of the city, which at present are very inaccessible to each other.

THE ROYAL INSTITUTION LECTURES FOR JUVENILES.

On the 2nd inst. Professor Rücker continued his lectures on "Electricity." Further illustrations were given of phosphorescence by the discharge of electricity in rarified gases, the stream of electrified particles striking against lazaea stone, pectolite, and Iceland spar, and giving brilliant lights of various tints. By various experiments it was shown that electricity was capable of producing motion in a body and of overcoming resistance. When two electrified bodies meet, and there is an electrical discharge, what has become of the energy? It still exists, the lecturer said, in a different form. By an analogy of moving bodies coming into contact, and also by experiments, it was proved that the electrical energy was converted into heat. A piece of looking-glass struck by lightning at Durham was shown upon the screen. The silvered surface was burnt into the glass. The whole effect was probably not merely produced by heat, but partly due to mechanical action. The instantaneous nature of lightning was shown by the passage of a spark, first over a motionless glass plate coated with lamp black, and, secondly, over a similar plate revolving at least 45 times a second. The marks produced on the lamp black were very similar.

Some beautiful photographs by Dr. Hüffer (taken during the storm in June last) were exhibited. It could be seen from these photographs that what appeared to the eye as one flash was in reality composed of several.

The fourth lecture, delivered on the 4th inst., commenced with an explanation of "potential." Although (as shown in a previous lecture) electricity tended to accumulate most at the most pointed part of the conductor, the tendency of flow is the same in all parts. Reference was made to the distribution of electricity on bodies in relation to electrified bodies, and it was shown that the introduction of a conductor altered the potential of the electrified body.

The effect of electricity in decomposing chemical substances was next demonstrated. The substance chosen was acetate of lead, and on an electrical current being passed the chemical action was easily observed. Up to a certain point absence of air in a tube facilitated the flow of electricity from one terminal to another. Either exhausting the air too far or having too much air impedes the flow of the electrical current, and at last stops it. At the conclusion the lecturer exhibited the "Vacuum tubes" of Messrs. De la Rue, containing gases of varying densities—namely, hydrogen, carbonic acid, air. The striations were most pronounced, and in the tubes of irregular shapes the colour was brightest where the tube was narrowest.

The fifth lecture, on 7th inst., consisted essentially in showing the application of electricity to the service of man. Explanation was given of the principles on which the electric telegraph, electric bells, and the telephone were worked. By means of diagrams and models Edison's receiver and Blake's transmitter were explained. Some interesting figures were given with reference to the National Telephone Company. In London they have 23 exchanges, with 5,500 subscribers. As many as 28,000 connections are made daily in the metropolitan area. This is, of course, in excess of the messages, as two or three connections have often to be made for each message. By the courtesy of the Company, connection was made between the Croydon Exchange and the Theatre of the Royal Institution. By means of the loud speaking telephone the whole audience could hear what was being said ten miles off.

INDUSTRIAL WILLS OF 1889.

The following wills connected with industrial celebrities were proved in 1889. In each case the personal estate alone is given:—

Iron and Steel Manufactures.—Mr. Robt. Fowler, steam plough works, Leeds, £219,617; Mr. Richard Peacock, M.P., locomotive builder, Gorton, £204,159; Mr. Robert S. Newall, submarine cables, Gateshead, £166,981; Mr. Edwin L. Pease, Skorne Ironworks, Darlington, £142,694; Mr. P. H. Muntz, Leamington, £95,000; Mr. James Howard, agricultural implements, Bedford, £82,702; Mr. G. N. Vickers, steel manufacturer, London, £71,000.

Coal.—Mr. William Hedley, Burnhopeside, colliery owner, £174,119; Lord Dunsany, Pelton Collieries, £137,880; Mr. Jonathan Priestly, colliery owner, Shotley Bridge, £97,945; Mr. Ed. T. Boyd, mineral agent, Leamside, Durham, £42,983; Mr. Herbert Clarke, London, coal merchant, £157,336.

Railways.—Sir Daniel Gooch, Bart., chairman, Great Western Company, £693,492; Col. McMurdo, Delagoa Bay Concession, £395,780; Charles Sacré, chief engineer, Manchester, Sheffield, & Lincolnshire Railway, £165,000; Mr. Robert G. Underdown, manager, Manchester, Sheffield, & Lincolnshire Railway, £62,841; Sir James Falshaw, Bart., railway engineer, Edinburgh, £88,000.

Shipping.—Sir William Pearce, Bart. (Messrs. Elder & Co.), Govan, shipbuilders, £1,069,000; Mr. T. D. Hornby, chairman, Mersey Docks and Harbour Board, £159,319; Mr. Alex. Petrie, shipowner, Stockton, £33,000.

Chemicals.—Mr. W. J. Cookson, Worksop and Newcastle-on-Tyne, £585,000; Mr. James Cant, £216,000; Mr. F. J. Bryant (Bryant & May), £272,321.

Cotton, Linen, and Woollen Goods.—Mr. John Rylands, founder of Rylands & Son, London and Manchester, £2,574,922; Mr. Julius Behrens, Manchester, £420,000; Mrs. Margaret Platt, Staleybridge Mills, £412,000; Sir William Ewart, Bart., M.P., Belfast, linen manufacturer, £350,000; Mr. James Murray, Manchester, cotton spinner, £325,053; Mr. William Carver, ditto, £272,252; Mr. David Spencer, woollendraper, Coventry, £240,000; Mr. William Tipping, of Bold, £235,406.

Leather Trades.—Mr. R. Borras, fur manufacturer, Old Change, £82,000; Mr. John Southgate, portmanteaus, City, £80,000; Mr. James Chaloner West, leatherdresser, Bermondsey, £46,000; Mr. Ed. Wm. Clarke, boots, London, £41,000; Mr. John Oaster, Bermondsey, tanner, £20,000.

Provisions.—Mr. George Borwick, baking powder, £259,740; Mr. J. Collier Harter, Leamington, late Manchester, drysalter, £267,000; Mr. Henry Barter, grocer, City, £149,000; Mr. Hy. Wm. Nevill, London, baker, £283,256; Mr. John Cadbury, cocoa, Birmingham, £43,773.

Liquor and Tobacco. — Messrs. James Jameson, Dublin, distiller, £489,352; Daniel Thwaites, Blackburn, brewer, £464,516; W. H. Crawford, Cork, brewer, £328,000; R. Prior, Hatfield, brewer, £171,180; John Thwaites, Blackburn, brewer, £164,000; W. T. Dibb, Hull, brewer, £162,936; John Turner, Chiswick, brewer, £154,422; George Wills, Bristol, tobacco manufacturer, £151,677.

Letters to the Editor.

THE GAS STOKERS' DISPUTES.

To the Editor of "Industries."

Sir,—Your correspondent "T. M.," in what, I have no doubt, he would term a reply to my letter to you, has very much avoided the question at issue. He has gone into those matters which I mentioned in my last were entirely apart from the main point. I quoted the manifesto of the men and confined myself to it, but your correspondent goes off on another tack, and he shows ignorance in addition. He states "the men were employed on certain terms; afterwards the directors of the Gas Company announced that they were about to alter those terms, adding that if the men did not agree to this alteration they might go." I never incline to hair-splitting, and I am content to take this assertion in a general way, but even then it does not bear any relation to facts. I quite understand that "T. M.," writing from Glasgow, has not quite the data to go upon that I have in London, but even this does not justify his recklessness. The directors proposed a bonus scheme, and allowed those to sign it who chose to do so. It is untrue, however, that they told those men to leave their employment who did not sign. Either "T. M." is ignorant of the main question, or else he is perverting the truth. It may, or may not, be true that I am the holder of obsolete ideas, as he says, but at any rate I have firm facts before I commit myself to statements The cause of the strike was given in my quotation from the resolution of the union. "T. M." asserts that observations on this point are beside the mark, but if this be the case I am not to blame, but the passers of the resolution.

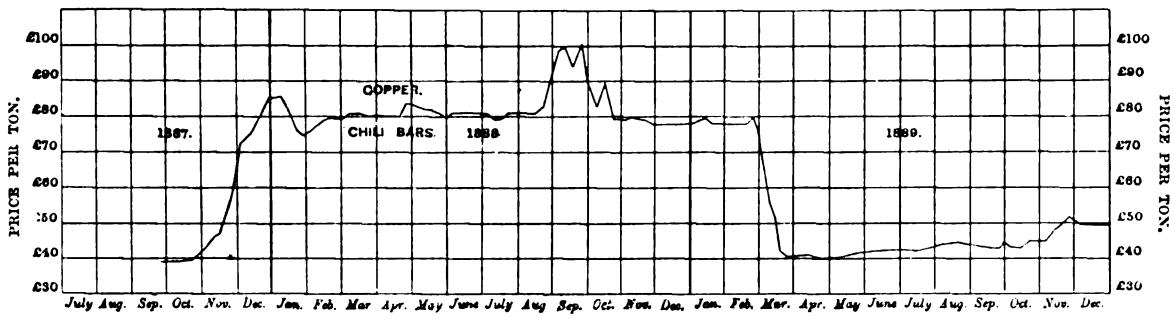
The whole question resolves itself into whether Mr. Livesey may employ a "blackleg." He says "Yes," and so do I, and the whole of "T. M.'s" utterances do not touch the matter. A proof that the union was not affected by the bonus scheme was that the men who signed it were members of the union. This is evidence *primâ facie* that the signatories did not look upon it as a means of suppressing their powers. I quite admit the right of the stokers or any one else to form a union. So far as this is concerned there is no difference between "T. M." and myself, but we may perhaps dissent as to the mode of carrying it out.

Trade unionism forms a very wide subject of discussion, and in its general bearings does not come into this. If "T. M." cares to formulate his views on the subject separately I will reply to him, but such generalities should be kept apart from the special subject. No one has disputed the fact that the men have had a right to form a union any more than that they have a right to leave work when they care to give notice and to starve in consequence.

"T. M." says the position of the men is tenable. This is no argument, but merely a question of endurance. As far as things have gone it does not appear tenable, for funds are getting low, and public sympathy is nowhere. If the question of sentiment, which your correspondent so much objects to, is to be eliminated

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CHART SHOWING THE PRICES OF COPPER FROM SEPTEMBER 1887 TO DECEMBER 1889.



we are brought down to the economic theory of obtaining the cheapest labour where it can be had, and Mr. Livesey has settled this with apparent satisfaction to himself.

Yours, &c.,

CHAS. W. RAUSCH.

London, 4th January, 1890.

COMMUNICATION BETWEEN ENGLAND AND FRANCE.

TO THE EDITOR OF "INDUSTRIES."

SIR,—In addition to the modes of crossing the Channel, of which you treated in your recent number, there was a project put upon paper somewhere about ten or twelve years ago which may be added to the list given, but, as I am writing from memory, I am unable to state who the author was. His proposal was to construct a submarine causeway to carry a line of railway, on which a long, wide, and heavy trolley was to run. On the trolley there was to be fixed a structure shaped like a barge, which contained the driving machinery (of compressed air) and also the passengers. The latter were to be admitted to water-tight compartments in the carriage, if such it can be termed, on the one shore, which was to be closed on them, and during the journey they were to be supplied from reservoirs of compressed air. It was arranged that, in case anything went wrong, the superstructure could be detached from the trolley by the engineer in charge, and the carriage-boat was then to "bob up serenely from below" and float on the surface of the water till help came. I need hardly add that this project never reached a stage beyond being put upon paper, but it deserves a place among some of the other curiosities to which you have referred.

Yours, &c.,

London, 28th December, 1889. T. C.

SAFETY APPARATUS FOR TRANSFORMERS.

TO THE EDITOR OF "INDUSTRIES."

SIR,—Perhaps you will allow me to make a few remarks in answer to your criticisms last week on the proposed use of these devices, and on their efficiency.

It appears from your remarks that you are not aware of the connections and arrangement of the apparatus, which have been found to work best in practice. These are extremely simple. The bottom plate, with the aluminium foil lying on it, is connected to earth; the attracting disc to the secondary circuit—in the centre if available—if not, to one side. The apparatus is set to act at a potential of between 300 and 400 volts from earth, and both theory and considerable practical experience show that, whether this potential be acquired by the secondary circuit as a result of a metallic contact with the primary or of a partial contact, or of electrostatic induction, the foil will certainly act. In fact it is impossible with this arrangement and a good earth connection to maintain a difference of potential from earth on the secondary circuit exceeding the limit for which it is set. It is also found by experience that after having blown one primary fuse and cut off one source of dangerous potential, the foil is not materially damaged, and is ready to act again and blow the other fuse if necessary, the foil merely starting a momentary arc. At the same time, so far as the 100 or 50 volts of the secondary circuit itself are concerned, the device puts on no earth at all, and this, I venture to think, from the point of view of fire risk, is a great advantage.

It is impossible within the limits of a letter to analyse all the various cases and combinations that may arise, but I think the foregoing will be found to answer your criticisms.

Yours, &c.

(For Drake & Gorham).

B. DRAKE.

66, Victoria Street, London, S.W.,
6th January, 1890.

Reviews.

ELECTRICITY IN MODERN LIFE. By G. W. de Tunzelman, B.Sc. London: WALTER SCOTT. 1889.

This is one of the first volumes of the Contemporary Science Series, in which it is promised that "the best that is known and thought in all the departments of modern scientific research," "all the questions of modern life," "the most recent researches in the knowledge of man, the past and present experiences of the race, and the nature of its environment," and a few other matters, "will be frankly investigated and clearly presented" by various writers, and will be edited by Mr. Havelock Ellis. The author of this little book must have needed no small courage to take his part in so ambitious a scheme. The first chapter deals with sticks of resin, pith balls, prime conductors; Thales and his amber turning up, of course, at the third line. Who will be the first to dare to relegate all this to the last pages of a book on electricity? A chapter on "Force Work and Power" is clearly written, but states that "for ordinary engineering purposes . . . the unit of work . . . is a foot-pound. . . . The absolute unit of work employed for all scientific purposes is the work done by a force of one dyne acting in its own direction through a distance of one centimetre. This unit of work is called an erg." This suggests a marked and somewhat unfavourable comparison between "engineering" and "scientific" purposes, but the reader is not enabled to judge of the comparative utility of the systems, for, in his anxiety to make the book popular, the author has not only omitted to express the erg and dyne in intelligible language, but has not even given the values of the centimetre and gramme in English units. The absence of figures is remarkable; there are no formulæ, and hardly any numerals in the book besides dates, and the author has so thoroughly sunk his mathematical abilities as to refrain from expressing Ohm's law in symbols. While at such pains to be popular, it seems a pity to deal with tubes, instead of lines of force. The history of electrical measurements and of the telegraph are admirably written, the former being necessarily somewhat dry, but the latter most interesting. Two good chapters on the telephone include descriptions of the phonograph and graphophone, with the apology that they are closely allied to the telephone. No allusion is made to the original determination of the ohm, but the "legal ohm" is referred to in several places. It is a pity that this misleading name should have survived for more than five years. In a popular work of this kind an attempt should be made to give some faint idea of the value of the electrical units—*e.g.*, the resistance of iron telegraph wire is about 12 ohms per mile, an electric bell battery gives about one and a half volts per cell, the current used for a glow lamp is generally between half an ampere to one ampere. In describing the manufacture of glow lamps "running on the pumps" is confused with "flashing," and Lodyguine's name is misspelt. The continual use of the expression "e.m.f." is to be regretted, the word "pressure" being quite suitable for the purpose of this book, which, if not quite up to the programme of the Contemporary Science Series, is excellently adapted to give an accurate idea of the applications of electricity to daily life; and we can recommend it to those who have no previous knowledge of the subject.

THE FEDERATION OF THE BRITISH EMPIRE. By the Rt. Hon. Sir George F. Bowen, G.C.M.G. London: KEGAN PAUL, TRENCH, & Co.

THE FUTURE OF THE EMPIRE. By Alexander Gordon. London: SIMPKIN, MARSHALL, & Co.

We have on several occasions directed the attention of our readers to the important question of Imperial Federation, especially in its bearings on the industries and commerce of the country, and we promised to place before them both sides of the question. On such an important matter, however, a considerable amount of literature is likely to appear, and we may save our space if we occasionally bring some of it before the notice of our readers. The two pamphlets mentioned at the head of this notice take opposite sides on the question, and that is one reason why we have placed them together. Sir George Bowen is an ardent Federationist, and he quotes with decided approval Lord Rosebery's opinion that Imperial Federation "is a cause for which any one might be content to live; it is a cause for which, if need be, any one might be content to die;" and his long experience as a Colonial Governor gives great weight to his opinions. The only fault we have to find with the pamphlet is that it is written in a somewhat egotistic style, and brings the personal services of the author somewhat too prominently to view. Nevertheless it presents a very good view of his side of the case.

The other side is presented by Mr. Gordon, who shows some of the difficulties in the way, but it seems to us that his conclusions are not necessarily opposed to Federation. After pointing out what he considers the true use of colonies, and assuming that they must ultimately become independent States, he advocates alliance rather than federation—an alliance from which the greatest of all English-speaking people, the citizens of the United States, should not be excluded. We might have a Federation of the British Empire in which the various elements were as independent as the States in America, and then an alliance with the United States. The Imperial Federationists have not drawn out any exact scheme whereby their wishes are to be carried out, but are willing to leave the details to be developed with events, and these might even tend in the direction indicated by Mr. Gordon. In any case the various aspects of the subject should be carefully considered, and the two pamphlets we have mentioned are well worthy of perusal.

THE FORTH BRIDGE

THE Twenty-seventh Quarterly Report of Inspection by Major-General Hutchinson, R.E., and Major Marindin, C.M.G., R.E., of the works in progress for the construction of the bridge over the River Forth has just been published. We append it in full:—

We have the honour to report, for the information of the Board of Trade, that in compliance with the instructions contained in the order of the 26th October, 1882, and in accordance with the provisions of the Forth Bridge Railway Act of 1882, we have made our twenty-seventh quarterly inspection of the works for the construction of the bridge over the Firth of Forth at Queensferry, now nearly completed.

Both the central girders of the two large spans have been connected together during the last quarter, and the bridge can now be traversed from end to end.

All work of a temporary character has ceased, and the work done upon the permanent structure and its present state are briefly described below.

SOUTH QUEENSFERRY.

South Cantilever.—The erection and riveting of this are practically completed.

North Cantilever.—The main members of this cantilever are complete, and with the exception of a few feet of the wind fence, and footpaths in bay 6, the whole of the internal viaduct is in place, and nearly the whole is riveted.

South Central Girder.—With the exception of the footpaths, and a few feet of the wind fence, the whole of this girder is erected, and very little of the riveting remains to be done.

The riveted work at South Queensferry now amounts to 15,900 tons, an addition of 600 tons during the quarter, as compared with 1,350 tons during the previous quarter, leaving 130 tons to be completed.

INCH GARVIE.

South Cantilever.—This is completed.

North Cantilever.—The whole of the main members are in place, and practically the whole are riveted, and with the exception of a small portion of the wind fence and footpaths of bay 6, the internal viaduct is completely built and riveted.

North Central Girder.—With the exception of the wind fence, footpaths, one-half of the flooring, and a small portion of the bracing, the whole of this girder is erected, and about three-fourths of it are riveted.

The total quantity of riveted steel work at Inch Garvie is 18,402 tons, an addition of 850 tons during the quarter, as compared with 1,400 tons during the previous quarter, leaving 320 tons to be completed.

NORTH QUEENSFERRY.

South Cantilever.—This is completed.

North Cantilever.—With the exception of the bracing between the struts in bay 6, the whole of the main members are erected, and very little of the riveting remains to be done.

The flooring of bay 6 of the north cantilever, and the footpaths and wind fence of bay 6 of both cantilevers, are unfinished, but with these exceptions the whole of the internal viaduct is erected, and nearly the whole is riveted.

The total quantity of riveted steel work at North Queensferry is about 15,750 tons, an addition of 650 tons during the quarter, as compared with 1,250 tons during the previous quarter, leaving 280 tons to be completed.

PERMANENT WAY.

South Approach Viaduct.—All the longitudinal sleepers are in place, and the rails laid and nearly all screwed down.

South Queensferry.—The teak and pine blocks in the troughs under the sleepers are laid from the end of bay 5, south to the end of bay 4, north cantilever, and about 200 feet of the sleepers are laid.

Inch Garvie.—The teak and pine blocks are laid from the end of bay 4 south to the end of bay 4, north cantilever.

North Queensferry.—The teak and pine blocks are laid from the end of bay 3 south to the middle of bay 4, north cantilever, and the longitudinal sleepers are laid from the vertical columns to the end of bay 3, on the south cantilever.

North Approach Viaduct.—With the exception of a length of 80 feet, all the sleepers are in place, and the rails, except for a length of 160 feet, are laid, but not screwed down.

GENERAL REMARKS.

Steel Work.—With the exception of that for the footpaths and the wind fence for the north central girder, the whole of the steel for the bridge has been drilled and fitted.

Masonry.—The coping of the cantilever piers is all that remains unfinished.

Weather.—The weather during the past quarter has, on the whole, been very favourable considering the season of the year.

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IMPROVED CHAIR AND SLEEPER FOR RAILWAYS.

CONSTRUCTED BY THE CHAIR AND SLEEPER COMPANY, WIDNES.

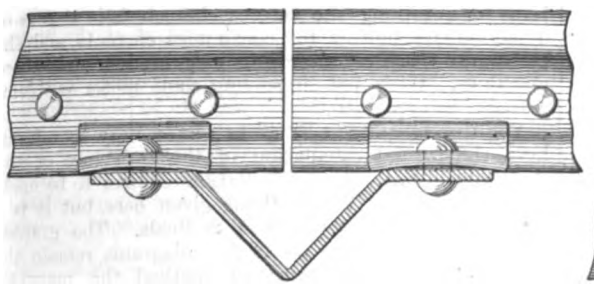


FIG. 1.

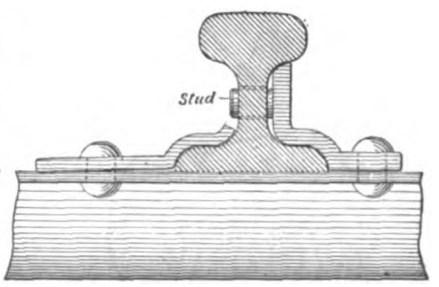


FIG. 2.

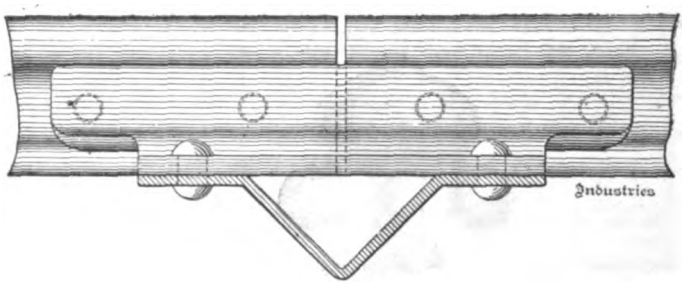


FIG. 3.

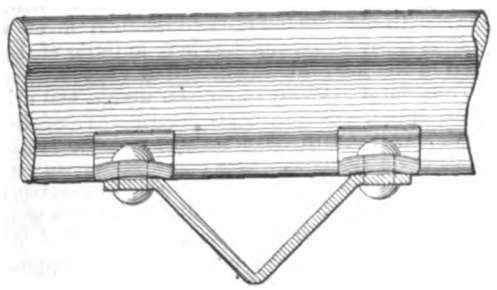


FIG. 4.

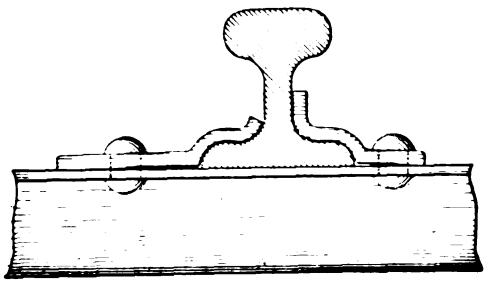


FIG. 5.

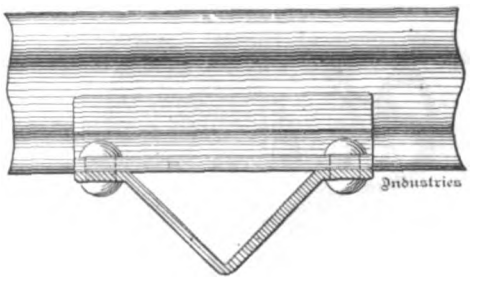


FIG. 6.

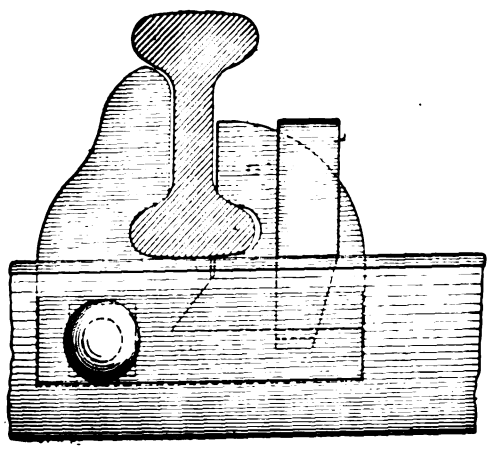


FIG. 7.

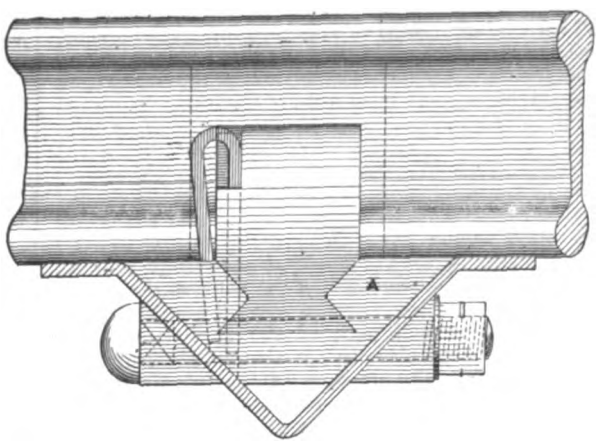


FIG. 8.

The highest wind pressures recorded at Garvie Castle were on November 2nd, 1889, when the large gauge showed a pressure of 12lb., the small gauge a pressure of 34lb., and the revolving gauge a pressure of 27lb.

The average number of men employed per diem during the quarter has been 1,795, and the number employed on November 23rd was 1,585.

We regret to have to report that, even with this reduced number of workmen, there have been four fatal accidents, one of which, on September 12th, when a riveter, John Aitkin, aged 16, was killed, was due apparently to carelessness in the fixing of a stage upon which he was working. Two others, on the 18th and 24th September, are stated to have been due to the falling of pieces of wood from a height, which should not occur if proper care be taken. In the fourth case a rigger unfortunately lost his balance and fell into the water, receiving fatal injuries.

The result of measurements taken on November 26th shows that under the central girders there is a clear headway in no case less than 1ft. 1in. above that specified in Section 5 of the Forth Bridge Act.

In conclusion, we can state that, so far as it is possible to judge from a periodical inspection, the high character of the work is being maintained to the end.

IMPROVED SLEEPER FOR RAILWAYS.

AN improved form of chair and sleeper for light and heavy railways has just been brought out by the Chair and Sleeper Company, Limited, Widnes, Lancashire. The sleeper and rail fastenings intended for light railways and tramways are shown in Figs. 1, 2, 3, 4, 5, and 6. It will be seen from Figs. 2 and 3 that only one fish-plate is used at the joint, this fish-plate being provided with studs slightly tapered, which take the place of the fish-bolts ordinarily used. All the clips, both for the joint and intermediate sleepers, are riveted, and for colliery and other light lines, where the vibration from the traffic will be practically *nil*, this form of construction is at once simple and effective. In Figs. 7 and 8 is shown a special form of chair and sleeper intended for double-headed rails, such as are ordinarily used on our main lines. It will be seen that the chair base A, Fig. 8, which is of malleable cast iron or mild steel, is V-shaped, and is held in position by a bolt with lock nut. In place of the ordinary wooden key the rail is fixed in position by a sliding jaw, which is forced against the rail by a spring key shown on the left of the chair in Fig. 8. As regards the sleeper itself, it will be seen that for light and heavy railways it is of the same section, only for heavy work the sleeper plate is made thicker. The wedge shape of the under part of the sleeper enables it to embed itself firmly into the ballast in such a way as to prevent any shifting, thus saving expense in ballasting, which is an important item in the maintenance charges of our chief railways.

MINING ENGINEERING IN 1889.

There have been but few achievements in the mining branch of engineering to render the year 1889 remarkable. Genuine progress has no doubt been made; but there have been no startling inventions, no great advances made in the application of recently required knowledge—nothing, in short, which can be properly described as a distinct step forward, or as an event capable of serving as a landmark in the history of mining science or practice.

In reviewing the work of the past year we naturally turn first to the achievements of the electricians, and are somewhat disappointed to find that, while fresh developments have been made in nearly all directions, mining has been exceptionally neglected. The important problem of a miner's safety lamp has not been solved. It has, indeed, judging from the results of experiments made publicly known, advanced no nearer to solution. In the matter of the electrical ignition of blasting shots we seem to have retrogressed, in spite of the fact that powerful electric currents are now at the disposal of the mining engineer at almost every pit. This is a direction in which inventive talent may profitably be turned in 1890. The year is, however, not altogether a blank in electrical progress for the mining world. In our issue of February 8th we described and illustrated an electric locomotive which, though introduced in 1888, underwent its practical tests in the year just ended; and later, on the 15th November, we illustrated an electric hoist for mines designed by the Brush Electric Company, of Cleveland, Ohio, U.S.

In the work of coal-getting there is but little scientific progress to report. Of improvements in coal-cutting machines we have heard practically nothing. But here again the year has not been wholly void; for a movement was set on foot with a view to bring back to this important subject the attention which has of late been diverted into other directions. To effect this purpose, the North of England Institute of Mining and Mechanical Engineers have appointed a committee to report upon the use of coal-cutting machinery, and to offer suggestions for its improvement and adoption. For the "falling" of coal—that is, the breaking down of the under-cut seam—nothing new has been made known; and it does not appear that much progress has been made in the application of those machines and apparatus which were introduced in the previous year. There has been a lull, too, in the invention of flameless explosives, so numerous in 1887 and 1888. But the use of some of these has been considerably extended.

In the field of metal mining, inventive genius has been scarcely more active. The extraction of gold from its ores seems to have received most attention in the past year. It cannot, however, be said that much has been accomplished even in this direction. We have noticed some further developments of known processes and some new applications of principles which may develop into something important later. In our issue of the 27th September we described a system for the treatment of gold ores, especially suitable for the pyritiferous sorts, seen for the first time in England at the works of Messrs. Hornsby & Sons, at Grantham. This process, devised by R. L. Cousens, is a combination of the electrical and the chlorination methods. In our issue of the previous week we had described the latest development of what is known as the "Cassel" gold extracting process, a system specially applicable to poor and refractory ores. Beyond these, there is nothing specially worthy of note. For some remarkable examples of construction in mining machinery, see *Industries*, Vol. VI., No. 138, and Vol. VII., No. 170.

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THE "EXACT" GOVERNOR.

CONSTRUCTED BY MESSRS. SCHAFFER & BUDENBERG, MANCHESTER.

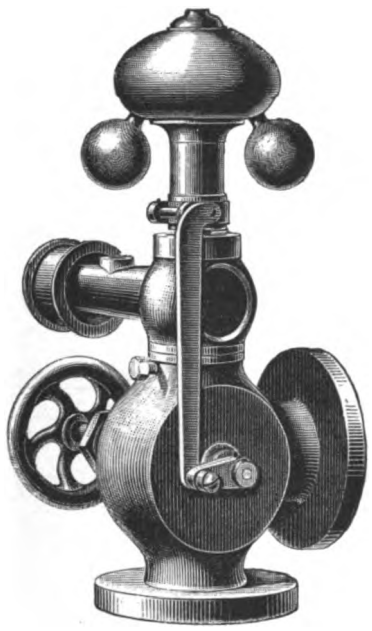


FIG. 1.—GENERAL VIEW.

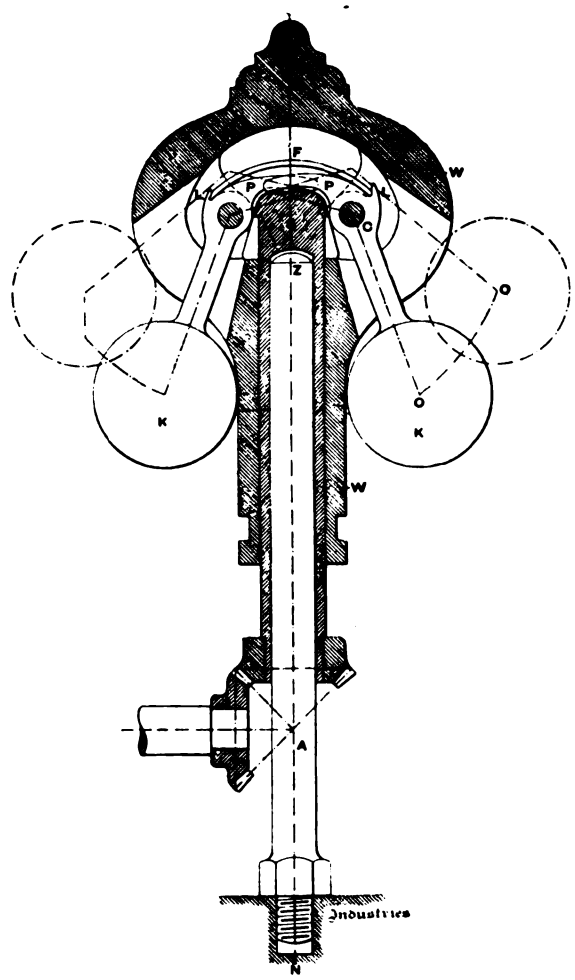


FIG. 2.—SECTION OF GOVERNOR.

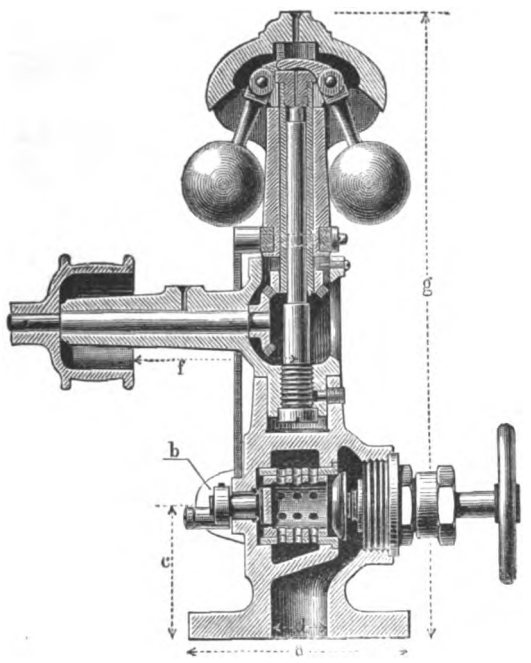


FIG. 3.—SECTION OF GOVERNOR AND STOP VALVE.

THE "EXACT" GOVERNOR.

WE give illustrations in Figs. 1, 2, and 3 of a new design of high-speed governor which is being put upon the market by Messrs. Schäffer & Budenberg, of Manchester, London, and Glasgow. Fig. 1 gives a general view of the governor, Fig. 3 is a sectional view, and Fig. 2 is an enlarged sectional view of the governor proper. The curves which are described by the balls in their rise and fall are approximately part of a parabola. By reference to Fig. 2 it will be seen that the fulcrum C of each of the pendulous levers are situated on the sliding weight W. A short cam P is connected to the lever, extending from the fulcrum towards the axis of the governor, and rests upon a shaft S, which revolves upon the spindle Z. The latter serves to support the governor, while the shaft S has only a rotary, and not any vertical, movement. In parabolic governors as ordinarily made, the actual path O O^1 of the governor-ball centres coincides with the parabola only at one point—viz., when the balls are in their lowest position O—when it forms a tangent to the parabola. In the new governor, on the contrary, the ratio between the length of the pendulous levers O C and the dimension O X is such that the actual path of the governor forms a tangent to the parabola when the balls are in their middle position. The distance of the fulcrum C from the axis of the governor is constant, and, in consequence, the end X of the short arm C X slides a little on the top of the shaft S. If a straight line be drawn from X perpendicularly to the path O O^1 it will intersect the path in the middle, so that X may be considered to be the centre of curvature for the parabola touching the side of the path between O and O^1. A governor constructed in this way rises from its lowest to its middle position as soon as its normal velocity of equilibrium has been attained, and will form, in its higher positions, a near approach to a perfectly isochronous governor. There are, however, two defects to be overcome. In the lower half of the lift the governor has not sufficient stability to be useful, while in its upper half its sensitiveness is excessive, and unfits it for practical use. In order to obtain the required stability and sensitiveness in all positions, a spring F is placed between the two pendula, being arranged so that the ends of the spring press symmetrically on suitable projections. The spring forms a sort of arch between the upper ends of the pendula, and, as the balls are raised, a certain tendency to compression in the spring is established, the arch being flattened or bulged proportionately to the lift of the balls. A support for the governor is arranged near the top upon the fixed steel spindle Z. The friction of the governor is thus reduced to a minimum, and the wear of the toothed wheels is almost completely obviated. From this cause the risk of slipping in the belt is reduced, as the governor is so easily actuated. The throttle valve is of the rotary type, a complete equilibrium being thus established, and only a slight resistance to the motion of the governor is made. The stuffing box on the throttle valve spindle is replaced by a conical valve seating kept tight by the steam pressure in the valve. The latter is combined with a stop valve, and the lateral arm supporting the driving pulley can be adjusted to suit any conditions. The governor is made in six sizes, the smallest having a ¾in. valve, a uniform speed of 300 revolutions being adopted. It is of a good appearance, and we understand that the price is moderate.

GRAPHIC CONSTRUCTIONS FOR DYNAMOS AND MOTORS.

BY PROFESSOR ROBERT H. SMITH.

I.

IT is proposed here to describe certain easy constructions for obtaining the various characteristic curves of dynamos and motors for continuous currents, and the assistance these constructions give in designing these machines. Their use in solving some motor problems will also be explained.

For this purpose it is quite unnecessary to set out here the formal calculation of the resistance of the magnetic circuit. That calculation requires to be made by any one using the methods given here, but it is a matter independent of these methods. The graphic constructions and the use of the diagrams remain the same by whatever theory or method the magnetic resistance be calculated. In commencing the diagram one has to use a pair of quantities which have been found either by such a calculation or else directly by special experiment; but it would quite unnecessarily complicate the symbolisation required if we were to express these two quantities here in terms of the dimensions of the machine on which they depend.

Thus, for a machine of a given design, and driven at a given speed, a definite curve describes the relation of the e.m.f. generated in its armature and the ampere-turns exciting its magnets. This curve starts with a certain initial slope and rises asymptotically to a certain limiting height, where it becomes parallel to the axis along which the ampere-turns are plotted. This initial slope is a matter of easy calculation (to a degree of approximation sufficient for the practical purposes of design). The calculation involves the dimensions of the machine, exclusive of the number of turns and the currents in the magnet coils, the speed, and in a slight degree the "initial permeability" of the quality of iron used. This slope is, in fact, proportional to the speed, to the number of coils in the armature, to the average cross-section of the magnetic circuit, and to the average "initial permeability," the average being taken in the proper way right round the magnetic circuit, including the air and other non-iron parts of the circuit: while it is inversely proportioned to the length of this circuit, and also depends on the amount of magnetic leakage, decreasing as that leakage increases. The limiting e.m.f. towards which the curve rises asymptotically is proportional to the speed, to the number of armature coils, to the armature cross-section, and to the maximum intensity of magnetic induction that can be obtained in the armature section by raising the magnet ampere-turns to an indefinitely high amount. This latter intensity, of course, does not depend on the speed. Neither does it depend on the "air spaces"; nor on the quality of iron in the magnet cores or pole pieces, nor the dimensions of these; nor even upon the coefficients of magnetic leakage. It depends only on the construction of the armature itself, and chiefly on the quality of the iron in the armature core. To a certain degree, which, however, is small in well-constructed machines, it is affected by the armature cross-magnetisation and self-induction, and this again depends on the speed and armature current. It and the initial permeability being fairly well known from the experimental researches of Hopkinson and others, the above two fundamental elements of the diagram can be calculated from the above-mentioned data with, at any rate, a certain approximation to accuracy (the roughness of which depends only on our knowledge of the degree in which magnetic leakage, armature cross-magnetisation, and self-induction will affect the result); or else the two may be determined by experiment if the skeleton of the machine be already made.

From these elements the diagram may be completed by graphic construction. The construction may be made according to either of three laws. The first is Fröhlich's law, illustrated in Fig. 1; the second, Lamont's law, according to which Fig. 2 is drawn; the third is shown in Fig. 3. The first is a rough approximation to the actual truth, as tested by experiment; the second is a closer approximation, and is equally easy for graphic construction. Both of these laws or formulas were framed in order to represent the relation between the increasing ampere-turns, or the "magneto-motive force," on an electromagnet, and the consequent increasing magnetic intensity in the field of the magnet. But they may also be used for the purpose here stated with accuracy enough for many practical purposes.

From the origin (point 1) is plotted upwards 1, 2 = E, the maximum limit of the e.m.f. From 2 is drawn a horizontal line, and from 1 is drawn 1, 3 at the "initial slope" of the curve, these two lines intersecting at point 3. Note that since both E and the slope $\frac{1}{2}\frac{2}{3}$ are directly proportional to the speed of revolution, therefore the horizontal distance 2, 3 is independent of the speed. Thus, if a number of diagrams be drawn for the same machine at various speeds, all the

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GRAPHIC CONSTRUCTIONS FOR DYNAMOS AND MOTORS.

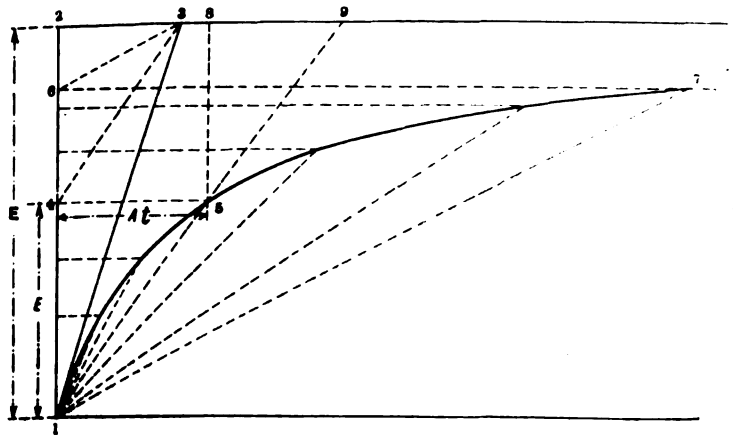


FIG 1.

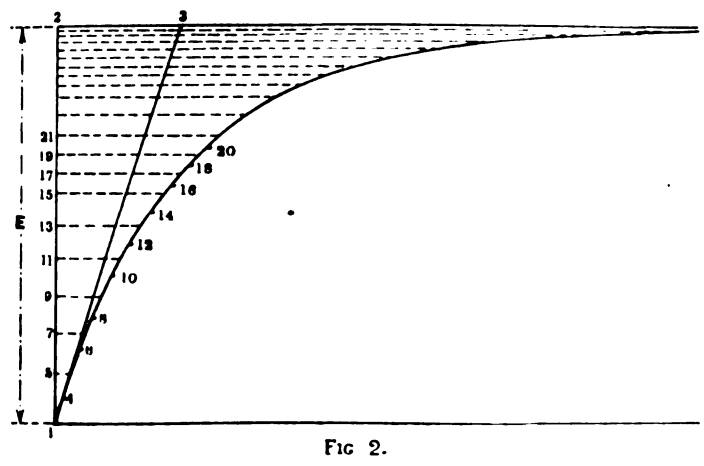


FIG 2.

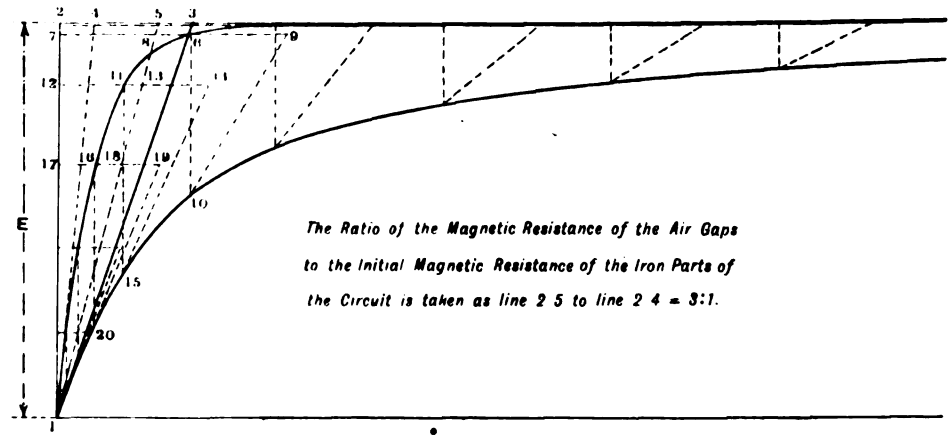


FIG. 3.

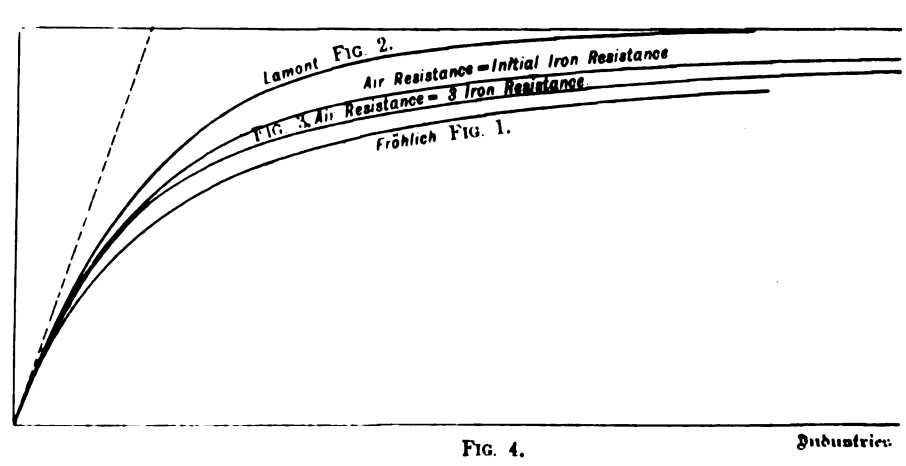


FIG. 4.

points 3 for those different diagrams will lie on the same vertical line.

In Fig. 1 (Fröhlich's law) the points of the curve are obtained thus: For any e.m.f. or height E = 14 draw the horizontal 4, 5, and parallel to 4, 3 draw from the origin the line 1, 5 to intersect 4, 5 in point 5. This point 5 so found is a point in the curve. Thus point 7 is obtained by drawing 1, 7 parallel to 6, 3 to meet the horizontal through 6. Obviously, another way of carrying out the same construction is the following: For any horizontal ordinate 4, 5 = 2, 8, set off 8, 9 = 2, 3 along the top edge of the diagram. Through the origin draw 1, 9, intersect the vertical line 8, 5 in point 5. This point 5 is a point in the curve.

In Fig. 2 (Lamont's law) the construction proceeds as follows: On the vertical axis choose any points 5, 7, 9, 11, 13, 15, 17, 19, 21, &c., these points being taken closer together the higher or nearer 2 they are. From point 4, taken on line 1, 3 at mid-level between 1 and 5, draw 4, 6 parallel to 5, 3, the line being carried on to 6 at mid-level between 5 and 7. Then draw 6, 8 parallel to 7, 3 as far as 8 at mid-level between 7 and 9. Then draw 8, 10 parallel to 9, 3 as far as 10 at mid-level between 9 and 11. Then draw 10, 12 parallel to 11, 3 as far as 12 at mid-level between 11 and 13. This process is continued to the extremity, or, rather, as far as it may be desired to draw the curve. The points successively obtained are numbered in Fig. 2 up to 20 and 21. For instance, the element 18, 20 is drawn parallel to 19, 3 as far as point 20 at mid-level between 19 and 21. These short straight lines are tangents to the true curve, which should be drawn inside them so as to touch all of them. The curve, therefore, does not really pass through the points 4, 6, 8, 10, &c., but through nearly the middle points of the lines between these. But in practical work, provided the points be taken sufficiently numerous, it makes no appreciable difference whether the curve be drawn through points 4, 6, 8, &c., or tangent to these lines. It is, however, just as easy to draw the curve correctly (tangent to the lines) as incorrectly (through the points).

Figs. 1 and 2 have been drawn with the same asymptotic height E and the same initial slope. They show at a glance what a large difference there is between the two laws. It is curious that some electrical engineers, who admit Lamont's law to be the more accurate, still recommend the use of Fröhlich's because of what they imagine to be its superior simplicity. Its algebraic expression looks certainly simpler, or is, at any rate, more elementary; but graphically the one is quite as easy to deal with as the other.

Neither of these curves represent very truly the "total" or "internal" characteristic of a dynamo. If the whole of the magnetic resistance of a dynamo were due to the resistance of the iron parts of the circuit, very probably Lamont's rule, Fig. 2, would represent the result very accurately. But the resistance of the circuit is the sum of two parts—one that of the iron increasing according to a definite law with the magneto-motive force, the other that of the air gaps and insulating material which remains constant throughout the whole range of magneto-motive force ever applied. In Fig. 3 this difference between the two parts is allowed for. Fig. 3 is drawn so as to have the same initial slope and the same asymptotic height as Figs 1 and 2.

If the whole magnetic resistance were constant, the curve would be a straight line. Let 1, 5 be the straight line characteristic which the dynamo would have if its whole magnetic resistance were due to the air gaps and the insulating material and wire in the armature. Let 16, 11, 6 be the Lamont curve characteristic which it would have if there were no magnetic resistance except that due to the iron in the magnet and armature cores, the line 14 gives the initial slope of this curve.

The initial slope of the integral curve 20, 15, 10, compounded from these two, is given by line 1, 3, the tangent from the vertical being the sum of the tangents of the two other lines—that is, 5, 3 = 2, 4. On any horizontal 7, 9 cutting the curve in point 6, set-off 6, 9 = 7, 8. Through the origin draw 1, 9 to cut the vertical through 6 in point 10. This 10 is a point in the new curve. Similarly make 11, 14 = 12, 13; draw 1, 14 to cut vertical through 11 in 15. Similarly make 16, 19, = 17, 18; draw 1, 19 to cut vertical through 16 in point 20.

Fig. 3 has been drawn on the assumption that the *initial* magnetic resistance due to the air gaps, &c., is *thrice* that due to the iron in the circuit. The uppermost part of the Fig. 3 curve is very nearly the same as if it were drawn out according to the Frölich formula, the dimension 2, 5 in Fig. 3 having the same function as 2, 3 in Fig. 1, so far as this part of the curve is concerned.

In Fig. 4 the three curves of Figs. 1, 2, and 3 are reproduced, so as to make the comparison between them more easy. In Fig. 4, a fourth curve is drawn, by the construction of Fig. 3 with the initial iron resistance equal to the air resistance.

The elements for the construction of these curves can, as already said, be found by simple calculation. If it be desired to find them from direct experiment on the already built dynamo, two co-ordinated measurements of ampere-turns and e.m.f. are sufficient for Fig. 1. For instance, if from these two tests the points 5 and 7 can be plotted, then in order to find 3 all that is needed is to draw from 4 and 6 two lines parallel to 1, 5 and 1, 7. Their intersection gives 3, from which the rest of the curve may be drawn.

For Fig. 2 four measurements are needed, giving two pairs of points, the points of each pair lying near each other. For example, if 8, 10 and 18, 20 could be plotted from four such measurements; then, taking 9 and 19 at the mid-levels between these pairs of points, draw from 9 and 19 two lines parallel to 8, 10 and 18, 20. They will meet in the point 3, from which the rest of the curve can be drawn. In this case the construction furnishes a check on the accuracy of the operation, for, after finding the point 3, the curve drawn by its help outwards from the origin may not pass through the already determined points if either the formula be wrong or the measurements or plotting be incorrect.

The construction of Fig. 3 has the disadvantage that the elements for its complete construction are not so easily obtained from points plotted to represent a few isolated experiments. Nevertheless, it seems to give the actual shape, as found from dynamo tests, more accurately than any other formula capable of simple graphic manipulation.

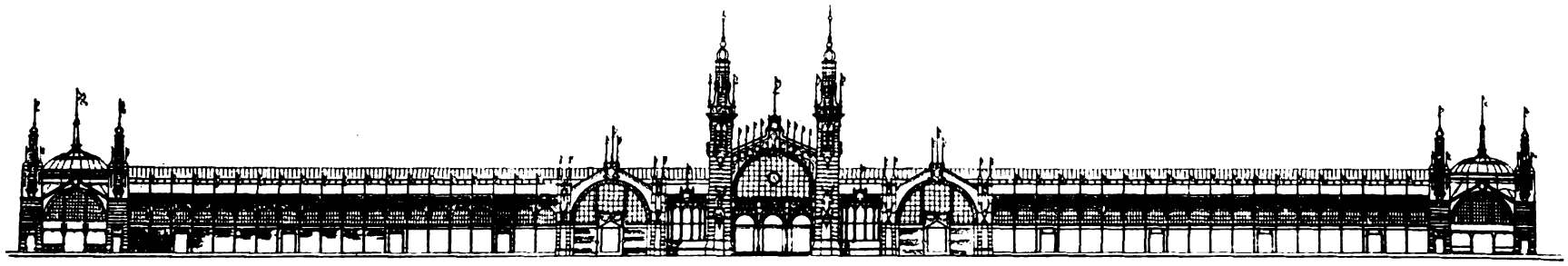
Having obtained this curve co-ordinating E, the whole electromotive force generated in the armature and the ampere-turns round the magnets, it can be easily converted in the case of a series dynamo into a curve whose horizontal ordinates are the currents by simply changing the horizontal scale in the ratio of the number of turns in the magnet coils. It then becomes the "internal characteristic" of a series dynamo. The actual geometrical slope at any point of either this or the original curve depends entirely, of course, upon the scales that have been selected as convenient for the e.m.f.'s, and for the currents or ampere-turns.

To deduce from this latter the "external characteristic" of the series dynamo co-ordinating the external e.m.f. between the terminals and the current requires only a very simple and well-known modification. Through the origin a straight line is drawn at a slope representing the internal resistance between the terminals, and the heights of the new curve are measured between this line and the "external characteristic" curve. Where the latter is parallel to the internal resistance line, the external characteristic becomes horizontal; that is, this point gives the maximum external e.m.f. and the corresponding current. These constructions are well known, and are not, therefore, here illustrated by a diagram.

(To be continued.)

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THE EDINBURGH EXHIBITION, 1890.



General Elevation of the Main Building.

THE EDINBURGH EXHIBITION, 1890.

The idea of having an International Exhibition of Electrical Engineering, General Inventions, and Industries, at Edinburgh, was first brought forward about six months ago, it being thought that the completion of the Forth Bridge would attract a large number of tourists to Edinburgh during the coming summer, and that an Exhibition of a scientific character would be a fitting celebration of this event. The popularity of the undertaking is proved by the rapidity with which a large guarantee fund has been raised and all preliminary arrangements made. The Exhibition has, we understand, received the official recognition of the French Government, and a large number of exhibits are to be forwarded from Paris, including the whole of the Edison collection. As we explained in our issue of the 1st November, a site of ninety acres has been secured in a commanding situation near Merchiston, to the south-west of the city, which has the advantage of being in immediate proximity to two railways, each of which will have a special station within the grounds. There are to be two main buildings, one of which will be devoted entirely to the electrical exhibits and machinery in motion, and will be separated from the other by the South Side Suburban Railway, thus removing all objections to the noise of the machinery being heard in the concert hall and other parts. The two buildings are connected by a covered way, crossing the railway by a substantial wooden bridge, and midway between an annexe will probably be erected. The building for general exhibits, which is 700ft. by 200ft., is approached from the main entrance by a handsome iron bridge crossing the Union Canal. The general character of the design of the main building is that of the French Renaissance, the towers being, as has become almost universal in Exhibition buildings, somewhat Moorish. The engineer and architect-in-chief is Mr. W. Allan Carter, M.Inst.C.E., and his assistants are Mr. Frank W. Simon, architect, and Mr. Penman, C.E.

The space is occupied by the main building, the machinery hall, which is about 700ft. long by 150ft. wide, the boiler annexe, and an additional annexe containing a lecture hall and space for exhibits. In the grounds there are, besides a recreation park for football, &c., a panorama, Japanese village, a lighthouse, kiosks, numerous cafés, an exhibitors' club, electric launches on the canal, a working model of the patent ship railway (designed by Mr. William Smith, harbour engineer, Aberdeen), an electric railway, and the ubiquitous switchback. The space for outdoor exhibits is practically unlimited, as the lands adjoining are available should extension be necessary. The machinery hall and annexes are connected with the main building by a covered way.

A special feature of the Exhibition will be the provision of a lecture hall, to be utilised for the meetings of the Institution of Electrical Engineers and other kindred societies which have arranged to visit Edinburgh this year. Popular lectures are also to be delivered at frequent intervals, with a view to making use of the collection of electrical and other appliances which will be brought together, and thus giving the Exhibition an educational value beyond that of many recent undertakings of a similar kind. The offices of the Exhibition are at 40, Frederick Street, Edinburgh, and 3, Queen Victoria Street, London, E.C. The general management of the Exhibition is in the hands of Mr. Samuel Lee Bapty, who has had extensive experience in this form of catering for public amusement and edification.

In consequence of the representations of the Electrical Section of the London Chamber of Commerce, the Executive Council have decided to grant space to exhibitors free of charge unless the receipts of the Exhibition fall short of the amount of the expenses. This concession will apply retrospectively to all applications for space, and is an important and thoroughly just change in Exhibition arrangements. It will doubtless establish a precedent for the executive councils of future Exhibitions. Upwards of 150 electrical exhibits will come from France, while the Italian and Austrian exhibits will be specially extensive. In general inventions it is expected Japan, China, and India will be represented largely. The leading railway companies have promised exhibits of railway appliances. Among the electrical exhibitors are Sir William Thomson; W. H. Preece; Edison; General Post Office; Edison-Swan Company; Laing, Wharton, & Down; Anglo-American Brush; Paterson & Cooper; United Electrical Engineering Company; King, Brown, & Co.; Mavor & Coulson; Sir Wm. Vavassour, Ld.; Elmore Copper Depositing Company; Thomson-Houston; Electric Welding Company; Newall Engine Company; Robey & Co.; Electric Traction Company; Ernest Scott & Co.; Ronald Scott; Woodhouse & Rawson; Butler, Jobson, & Co.; W. T. Glover & Co.; National Telephone Company; Consolidated Telephone Construction Company; Colonel Gouraud; Gent & Co.; Exchange Telegraph Company; and the Eastern Telegraph Company. The Decauville Company will show a narrow gauge electric railway. Messrs. Immisch & Co. will provide by arrangement with the Executive Council a service of electric launches on the Union Canal between Fountain Bridge and the Exhibition. Boats will leave either end of the route every ten minutes. The sums already paid by refreshment contractors and other concessionaires place, it is said, the Exhibition on a solid financial basis, the sums so accruing being sufficient to defray the cost of the buildings, &c., thus leaving the admission receipts to pay the working expenses. It is to be specially noted that applications for space finally close on Wednesday, the 15th January, the time having already been extended.

THE SOCIETY OF CHEMICAL INDUSTRY.

At the meeting of the London Section, held on Monday, 6th inst., Mr. C. T. Kingzett, F.I.C., F.C.S., read a paper on "Peroxide of Hydrogen and its Uses," in which he described several series of experiments which he had undertaken with a view of ascertaining the best means of preserving solutions of this compound from decomposition. The method which he adopted consisted in first determining the amount of iodine by titration with standard hyposulphite, which was liberated by the solution employed, and then adding known weights of other reagents to samples of the same solution of peroxide and again determining the iodine value of the several solutions after definite intervals of time. From the first set of experiments it was seen that whereas the original solution slowly lost its strength until after 176 days the loss was equivalent to 20 per cent., the addition of ferrous nitrate and sulphate, and zinc sulphate accelerated this decomposition, so that the solutions after the same lapse of time showed 95–97 per cent. of loss, and the addition of the chlorides and nitrates of the alkaline metals and earths had a slight retarding action, the minimum loss being 14 per cent. when a 5 per cent. solution of strontium nitrate was employed.

In a fresh series of experiments the one cent. of substance was added in each case, and organic substances were employed, and it was found that under these conditions alcohol and ether had the greatest retarding action, while phenylacetic acid, sulphophenic acid, chloral, phenol, β-naphthol, and thymol had also considerable retarding power. The last three of these reagents had, however, undergone some change, as the solution, at the end of the experiments, was discoloured brown. These last experiments were also performed with neutral solutions of the hydrogen peroxide, as by a further set of results with a slightly acid solution different percentages of loss were obtained.

As a result of this investigation the author has patented the use of certain chemicals for retarding the decomposition of solutions of hydrogen peroxide, and the Sanitas Company are now selling a patent preserved peroxide of hydrogen of ten volumes strength for bleaching wool, silk, ostrich feathers, hair, ivory, bone, sponges, and other materials. It is also suggested for use in breweries as a substitute for sulphurous acid and bisulphite of lime, and as an antiseptic and general sanitary reagent. In the course of the paper the author stated the action of silver oxide or peroxide, as producing ozone, according to the equation

$$3H_2O_2 + 3Ag_2O = 3H_2O_2 + Ag_4O_4 + Ag_2 + O_2,$$

and, in reply to Professor Clowes, stated that such reaction had been demonstrated by Berthelot. The author also was of opinion that in hydrogen peroxide the second atom of oxygen possessed an unusual valency, and, in reply to Dr. Rideal, stated that he had no statistics to show the economy of oxygen in this form over other bleaching compounds.

Mr. Joseph W. Lovibond then gave a demonstration of the value of his patent tintometer for measuring and recording the colours of bodies. This instrument, of which several forms were exhibited, consists of two tubes, side by side, both open at one end, one giving a view of the object to be measured and the other a view of certain coloured glasses which are introduced to match the colour of the object. At the other end of the instrument is a single eye-piece, commanding a clear vision at the same time of the object on one side, and measuring glasses on the other, under exactly similar conditions, and uninfluenced by the nature and colour of the surroundings. The coloured glasses are made on a series of standard scales in three colours, from cobalt, gold, and silver glass, and from these three primary standards by combination all other colours can be obtained. By its use a permanent record of the colour of a substance can be obtained and recorded in numbers, and can be reproduced at any future time. The author is of opinion that the coloured glasses employed, which have been made with great care, will be permanent and capable of being reproduced without alteration of the numerical scale now adopted, and maintains that the unit can always be checked by means of substances of permanent colour—*e.g.*, copper nitrate, potassium bichromate. The colours are measured on a black ground of pure plaster of Paris or on Chance's opal glass, and any ordinary daylight is suitable, except direct sunlight and twilight, for illuminating the glasses and object. The instrument has already been used with success for many scientific and trade purposes, such as the determination of the amount of carbon in steel, of ammonia by the Nessler test, and for recording the colour of fabrics, yarns, sugars, petroleum, flour, malt, paints, &c. Dr. Munro has also used the instrument for recording the colours of different waters, and from an examination of the varying colour of a sulphur spa was able to show that the colour variation coincided approximately with the amount of sulphuretted hydrogen present in the water, and from noting the colours of adjacent waters formed an opinion as to which of these several waters percolated into the sulphur spring.

Notes.

SAFETY APPARATUS FOR TRANSFORMERS.

In our note under this heading last week we described Major Cardew's apparatus as if it were arranged so as to short circuit the primary or secondary and melt the fuses in case of its acting. Though this method of connection has been described, in practice it is now arranged merely to earth the secondary when necessary. Its efficient action, therefore, does not depend on the primary fuses going. This difference of connection does not affect our other remarks.

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VENTILATING ELECTRIC SUBWAYS.

Mr. Isaac La Rue Johnson proposes to ventilate subways by making one of the lamp posts, every here and there, of special form, and driving a screw fan in it by a little electromotor.

"ELECTRICAL INDUSTRIES."

Under this title a new paper was started in Chicago on the 1st of December last. It commences with well-written articles, good illustrations, and a fair instalment of advertisements. Like most American papers, it is well printed, and we have little doubt that our new contemporary will have the long life we heartily wish it.

INSULATING VARNISH.

We have tested Messrs. Griffiths' so-called anti-sulphuric black varnish. It dries quickly, and gives a very good surface. We have baked it in a self-regulating oven, and find it stands 120° C. for long periods. Kept at 150° C. for twenty-four hours it gets brittle.

FREE SPACE IN THE EDINBURGH EXHIBITION.

The Council have resolved to charge no rent for space unless the working of the Exhibition results in a deficiency. If it does, it seems only fair that the rent then charged should fall on the shopkeeping exhibitors, and not on those who show new and attractive exhibits. We wonder whether the London Chamber of Commerce will protest that the electrical exhibitors should be rent free in any case.

MINERALS IN COLORADO.

Some official figures have been issued dealing with the mineral resources of Colorado, from which it appears that coal lies under 36,000 square miles of territory, and has scarcely been touched. Both soft and hard coal are found, and in addition ironstone of various qualities exists in large quantities. Copper and lead are abundant, gold and silver also are obtainable, and petroleum has been recently discovered in several districts. It is only within the last few years that the State has directed attention to the large mineral wealth which it possesses, but there is little doubt that it will soon be developed.

A NEW THEORY OF DYNAMO DESIGN.

Mr. Nikola Tesla, who is perfectly indefatigable in inventing queer alternating motors, has started the theory that, as the output of a machine varies as the product of the energies spent in the armature and fields, these losses should be equal to give the largest output with a given loss. There seems to be some obscurity about this reasoning. The output of a machine does not vary as the product of the ampere and field ampere turns alone, but also depends on the design of the armature, field magnets and pole pieces, and air gap. Moreover, the power lost in the armature and field magnets depends on the lengths of the windings and on the current densities.

IRONMONGERS' EXHIBITION.

Mr. Harry Etherington, of 43, New Oxford Street, who rather more than a year ago arranged an Ironmongers' Exhibition at the Agricultural Hall, Islington, intends to repeat the venture in March with a more extensive scope, indicated in its new title—viz., "An International Exhibition of Machinery, Manufactures, Appliances, and Inventions incidental to Engineers, Electricians, Builders, and Ironmongers." On this occasion the building will be lighted by electricity, and it might be incidentally suggested that a permanent electric light plant would be an advantage there, especially when the Smithfield Show is being held. Applications for space are to be made before the 24th of February.

CONTRACTS FOR LOCOMOTIVE COAL IN 1889.

There is nobody that is likely to suffer more from the increased price of coal than the railway companies, some of which, at the lower rates of the last few years, have paid from £16,000 to £22,000 a month for their locomotive fuel. Up to about the end of 1888 and during the first half of the year 1889 the average price paid for coal by the railway companies was about 6s. per ton, but owing to the increased demand for all kinds of coal which began in the last quarter of the year named, and the consequent advance in the wages paid to miners, the colliery owners gave timely notice that the new contracts for coal and coke would only be taken at rates considerably above those then running. It appears that when coal was at the ordinary rate alluded to the London and North-Western expended about £22,000 a month for locomotive or steam coal, the Midland £18,000, the Great Western £16,000, and the North-Eastern £17,000, the latter consuming about 50,000 tons of coal monthly. One of the first contracts that were required at the commencement of last year was that of the Great Northern, who had been paying 6s. a ton, but the old contractor required an advance of about 40 per cent., but ultimately agreed to a short time contract at 8s. per ton. At the end of June the contracts of several railway companies expired, and they sought for renewals, but these were only offered at not less than 8s. 6d. per ton, or an advance of about 42 per cent., and these the companies were obliged to accept, with the exception of the Great Eastern, the directors of which were able to obtain a small contract at a rather less price, but were obliged to take a rather inferior quality of coal. The last proposal for tenders was made at the beginning of December, on the part of the North-Eastern, for supplies for the new year, commencing with January.

EXHIBITION OF BRASS WORK AND ARMOURY.

The Company of Armourers and Brasiers intend to hold in May next an Exhibition of modern armour and blades, and of works in brass, bronze copper, and other metals combined with brass. The exhibits will comprise helmets, breastplates, and blades; church furniture, such as altar crosses, screens and gates, ornamental hinges; stove decorative mounts, fire-dogs, fenders; chandeliers, gaseliers, electroliers; cire perdue castings, &c. For very large work, such as park gates, chancel gates, &c., only designs can be accepted. Numerous prizes will be given to craftsmen, and certificates to manufacturers. Specimens, models, or designs of improved tools for use in the manufacture of the foregoing articles will have a section reserved for them. Applications for space should be made to Mr. Marshall Pontifex, Armourers' Hall, 81, Coleman Street, E.C.

ORIENTAL ENAMEL ON TILES.

J. Boeck has recently communicated to the *Journal fur Practische Chemie* the results of his examination of the chemical composition of certain ancient Turkish blue enamels, and suggests that this enamel can be imitated in the following way:—A mixture of sand (53·53 p.c.), copper oxide (3·51 p.c.), litharge (18·3 p.c.), chalk (5·4 p.c.), tin oxide (6·9 p.c.), potassium carbonate (5·2 p.c.), and sodium carbonate (12·5 p.c.) is heated in a Hessian crucible until the mass begins to soften and form a glass without dissolving the oxide of tin. In this operation air must have free access to the mixture, so that the lead and copper oxide are not reduced. The mixture is next poured into water, powdered, and moistened with water, and is then ready for burning on to the clay. The earthenware from which the enamel was taken was made from a marly clay, and was very porous, but had been burnt to a moderate hardness.

JAPANESE LACQUER.

Japanese lacquer is an exudation from cuts in the bark of the young trees of *Rhus vernicifera*. The sap is first greyish white and thick, but rapidly darkens through yellow to black. An inferior lacquer is obtained by soaking the branches in water, and requires straining before being fit for use. Certain lacquers have a small proportion of drying oil (perilla oil) added to them. The principal constituent is urushic acid, and this acid is always associated with an albuminoid substance, a gum, and a poisonous volatile acid. The hardening of lacquer is due to the oxidation of urushic acid, and the finest black is obtained by adding iron or an iron salt to the liquid, which forms a black iron salt with this acid. A coniferous wood is usually used for lacquer work, and all joints and holes are first filled with a putty-like material made from inferior lacquer and rice flour.

FREEDOM OF CONTRACT.

Although action has been taken in the past by the Liberty and Property Defence League in connection with legislation affecting the relations between capital and labour, that body has hitherto not concerned itself with labour difficulties. In the annual report, which has just been published, they, however, express the opinion that in some of the strikes which have occurred within the past six months the men have shown an intention of claiming more than the right of combination ensured to them by the Trades Union Act of 1871. They state that "the intimidation and picketing directed against non-unionists, willing to sell their labour to the employers in the open market at the market price, is an attempt by the trade unionists on strike to add to their own share of liberty by curtailing the liberty of their fellow workmen."

THE "POST OFFICE GUIDE."

In a disastrous fire which occurred at the business premises of the printer of the "Post Office Guide" on December 25th, the whole of the type set up for the publication of the January edition was destroyed, as well as many thousand copies of the Guide which were already completed for issue. As it is found that it will be impossible to reset the type and to issue a new edition of the Guide for a considerable time, the Postmaster-General, while deeply regretting the inconvenience which will be caused to the public, has decided to suspend the January edition altogether, and to issue an edition on March 1, to be substituted for the edition which in ordinary course would have been issued on April 1 next. In order that the public may suffer the least possible inconvenience from this disaster, a short statement of the principal alterations which would have appeared in the January edition has been printed on a separate sheet, copies of which are obtainable at any post-office. The "Post Office Handbook," in which these alterations are to a great extent embodied, has been issued in due course, and copies may be obtained at any post-office at the price of one penny.

A SUBSTITUTE FOR OAK BARK IN TANNING.

In a recent United States consular report Mr. Merry describes "a vegetable product which will become a ready and perfect substitute for the rapidly vanishing oak of our own country." This is the Australian wattle, which belongs to the widespread family of acacias, and which is cultivated extensively in New South Wales and Victoria, where it lends a charm to the scenery both by its fragrant blossoms and its exquisite foliage. The two varieties most cultivated are the black and the broad-leaved wattle, and both can be grown in an exceedingly dry climate and a poor soil. The black wattle produces a large amount of tannic acid. Its value for tanning will be understood when it is mentioned that hides can be readily tanned in a bath of liquor made from black wattle in 47 days, whereas in liquor made from the bark of the Santa Cruz oak, the best known in the Pacific States, the time required is 75 to 80 days. The black wattle contains 30 to 32 per cent. of tannic acid, the broad-leaved wattle 26 to 28, Santa Cruz oak 16 to 18, and other kinds of oak less still. Although the broad-leaved wattle has less acid, it has certain advantages over the black variety. It is a larger and handsomer tree, and can withstand a greater amount of frost.

OXALATE OF MANGANESE AS A DRYER.

M. John Castelar, in the *Moniteur des Produits Chimiques*, has drawn attention to the valuable properties possessed by manganese oxalate as a dryer. This salt has hitherto not had any important industrial uses; but as it can be readily prepared in a state of purity from the native carbonate by the action of oxalic acid, the author is of opinion that it will be found of use for this purpose. If prepared from carbonate free from iron and lime, it can be obtained as a fine crystalline white powder, and 2–5 per cent. is sufficient to being about the change. The oxalate is resolved by heat into manganese oxide, carbonic acid, and carbon monoxide, and in the presence of fatty acids the manganese oxide formed combines with them, the decomposition taking place at about 130 deg. The operation is easily carried out by mixing in a mortar the oxalate with two or three times its weight of oil, and then adding the mixture to the main portion of the oil. The heat should be applied gradually, and the decomposition is known to be complete when there is no further evolution of gas. The boiled oil, under this treatment, preserves its limpidity, and also remains colourless. Manganese oxalate has the advantage over oxide of lead, which is commonly employed for this purpose, in causing the oil to remain transparent when exposed to sulphur vapours. Manganese acetate has also been used, but it likewise causes a darkening in the colour of the oil, and the nitrate is dangerous, owing to the possible action of nitric acid on the fats present in the oil. Manganese borate appears to be next in value to the oxalate as an oil dryer.

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Patent Record.

(Compiled from "The Illustrated Official Journal (Patents).")

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

23rd December, 1889.

20593. Coleby, Guest, & Brookes ..... Reels for reeling yarn.
20594. Smyth & Middleton ... Shuttle guards for looms.
20603. Stephenson & Stephenson ..... Shuttle tongues or pegs for weaving.
20607. Smiddy, T. M. ..... Engine oil lubricator.
20613. Shaw & Harcourt ..... Transmitting rotary motion.
20622. Whitehead, W. ..... Automatic sprinklers.
20624. Thebermann, W. P..... Apparatus for raising water.
20626. Ogden & Ogden ..... Looms.
20633. Paton, A. ..... Printing machinery.
20638. Barcroft, H. ..... Propelling and steering boats.
20647. Suchland, T. ..... Lathes.
20649. Clarke, A. M. ..... Traction engines (*Hursey & Madden*).
20650. Gray, J. D. ..... Governors.
20658. Young, G. H. ..... Hay-turning machine.
20661. Poat, J. ..... Heating apparatus.
20663. Crawford, M. ..... Grinding apparatus for gold and silver ores.
20669-70. Libbey, H. W. ..... Anti-friction bearings.
20673. Thomas & Hausman ... Surf-power machine.
20675. Sautenard, F. N. ..... Lubricators.
20676. Schinzel, E..... Water meter.
20677. Wise, W. L. ..... Apparatus for treating metalliferous material (*Walker*).
20682. Fleck, Fleck, & Schrader ..... Force accumulators.
20683. Ball, C. J..... Ejector dredger.

24th December, 1889.

20687. Washington, S. ..... Furnaces for melting glass.
20688. Morley, H. W..... Steam engines.
20689. Butterworth, J. ..... Looms for weaving.
20690. Irvine, A. K. ..... Apparatus for compressing tobacco.
20692. Coulter, J. ..... Machine for dressing stones.
20696. West, W. R..... Bearings for shafts.
20697. Cran, J..... Furnaces and flues.
20700. Hassel & Holt..... Driving machinery.
20701. Paton, A. ..... Printing machinery.
20703. Snelling, J..... Rotary engines.
20708. Hett, C. L. ..... Turbines.
20712. White & Boyd ..... Brick-making machines.
20715. Delahunty, J. P. ..... Dyeing machines.
20716. Trappen, A..... Forging presses.
20718. Sale & Sale ..... Starting tramcars.
20726. Eynon, T. ..... Milling tools.
20730. Morris & Wood ..... Drying apparatus.
20735. Haddan, R. ..... Eyelet-setting machine (*Coles*).
20737. Davy, C..... Hydraulic forging presses.
20739. Hobson, A. H. ..... Desiccating apparatus.
20745. Horn, W. W. ..... Washing machine and churn (*Churchill*).
20746. Baier, X. ..... Finishing planes for tyres.
20747. Vavasseur, J. ..... Mounting for gun.
20748. Jenks, W. H. ..... Engine governors.
20749. Wolseley, F. Y..... Apparatus for imparting motion to machinery.
20753. Bénier, L..... Steam engines.
20755. Gehre, M. ..... Determining amount of water contained in steam.
20756. Hope, G. F. W. ..... Sand separators.

ELECTRICITY.

23rd December, 1889.

20627. Mordey, W. M. ..... Electric distribution.
20645. Dearlove, J. A. L..... Coating telegraph cables.
20646. Cassagnes, G. A..... Printing telegraphic apparatus.
20652. Edmundson & Clarke Incandescence electric lamps.
20653. Foster & Griffiths ... Telegraphic insulators.
20660. Winckler, J. O. ..... Electric signalling apparatus.

24th December, 1889.

20717. Prentiss, H. S..... Electric cams.
20734. Haddan, R. ..... Magneto-electric machines (*Gillette*).
20743. Sechehaye, E. ..... Projectors of electric light.
20751. Marx, F. ..... Accumulators.
20752. Marx, F. ..... Electrodes.
20764. Thompson, W. P. ..... Electric machines (*Westinghouse Electric Company*).

CHEMISTRY.

23rd December, 1889.

20665. Baswitz, C. ..... Treatment of textiles by ammoniacal oxide of copper.
20668. Johnson, J. Y..... Colouring matters (*Badische Anilin und Soda Fabrik*).
20678. Imray, O. ..... Rosaniline dyes (*Farbwerke vormals Meister, Lucius and Brüning*).

24th December, 1889.

20722. Fell, J. C..... Ammonia from atmospheric nitrogen (*American Ammonia Manufacturing Company*).

MISCELLANEOUS.

23rd December, 1889.

20596. Alderton, G. H. ..... Fog signals.
20599. Waller, G. ..... Decorative earthenware tiles.
20610. Illingworth, C. R. ... Shoes for horses.
20611. Foden, E. R..... Apparatus for signalling.
20619. Sowerby, J. G. ..... Cutting glassware.
20634. Snoeck, A. ..... Shuttles.
20679. Myall, A. ..... Smokeless and gasless fuel (*Lancaster*).

24th December, 1889.

20693. Gillett, S. W..... Shuttles (*Kelly & Kelly*).
20750. Bing, N. C. ..... Distributing oil on water.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

Gas Engines.—*J. McClure, Caldwell Paton, Nottingham.*—The invention consists of an appliance for starting gas and similar engines. The improvement consists in the employment of a self-acting centrifugal friction clutch, which releases the driving pulley upon the crank shaft when starting, but after the engine has attained sufficient speed automatically couples it to the shaft. The clutch is formed of friction blocks fixed to the crank shaft by levers. When the engine is moved slowly the blocks are held by springs close to the shaft, but as the speed increases the centrifugal force presses the blocks out and against the rim of the driving pulley. Claim: The application upon the crank shaft of a gas or similar engine of a centrifugal clutch so arranged that it disconnects the crank shaft and driving pulley when the engine is stopped, and automatically connects them when the engine is nearing its normal rate of speed, and automatically disconnects them again when the engine slows speed. —No. 441. January 10th, 1889. 8*d.*

Lathes for Stone.—*T. Turner, Ketton, Rutland.*—This invention relates to lathes for turning stone, and its object is to improve the arrangement of the tool rests and apparatus for gauging articles in process of turning. The inventor arranges a shaft or bar above, and parallel to, the lathe centres. It may be carried in bearings formed in vertical supports, the lower ends of which may be secured to the headstocks. On this shaft a number of gauges are arranged; they are carried on or between sliding bosses, by means of which the gauges are adjusted and secured in their desired positions on the shaft. The gauges rotate freely on or between the bosses secured on the shaft, and each one is provided with a steel pointer sliding freely in the gauge, the point of which may be adjusted to any suitable distance from the centre of the shaft or lathe, and secured by means of a set screw. The points of the gauges are set so as to pass over the article in the process of turning at that part where they are fixed to gauge, as soon as it is reduced to the desired diameter, when they pass to the back out of the way, and may be turned over the top of the shaft and brought in front when commencing a fresh article. The points of the gauges may be held in contact with the article in the lathe centres by springs, or they may be formed with a weight, or be provided with a vessel in which weights may be placed as required. By this arrangement, when turning fancy articles, such as balusters, a gauge may be arranged for each separate part of the baluster. The gauges are held in contact with the baluster, and indicate immediately when each part is reduced to the requisite diameter. The inventor arranges on the tool rest two or more checks or plates, which slide laterally on the rest, and which may be adjusted and secured by set screws to different parts of the work, and act as guides for the tool. Centres may be formed for turning such articles as stone balusters by forming a hole at each end and inserting a metal plug or a metal plate having one or more projections fitting into corresponding holes in the ends of the balusters, centres being formed in the plug or plate, which are secured by any suitable composition to the baluster. The stone balusters are driven by means of an adjustable clamp fitting on and bolted to the square end, which engages with a pin in the driving plate of the lathe. There are two claims.—No. 685. January 14th, 1889. 6*d.*

Brake for Hoisting Apparatus.—*W. M. Simons & G. Sadler, Nottingham.*—The apparatus here described is operated by a rope coiled round a flanged pulley, which is attached to the axle of the hoisting drum. As the load is raised by pulling the rope, the rope unwinds from the pulley and *vice versâ*. The rope, as it leaves the flanged pulley, passes over a second pulley, supported upon one arm of a lever, the other arm of the lever being made to raise or lower a wedge between the flanged pulley and the frame of the apparatus. When the rope is pulled to raise the load, the force exerted upon it causes it to depress that end of the lever supporting the pulley, and the other end is therefore raised, and in its turn raises the wedge behind the flanged pulley and so releases the pulley. If the hoisting rope be now let go the lever assumes its former position, and the wedge drops behind the flange pulley and holds the drum fast. One claim is made for the construction of an automatic brake as described.—No. 1726. January 31st, 1889. 6*d.*

Hydraulic Hoists.—*R. Wright, Newcastle-upon-Tyne.*—In this apparatus the lift cylinder is connected to another cylinder of the same capacity in which a plunger works. This plunger is forced in by the combined efforts of three other hydraulic cylinders. The ram of one of these cylinders acts upon the plunger vertically and in a line with its axis. This ram is of the dimensions required for lifting the live load. The cradle and the lift ram are balanced by the two other cylinders, and in such a manner as to compensate the varying immersion of the lift ram. The balancing cylinders are constantly open to the pressure main; they are carried by trunnions arranged so that their rams act obliquely on the plunger. The obliquity increases as the plunger passes from one end of its course to the other. The variation of the obliquity of action of the compensating rams is made to counter-balance the effects of the varying immersion of the lift ram. Claims: (1) Compensating the varying immersion of the lift ram and plunger or plungers by the varying obliquity of cylinders forming a portion of the hydraulic gear; (2) the arrangement of direct acting hydraulic hoists or lifts as described.—No. 2075. February 5th, 1889.

Carding Engines.—*J. McQueen, Manchester.*—The invention relates to the means employed to obtain a reduced speed of revolution of the main cylinder and doffer of a carding engine during the operation of grinding the wire cards on such cylinders. In the improved apparatus is employed a differential motion to effect the required reduction of speed. In the motion an external spur wheel is carried around in rolling contact with an internal spur wheel and is attached to a second external spur wheel which gears with a second internal spur wheel. The two internal spur wheels differ in the number of their teeth, and as the first one is kept from revolving, the second one is caused to revolve, but at a speed which is less than that of the part which carries around the first external spur wheel. Fig. 1 is a front view of the apparatus, Fig. 2 a side view in section, and Fig. 3 shows the apparatus mounted upon the carding engine. Through the

FIG. 1.

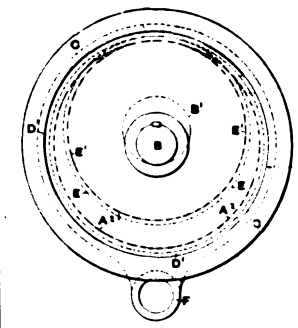
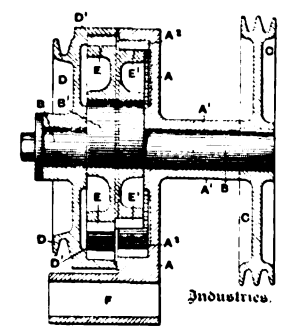
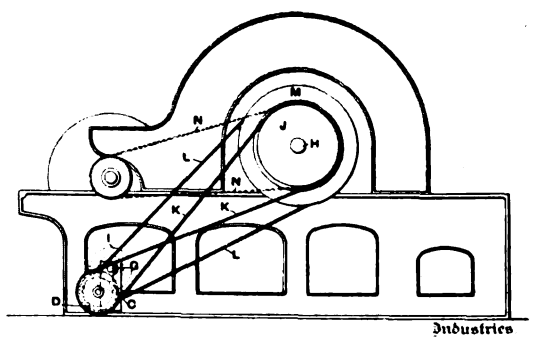


FIG. 2.



boss A^1 of a supporting frame A passes the shaft B with an eccentric B^1 fixed to it. Upon one end of the shaft is fixed the V pulley C, and upon the eccentric is supported a double-toothed gear wheel, which is free to revolve upon the eccentric, and has one part E^1 smaller in diameter than the other part E. The part E^1 of the double-toothed wheel gears in the supporting frame A, whilst the part E gears in the internally geared surface D^1 of the V pulley D, which is also supported upon the shaft B. It may now be seen that by revolving the pulley C the eccentric B^1 will revolve and cause the part E^1 to roll in gear with part A^2, and the part E with the geared surface D^2. The surface A^2 remaining stationary and part E being larger than part E^1, will cause the pulley D to revolve at a slow speed in the same direction as the shaft. Fig. 3 shows the apparatus mounted upon a stud G, which usually carries the intermediate band pulleys as

FIG. 3.



indicated by the dotted line I. The pulley C of the slow motion apparatus is driven by a band K passing over the pulley J upon the main cylinder shaft H, and the slow motion is communicated to the main cylinder by the band L passing around the pulley D. Claims: (1) The apparatus constructed as described; (2) a slow motion apparatus for carding engines provided with the differential gearing A^2 E^1 C and D^1; (3) a slow motion apparatus for carding engines adapted to be applied as an intermediary between the ordinary driving apparatus and the main cylinder or doffer, such apparatus being provided with a pair of differential spur wheels eccentrically mounted upon a central shaft and carried around so that one wheel is in rolling gear with a fixed internal wheel and the other spur wheel is in gear with a second internal wheel, which imparts the motion reduced in speed to the main cylinder or doffer; (4) the means for obtaining slow rotation of carding engine cylinders.—No. 817. January 16th, 1889. 8*d.*

Safety Valves for Hydraulic Cranes, &c.—*T. Harris, Newport.*—The valve is contained in a chamber fixed to and communicating with the pipe through which the water flows to and from the ram cylinder, and is situated between the ram cylinder and the regulating valves. To the valve proper is attached a piston working up and down within a cylinder. The piston, and thus the valve, are pressed down to close the valve by a suitable spring acting upon the top of the piston. The under side of the piston and cylinder are in communication with the hydraulic main, the pressure of water from the main being sufficient to overcome the resistance of the spring and keep the valve open. Should the pressure in the main become reduced by fracture or other means, the pressure under the piston being then

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reduced, the spring forces down the valve, and prevents the escape of water from the ram cylinder. Claim: In a hydraulic crane, hoist, lift, and the like, the use, between the working valves and the ram, of a valve, the spindle of which is fitted with a piston surrounded by a spring or its equivalent, and working in a chamber communicating at the bottom by an orifice or channel with the water supply by which the ram is actuated.—No. 1875. February 2nd, 1889. 6*d*.

LIFT APPARATUS.—*J. Haskins, London.*—An apparatus is here described for raising loads, the load raised being caught and retained at any point where the haulage ceases. Fig. 1 is a side elevation of the apparatus, Fig. 2 is an end elevation of the apparatus, Fig. 3 is a side elevation with part broken away, and Fig. 4 is an end elevation partly in section. Referring to the figures, C is the pulley for raising the load by the rope D, F the pulley for hauling up the load by the rope G. The two pulleys F and C are connected to the shaft B, whose ends are supported in the bearings E E^1, and its centre supported by hinged collars I J suspended from a shaft K. The bearing E^1 of the spindle B is free to rise and fall in guides in the framing, but the height to which it can rise is adjusted by a screw A^2. The bearing E also works in a guide and rests upon the pin E^2 of a weighted lever

FIG. 1.

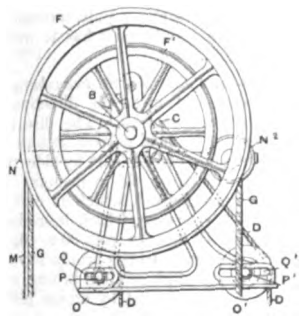
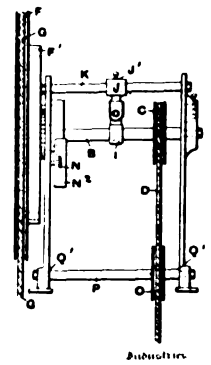


FIG. 2.



N. The central bearing collars I J are made adjustable upon the two shafts. Upon one side of the wheel F is a flange F^1, which constitutes with the wheel H a friction break. The wheel H is mounted upon a hollow boss, and is prevented turning in a direction opposite to the hauling motion by a ratchet wheel and pawl L^1. The action of the apparatus is as follows: When the weight becomes suspended upon the pulley C, the end B^2 of the shaft becomes depressed, and the shaft levering upon the collars I J the opposite end B^1 is raised, and the flange F^1 coming into contact with the wheel H forms the break, and holds the load in that position. If hauling is now commenced the end B^1 becomes depressed and flange F^1 freed from contact with the break wheel H, as the weight of the load is made to balance the pull upon the hauling cord by adjusting the collars I J. If a rapid descent of the load is required the bearing E is released from the

FIG. 3.

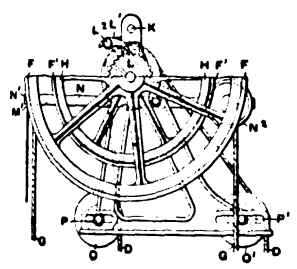
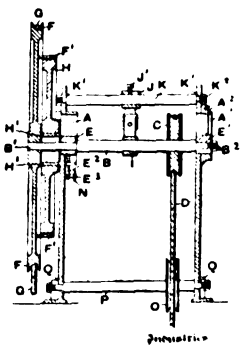


FIG. 4.



action of the weighted lever by the cord M^1. Claims: (1) In a lift apparatus the combination with the break wheel of a haulage wheel having its axis suspended on a rocking centre, arranged so as to be adjustable as to the leverage exercised on the load wheel; (2) in a lift apparatus the arrangement or combination and use of adjustable sliding suspending bearings linked or hinged together, forming an adjustable point of suspension for an axis carrying the haulage wheel or wheels, and the load supporting wheel or wheels, sliding vertical bearings therefor, a break wheel to co-operate with said haulage wheel, a lever for disconnecting the same for lowering; (3) the combination or arrangement and use of parts of lift apparatus as described.—No. 1034. January 19th, 1889. 8*d*.

SAFETY APPLIANCES FOR HOISTS.—*R. Middleton, Leeds.*—This invention consists of a mode of actuating safety catches. An extra rope is attached to the main balance weights, and, in case the main balance weights give way, it produces a pull such as throws the safety clutches into action. This rope also causes an arm on a shaft, round which it is led on a rope-pulley, to revolve so that when any dangerous speed is reached a portion of the revolving arm flies out and releases a catch. This catch either brings the gripping devices into action or sets a brake to work on the main shaft. The object of this invention is to simplify the mechanism and increase the efficiency of safety catches; and to add to the usefulness of the gripping wedges referred to in the complete Specification No. 15292 of 1887. The gripping wedges are fixed to the cages, and their actuating levers are arranged on the cage roof. In connection with these latter is the safety-rope, so attached that when firmly pulled the wedges are put into action. The "safety-rope" is led upwards to the overhead beams, and then downwards, after being taken over one or more pulleys. Attached to its end are by preference one or more smaller counter-weights, whose duty it is to keep the rope tight and consequently in good contact with the last-mentioned pulleys. On the shaft of one of these pulleys is fixed a wheel capable of retaining any catch that may be dropped into it, and an arm or lever on which a weight is arranged to slide. This weight is held in mid position on the arm by one or more springs. The arm and its weight necessarily revolve whenever the cage moves, by reason of the "safety-rope" being led over it. At ordinary speeds the weight on the arm occupies a position which clears an adjacent tappet, but at a given extra speed it flies out far enough to strike this tappet. The consequent locking of the pulley produces an additional pull at that end of the "safety-rope" which is attached to the levers, and the gripping wedges are thus pulled into action. There are five claims.—No. 2109. February 6th, 1889. 8*d*.

ARMOUR PLATING.—*J. Ward, Coatbridge, Glasgow.*—This invention has reference to a new construction of compound armour plates, and is also applicable to compound ship and boiler plates and sheets. The novelty of the invention consists in the use of layers of puddled bar iron in combination with steel or iron. According to one arrangement, a compound steel and iron armour plate is produced, by taking a hard steel face block or slab, and an ordinary malleable iron back plate or slab, both previously roughly cogged or hammered to the desired thickness, and uniting them together by placing a thin layer of puddled bar iron between the inner surfaces of these slabs, and then heating the combined block when placed in a furnace. When sufficiently heated they are removed from the furnace and rolled through the rolls of a mill, and thus reduced to the desired thickness of plate required. Under another arrangement, a compound steel armour plate is produced by taking a face block or slab of hard steel, and a back slab or block of soft steel low in carbon, all previously roughly cogged or hammered, and uniting them together by placing a thin layer or layers of puddled bar iron between the inner surfaces of these slabs or blocks, and then heating the combined slabs thus placed together in a furnace, and when sufficiently heated passing the combined slab or block thus formed through the rolls of a rolling mill to reduce the compound plate to the thickness desired. Other methods are also described in the specification. There are four claims.—No. 1,987. February 4th, 1889. 8*d*.

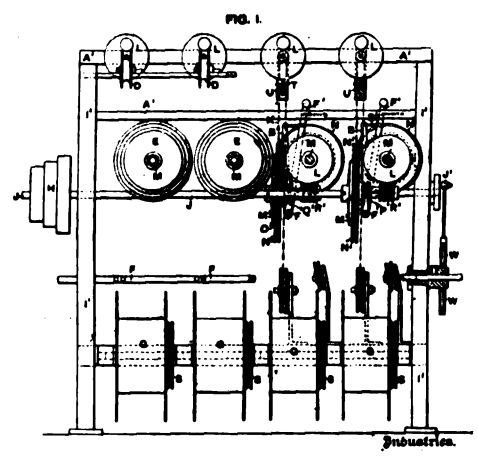
STEERING VESSELS.—*B. J. B. Mills, London.* (*J. L. Horing, Jersey City, U.S.A.*)—This invention relates to that kind of steering apparatus for vessels in which the rudder of the vessel is moved by the admission to a cylinder of a fluid such as air, steam, or water, under pressure. One object of the inventor is to provide a simple arrangement by means of which the valve will be brought back to its position of closing the cylinder ports by the movement of the rudder. A further object is to so combine the power-steering apparatus with the hand-steering apparatus that if at any time the power apparatus becomes inoperative, the hand apparatus may be readily used instead. The method of carrying out these improvements will be understood from the claims: (1) The apparatus for steering vessels having in combination with the rudder the fluid pressure motor containing a piston connected with the rudder, the hand-steering wheel also connected with the rudder, the power-steering wheel, a bevel gear on the shaft of said hand-steering wheel, a bevel gear on the shaft of said power-steering wheel, a bevel gear engaging with both said gears, a gear wheel carrying said last-mentioned bevel gear, another gear wheel with which said carrying wheel engages, and connections from the shaft of said last-mentioned gear wheel to the valve, which controls the admission and outlet of fluid for the motor; (2) the combination of the rudder, the fluid pressure motor having a piston connected with the rudder, the hand-steering apparatus and the relief cocks and inlet valve for the motor connected with a handle at the place where the steering is performed so as to enable the hand-steering apparatus to be used; (3) the use in steering apparatus, in combination with a rudder, of a motor consisting of a tight case which is fan-shaped or approximately so, and a movable piston within such case, which is pivoted at the apex or small end of the case so as to be moved on its pivot in a curved line by the pressure in said case, said piston being connected with the rudder head.—No. 1887. February 2nd, 1889. 8*d*.

APPARATUS FOR WORKING PUNKAHS.—*T. T. Watson, Jubalpur, India.*—On a framing is mounted, some height from the ground, a horizontal cylinder fitted with a piston and provided with a slide valve and ports for admission and emission of the working fluid. The piston rod crosshead is connected by side links to a lever, which is pivoted at the lower part of the frame, and extends upwards, having attached to its top the rope leading to a punkah. The piston rod crosshead acts on adjustable tappets on the rod of the slide valve, so as to shift the valve at each end of the stroke. The working fluid acts on the one end of the cylinder, the bottom being opened when fluid under pressure is used, but when the apparatus is worked by vacuum the bottom is closed and connected to a vacuum chamber. The fluid in propelling the piston back thereby pulls the lever and the punkah attached to it, and the crosshead on meeting the hinder tappet shifts the slide valve so as to cut off supply of fluid and open discharge. The punkah and lever then swing back, drawing the piston until its crosshead meets the front tappet and shifts the valve, so that the discharge is closed and fluid again acts upon the piston. Claim: Apparatus for working punkahs, consisting of a vertical lever connected to a punkah or set of punkahs, and to the rod of a piston moved by fluid pressure in a cylinder, the ingress and egress of the working fluid being governed by a slide valve moved by adjustable tappets acted on by the piston rod as described.—No. 18087. December 11th, 1888. 6*d*.

REFRIGERATING CHAMBERS.—*R. C. A. Banfield, London.*—The cooling of air is effected by contact with extended surfaces which are cooled by refrigerated brine or other uncongealable liquid. The cold air is by pumping or otherwise caused to circulate from and to the refrigerating apparatus and through a set of troughs. In the troughs are mounted several transverse shafts, which are caused to revolve. On each shaft are fixed a number of parallel discs partly immersed in liquid. The troughs are situated in a passage through which the air passes in a current parallel to the revolving discs. Thus, as the discs revolve in the refrigerated liquid, the air passing in numerous streams through the spaces between the discs becomes cooled, depositing excess of moisture and impure gases or other matters that may be suspended in it, by contact with the cold moist surfaces of the discs. Claims: (1) The herein-described method of cooling air by causing it to pass in numerous thin streams between discs revolving partly immersed in cold liquid; (2) for the purpose of cooling air in the manner above referred to, apparatus consisting of a number of parallel discs mounted in the air channel and caused to revolve partly immersed in cold liquid, circulating from and to refrigerating apparatus.—No. 11849. July 25th, 1889. 6*d*.

COVERING WIRE WITH COTTON, &c.—*T. C. Barraclough, Manchester.*—This machine is designed to give off a larger percentage of work than is usual in present machines. The machine is constructed of a number of similar sections, and each individual section made to stop instantly and automatically whenever a spool or bobbin becomes empty. Fig. 1 is a front elevation, and Fig. 2 an end elevation of the machine; parts in each being shown in section. A driving bar J is mounted upon the framing I^1 of the machine. In each similar division of the machine a friction disc M^1 is fixed to the shaft J. The friction disc drives the V pulley N^1 which is connected to the worm R^1. The worm R^1 is geared to a wheel L upon the shaft M, which carries the drawing rolls E and a V pulley N for driving the receiving reels G. The reels G are driven by an endless belt passing round the pulleys N, P, Q, and S. A is the spool for the bare wire. L^1 are the spinning discs

FIG. 1.



which are driven by an endless belt passing over the pulleys B, C, R, and N^1. A clutch arrangement Q^1 F^1 is provided for putting the pulley N^1 in contact with the friction disc. The action of the machine is as follows:—The two spools containing the desired covering yarns or strands are placed upon the pins of the spinning discs L. The bare wire upon the spool A is drawn through the two hollow spindles of the spinning discs, over the guide pulley D, and once or more round the drawing pulley E, and then fixed to the reel G. The ends of the covering yarns or strands are drawn through eyes formed in the small hinged levers U and through the guiding levers T and fixed to the wire. The machine thus prepared is set in motion, and as the drawing pulley E draws the wire off the spool A the two spinning discs rotate in opposite directions and wind the fibrous material round the wire in a spiral direction. When a covering yarn or a strand breaks, or a spool

FIG. 2

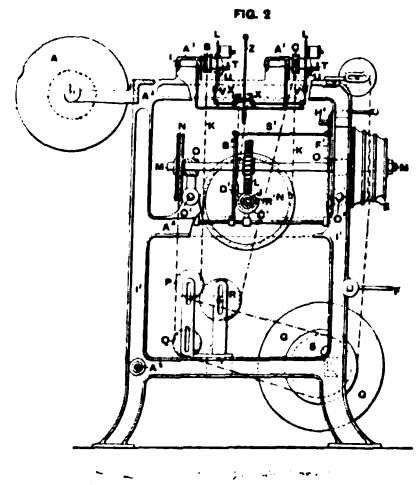


FIG. 3

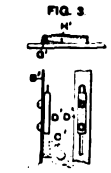
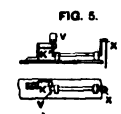


FIG. 4.

FIG. 5.



becomes empty, the hinged lever U ceases to be held in position by the tension of the threads. The centrifugal force of the spinning disc therefore acts upon it and causes it to assume a radial position and strike the lever V. The lever V when struck falls and allows the weight D^1, attached to the other end of the lever by a string, to fall and put the striking gear out of action. A crank disc is mounted upon the end of the shaft J, to work by a ratchet wheel W the guides F of the receiving reels G. Claim: The improved construction and arrangement of wire covering or lapping machine provided with automatic disconnecting gear in which the stoppage of each covering and winding section of the machine is ensured whenever a breakage occurs in the winding threads or strands or a spool becomes empty by a lever mounted upon the spinning discs and held by the tension of the threads, and which tension being removed causes the release of a friction coupling.—No. 15340. September 30th, 1889. 8*d*.

HYDRAULIC GAS MAINS.—*D. Irving, Bristol.*—This hydraulic gas main is constructed in such a manner as to allow of the seal of the dip pipes being adjusted with facility and accuracy, and at the same time afford ready means for flushing the main to remove any thick tar that may accumulate. The liquid for sealing the dip pipe is kept within the main by a sluice gate form of valve. The liquid is kept at a certain height by raising or lowering the gate, the superfluous liquid flowing over the edge of the gate. When it is required to discharge the thick tar accumulated in the main the gate is raised to its full height, and the tar allowed to flow out beneath into a pipe below the gas outlet pipe provided for carrying off the liquid. The gate is raised and lowered by a worm upon a shaft gearing into a rack upon the back of the gate. The shaft is operated from above by a wrench, and is provided

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with a pointer to indicate the position of the gate, and a locking arrangement to prevent the gate being raised too high in error, and so allow the liquid to escape, breaking the seal. Two claims are made for the apparatus as described.—No. 17697. November 6th, 1889. 6*d*.

Tramway Points.—*T. Tweddell, Hartlepool.*—The invention is applicable to tramways in which the flange of the wheel runs in a sunk groove, and is to avoid the dangers of the wheels taking the wrong grooves and opposite grooves. According to the invention, the groove and the flange or "tread" of the "open" point are made with a gradual depression commencing at the narrow end of the point, and reaching its lowest point at the place where the two grooves diverge, and thence rising to the normal levels of the groove, flange, or "tread" of the rail. Thus the "tread" of the wheel of the car, entering from the narrow end of the point, follows the depression of the rail and the flange, and is imprisoned in the depressed grooves until the opposite wheel has taken its proper groove in the loose point. Claim: The improvement in tramway points consisting in making the groove and the rail flange at the narrow or "taking on" end with a gradual depression reaching the lowest point at or about the place where the two grooves diverge, and thence rising gradually to the normal level.—No. 2191. February 7th, 1889. 6*d*.

Spring Making Machine.—*H. Knipping & F. Hohage, Altena, Prussia.*—This machine is designed for making spiral springs such as furniture springs. The whole process is effected automatically. The wire is led to and attached to the spools upon which it is wound, and when the winding is completed, cut off by automatically working shears. Fig. 1 is a front elevation, and Fig. 2 a plan of the machine. The different parts of the machine are worked by pieces attached to the shaft A. The disc B, with a groove cut in it, gives one spool the backward and forward horizontal action for discharging the completed springs. The cam C actuates the shears A^1, and the heart-shaped cam E causes the rack F to rise and fall, thereby working the gear wheels E^1 S. The gear wheels E^1 S work the screw G for oscillating the guide O, and also work the two spools H, P, the spool P being connected to the other gear by the bar F^1 and additional

FIG. 1.

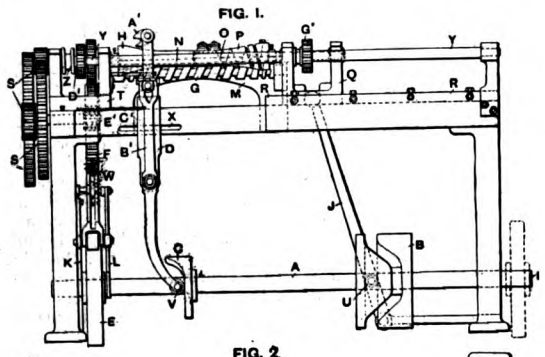
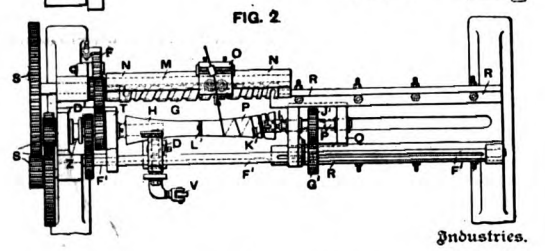


FIG. 2



Industries.

gearing G^1. The working of the machine is as follows:—At the beginning of the winding of each spring the spindle bearing Q, with the spool P and the guide O, are at the right end of their guides. The wire projects from the guide O, and is seized by the hook K^1 upon the spool P. The bearing Q is then moved to the left by the disc B, and the spools receiving motion from the rack F winds the wire upon the spools, and forms the spring. The spring is wound with more coils than is actually required to allow for the contraction when it is released from the spools. At the end of the winding the rack F reverses its motion, and by unwinding the spring allows it to contract in length and assume a larger diameter, and at the same time releases the end from the hook K^1 upon the spool P. On the backward motion of the guide O with the spring, the wire is brought between the shears and cut, so that the projecting end is of sufficient length to catch under the hook of the spool P as it moves forward again. Eight claims are made.—No. 14117. September 7th, 1889. 8*d*.

Healds of Looms.—*W. Ineson, Batley, Yorkshire.*—The object of this invention is to prevent the healds or gear of looms from rubbing or coming in contact with each other, and allowing a larger quantity of heald shafts to be employed. A series of loose vertical rods, wires, sticks, or other suitable substances are placed between each shaft at each end so as to leave a clear space between each shaft, forming slides for the said shafts, and so protecting the gear or heald yarns from rubbing. The rods, &c., are carried on cross shafts or rods by brackets attached to the loom frame. Claim: The use and employment of loose vertical rods or laths upon cross shafts as and for the purpose described.—No. 8206. May 17th, 1889. 6*d*.

Sawing Machinery.—*F. R. Lane, Woolborough.*—The novelty of this invention partly consists in the employment of air cushions to check the motion of the saws at the end of each stroke for the purpose of preventing vibration. A method of effecting this consists in making the backbone of the saw tubular, and with a stuffing box at each end. Through the stuffing boxes passes a fixed rod carrying two pistons so adjusted as to compress the air alternately at each end of the cylinder as the frame oscillates. The invention also relates to the method of driving the saws. A disc is fixed upon a shaft, which is revolved by belt pulleys, the disc having upon its face a swivel stud, which works between vertical guides fixed in the middle of the saw frame. Claim: In horizontal sawing machinery, the mechanism for driving the saw, consisting of a disc, provided with a swivel stud working in a yoke, of the afore-described rectangular saw frame, said disc being rotated by pulley and belt.—No. 4,638. March 16th, 1889. 6*d*.

Permanent Way of Railways.—*G. Robins, London.*—The inventor describes a method of preventing the longitudinal movement of switch tongues or rails. The inside of the jaws of every chair is notched or fluted, and the rails are rolled with corresponding ribs or projections, which fit in the notched flutes of the chairs. The ribs are rolled upon each side of the rail, and thus act as key fasteners to the wooden keys. Claim: In railway permanent way, providing teeth or ribs on one or both sides of the webs of the rails, and corresponding notches or channels on the inside jaws of the chairs.—No. 3575. February 28th, 1889. 8*d*.

Gas Engines.—*E. Repland, London.* (*P. Niel, Evreux, France.*)—This invention consists of a form of double-expansion engine, in which the products of combustion are mixed and expanded with air in a second cylinder. The object of mixing the air and exploded charge is to utilise the heat of the latter to expand the air and so produce greater pressure than the exploded charge would possess alone. In the cylinder D works the piston E, actuating with its rod G the crank F. The distribution of air and gas and the ignition take place through the lateral duct H, which is regulated by a tapered cock and shaft I, revolving once to two revolutions of the shaft. The valve box, shown in cross section by Fig. 2, establishes communication between cylinder D and air chamber O and between the cylinders and the conduit U. The valves are worked by cams R and T upon the shaft I. The air chamber O has a cubic capacity double that of the cylinder D, and its piston is connected to a crank pin N, situated upon the crank shaft directly opposite to the crank F. Whilst the piston E compresses its explosive charge, the piston L draws in air through the valve P. At the end of this first stroke the charge is exploded, and the piston E travels outward, doing work, and the piston L inward, compressing the charge of air previously drawn in. During the inward stroke, however, of the piston L the valve S is open half the distance of the

FIG. 1.

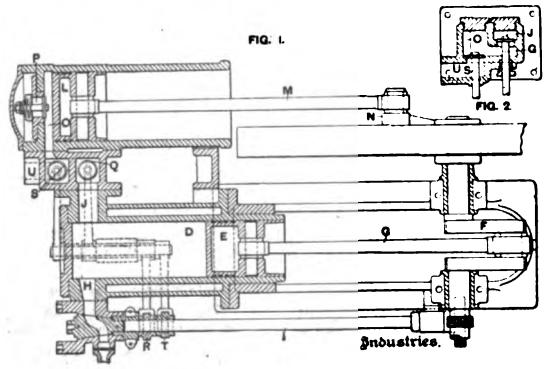
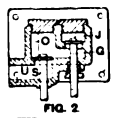


FIG. 2



Industries.

stroke, and thus half the air is allowed to escape. The air at the end of the inward stroke of the piston L is compressed to a pressure approximately equal to the pressure of the exploded and expanded charge in the cylinder D. The exploded charge and the compressed air are now mixed by valve Q being raised, and the heat of the charge coming into contact with the air expands the latter and increases the pressure of the mixed gases. As the pressure of the gases acting upon each piston is the same, and the area of the piston L is larger than that of the piston E, the extra pressure upon L causes it to perform work in the next (the third) stroke. At the fourth stroke the piston E draws in a fresh explosive charge, and the mixed gases in the cylinder K are discharged through the conduit U, and the cycle is then repeated. Claim: The application in gas motors of a second cylinder of greater volume than that of the gas motor, said second cylinder receiving a charge of air or other non-inflammable gas, a portion of which is compressed at the moment of escape of the products of combustion, which charge, by the action of the heat of the said products, expands, thereby producing additional motive force to act on the shaft, and consequently resulting in an economy of combustion.—No. 875. January 17th, 1889. 8*d*.

ELECTRICITY.

Dynamo Electrical Machines.—*W. T. Goolden, & H. W. Ravenshaw, London.*—According to this invention the commutator sections or strips are brought into the same plane as that in which is situated the side of the armature next the commutator or beyond the plane inwards of the armature side, and the armature wires, conductors, or windings are led down to, and are hooked or passed under the ends of the commutator strips and are fixed to them, so that the wires, conductors, or windings can be readily removed and replaced. The frame or support for the field magnets is preferably arranged on one side only of the armature, each magnet having its pole piece extending on both sides of the armature. The armature is of the disc type, and its core is preferably composed of a riband of soft iron wound with intervening insulation, on a frame, or hub, on the armature shaft. This core may be encircled with wood or other insulating material, which should be provided with notches to receive the coils of the armature wires, conductors, or windings. The winding may be done after the manner of the winding of a gramme armature. The commutator is preferably situated on the side of the armature opposite to that on which the frame or support for the field magnets is situated. The armature may be protected by covers between the field pieces. When it is desired to inspect or repair, the armature covers are removed and the armature is turned until the part to be inspected is brought opposite an opening. Claims: (1) In a dynamo electrical machine with disc armature a commutator so situated, or with its sections or strips so angled or arranged, that the points of connection of the sections or strips with the armature conductors are situated in the same plane, or behind the same plane, as that in which the face of the armature next the commutator is situated, and armature wires, conductors, or windings engaging with the ends of the said sections or strips; (2) the arrangement and combination of parts constituting a dynamo electrical machine as described.—No. 16710. October 22nd, 1889. 6*d*.

Dynamos.—*I. A. Timmis, London.*—This is an arrangement to prevent the effect of the varying speeds of dynamos and to keep the current practically constant. The principle of this arrangement is the employment of resistances which are automatically switched in at the desired moment. The resistances may be of any convenient form. The resistances are switched in automatically as the e.m.f. of the dynamo has reached such a value that current in the external circuit may be prevented from reaching such a limit as to be dangerous to the lamps or batteries in circuit. When a second dangerous speed limit is approached, a second resistance is switched in, and so on. To switch the resistances in, a long pull magnet is preferably employed, but any convenient shape may be used. Claims: (1) The arrangement of long pull magnets, electromagnets, or solenoids, with resistances automatically working in the field magnet circuit of any dynamo, either shunt, series, or compound wound, arranged and operating substantially as and for the purposes hereinbefore described; (2) an arrangement of long pull magnets, electromagnets, or solenoids, whose coils are connected up either as a shunt to the field magnet coils, or in series with the field magnet coils, and also in series with the resistances; (3) a long pull magnet or solenoid, with automatic cut-out contact pieces and resistance attached, as described; (4) the use of an electromagnet or solenoid, which has a diagrammatic pull, increasing in an equal ratio (practically) with the resistance it has to overcome.—No. 1535. January 28th, 1889. 8*d*.

Dynamo Electric Machines.—*A. Poleschko, St. Petersburg.*—The machine consists of an iron disc cut up in the direction of its radii into a large number of narrow sectors. The disc revolves between pole pieces having the form of narrow sectors on the sides facing the disc. Two brushes placed side by side rub on the periphery of the disc, and constitute the collectors. In the figures A is the core of the electromagnet, which is cast in soft steel in a single piece; D is the iron disc, which is made of one piece, and cut afterwards into small sectors from 60 to 100 in number. The disc is electrically soldered to the bronze nave H and the shaft B. The shaft B is made of aluminium bronze, and runs in steel bearings F, which are surrounded by bronze pieces E, the whole being supported in the arms C of the electromagnet. The object of making the shaft B of bronze is to avoid

FIG. 1.

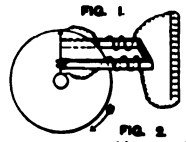


FIG. 2.

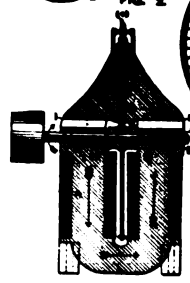


FIG. 3.

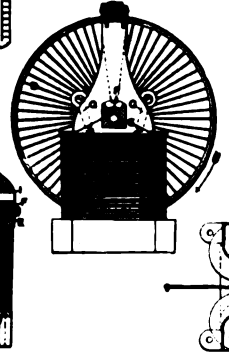
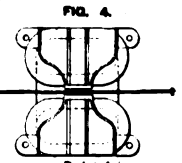


FIG. 4.



Industries.

the diversion of the lines of magnetic force in this shaft. The bronze pieces are used to separate the shaft from the magnetic centre of the poles of the electromagnet. The collecting brushes are attached to the top of the arms of the electromagnet as shown. Claims: (1) The rotary induced piece of machinery or armature exclusively of iron, in the form of an iron disc, cut up, in the direction of its radii, into a large number of narrow sectors; (2) the polar pieces having the form of narrow sectors on the inner side turned towards the disc, and condensing, so to speak, the magnetic flux along the radius of the disc; towards the outer side these polar pieces widen out, so that they present throughout a sufficient transverse section for the magnetic flux; (3) the system of the upper collector or brush in the form of two combs, side by side, and able to move independently of each other on the circumference of the disc, for the purpose of introducing into the circuit, and excluding therefrom the sectors of the disc, at the precise moment of the absence of current in the corresponding sectors.—No. 85. January 2nd, 1889. 8d.

MISCELLANEOUS.

Dye Extractors.—*F. Rhodes, Gomersall, Yorkshire.*—This invention relates to an improved form of apparatus for extracting the soluble colouring matter from dye-woods or other materials employed in dyeing. The inventor employs in combination with an ordinary dye vat and water heating and raising appliances, an extracting vessel of either rectangular or cylindrical form, one end of which is closed permanently and the other end is provided with a movable steam-tight cover secured by bolts and nuts. The extracting vessel is most conveniently used in a horizontal position, and is furnished with a perforated false bottom or strainer, upon which is placed the dye-wood or other material from which the soluble colouring matter is to be extracted. An inlet is formed at the top side of the extracting vessel for the admission of hot water or dye liquor, and an outlet at the bottom of the vessel. The temperature of the liquor contained in or passing through the extracting vessel is maintained by means of a steam coil or by blowing in steam or by steam jacketing. There are four claims.—No. 15558. October 3rd, 1888. 6*d*.

Copies of the British specifications may be obtained on application to H. Reader Lack, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every 10d. or fraction of 10d. Remittances exceeding one shilling must be made by Post Office Order.*

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THE PROGRESS OF ELECTRICAL ENGINEERING IN 1889.

THE past year has been remarkable for the extraordinary commercial activity in electric light and heavy electrical engineering businesses. Most of the manufacturing firms have been as busy as they possibly could be, and have had a turn-out of from two to three times that of former years.

The greatest development has been in central lighting stations. In some respects, we fear, things have been going a little too fast. The public has been asked for, and has perhaps given, a good deal more money than can be very safely invested. Central stations have paid remarkably well in the United States, and will probably pay nearly as well in this country, but there seems to be no reason for such an extraordinary rush for provisional orders.

On the other hand, there is some chance of a kind of silly panic being spread by the untechnical press. They kill a man every now and then in the States by overhead high-tension circuits, having a bare apology for insulation; it is then taken for granted by energetic and sensational journalists that we are going to do the same in some mysterious way with underground mains, and even with low-pressure circuits. The rules and regulations in force in this country are so strict that it would be practically impossible to kill any but a most ingeniously suicidal customer. Though to electrical engineers this outcry about danger appears to be very silly and unnecessary, it must be remembered that it is of enormous importance. Electricians may know perfectly well that a properly arranged installation is far safer, both as to risks of fire and of life, than oil lamps, gas, or candles; but it must be borne in mind that the public knows a great deal less than nothing about electric lighting; that is to say, it has all sorts of wrong ideas which may be very difficult to eradicate. A public which solemnly reads the blood-curdling accounts of utterly impossible details of American accidents may at any time come to believe that the electric light is really dangerous; and it is utterly impossible for the electric light to make any headway in the teeth of adverse public opinion. This outcry in America has been especially directed against the alternate current system, and it seems to have been started by people interested in direct current systems. As a matter of fact there is no reason why the alternate system, even with a transformer in each house, should not be perfectly safe. The accidents in America are nearly always due to badly insulated overhead direct current arc-light circuits. In England we run very few overhead arc circuits, and when we do we insulate them properly, and put them out of reach of the public.

CENTRAL STATION LIGHTING.

We will now discuss our subject under its separate heads. Little need be said here about central lighting stations, as we intend to publish a series of articles on this subject in a few weeks.

Of the contractors for station plant we may mention the Brush Engineering Company, which has supplied a number of Mordey alternating current machines and transformers, both for this country and for abroad. Mr. Ferranti has supplied the large dynamos for the London Electric Supply Corporation, and a 150 h.p. machine for Messrs. Muir, Mavor, & Coulson's installation in Glasgow, and has also done a large export business, viz.:—Paris, Halle Centrale, three 150 h.p. dynamos; Paris Exhibition, one 150 h.p. machine. In course of construction:—Havre, two 300 e.h.p. machines; Troyes, one 150 e.h.p. machine; Melun, one 150 e.h.p. machine; Lens, one 150 e.h.p. machine. Sent to South America:—La Plata, two 150 e.h.p. machines; Rosario, two 150 e.h.p. machines; Buenos Ayres, two 150 h.p. machines. These two machines are now in course of construction. With the plants for Rosario and La Plata, Corliss vertical compound engines, made by Messrs. Hick, Hargreaves, & Co., Bolton, and Babcock & Wilcox boilers were sent out.

Messrs. Crompton & Co., Limited, have, during the past year, carried out the whole of the contract work for the Kensington and Knightsbridge Company, including the erection and part equipment of two large central stations, each of which when complete will eventually be on a scale sufficient to supply 130,000 10 c.p. lamps. These two stations are on the battery transformer system. At Chelmsford they have nearly completed a central station for lighting the town on the alternating transformer system. At Northampton they have secured the order for, and are just commencing work on, a central station, on the battery transformer system. At Swansea they are just commencing work for a central station on the same system. At Port Barry they have nearly completed a central station on the combined high tension series, arc lighting, and alternating transformer system. They have secured the contract, and are now commencing work, on a similar station for Folkestone, and have secured a contract, particulars of which are not yet settled, for a central station for the Westminster Electric Supply Corporation. In addition to contracts for the complete supply of central stations, they have obtained large orders for plant of the same nature for the Central Argentine Railway, through their agent in London for the Central Station in Gothenberg, through Mr. Calvert for the Liverpool Electric Supply Corporation, and for the Crompton Electric Supply Company of Australia. Messrs. Johnson & Phillips have contracted for plant for two stations in England, and one in Hong Kong, using dynamos and transformers designed by Mr. Kapp. Messrs. J. H. Holmes & Co. have sent out machines for a station in Spain, and complete installations for Australia and South Africa. Messrs. J. G. Statter & Co. and the United Electrical Engineering Company have also been busy in the same direction.

PRIVATE INSTALLATIONS.

Messrs. Crompton & Co. have fitted up no less than ninety-three installations, the total number of lamps in these being upwards of 11,500. Messrs. Drake & Gorham have also done a great deal of work last year. Among Messrs. Paterson & Cooper's more important private installations may be mentioned the Albert Institute, Dundee; the Pontardawe Tin Plate Works, South Wales; the Overton Paper Mills, Greenock; Messrs. I. and B. Stevenson's bakeries at Battersea; Kingswood Warren, Epsom, the residence of H. C. Bonsor, Esq., M.P.; the factories of Messrs. Davis, Moore, & Co., Leicester; and the wharf of the Dundee, Perth, and London Shipping Co., at Wapping. They have executed a large number of minor contracts, carried out wiring and extension work, and have several contracts still to finish.

Among the principal work carried out during the past year by Messrs. Woodhouse & Rawson has been installation work for the Paris Exhibition, Messrs. W. H. Smith & Son, Crosse & Blackwell, Peak, Frean, & Co., Savoy Mansions, Lord Ripon, Sir Frederick Carden, Salisbury Club, &c.; besides one or two large central stations.

Messrs. J. H. Holmes & Co. have had a great number of installations in mills and factories, including spinning and weaving mills, flour mills, paper mills, clothing factories, co-operative stores, chemical works, meat stores, wharves, collieries, science schools, &c., besides private houses and hotels. Besides these installations, the "Castle" dynamos have been supplied to a number of electrical engineers; altogether over 200 dynamos have been turned out in 1889, mostly of large size. A large number of Mr. J. H. Holmes' patent arc lamps have been sent out, one installation at an engine works with 25 arcs, and another at a shipyard with 20 arcs, besides many others. In addition to dynamos, Mr. J. H. Holmes' patent switches with switchboard, automatic switches, and various ship and other fittings, cargo and ship lamps, &c., have kept the works very busy.

Messrs. Verity, Messrs. Laurence, Paris, & Scott, and, in fact, most firms, have also been busy in this department.

A great deal of work has been done in ship lighting. Messrs. Holmes & Co. have, during the last year, lighted up thirty-five steamers. Many of the steamers have been fitted up with direct driven plant, the dynamos being coupled to vertical engines, both simple and compound. These run at from 200 to 350 revolutions, and have stood the test of very hot engine rooms and tropical climates without injury. Projector lights for the Suez Canal have been fitted in many vessels. Besides those already fitted, the firm have orders now on their books for the lighting of twenty-four steamers.

Messrs. Paterson & Cooper have supplied more machines than in any former year, both rope and direct driven. Among the steamers fitted by them may be mentioned the "Curlew," "Pladda," "Ardle," "Dean," "Modjeska," "St. Magnus," "Red Sea," "Rajah Brooke," "City of Venice," and yacht "Tighnamara." The end of the year finds them with orders for the lighting of several ships on hand.

Messrs. Crompton & Co. have supplied several sets of plant to the English and Dutch Admiralty. They have fitted up eleven steamships complete, and supplied the steam dynamos for the White Star ships "Teutonic" and "Majestic." These two last are probably the lowest speed direct-driven sets ever constructed, the actual running speed being 170 revolutions for 110 volt lamps.

Messrs. King, Brown, & Co. have put in a number of their engine and dynamo sets.

ELECTRIC TRANSMISSION OF POWER.

The electrical transmission of power does not seem to go forward as fast as it ought. Some work has been done, but there seems to be little enterprise in the electrical engineering industry in this direction. With one or two exceptions the leading firms do not really advertise or push their motors, and the public—and in fact a good many engineers—still cling to the old fallacy that a motor should be designed quite differently from a dynamo. Nearly the whole onus of the transmission of power business is left upon the shoulders of one firm, which makes a specialty of it and carries its burden very successfully. We should be sorry to see other firms which have not spent so much time and money in bringing electrical transmission into notice taking away any of Messrs. Immisch's work, but we would like to see them helping to push that branch of the business and creating more demand.

Messrs. Immisch & Co. find a steadily increasing demand for electrical plant for transmission of power, both at home and abroad. During the year this firm has more than doubled the output of the preceding twelve months. Amongst the plants turned out are a 70 h.p. hauling plant for St. John's Colliery, Normanton; a 30 h.p. pumping and hauling plant for Llancoch Pit, Pontypool; a 30 h.p. pumping plant for the Shale Mines, at West Calder; a 35 h.p. pumping and winding plant for tin mines in Bohemia; a 40 h.p. fan driving plant for Bohemia, &c.

Messrs. Mather & Platt have also done some work in the electrical transmission of power, and a few other firms have done anything that has come in their way, but to Messrs. Immisch belongs the credit of advertising and pushing this branch of the business. They have also developed a new branch of electrical engineering in their electric launches and charging stations on the Thames. The demand was so great during last summer that they intend to increase the little fleet of launches and the number of charging stations. There will then be four floating stations and eight or ten launches. The smallest carry about twenty people, while the largest (the "Viscountess Bury") is licensed to carry a hundred and fifty.

ELECTRIC TRACTION AND TELPHERAGE.

Electric tramways are now beginning to show signs of rapid progress in this country at last. The saving in comparison with horse traction, even if overhead wires are not allowed, is so great that there cannot but be a great future for electric traction. Traction has, like many other branches of electrical industry, been kept back by being to some extent taken up at first by the wrong people.

If a man comes forward and says he has no special invention or patent, but that he can work an electric tramway with the machinery in the market a good deal cheaper than it can be done by horses, the capitalist will not listen to him; but if an enthusiast with a wild scheme, and a system of his own which is to do impossible things, springs up, money is put in and a failure results, which discourages all advance for a year or two till the matter is forgotten. Good solid work is now beginning, and electrical traction is at last looking very promising.

The Electric Traction Company, in connection with Messrs. Immisch & Co., have been running self-contained tramcars on the North Metropolitan lines, between Barking and Canning Town, continuously for more than seven months. At the end of November, when five cars were running, the horses were withdrawn, and the service depended entirely upon the electric cars. Each car makes on an average 60 miles per day, so that the possible car mileage per week is about 2,100. The total mileage yet made is about 40,000. The cars have kept the schedule time within about 2 per cent. The engineers report that the Electrical Power Storage Company's plates are standing the rough usage much better than they expected. Indeed, the chief difficulty experienced has been due to faulty burning of the lugs to the cross-bars. Since the cells have now been in practically constant use for about seven months, the figures obtained are of some commercial value in estimating the probable cost of electric traction by accumulator cars. After carefully considering these, the Electric Traction Company feel satisfied that their original estimate of 4½d. per car mile is well within the mark.

The United Electrical Engineering Company have been engaged on the Northfleet series traction line, which has already been described in this journal, and they have also a good deal of material in hand for a series tramway for Italy. A rigid rail telpher line, having the exceptionally heavy grade of uniformly 1 in 11·5, has also been erected by them. It reaches from the Wood Green Station of the Great Northern Railway up the hill to the Alexandra Palace, and demonstrates the suitability of telpherage for passenger and heavy goods traffic under more onerous conditions than had previously been very generally expected. A line of a little over a mile and a quarter in length, for the transport of 1,000 tons of tin ore per week, is now in course of construction at the well-known Eastpool Tin Mine in Cornwall. An order is also in hand for an equipment for a telpher line in Rome. Telpherage is thus making active progress, and contracts are in the course of negotiation for South Africa and elsewhere.

Electric traction on a still higher scale is in progress in the Thames Subway, which is an electric railway, and

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is being fitted electrically by Messrs. Mather & Platt. Trials under power have already taken place, the locomotives being tested with an artificial load of pig iron. Except a trifling hitch due to an armature, we believe everything is going perfectly.

Progress in Inventions and Designs.

Very little has been done in the way of striking inventions during the last year; engineers have been too busy in meeting the enormous demands for machinery of existing patterns to have been able to give much time to its improvement. It seems as if there was little to be done in the way of invention in such things as dynamos and motors, but designs have been greatly improving. Messrs. Chamberlain & Hookham have been perfecting M. Housman's dynamos with reversing pole-pieces. These machines are said to need no movement of the brushes when the load varies, and to be free from sparking at all loads. Mr. Kapp has introduced a neat end connection for drum armatures. Messrs. Crompton & Co. are said to be introducing Fritsche dynamos for central station work.

Probably more progress has been made in alternating motors than anything else, but nothing has been published, and the results of last year's work will not emerge from the secret archives of the Patent Office for some months. Mr. Mordey has propounded the theory that an alternate current motor should be exactly like an alternate current dynamo, but should have as little armature resistance and as little self-induction or armature reaction as possible, and he has many followers. Others dispute this. Besides the Brush Company, Messrs. Goolden & Co., Mr. Ferranti, and one or two other firms have been carrying out experiments on alternate motors.

Engines.

Messrs. Marshall, Robey, Davey Paxman, and Crossley Brothers have been, of course, supplying engines and boilers as usual, but in greater numbers. Messrs. Crossley have introduced lifting valves instead of slides in their larger gas engines, and they claim that engines above 4 h.p. can be run direct—that is to say, without accumulators—without any flickering of the lamps. The great advance of electric lighting has been chiefly in connection with central station work, so there has been an enormous demand for high speed engines, though many engineers prefer slow running engines, generally with Corliss gear, and belt or rope driving. To give some idea of the enormous demand for high speed engines for central stations and for ship lighting, we may instance Messrs. Willans & Robinson. They had a fire at the end of 1888, and began 1889 with no tools and hardly so much as a connecting rod in stock. In spite of this, their orders have approached 18,000 h.p., of which 4,000 is for ship work. Most of these engines have been delivered. The larger work of this company for the past year has been a series of engines for the St. James's and Pall Mall Company, to whom Messrs. Latimer Clark, Muirhead, & Co. are the contractors. Here there will be ten engines of 200 i.h.p. each, and ten of 80 i.h.p. each. Messrs. Willans & Robinson are also carrying out a very complete scheme of duplicated steam pipes for this installation. We append a list of the engines supplied by this firm:—For Messrs. Crompton & Co. (for the Kensington and Knightsbridge Company) a large number of engines have been made, aggregating over 1,200 i.h.p., while for the Electric Construction Corporation (for the Metropolitan Electric Light Company) over 3,500 i.h.p. have been set to work in, or got ready for, the new central stations in Rathbone Place and in Manchester Square. On behalf of the Chelsea Electricity Supply Company, the Brush Electrical Engineering Company has been a customer for six engines of 70 h.p. each, and the station of Messrs. Gatti, in the Strand, already furnished with about 450 h.p. of these engines, is being supplied with an additional engine of 140 h.p. through Messrs. Mather & Platt. The neighbouring installation at the Surrey Theatre is fitted with Willans' engines and Siemens' dynamos. Messrs. B. Verity & Sons' almost deserves to be ranked as the central station of the year, including as it does three engines of 200 h.p. each and one of 70 h.p. For the Liverpool Electricity Supply Company, under the management of Messrs. Holmes & Vaudrey, this firm has during the year supplied six engines of 200 h.p. each, besides some of 80 h.p. During the year 140 h.p. belt-driving engines have also been made for the new station of the Taunton Company. For the Corporation of Bradford two engines of about 160 h.p. each have been supplied. No less than forty-two comparatively large engines—namely, 200 h.p. at 350 revolutions—have been made during the year. They have also made a large number of small engines for the Navy, for merchant service, and for private installations, but there are too many of these to enumerate.

Cables.

The output of cables has naturally kept pace with the development of central station work. Messrs. Siemens have been supplying large quantities of cable to Bradford, and to the London Electric Supply Company, and to other stations. The Fowler-Waring cable has also been coming rapidly into favour. The question of the best insulation for underground work is of the greatest importance, and it is a little doubtful whether rubber, paraffin, bitumen, or such things as rosin oil will prove the best in the end. Messrs. Siemens adhere to rubber, and so do the Silvertown Company; while for very high pressure Mr. Ferranti depends on paper soaked with ozokerit. Messrs. Callender have supplied cables for the Liverpool Supply Company to the following stations—Whitehall, Strand, Chelsea, Bath—and for some seven or eight foreign supply companies. They have also supplied a large quantity for colliery and for ship work. The mains at Kensington Court and St. James's are, as is well known, strips of bare copper resting in stoneware wire insulators. The various systems of mains and their advantages and disadvantages will be more fully discussed at some future time.

Train Lighting and Electric Brakes.

Another very backward industry is train lighting. Train lighting has suffered in the same way as many other branches of electrical engineering. It was neglected early in the day by the lighting engineers, and was taken in hand by small firms with the unlimited enthusiasm which often accompanies ignorance of the real difficulties, and it has in some cases been rather a failure. On the other hand, it was shown to be a complete success on several railways some years ago. Pintsch's compressed gas is a serious competitor; but every traveller wants to see either the electric light or gas in use, instead of the miserable oil lamps. Mr. Timmis has been pushing forward as much as possible against the lethargy, and the dead weight of opposition, but train lighting does not even yet go as it ought. Messrs. Timmis & Forbes have also succeeded in getting an electric continuous brake tried, and it has been very successful. When the electric light is in common use on trains the electric brake will probably supplant the air brake. Electric brakes have been frequently proposed during the last ten years, but could not come into use because there was no source of electric power available. If there is a dynamo or storage cells on every train there is no difficulty in applying electromagnetic brakes. A pressure brake demands a steam engine and a pump, an electric brake needs a steam engine and a dynamo, but they also supply the lights, so that a train fitted with the electric light and electric brakes is very much simpler. Messrs. Dorman & Smith and some other firms have also been doing good work in train lighting.

Electrometallurgy.

Messrs. Crompton & Co. have turned out a good deal of electro-deposition machinery, including a 60 volt 2,500 ampere machine.

Messrs. Woodhouse & Rawson have taken up the Elmore deposition process. An English company has been formed, and appears to have very good prospects. It is rumoured that the same process can be applied to another very important metal. Messrs. J. H. Holmes & Co. have also made several large electro-deposition dynamos.

Electric Welding.

This industry has not yet started commercially in this country, but will do so very soon. A syndicate has been formed to push the industry in this country, and a small plant is fitted up in Fanshaw Street, where welding up to two inches or so diameter is done. We shall have more to say about this at some future date.

Miscellaneous.

In measuring instruments, Sir W. Thomson has been adding more links to his ever-lengthening chain. Messrs. Goolden & Co., the Walsall Co., Messrs. Siemens, and other makers have also been turning out large numbers of instruments. Meters have been in great demand. Messrs. Chamberlain & Hookham's output has been trebled, and these meters are alone in use in Liverpool, Leamington, and Derby, and are in use in London, Bradford, and elsewhere.

Mr. Ferranti has now 120 meters at work in Brighton and 120 more mercury meters are at work on the London Electric Supply Corporation Station. He has between 400 and 500 more on hand. He has brought out a new form under patents of his own and of M. Borel, and of Mr. Arthur Wright. It is rumoured that the Borel patent covers all meters of the electrical tourniquet type.

A very large number of Aron meters has also been sold. Messrs. Laurence, Paris, & Scott, the Brush Engineering Company, and Mr. Edmundson have also been perfecting meters.

Litigation.

Very fortunately there has been little money wasted over lawsuits. Three very important decisions have been given. The appeal judgment in favour of Edison's patent leaves the Edison-Swan Company in possession of the field in incandescent lamps. On the other hand, the so-called compound winding and Gaulard and Gibbs' transformer patent have been held invalid. The last two are still under appeal, one to the Court of Session, the other to the House of Lords.

THE PROGRESS OF CHEMICAL INDUSTRY IN 1889.

Our annual review of the progress of chemistry for the past year anticipates the complete official statistics and other returns for the twelve months, but we have ample data for making a general statement to the effect that the position of industrial chemistry has been maintained in this country during the year which has just closed. When manufacturers in this country realise that the conditions of the time necessitate—for a successful struggle for survival in the competition with rival nations—that they must educate themselves in the progress of scientific knowledge, then they will be in a position to utilise the discoveries of the workers in pure science for the advancement of the wealth of the country. Our continental rivals have already taken steps towards this combination of pure and applied chemistry, and have in a great measure broken down the division which existed between the two, and the scientific adviser is there seen to be indispensable to the manufacturer of chemical products. The intelligent workman holding the position of works chemist in some cases is useful in a stereotyped manufactory, but advance and development of new processes and an increase in the efficiency of the industrial machine can only be effected by research and the employment of capital in scientific speculation.

The statistics for the summer months of the past year show in the alkali trade a slight falling off, both in exports and imports, as compared with the corresponding period of the previous year, and there has also been a diminution in the quantity of bleaching materials exported. The low prices which prevailed during the past year have been unfavourable for the development of trade, and have caused the closing of several of the smaller alkali works. In the annual report of the Chief Alkali Inspector we note that the number of alkali works in Great Britain and Ireland under inspection have decreased from 1,066 in 1887 to 1,057 in 1888, and that there are indications of the gradual extinction of all the minor works, while the manufacturers who have available capital, by extension of their already large works, are able to adopt more economical processes, and thus maintain their business, even at the prevailing low prices. The erection of Chance's sulphur recovery plant by several of the important companies involves the expenditure of much capital, and, while giving a new lease of life to the larger Leblanc works, extinguishes the small manufacturer using the same process. Gossage's new process for the making of soda by heating the sulphate and salt with small coal, and subsequent treatment with carbonic acid, commends itself to the small capitalist as not requiring the elaborate plant of the Chance's system, but it at present requires further trial to demonstrate its economic advantages. Notwithstanding these improvements the ammonia soda makers seem still to be taking the trade from those who keep to the older process. Improvements in the recovery of sulphur have also been accompanied with improvements in the construction of the Leblanc plant, and Lunge has recently described a method for utilising the heat of pyrites burner gases for concentrating the chamber acid outside the Glover tower by an indirect system of heating in pans or lead piping. This waste heat is thus utilised before the gases are led into the Glover tower, where they subsequently have merely a denitrating action. The trade in Sicilian sulphur has likewise diminished in the year, partly owing to the low prices which have been current, and partly, no doubt, to the newer processes of sulphur recovery, both by the alkali manufacturer and in the coal gas industry. These last two sources of sulphur will necessarily reduce the demand for Sicilian sulphur. In connection with the manufacture of sulphuric acid from pyrites we note that the French Society for the Encouragement of Arts and Sciences has offered a prize of 2,000fr. to the manufacturer who shall be the first to bring into commerce a sulphuric acid manufactured from pyrites which shall be perfectly free from arsenic. The production of hydrochloric and sulphuric acids has largely increased in France during the last two years, and these industrial prizes will further stimulate the industry. The operations of the Salt Union in raising the price of salt in the spring from 7s. 6d. to 13s. 6d. for common salt has also

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militated against the alkali manufacturers, and only those who are fortunate enough in commanding brine wells of their own have had the advantage of a supply of salt at a reasonable price. The year closed with the expiration of the Bleach Association, which has controlled the price of this important bye-product for the last seven years. Although a free competition in the price of bleaching powder will undoubtedly have the effect of considerably lowering the price of this commodity, it seems improbable that, with coal, salt, and wages all dearer than seven years ago, the previous low rates will return. The Society of Encouragement of Arts and Sciences in France has also offered a second 2,000fr. for improvements in the manufacture of chlorine, and it seems probable that some electrolytic process for preparing this bleaching agent directly from salt, similar to the laboratory method devised by Hempel, may eventually be the death knell of the Leblanc process. Ozone may also before long be an industrial bleaching agent, and may possibly be economically obtained from the cheap oxygen due to Brins' process. France also stimulates research in this direction by offering a prize of 2,000fr. for the best industrial application of this allotropic form of oxygen. The sulphite methods for bleaching wood pulp for the paper manufacture has also, undoubtedly, curtailed the use of bleaching powder in the paper making industry. These remarks will likewise apply to the use of soda in paper making works, as although bleaching powder is at present lower in price, soda has increased in value and is likely to become still higher, and will thus cause the paper maker to turn his attention to other bleaching agents.

The Bleach Association was followed by a combination of the hydrochloric acid manufacturers, and they, after demanding higher prices for this acid, have found it advisable to again act independently. An increase in the price reduces the consumption, as vitriol is then found cheaper for a variety of purposes, and is used in preference. If the consumption of the acid can be increased by moderate prices, there will be less necessity for the manufacture of a larger quantity of bleach, and thus a considerable lowering in the price of this article would be avoided. In 1888 the price of bleaching powder was £7 7s. 6d. per ton; now it has reached the low value of £4 12s. 6d. to £5 for soft wood casks; and the export of bleaching materials during the last few months has declined, especially to America, being 3,585 tons less in the eleven months ending November. Brock & Minton's lime sprinkling machine, for absorbing the residual chlorine in the bleaching powder chambers, deserves to be mentioned in connection with this industry, as the patentees state that they have obtained about 200 tons of additional bleach at their works by its use. The increase in the shipments of nitrate of soda to this country, to which we shall allude later, renders nitric acid a cheaper commodity, and suggests that the processes for the preparation of chlorine by the action of nitric acid upon hydrochloric acid may be found cheaper than that of oxidation by manganese dioxide, especially as the nitrous fumes produced in the process can be recovered and utilised in the leaden chamber and in other ways. The Chief Alkali Inspector has also drawn attention in his annual report to a valuable improvement on the Weldon plant, whereby the acid liquors are completely neutralised in the stills by Weldon mud. This method gives a considerable saving in limestone, and enables a ton of bleach to be manufactured from 45cwt. of salt instead of 50 as formerly. Gamble has also patented a method for the manufacture of chlorine and hydrochloric acid from a mixture of magnesia and magnesium chloride by the action of strongly heated air similar to the Weldon Pechiney process, and a process has been devised for obtaining these bodies by the joint action of air and sulphurous acid on salt containing manganese chloride and dioxide, while Salzburg proposes to use carnallite as a source of hydrochloric acid and chlorine. In connection with the alkali trade, we note that Messrs. Chance, and Messrs. Parnell and Simpson, have patented several improvements in their respective processes for the recovery of sulphur from alkali waste, and Hammill, by the refrigeration of the liquors obtained in the manufacture of potassium chlorate, has succeeded in obtaining a much improved yield of chlorate. The two important artificial nitrogenous manures—nitrate of soda and ammonium sulphate—continue to be placed on the market in ever increasing quantities. In 1888 no less than 122,785 tons of ammonium sulphate were produced in this country, and the returns for the past year will be of a much greater magnitude. This compound is now obtained as a bye-product in all the larger gas, iron, shale, and coke works, and in the Chief Alkali Inspector's report a favourable notice of Mond's process is given, in which it is stated that 66lb. of ammonium sulphate is obtained per ton of slack from the coal burnt in his firm's furnaces. A method for the recovery of the nitrogen as ammonia from the cyanides of black ash is also proposed by Hawliczek. The nitrate industry has also developed at an unprecedented rate, and now the output has to be restricted and the price lowered to £8 10s. per ton. The total shipments from South America since 1830, when only 800 tons were imported, amount to 8,257,900 tons; and Messrs. Laird & Adamson give the following statistics, showing the growth of the trade during the last few years:—

Year.	Ships.	Quantity.	Consumption.
1886	371	437,500	486,000
1887	516	680,600	686,000
1888	533	745,700	700,000
1889	—	903,000 (estimated)	

The history of the Chilian nitrate industry is of a complicated nature, and the political and speculative interests which have been at work have, in all probability, handicapped the progress and prosperity of the industry. The Rothamstead experiments in this country, and the researches of Berthelot on the fixation of nitrogen by vegetable soil, and Debérain's statistics on the losses and gains of nitrogen in the experimental field of Grignon, as well as the admirable special treatises by Paul Wagner and others, all tend to impress upon the agriculturist the advantages to be derived from the application of a nitrogenous manure to his crops, and render the further development of this industry only a matter of time. It is well known that the Peruvian guano deposits are rapidly becoming exhausted, while the development of the Stassfurt potassium salt industry and the cheapness of Thomas slag as a source of phosphorus contribute to render the farmer more willing to avail himself of these artificial fertilisers. The consumption of nitrate for agricultural purposes is only in its infancy, and although at present more largely used on the Continent than in this country, it will not be long before the English farmer finds it a necessity for successful farming, and large quantities will be exported again from this country to our grain-growing colonies in Australia and New Zealand and the tea and coffee districts of India.

We have not space in the present article to trace the development of metallurgical chemistry during the year. The manufacture of aluminium and its alloys by several processes is now established on a commercial basis, and the new metal is gradually being introduced to the public in a variety of forms. The metal nickel is also being experimented with, and Mr. Riley, in the beginning of last year, drew attention to the valuable properties of the nickel steel alloys, which indicate that they have a future before them. Recent discoveries of nickel in large quantities at Sudbury, in America, and in the Urals will help considerably to a more general use of this metal. Cobalt has been used successfully as a substitute for nickel in electroplating, and Krüss and Schmidt have confirmed their statement with regard to the presence of a new element in the commercial samples of nickel salts which they have examined. The chemistry of the blast furnace has been discussed by Sir Lowthian Bell, and a valuable paper on the advantages to be derived from the use of lime in the place of limestone as a flux in blast furnace practice was communicated to the Institution of Mechanical Engineers by Mr. C. Cochrane. Under the heading of fuel and gas, the year has been signalised by a discussion in this country on the merits of water-gas, and it has been adopted at some works, where great heat has to be applied to a limited area, with success. The poisonous nature of this and producer-gas necessitate extra precautions in its use, and we note that a patent has been obtained by Fox and Blass for adding the vapours of volatile liquids to the gas, which will give it an odour and render it possible to readily detect an escape. The Ramsgate Corporation have expressed satisfaction at the experiments of Mr. Valon on the use of oxygen for removing the sulphur compounds from coal gas, and is proceeding with the erection of plant for the treatment of the town's gas supply by the new process. The Dinsmore system of gas-making, in which some of the tar produced is utilised by mixing it with the coal used in the retorts, has been pronounced successful, and the difficulties at first met with through blocking of the pipes with undecomposed tar has been overcome by means of a specially constructed cooled passage for the condensation of volatile products. Processes are being developed for the recovery of sulphocyanogen and ferrocyanogen compounds from the spent oxide of gas purifiers, and at Belfast the Claus process is at work, in which these valuable cyanogen compounds and free sulphur are recovered in the coal gas manufacture. The importation of petroleum has undergone a change by the substitution of tank steamers for the American trade with Newcastle, and the Anglo-American Oil Company have recently commenced operations in London on the same plan. In tar products prices have improved considerably during the year, and tar oils, pitch, and tar are all higher than they have been for several years. Pitch, for example, was selling in December, 1888, at 25s. per ton, while the price now is about 36s. Solvent naphtha has likewise shown a marked increase in price. The market in carbolic acid is, however, much weaker, and there are no inquiries for this acid at present. The stagnation in this department seems due to the action of the French Government in abandoning the idea of using this product for the manufacture of explosives. This remark likewise applies to picric acid, which has varied in demand with that of carbolic acid. The Badische Anilin und Soda Fabrik have introduced during the year a pure carbolic acid made synthetically. Benzene and anthracene remain steady, and the increase in the value of pitch is due in a great measure to the large quantities which have been exported to America during the year for the manufacture of patent fuel in that country. This demand, however, is not likely to be maintained, as there is every probability of tar distilling plant being erected in that country. Creasote is now largely employed for illumination in the larger industrial oil lamps. In Germany, the trade in tar products is still favourable, and aniline dyes improve slowly. The imports to this country of coal tar colours (aniline, alizarine, and other coal tar dyes) has increased from £262,101 in 1888 to £298,859 for the corresponding six months in 1889. It is impossible to discuss the many new dyestuffs which have been introduced during the year, but we cannot omit to allude to the starting of a new Quarterly Journal by E. Börnstein called *Die Farben Industrie*, which is devoted to this rapidly developed industry. The manufacture of induline colouring matters soluble in water, of the primuline colours, and of colouring matters obtained by the action of diazo-compounds on the naphthols and naphthylamines have all been patented during the year, and considerable improvements have been made in dyeing with mixed colours. Hirsch has contributed a paper on the theory of the aniline blue process, and Dommergue has given a valuable summary of the methods for detecting the colours of dyed wools. In pharmaceutical preparations we may mention the extended use of sulphonal and antipyrine, and the introduction of thiocamph by Emerson Reynolds as a new disinfectant, and Lister's suggestion to substitute the double mercuric cyanide for the chloride in antiseptic treatment. The efforts of the London Chamber of Commerce in obtaining a drawback on spirituous preparations, and the permission to remove damaged tea in bond for the preparation of caffeine in this country, which we alluded to in our annual review of 1888 have been beneficial to the manufacturers of pharmaceutical products, and these facilities are enabling the British manufacturers to compete with Germany in exporting chemicals of English manufacture to Brazil and other countries.

Considerable progress has been made during the year in the manufacture of explosives, and many new compositions have been patented. Most of these new explosives are the so-called nitro-compounds of the carbohydrates, and are prepared by nitrating woody matter, vegetable fibre, cellulose, straw, paper pulp, or starch. The nitrated compound is then dissolved in acetic ether, or other solvent, and can then be reduced to a powder, or made to assume a cylindrical or granular form by distilling off the solvent. By mixing dynamite or gun-cotton with nitrate of urea a smokeless explosive has been obtained, and Schückher, in Vienna, has patented the manufacture of a smokeless powder from nitro-starch, saltpetre, and nitrobenzole. Hengst's improved safety smokeless powder is produced by nitrating pulped straw and granulating the products. We alluded in our issue of the 3rd inst. to the recent progress made in our knowledge of the constitution of cellulose by Cross and Bevan.

We cannot conclude this brief summary of the progress of industrial chemistry without drawing attention to the work and formation of several new companies for working novel chemical processes. Brins' Oxygen Company have recently shown that oxygen gas when introduced into a bleaching liquid considerably augments its bleaching action, and also that the gas has the effect of maturing raw and young whiskies. Hannay (of the White Lead Company) has patented a process for the direct oxidation of galena to white lead sulphate, which is found to possess all the qualities necessary for a good substitute for ordinary white lead, and Groth has devised a method of tanning by electricity, which has been satisfactorily at work at Messrs. Tebbitt's tannery at Bermondsey during last year. The British Tanning Company has also been formed to acquire the patents of Messrs. Worms & Balé, of Paris, in this country. This process consists of subjecting the hides in contact with ordinary tanning materials (without acids) to the action of a current of electricity in a revolving drum.

In theoretical chemistry points of interest seem to be the formation of an aluminous compound $2NaF.AlF_2$ by Hampé, the production of a new acid from tin by dialysis having the constitution $H_2Sn_2O_7$ (W. Spring), the new methods for obtaining the elements silicon and boron by the use of magnesium powder, described by Gallermann, and the continuance of the researches on the molecular weight of solids by means of Raolt's law.

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IMPROVED MACHINES FOR TESTING THE STRENGTH OF MATERIALS.

CONSTRUCTED BY MR. ARTHUR H. KUHLMANN. ENGINEER, LONDON.

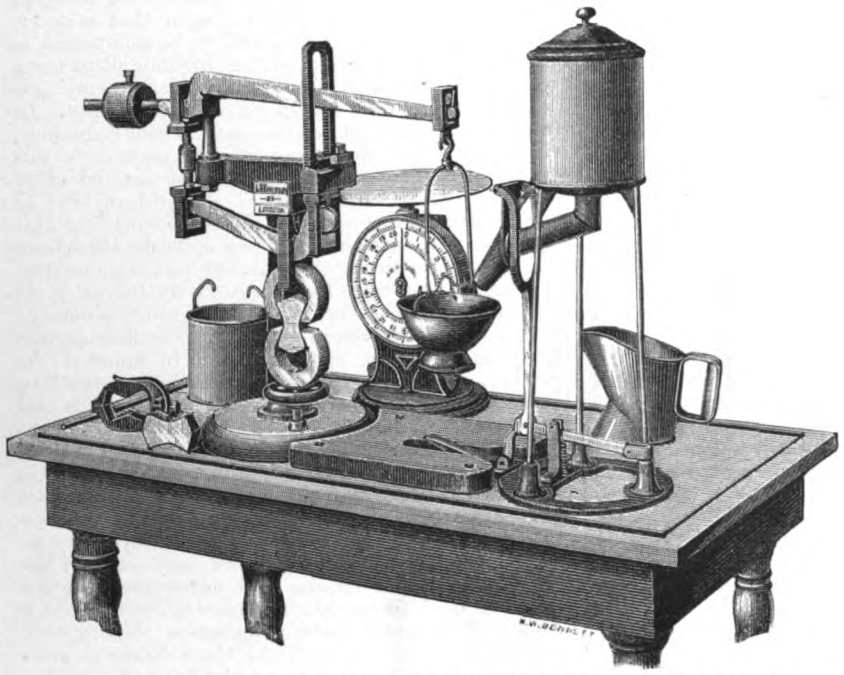


FIG. 1.—MACHINE FOR TESTING THE TENSILE STRENGTH OF CEMENT.

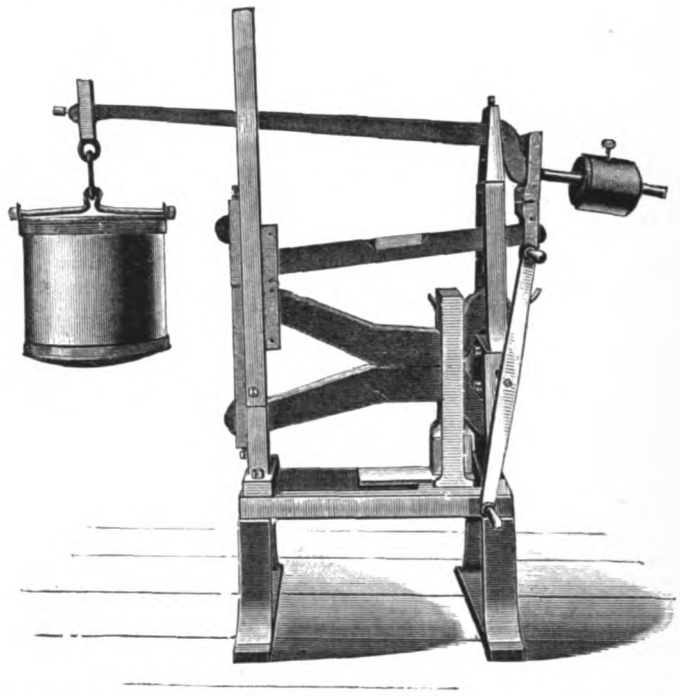


FIG. 2.—MACHINE FOR TESTING THE CRUSHING STRENGTH OF CEMENT.

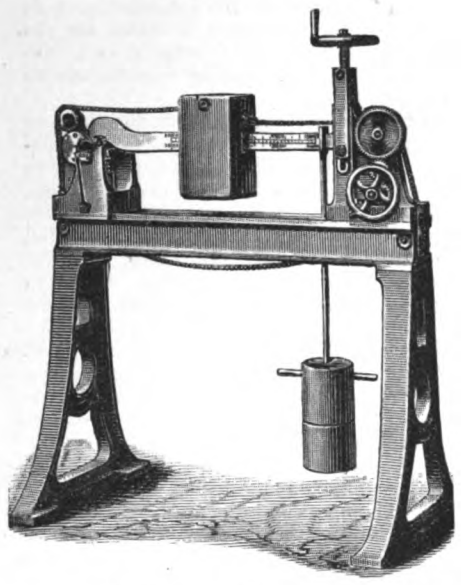


FIG. 3.—MACHINE FOR TESTING TRANSVERSE STRENGTH OF CAST IRON BARS.

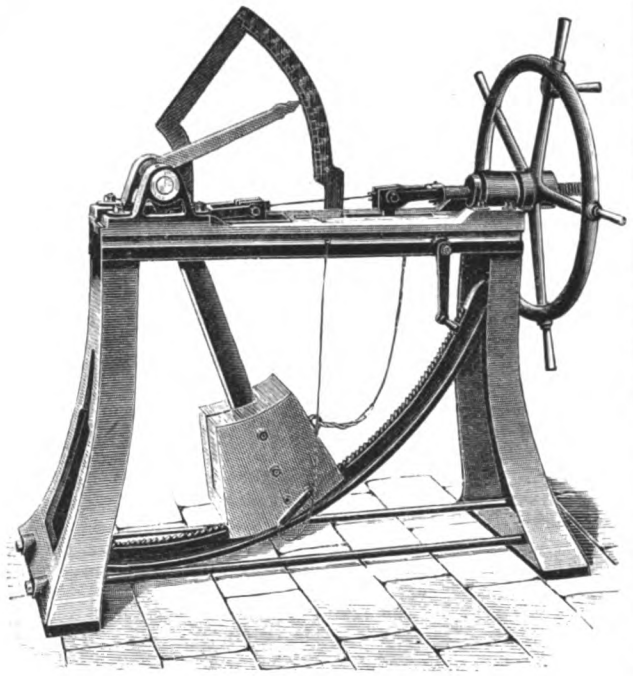


FIG. 4.—MACHINE FOR TESTING WIRE.

KUHLMANN'S TESTING MACHINES.

WE illustrate above a number of testing machines which are being made by Mr. Arthur H. Kuhlmann, 23, Great St. Helen's, London, E.C. The machine illustrated in Fig. 1 has been on the market for a year or two, and has been adopted by many of the leading contractors, railway authorities, harbour boards, &c. The remaining machines are now being placed on the market in consequence of the success of the first-named.

In Fig. 1 is shown a general view of a machine for testing the strength of cement. The briquette of cement is held between two clamps, one of which is fixed to the base of the machine and the other to the end of a lever. This lever is in gear with another lever above, at the other extremity of which there is a pan. The load is gradually added to the pan, and the stress thus generated is multiplied by the levers to fifty times the weight of the load in the pan. The load which is most convenient is No. 6 fine shot, and it is slowly poured from a self-acting shot-run at the side of the machine. The apparatus has been successfully used at a number of waterworks and harbour works, at University College Engineering Laboratory, and at many other places.

The machine which we illustrate in Fig. 2 is intended for testing the crushing strength of cement. The brick of cement is placed at the bottom of the short standard shown in the illustration, and by means of the double system of levers the load in the can is made to exercise a very powerful pressure upon the cement. This machine is made in a much stouter form than the one described in Fig. 1.

Fig. 3 shows a simple machine for testing the cross-breaking strength of cast iron. The load is a heavy weight which is moved along a horizontal arm, and the stress thus generated is multiplied in any proportion from 1 to 10, according to the position of the weight. The piece to be tested is 8in. long and $\frac{3}{8}$in. diameter, and the testing is therefore a matter of comparative ease. The machine generally is constructed on the principle of obtaining accurate results with a minimum expenditure of money and time.

In Fig. 4 we show a machine for testing the actual tensile strength of wire. The clamps are in a horizontal position, and are adapted to hold all sizes of wire. There are no binding screws on the clamps, and the centering of the wire is done automatically. The stress is put on the wire by the handwheel, and is taken up by the counterpoise. The stress is shown by an index, which is connected with the counterpoise. When the wire breaks the pawl pieces fall into the rack gear, and the counterpoise and index-finger remain in the position occupied at breakage. As an indication of the speed at which the machine can work, we may mention that a skilled operator can test about 100 pieces of wire of No. 11 B.W.G. in an hour.

ENGINES OF THE SS. "STUTTGART."

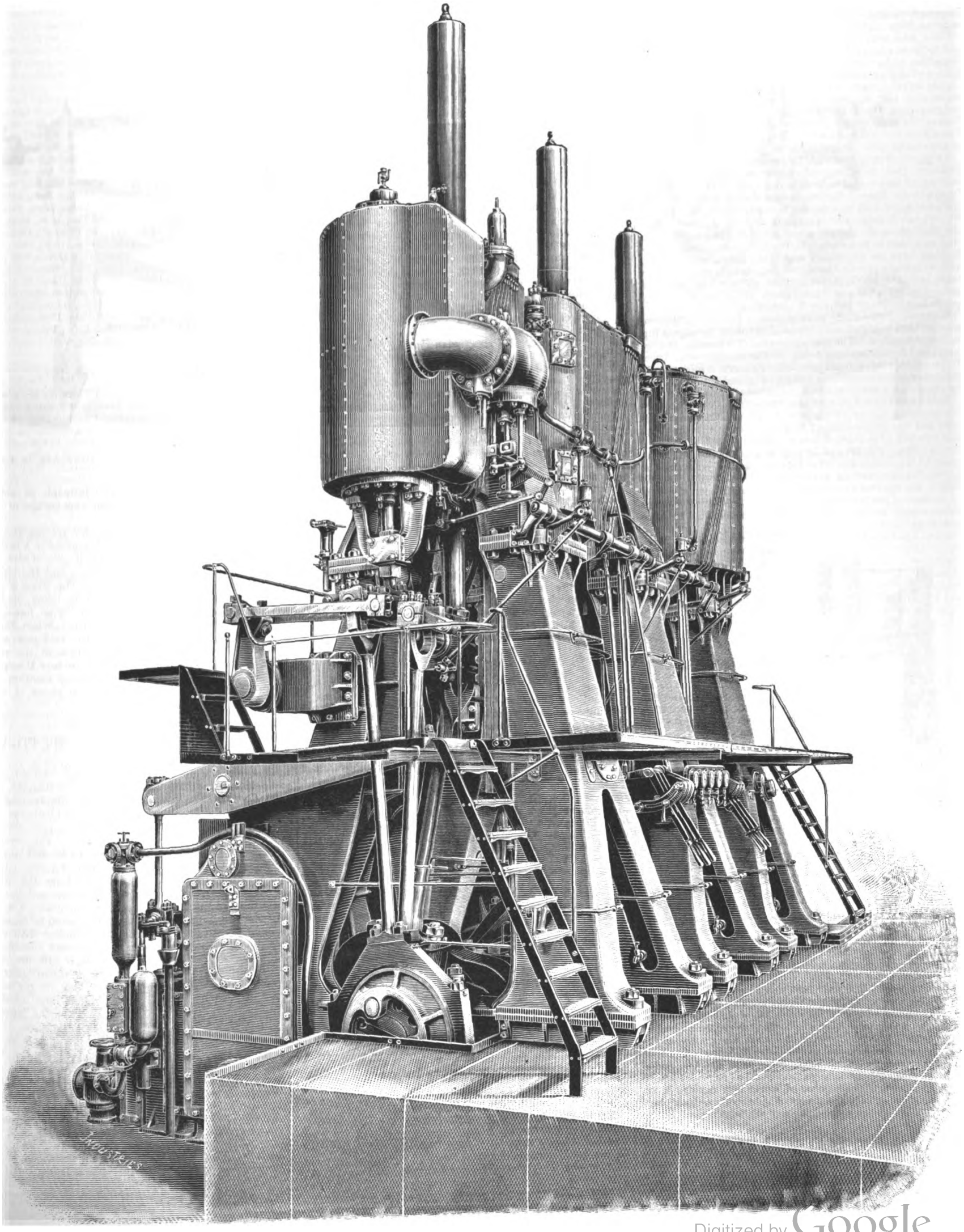
WE illustrate on the opposite page and on page 60 the engines of the screw steamer "Stuttgart," built by the Fairfield Shipbuilding and Engineering Company, Limited, Glasgow, for the Norddeutscher Lloyd, Bremen. A similar set of engines are also being supplied to the ss. "Carlsruhe." The two sister ships are vessels of 5,200 tons each, and the indicated horse-power of the engines is 3,200. The engines are of the triple expansion type, the cylinders being 31in., 52in., and 83in. respectively, and the stroke 4ft. 6in. Link valve gear is employed. The high-pressure cylinder is fitted with a piston valve, and the intermediate and low-pressure cylinders with double-ported slide valves. There are two double-ended boilers for the main engines, each 14ft. 4in. in diameter and 17ft. long, and two single-ended boilers, each 14ft. 4in. in diameter and 9ft. 8in. long, for the auxiliary engines. The double-ended boilers are fitted with Fox's patent corrugated furnaces, and the latter with Messrs. John Brown & Co.'s ribbed furnaces. All the boilers are intended for a working pressure of 150lb. per square inch. The reversing engines are by Messrs. Brown Brothers, Edinburgh. Messrs. G. & J. Weir's feed-water heater, pumps, and evaporators are fitted in both vessels. The crank shaft, which is of steel, was made by Messrs. Vickers, Sons, & Co., Sheffield; and the thrust-and-tunnel shafts, which are also of steel, have been made by Messrs. John Brown & Co., Sheffield. The boss and blades of the propeller are also made of cast steel. At the trial trip of the ss. "Stuttgart," which took place on the 13th ult., the mean speed of a two hours' run was 13 knots per hour.

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TRIPLE EXPANSION ENGINES OF THE SS. "STUTTGART."

CONSTRUCTED BY THE FAIRFIELD SHIPBUILDING AND ENGINEERING COMPANY, GOVAN, GLASGOW.

(For description see opposite page.)



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FOREIGN INDUSTRIES.

(From our own Correspondents.)

(FOR LATEST TELEGRAPHIC DESPATCHES SEE PAGE 57.)

PARIS, 14th January, 1890.

COAL.—The coal question is now almost the only one discussed in industrial circles. The interruption of the imports from Belgium, occasioned by the strike of the colliers, and heavy purchases of French coal on Belgian and German account, has brought about a scarcity that is beginning to be very seriously felt. English coal is being delivered at places where it was never before seen, but the supply is inadequate to the demand. The moment is a favourable one for the importers of English coal, and, judging from the activity of the agents of English producers, the opportunity is being turned to good account. The prices now offered are considerably above those current at the end of 1889.

IRON.—It is significant of the precarious character of the situation that in all contracts now entered into for the delivery of iron a clause is inserted to protect the manufacturers in case of the production being interrupted or seriously restricted by a failure in the coal supply. In the Meurthe-et-Moselle, the Haute-Marne, the Ardennes, and the Nord there are already a number of works compelled to stop two days in the week. In these circumstances manufacturers are by no means eager to accept fresh orders, and, as a consequence, the current of trade is checked. In other respects the market is in a satisfactory state, and the prospects for 1890 are fairly good. Makers of railway goods trucks are overwhelmed with work.

CANNON FOR FOG SIGNALLING.—In the lighthouse service trial is about to be made of artillery for signalling in foggy weather. The gun chosen for this purpose is very long, and is self-loading, being of the machine-gun type. It is capable of firing from 20 to 30 shots a minute. If the experiment succeeds, a system of sound signals will be established for communicating with vessels at sea.

ELECTRIC TRAMWAY AT CLERMONT-FERRAND.—An electric tramway has just been opened between Clermont-Ferrand and Royat, two towns 7 kilometres apart. The installation consists of a Farcot steam engine of 150 h.p. and a six-pole Thury dynamo of 300 volts and 350 amperes. A small 24 h.p. steam engine and dynamo is used to excite the larger dynamo and to supply the station with electric light. The current is supplied to the motors on the cars by means of an overhead wire, and the return current passes along the rail. The speed of the cars is 12 kilometres per hour.

THE VALUE OF THE OHM.—M. Wuilleumier, of Paris, has recently conducted a series of experiments, by M. Lippmann's method, to determine the true value of the ohm. He found that it was equal to the resistance of a column of mercury at 0° C., 1 square mm. cross section, and 106·27 centimetres high. This value differs by 1/5000th from the values adopted in 1881 and 1884.

BERLIN, January 13th, 1890.

COAL PRICES.—A comparison of the prices of Silesian on January 1st and December 31st, 1889, shows in a forcible manner the change which has taken place in the situation of the coal trade. The figures represent the prices in shillings per ton on trucks at the railway stations nearest the pits. First quality: Large, 6s. 4d.—8s. 4d.; round, 6s. 4d.– 8s. 4d.; nuts, 6s. 4d.—8s. 4d.; small, 3s. 8d.—6s. 2d.; slack, 3s. 4d.—5s. 8d. Seconds: Large, 5s. 6d.—7s. 8d.; round, 5s. 6d.—7s. 8d.; nuts, 5s. 6d.—7s. 8d.; small, 3s.—5s. 2d.; slack, 3s.—5s. 4d. Thirds: Large, 4s. 4d.—6s. 4d.; round, 4s.—6s.; nuts, 3s.—5s. Coke, 10s.—24s.

IRON.—At a meeting of Silesian ironmasters, held here on the 10th inst., it was resolved, after a long debate, to make no further advance in the price of iron for the present. The reason which weighed most in coming to this decision was the difficulty of meeting English competition with the high rates now current. In spite of the high protective duties, German manufacturers exported to Russia in the first eleven months of 1889, 25,067 tons of pig iron, and 48,906 tons of finished iron and steel, in the form of bars, angles, and plates. For the same time the exports of this form of finished produce to Italy amounted to 35,065 tons, The exports of German wire to Italy amounted to 11,034 tons.

ZINC IN 1889.—The year 1889 was a period of constantly increasing prosperity for the Upper Silesian zinc industry. Prices steadily advanced from the 1st of January till they reached, on December 31st, a level that has not been touched since 1873. The W. H. brand of spelter was quoted at the former date £18 12s., and at the latter £25, free on rails at Breslau. Godulla, which began the year at £16 14s., ended it at £23 13s. Many manufacturers have sold forward to the end of 1890. The number of works now running is 23. A considerable rise in the wages of zinc workers took place in the course of the year. The outlook for the near future is very encouraging.

ASPHALTE IN STREETS.—Some interesting trials of asphalte are being made in the streets of Berlin. The powdered material, instead of being merely stamped down by hand rammers in the usual way, is strongly compressed by a 24-ton roller. The roller reduces the thickness about 25 per cent., making a very compact and hard surface, which is expected to resist the wear and tear of the wheels much better than the less dense form commonly employed. It has been found necessary to use a somewhat bituminous powder, as otherwise the surface is apt to crack. In some streets, to avoid the offensive smell of the heated asphalte, the latter is being laid down in large plates after the manner of flag-stone paving.

VIENNA, 13th January, 1890.

COALS.—The activity in the Bohemian coal market continues. The wintry weather and the situation in Germany had an important influence, and prices increased this week for both native and imported coals. Cokes are in good request, and are now double the price of the last year's. In January, 1889, a ton of coke was 7fl., and now its price is 14fl. The position of the West Bohemian trade during the last month is illustrated by the quantities of coals forwarded by the two railroads crossing the territory. The Dux-Bodenbach and the Prague-Dux railways forwarded last December 320,120 tons of coals, 147,465 tons more than in the same month of the previous year.

IRON.—In the iron market no change is to be noted, nor is one expected for a long time. The animated situation is sustained by an abundance of new orders, and many works are not able to cope with the demand. The trade in refined iron is very brisk, in spite of the steady increase of the prices, which are already 20 per cent. higher than they were at the beginning of 1889. A large order for bridge constructions has been given by the Southern railway to the Alpine Montan Company. The iron work to be delivered will amount in value to 1,250,000fl.

ELECTRIC LIGHT AT BUDAPEST.—The whole city of Budapest is going to be lighted by electricity. The municipal authority of the Hungarian capital has asked the Budapest Gas Company to give an estimate as to the expenses of substituting electricity for gas. The gas company's contract will end on December 18th, 1891. In their answer they offered to decrease the price of gas; and their estimate fixes the price of 100 watt hours at 0·056fl., and according to it the yearly expenses for a whole-night glow lamp of 14 c.p. comes to 98·22fl., whilst a 14 c.p. gas lamp charge is only 39·61fl. Notwithstanding this difference, the municipality is negotiating with the gas company for the establishment of an electric central station. If these alterations are not made by December of next year, the municipal authorities will give the orders to another firm, for it has resolved, at all costs, to start electric illumination.—Ganz & Co., of Budapest, in common with the Westinghouse Company, are erecting an electric central station of 15,000 lamps at Venice.

THE AUSTRIAN SUGAR INDUSTRY.—It is now just twenty years since the Austrian sugar industry became recognised as an international trade. In 1869 the first exports were made to England, Holland, and Germany. During the whole of the existence of this trade there has never been so great a fluctuation in prices as there was last year, when the price of raw sugar rose from 17fl. in January to 35fl. in July, and again fell to 14fl. in December.

BRUSSELS, 14th January, 1890.

THE COAL MARKET.—The position of the coal market is becoming seriously complicated by the continued strikes. The scarcity of coal is bad enough on account of the great demands, but the intervention of the strikes really makes the prospect of things alarming. The miners evidently think that they have now an opportunity if they ever had one, and they are holding out for higher wages and fewer hours, so as to participate in the higher prices received for the coal. Instead of the men abating their demands, they are now actually increasing them, and they have now fixed for a 25 per cent. rise in wages and a maximum day's work of nine hours. A great number of works of various kinds have been obliged to cease work on account of the scarcity of fuel. The Administration of the State Railways have been asking for tenders for the delivery of thirty-two lots of small coal of 1,000 tons each to be sent to different railway centres. There were no tenders at all sent in for most of the lots, and those that did come in for the others were quite irregular, and not at all in compliance with the regulations. The absence of tenders is not alone caused by the state of the market, but by the absurd clauses in the regulations for tenders.

THE IRON MARKET.—Manufactured iron remains firm at a base price of 18fr. per 100 kilogs. and 22fr. for plates. These prices, although high, do not repay the manufacturer, on account of the more than proportionately advanced rates for coal and pig iron. The prices really ought to be at least 3fr. per 100 kilogs. higher if they are to be at all remunerative. The New Congo Railway have ordered 1,300 tons of steel rails from Belgian makers. Several iron and steel works have recently been turned into joint stock companies.

THE GLASS MARKET.—The glass trade has been turned upside down by the continuation of the coal strike. The prices remain firm. What coal can be obtained is at a ruinous price. The operatives are beginning to consider whether it is not time for them to clamour and strike for a 30 per cent. advance in their wages. Such action, however, would most likely end in a complete collapse of the glass trade.

DÜSSELDORF, 13th January, 1890.

ENGLISH AND WESTPHALIAN COAL AT HAMBURG.—The following statistical records show the growth of the trade in English coal at Hamburg in the last ten years, and the competition encountered from the development of the trade in Westphalian coal. The figures represent the imports in tons; those in parentheses relate to the Westphalian produce received:—In 1880, 1,025,550 (338,910); in 1881, 1,001,118 (452,650); in 1882, 1,013,334 (475,890); in 1883, 1,050,000 (513,420); in 1884, 1,025,500 (548,730); in 1885, 1,138,700 (536,510); in 1886, 1,210,000 (518,930); in 1887, 1,230,000 (548,500); in 1888, 1,365,000 (627,890); in 1889, 1,580,000 (716,780). It will be seen from these returns that the Westphalian trade has considerably more than doubled itself in the last ten years.

IRON.—The situation of the market for crude iron is one of great strength. The production of the blast furnaces in the Rhenish-Westphalian syndicate in the last month of 1889 amounted to 127,923 tons, against 110,362 tons in November. In the same month the stocks, already very small, of forge Thomas and Bessemer pig were reduced by 3,000 tons, a healthy sign at this period of the year. The following are the prices of some finished forms of iron and steel at the end of each month of 1889:—Bars, 127s. 6d., 130s. 6d., 130s. 6d., 133s., 133s., 140s., 140s., 142s. 6d., 147s. 6d., 150s., 165s., 190s.; joists, 125s., 125s., 125s., 128s., 127s. 6d., 127s. 6d., 127s. 6d., 127s. 6d., 127s. 6d., 135s., 140s., 150s.; boiler plates, 170s., 175s., 180s., 180s., 180s., 180s., 195s., 200s., 200s., 215s., 220s., 245s.; thin sheets, 155s., 155s., 155s., 160s., 160s., 165s., 175s., 185s., 188s., 200s., 215s., 255s; hoops, 126s., 127s. 6d., 130s., 140s. 145s., 145s., 145s., 155s., 160s., 167s. 6d., 187s. 6d., 200s.; rolled iron wire (wire nail quality), 112s., 123s., 120s, 120s., 120s., 120s., 120s., 130s., 140s., 145s., 160s., 180s.; steel rails, 125s., 130s., 128s., 128s., 125s., 130s., 130s., 135s., 140s., 150s., 155s., 165s.

LILLE, 14th January, 1890.

IRON.—All the ironmasters of this locality are now well supplied with orders for the next four months, and fresh work is coming to hand freely. Considerable reluctance is, however, manifested to book fresh orders on account of the precarious position of affairs due to the scarcity of coal. The want of fuel is fast becoming a grave question for the ironworks of the Maubeuge district. Many of them are running but three days a week. Everywhere the coke ovens are idle, on account of the failure of the supply of coal. The scarcity is in large part due to the strike in Belgium.

TEXTILE MANUFACTURES.—The state of the market for linen goods in the last month of 1889 gave rise to hopes of a sharp revival of trade after the middle of January, when the holidays and the stock-taking season came to an end. These hopes are, it seems, doomed to be disappointed, for the market is growing more languid. The delay in the looked-for revival is no doubt due in part to the influenza, but this cause is certainly overrated. The truth is, the situation is not so strong as it was believed to be. Business is growing brisk again in the Roubaix-Tourcoing woollen trade. Manufacturers have in hand novelties for 1890 likely to excite admiration and to have a successful run. Since the Exhibition in Paris the Roubaix trade has undergone considerable expansion.

FLAX AND YARNS.—The flax market is not yet wholly out of the influence of the holidays and the stock-taking season. The quantity of home-grown flax on offer is small, and buyers are few. For the latter fact the influenza is largely responsible. Prices, both for home-grown and Russian, remain unaltered. For tows the market is in favour of buyers. Business is quiet in yarns, and prices are a little weak. Jute yarns, however, are in brisk demand. The prospects of the jute market are highly encouraging.

AMSTERDAM, 13th January, 1890.

THE LABOUR QUESTION.—The Dutch Government has sent in its reply to the remarks made by the Grand Committee of the First Chamber of the States-General regarding the Government proposals to continue the State inquiry into the economic condition of the working classes in Holland preparatory to remedial legislation. The Government agrees to extend the scope of the Commission's labours. The Commission is not only to examine factory and workshop hands, but also handicraftsmen generally, the labourers on peat bogs, the crews on board ship, and the employés of railways and other modes of transport. The Commission will also inquire into the working of insurance and pension funds for artisans. But there is no need to fix an elaborate programme beforehand; it can be settled gradually, as time goes on; and the Minister of Justice will have the power to instruct the Commission to proceed with one part of its task and then with another, after having consulted it thereon. In case of need, the Government will prepare new Bills conferring fresh powers upon the State Commission. The nature of the remedial legislation cannot now be indicated; much must necessarily depend upon the results of the Commission's labours. Nor is it possible to say for certain that there will be remedial legislation; but this doubt must not prevent an inquiry. Many evils cannot be remedied by legislation, but that is no reason to leave them unprobed, as an inquiry alone will convince numerous people that there is no remedy who now

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continually press for it. The Ministers consider the present laws to protect workmen willing to work against the molestation of strikers as amply sufficient.

THE WEST INDIAN MAIL SERVICE.—The Royal Mail Service has undergone a complete change as from January 1st. The steamers will leave Amsterdam for Curaçoa and Surinam every third Thursday of the month (commencing the 16th inst.), and from Surinam and Curaçoa for Amsterdam the third Saturday of every month (commencing March 22nd). The monthly service between New York and Curaçoa will also be altered into a three-weekly one, commencing March 8th. The West Indian Mail Steamship Company has just added a fine vessel to its fleet in the "Prins Willem III.," built at Feienoord for this company by the Netherland Steamboat Company, between January and November last year. It is a steel-built screw-steamer, 264ft. long, 36ft. broad, and 23ft. beam, with triple expansion engines of 1,250 i.h.p. She is supposed to run 13 knots an hour, and this rate was exceeded on the trial trip. The vessel is fitted out most luxuriously, regardless of expense, and appears to offer all comforts to first and second class mail passengers. She is described as A1 at Lloyd's and Veritas. The Netherland Steamboat Company, which has a large shipbuilding yard at Rotterdam, has likewise in hand two great steamers for the Indian Mail Service, the "Carpenter" and the "Van Diemen," both to be ready by the middle of July. The yard now employs 1,400 hands, and it is the largest establishment of its kind in Holland.

NEW DUTCH WAR VESSELS.—The expenses of the Dutch Navy Budget in 1890 will nearly reach £1,200,000. Two new ironclads of large dimensions are to be added to the war fleet, and they are now building. Messrs. Jarrow also have an order for another torpedo boat and a torpedo chaser, one of six ordered. These chasers run a minimum speed of 20 knots an hour, and each is armed with Hotchkiss quick-firing guns 1⅛in. and 3in., besides submarine torpedo tubes.

THE TRANSVAAL EXHIBITION AT AMSTERDAM.—This Exhibition has been opened in the gardens of the Crystal Palace, and proves a great success. The building is the same that stood in the Paris Universal Exhibition grounds, near the Seine, and is filled with products from the South African Republic, principally agricultural, but samples from the gold, silver, tin, copper, lead, manganese, and coal mines also take up much room. There are likewise ostrich feathers, different kinds of wood, elephant tusks, hides, fruits, &c., the whole giving a complete idea how varied and rich the Transvaal products are. The opening ceremony was attended by many officials, Dutch and South African, and numerous speeches testified to the importance of this Exhibition, and to the cordial feeling between the young republic and the old mother country.

COPENHAGEN, 11TH JANUARY, 1890.

THE SWEDISH NORWEGIAN RAILWAY COMPANY.—Considerable light has been thrown upon the history of this large, but so far unfortunate, undertaking by a volume of more than two hundred pages, published by the Swedish Civil Department. It appears that the original calculation of the promoters for the Lulea-Gellivara section was deemed much too low by the Swedish officials, who raised the sum that should serve as a basis from 4,236,177kr., 218,359kr. per Swedish mile (about 11 kilometres), to 7,300,000kr., or 376,288kr. per Swedish mile. On July 10th, 1884, the company gave notice that work had been commenced on the Lulea-Gellivara section of the line. The company appears often to have both applied for facilities in the terms of the concession as regards technical points, and also to have experienced considerable difficulty in carrying out the obligations incumbent upon it. As early as March 27th, 1885, the Swedish Government refused an application about alterations as to gradients, &c., and on December 2nd, 1887, the first application for prolongation of time was granted to a small extent. Also for the section between Gellivara and Luossovara, the Swedish Government found the company's estimated cost of 3,250,000kr. too low, and raised it to 4,019,990kr. On June 8th, 1888, the Swedish Government gave the company permission to commence work on the Gellivara-Luossovara section, although they did not consider that the company had complied with the terms of the concession as to having the necessary capital at its disposal. The Government's reason for granting this permission was consideration towards the many hands that would be thrown out of employment if permission were not given. This permission was, however, withdrawn on June 29th, the Government having learnt that the company in the meantime had dismissed a lot of men. On July 13th, renewed permission was, however, granted. On December 31st, 1888, the Government very promptly declined the company's one-sided offer to the Swedish State of the whole undertaking. In January, 1889, complaints were made about the company not replacing the undersized sleepers, and altogether as to the condition of the line, which, it appears, was built in a comparatively short time, so that the ore traffic could be commenced, but had not been kept in proper repair. The company was therefore requested to put the line in order as early as weather would allow of it. On July 26th the Government prohibited all traffic on the line, except conveyance of labourers and railway officials, &c., and on August 16th refused an application from the company about facilities as to monetary deposits for workmen, and on September 5th an application for permission to resume ore traffic had the same fate.

PAPER MANUFACTURE.—Another large paper mill company has just been formed in Sweden by the Klippau paper mill in Skane being transformed into a company for the purpose of extending their business. The manufacture will comprise paper, wood pulp, and starch. The capital will be about 2,000,000kr.

MATCH FACTORIES.—Fifty men from the Iönköping Match Manufactory are at present attending a slöjd school in Iönköping at their employers' expense. They are attending a course of what is called "pedagogical slöjd," and this is probably the first instance of labourers receiving such instruction. The Iönköping match manufactory is doing a great deal for their labourers, and trying to make things as pleasant for them as possible.

MADRID, 13TH JANUARY, 1890.

BILBAO PORT IMPROVEMENTS.—The improvements at the entrance of the port of Bilbao are being vigorously proceeded with, and both the authorities and the public in general are showing themselves well satisfied with the proceedings of the contractors.

LARGE RAILWAY DIVIDEND.—The directors of the railway from Bilbao to Durango (one metre gauge) have paid a dividend of 14 per cent. on the share capital of the company. It is supposed that this will be the final settlement of the year, and that any excess will be passed to the reserve fund. The shares are quoted at 250 per cent. premium.

ASTURIAN COAL.—Coal miners in Asturias are now actively preparing to increase their business in view of the high prices of coals prevailing in Europe. Another company, that of Messrs. Herreros, are about to acquire a steamer for their coal trade, and there is no question as to this being only a beginning of a very large fleet. The first step is to be the opening of the port of Aviles, after the works in progress are finished.

ELECTRIC LIGHT AT CADIZ.—On the 28th ult. the Cadiz Corporation signed a contract with Senor de la Viesca to light the public thoroughfares of the town with 1,000 incandescent electric lights of 16 candle-power. The condition is that each light will be used, on an average, seven hours per day.

ELECTRICAL ENGINEERS' ACADEMY.—As a sign of how strangely official things are dealt with here, the Minister of the Colonies is feeling the want of electrical engineers, and is therefore going to create an establishment for electrical teaching.

RESIGNATION OF THE MINISTER OF MARINE.—The Minister of Marine, Senor Rodriguez Arias, to whom the country owes a great deal, has resigned, as he is annoyed and discouraged by some criticisms in connection with some boats built by Messrs. Otero Gil & Co. The honesty and high character of the resigning Minister is acknowledged by everyone, and it would have been most unjust to ruin the house by refusing the boats when the fault was only imputable to the official naval architects.

MADRID GAS WORKS.—This company has made an experiment by issuing a quantity of debentures bearing 4 per cent. interest with a view of paying out their 5 per cent. ones, thus saving a considerable sum in interest paid. It is reported, however, that the public has not answered as they expected, and that the apparent subscription has been mostly covered by the shareholders themselves. The scheme has, therefore, been an utter failure.

NEW YORK, 4TH JANUARY, 1890.

THE COAL MARKET.—There is little change in the anthracite market. There is hardly any demand, and many of the collieries have closed down to half or three-quarter time. The past year, though considerably less prosperous than 1888, has a large amount of business to its credit. The total shipments have been only about 8 per cent. less than last year. Prices are low, however, some of the larger dealers selling at 25c. below circular rates, and allowing commission in addition. The consumption for steam and furnace purposes continues fair, but there is nothing doing in any other lines. Bituminous coal is scarce, owing to the difficulty of procuring transportation and prices are high in consequence.

THE IRON AND STEEL TRADE.—The past week or so has been nearly all holiday, so that there has been very little business done. What little has been done shows such a strong market that prices are very likely to be higher on the renewal of business. In pig iron, as all the larger consumers have placed their immediate orders, it is not likely that there will be much done for some time. There is not much disposition to place orders of any size at current rates. Plenty of buyers could be found at prices ruling a month ago, but there is no great disposition to take large lots at $20, $19, and $18 per ton, the present price at tide for the leading grades. In manufactured iron prices are nominally the same as last week, but a little more money would have to be paid to secure anything like good-sized lots. Sellers are in considerable doubt as to what the market will stand for deliveries a short distance ahead. Steel is decidedly dearer, and although iron is very firm the advancing tendency is less marked than in steel. Prices are from 1·95c. to 2c. per pound for best refined bars, 2·30c. to 2·35c. for plates and angles, and from ¼c. to 3·10c. more per pound for steel. Steel rails are firmly held at $35 per ton at mill. The demand has slackened off somewhat, but makers are satisfied with the market, and that prices will go still higher. Large sales of billets have been made at from $36 to $37 per ton at the mills, but higher prices are asked for increased amounts.

THE METAL MARKETS.—There has been an increased demand for copper, and prices are stronger in consequence. Lake is quoted at 14¼c. per pound, and other grades in proportion. The tin market is declining, with considerable speculative dealing. There is nothing doing in plates. The lead market has been quiet, with prices a little weaker. Sales have been made at from 3·85c. to 3·90c. per pound. The demand for spelter is strong, but shows signs of falling off. Prices are firm. Antimony is fluctuating considerably, average prices asked being about 20c. for Hallet and 28c. for Cookson.

THE CANADIAN RAILROADS.—The transhipment of goods in bond through the United States, on Canadian railroads, without payment of duty, is now done under Treasury regulations. This has enabled the Treasury officials to control this important matter, and to meet any movement antagonistic to the commerce of this country by the Canadian roads. These roads are anxious to get a Bill through Congress to take this power out of the hands of the Secretary of the Treasury, and are anxious to have a law passed similar to one introduced in the Senate a few days ago, which gives every road the right to tranship goods through the United States in bond, or to take them from one part of the United States to another through Canada without payment of duty. The matter promises to be of considerable prominence in this Congress.

BRUSH PATENTS.—The long-pending litigation relative to the infringement of the Brush electric light patents was brought to an end in the Federal Court by decision against the Jenney Electric Light Company. Judge Gresham, who heard the arguments over a year ago, and has since had the matter under advisement, decided that the Jenney Company had infringed the double-carbon burner invented and patented by Brush, and ordered an entry permanently enjoining it from continuing the manufacture of the burner. The decision will be very important in effect, and will probably have some influence upon many other infringement suits pending in different parts of the country.

BURNING OF AN ELECTRIC LIGHTING STATION.—The first central station for incandescent electric lighting, established by the Edison Illuminating Company, at 255-7, Pearl Street, New York City, in 1882, was burned out by a fire which started at about six o'clock a.m. on the 2nd inst. About 18,000 incandescent lamps were supplied from it in the lower part of the city, many buildings being entirely dependent upon electric illumination, while others were also supplied with gas. The machinery consisted of eight old style "Jumbo" dynamos, with the necessary boilers and engines. The cellar and basement were very much crowded, and the full capacity of the station was reached some time ago. The building was old and not fireproof. Had the station been constructed especially for the purpose, probably such an accident would have been provided against. The current was distributed by the Edison underground system, and it is supposed that through leakage one of the dynamos was short circuited and burned out, igniting the oil-soaked floor, and leading to such an immediate spreading of the flames that the station facilities for fire extinguishment could not be utilised. The public fire department was summoned at once, one fire engine being available immediately around the corner. The elevated railroad runs through Pearl Street, and it was necessary to suspend traffic for several hours, the firemen using the structure to good advantage, from which their streams could be brought effectively to bear upon the flames. Three hours elapsed before the fire was brought under control, and meanwhile new machinery was ordered from Schenectady, about 150 miles distant. An auxiliary station on Liberty Street, half a mile away, was also connected to the system, from which about 5,000 lamps are being supplied temporarily. The loss is given as 200,000 dols., upon which there was 125,000 dols. insurance. The fire occurred at a very unfortunate time, when so much stress had been laid upon the safety of the low tension system, as, amidst the clamour regarding the loss of life from high tension currents, the question of fire risk had been scarcely alluded to.

CHICAGO'S CANAL SCHEME.—Last week an election was held in Chicago, at which nine drainage trustees were chosen. Their duties are to supervise the construction of a canal connecting the waters of Lake Michigan and the Illinois River, which empties into the Mississippi, for the purpose of carrying off the sewage of the city in that direction, instead of emptying it into the lake. The canal, as proposed, will have sufficient dimension to admit of the passage through it of large lake vessels, and thus furnish a commercial outlet to the Gulf of Mexico. This is of course something of a menace to the railroads running south and west from Chicago, and a statement is made that a combination of these interests has been formed for the purpose of securing the contract for the work in order to defeat the commercial feature of it and make it merely a drainage canal.

ALASKA FISHERIES.—As stated in my last letter, the Secretary of the Treasury has invited proposals for the privilege of taking fur seals on the islands of St. Paul and St. George, Alaska. Bids will be opened on the 23rd inst. for the exclusive rights of the fisheries for twenty years from May the 1st, 1890. One requirement of the contract is that the successful bidder will have to provide a public school building on each island, and pay the expenses of keeping them up for not less than eight months; also to pay the inhabitants whatever just compensation the Secretary may prescribe for their labour. The number of seals to be killed for their skins the first year is limited to 60,000, and the Secretary will fix the numbers for the succeeding years.

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COMPARISON OF COST BETWEEN GAS AND ELECTRICITY.

THE ILLUMINATING POWER AND PRICE OF GAS PER 1,000 CUBIC FEET AS SUPPLIED IN LONDON, MANCHESTER, AND ABERDEEN.

					Equivalent light in candles for one hour.	Comparative cost.	Ratio of cost, showing the number of times cheaper gas is than electricity.
ELECTRICITY.	One incandescent lamp of 16 candle-power requires 60 watts per hour, or 60 Board of Trade units every 1,000 hours, which at 8d. per unit (the price now charged by the House to House Electric Supply Co., Kensington, and the Electric Supply Co., Liverpool) amounts to 40s. 0d. To which must be added the cost of lamp, 3s. 9d.				16,000	s. d. 43 9	1
WITH ORDINARY GAS BURNERS.	Quality of gas.	No. of cubic feet required to produce 16 candle-power per hour.	No. of cubic feet required for 1,000 hours.	Price of gas.			
				s. d.			
London . . .	16 candles	5 cubic feet	5,000 cubic feet	2 6	16,000	12 6	3·5
Manchester . . .	20 „	4 „	4,000 „	2 6	16,000	10 0	4·4
Aberdeen . . .	28 „	2·88 „	2,880 „	3 6	16,000	10 1	4·3
WITH REGENERATIVE BURNERS.							
London . . .	16 „	2½ „	2,500 „	2 6	16,000	6 3	7
Manchester . . .	20 „	2 „	2,000 „	2 6	16,000	5 0	8·7
Aberdeen . . .	28 „	1·44 „	1,440 „	3 6	16,000	5 0½	8·7

THE MANCHESTER ASSOCIATION OF ENGINEERS.

MR. JOHN WEST, M.Inst.C.E., gave his presidential address before the above association on the 11th inst. After referring to one or two local matters, Mr. West went on to consider the relative merits of electric and gas lighting. There were electric lighting companies formed for lighting London, with a united capital of over three millions sterling, and these companies were now erecting buildings, and putting down steam boilers, engines, electrical plant, and mains for supplying the various districts. Electricity was supplied by the various companies on the following different systems, viz.:—(1) The direct continuous current; (2) the direct continuous current storage system; and (3) the alternate current transformer system. The relative merits of the various systems were stated, after which Mr. West went on to deal with the question of the cost of the supply.

The charges for electricity ranged from 7d. to 8d. per Board of Trade unit of 1,000 watts, and some companies would not give a supply to a consumer under a minimum charge of £14 per annum. While it was admitted that electricians have made some progress in perfecting machinery for securing a better and more regular supply of electricity, it must not be forgotten that improved lighting by gas has also made very rapid strides. Having in 1882 dealt with the question of defective burners he pointed out that since that period two new systems of burners have been perfected. These were the regenerative burners of Siemens, Sugg, Wenham, Fourness, and others, and the incandescent burners of Welsbach, Clamond, and others, both these types having come into general use, particularly the regenerative kind, and from them a better light can be obtained with from half to one-third the quantity of gas. He had been favoured with the results of some experiments made by Mr. Alexander Smith, of Aberdeen, with regenerator burners of suitable size for lighting halls, shops, and large rooms, as follows:—

By consuming 10 cubic feet of gas per hour in one of these lamps a light equal to 155·2 candles was obtained, or 15·52 candles for each cubic foot of gas consumed per hour. This result was obtained with gas, which, when tested according to the method prescribed in the Gas Works Clauses Act, gives a light equal to 5·6 candles for each cubic foot, thus showing a gain of 9·92 candles for every foot of gas per hour when used by these lamps, or a gain of over 177 per cent.

Similar tests had been made with London gas, and with the Wenham and other regenerative lamps, which showed similar satisfactory results. A photometric test of the Welsbach lamp made by Professor Carlton J. Lambert showed that an illuminating power of 28·8 candles was obtained with a consumption of 3 cubic feet per hour of London 18-candle gas. The relative cost of gas and electricity with equal light from each was then compared. Eminent electricians stated that a 16 candle-power incandescent lamp was calculated to last about 1,000 hours, and would absorb 60 Board of Trade units of electricity in that time. The cost of 60 units at 8d. per unit, the usual Board of Trade limit of charge, would be 40s., to which must be added 3s. 9d., the cost of the lamp, which made a total of 43s. 9d. per 60 units. To make the comparison clear as to the cost of gas in London, Manchester, and Aberdeen to produce the same amount of light, both with ordinary burners and regenerator burners, Mr. West prepared the above table.

The comparison is made with the best type of burners, as these are in the reach of every one, and the gas is compared with an electric lamp which is assumed to give the same light throughout the 1,000 hours, but such is not the case, as it is found, after they have been used for a time, that the carbon filaments get volatilised and deposited on the glass, consequently the size of the filament is diminished and the surface of illumination reduced; the resistance of the filament would also be increased and the intensity of the incandescence decreased for a given power; the carbon on the glass further reducing the light. These facts are confirmed by the experiments of Mr. W. H. Preece, Chief Electrician to the Post Office, who states that the ordinary commercial lamps consuming 3·54 watts per candle-power when new, require 6·1 watts per candle-power after burning 900 hours, the mean absorption being 5·25 per lamp. Stated the other way, it appears that the candle-power of the lamps after burning 900 hours is only 58·5 per cent. of the initial duty, and the mean value of a lamp during its life is only 67 per cent. of that which it possesses when new. Assuming an average use of four hours per day for a lamp, this means not only that all incandescent lamps must be renewed before 225 days, when their luminosity is little more than half what it was when new; but taking all the lamps in an establishment together, three should be provided to do the work of two if the intended average lighting effect is to be maintained. The advantage of electric lighting in a low-pitched room where ventilation is defective was admitted, but this could be obtained with regenerative burners. Mr. West then went on to give his views as to the cheapest and best way of producing and delivering electricity to the consumer under varying circumstances. He was informed that in one town a complete electric lighting plant driven by steam power and supplying from a central station 3,000 incandescent lamps of 16 candle-power, with cables laid along the streets, would cost about £20,000. Mr. Ferguson Bell, of Stafford, stated that in their town it would cost £14,500 for a like installation, but he did not include the cost of land in his estimate, details of which were given.

If the number of lights was sufficient, there was the plan of a consumer providing himself with electric light by means of a complete plant, driven either by a gas engine or steam engine, on his own premises. A friend of his had given him the cost of a complete electric installation, including fittings for 320 incandescent lamps of 16 candle-power each, which had been working for about two years at one of the banks in London, and was driven by Crossley Bros.' gas engines. The plant included two 9 horse-power Otto engines, two dynamos, and two sets of accumulators, and cost £3,000. The working expenses—for 1,800 hours per annum, the building being dark—were, including interest on capital at 10 per cent., £1,012 10s. per annum. The current supplied was equal to about 38,500 Board of Trade units. The analysis of the above figures shows that—

	d.	
The cost for generating electricity, including wear and tear and interest on capital, is.....	5·58	per Board of Trade unit.
Interest on fittings	·56	„ „
Cost for renewal of lamps	·7	„ „
The total cost per Board of Trade unit on the complete installation	6·84	„ „

From these figures it will be seen that if the bank had obtained electricity from a central station electric lighting company, at 8d. per unit, the total cost to them would have been:—

	d.	
Electricity	8·0	per Board of Trade unit.
Interest on fittings	·56	„ „
Cost for renewal of lamps	·7	„ „
Total.....	9·26	„ „

So that by generating electricity on their own premises they saved 2·42d. per unit, or £357 19s. 2d. per annum. He thought it would be found in practice that the most economical and satisfactory way of producing and supplying electricity to the consumers would be by gas engines on their own premises, or by a system of very small central stations, where a few houses or shops were in close proximity and worked by the direct system of distribution. By this plan we would avoid expensive outlay on buildings, at the same time be advantageously using the existing gas mains, besides being able to dispense with the cost and maintenance of an electrical meter on the premises. The cost of generating plant for 400 incandescent 16 c.p. lamps on this plan would be as follows: Plant, £900; working expenses for 1,800 hours per annum, £660; current supplied, 43,200 Board of Trade units; cost per unit, 3·66d. In the case of an installation of 50 lamps of the same power, the cost of plant would be £275; the working expenses, £110 19s.; the current, 5,400 units; and the cost per unit, 4·93d.

By this plan electricity could be supplied, as shown by these examples, at prices varying from 3·66d. to 4·93d. per Board of Trade unit, according to the size of the installation, inclusive of working expenses, repairs, depreciation, and interest on capital. The usual charge by the London electrical companies, whose supply was generated for large districts in large stations driven by steam power, was 8d. per unit, showing a saving of 4·34d. and 3·07d. per unit respectively in favour of the gas engine scheme. To explain how the charge for working by gas was obtained, he took first the quantity of gas required per indicated horse-power per hour at 20 cubic feet; with this amount of gas a maximum of 8 lamps of 16 candle-power each could be maintained per hour, and by allowing a little extra for irregularities, and taking 50 cubic feet of gas to produce one Board of Trade unit, the gas would cost 1½d., to which must be added the other figures in the table of working expenses just given. The reason why electricity could be distributed to customers by gas engines cheaper than from a large central station, was because the very expensive cables for distributing the electricity (which in most cases take one-third of the capital employed) could be dispensed with, and the further expenses for renewal after they have been in use for a time. It was stated that Edison's cables in Berlin only lasted three years. These cables cost £90,000 for 36,000 lamps of 16 candle-power and 144 arc lamps. From these facts it was quite clear that the interest on the first cost and maintenance and renewals of distributing plant alone would be more than the cost of gas delivered on the consumers' premises from the existing mains. While approving of the action of the Corporation of Manchester in applying for a provisional order, he thought they should not put down a central station, but rather encourage separate installations in which gas engines would be used, Messrs. Crossley Brothers having sold 550 for this purpose. Gas engines and dynamos might be hired to consumers in the same way as stoves are. In many cases where arc lights of high power were employed on out-door work they had been superseded by the "Lucigen" and "Wells" patent portable lights, the latter being supplied with Wells oil or refined gas tar. This was a very cheap and useful light, 250 of them being in use on the Ship Canal. It must not be forgotten that in nearly all cases both gas and

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electric light were obtained from the energy contained in coal, and that gas companies and corporations who own gas works could produce as much light direct from the gas made from a ton of coal (if properly applied) as could be obtained from a ton of coal by any other means, besides having the resulting coke, tar, and ammoniacal liquor to dispose of. So, as far as he could judge, gas must remain by far the more economical of the two methods of lighting.

Dealing with the subject of "water gas," he said it had been brought very prominently before the public during the last year or two, more for the purpose of floating speculative companies, perhaps, than because of any real novelty; for at least thirty years had elapsed since it was new to English gas engineers, and many had been the trials of variations of the same principle, owing to the extreme simplicity of the apparatus and the large amount of work that could be done on a small area of land; but the question of ultimate economy had often prevented the success of schemes which otherwise were satisfactory. At the present moment he was referring more particularly to the use of water gas for general lighting purposes, as there were many examples in England of its admirable qualities as a heating agent for certain processes.

Mr. West then gave a brief description of the various methods of manufacturing water gas, and said that one great drawback to the process was the time spent in producing the necessary heat, and the large volume of producer gas of very poor quality thereby generated. In America, where the water gas system had reached its highest development, the gas was often produced from generators upon a large scale on the same works as ordinary coal gas. In some places in England, where water gas was used for heating the producer gas was a great nuisance and source of loss. There was a great difference between the circumstances of the production of water gas as a lighting agent in America, and its production here; for in America the petroleum oil used to invest the gas with lighting properties was easily obtained at a very low price, and the price of coal gas was much higher than in England, so there was a greater margin between the two kinds than was the case here. As a heating agent water gas was very valuable where a very high flame-temperature was desirable, as the theoretical temperature was about 5,000° F., while that of coal gas was about 2,500° F. In conclusion Mr. West said that many ways had been tried to obtain illumination from water gas, but he thought it questionable whether there were any advantages to be gained. The comparisons instituted had been founded on actual experiment and experience, and in this way only was the truth to be arrived at.

Notices of Meetings.

NEXT WEEK.

SOCIETY OF ARTS.—Monday, January 20th, 8 p.m. Cantor Lectures: "The Electromagnet," by Silvanus P. Thompson, D.Sc.

ROYAL STATISTICAL SOCIETY.—Tuesday, January 21st, 7.45 p.m. Paper to be read: "Popular Education in England and Wales since 1882," by Rowland Hamilton, Esq.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, January 21st, 8 p.m. Paper to be further discussed: "Recent Dock Extensions at Liverpool," by George Fosbery Lyster, M.Inst.C.E.

THE INSTITUTION OF ELECTRICAL ENGINEERS.—Thursday, January 23rd, 8 p.m. Adjourned Discussion on the President's Address on "Magnetism."

ROYAL INSTITUTION OF GREAT BRITAIN.—Friday, January 24th, 9 p.m. Professor Dewar, M.A., F.R.S., on "The Scientific Work of Joule."

PRICES CURRENT, 15TH JANUARY, 1890.

Quotations at per ton, unless otherwise specified.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	8 2 6	.....	8 12 6	f.o.t. wks.
" Angles	7 17 6	.....	8 7 6	"
" Plates	8 5 0	.....	8 15 0	"
Staffordshire Bars	9 7 6	.....	9 17 6	London.
" Angles	9 7 6	.....	9 17 6	"
Crown Sheets	9 0 0	.....	9 10 0	"
" Hoops	8 10 0	.....	9 0 0	"
"Siemens-Martin" Steel Boiler Plates	10 5 0			"
" Ship and Girder	9 5 0			"

Market firm.

PIG IRON.

Messrs. Raby, Fell, & Co., Manchester, quote as follows:—

Middlesbro' Warrants, No. 3	60/6	Cash
Scotch Warrants, m/n	61/3½	"
Hematite Warrants, m/n	77/3	"
Stocks in Stores — Scotch	925,352.—Dec. for week,	7,149 Tons.
Middlesbro'	184,208.—Inc. "	425 "
Hematite	186,340.—Inc. "	980 "

Exclusive of stocks in makers' yards.

	No. 1.	No. 3.		
Coltness	80/-	72/-	f.o.b.	Glasgow.
Gartsherrie	79/-	72/-	"	"
Dalmellington	71/-	70/-	"	Ardrossan.
Eglinton	68/-	67/-	"	"
Glengarnock	77/6	69/6	"	"
*Derbyshire	—	75/-	f.o.t.	Works.
*Lincolnshire	—	71/-	"	"
*Lancashire	—	73/-	"	"

*Forge quality, about 1s. per ton less.

Market unsettled and unsatisfactory.

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton	80/6	73/6

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

METALS.

		£ s. d.		£ s. d.
Spelter:	Ordinary	£25 10 0	to	£25 12 6
Copper:	British Cakes and Ingots	59 0 0	"	60 0 0
"	Chili Bars, G.O.B.'s	50 5 0	"	50 10 0
"	Other sorts, G.M.B.'s (equal to Chili Bars)	50 5 0	"	50 10 0
"	Manufactured (strong)	66 0 0	"	.....
Lead:	Common Pig	15 15 0	"	16 0 0
"	English Sheet	16 5 0	"	16 10 0
Tin:	Straits	94 0 0	"	94 10 0
"	Australian	.....	"	.....
"	English Ingots	99 10 0	"	.....

Messrs. Carrick & Brockbank, Manchester, report as follows:—

COPPER: There has been an irregular market in raw copper during the past week, owing to realisations on the part of certain speculators and the high rate of discount now ruling. Chili bars are consequently lower, quotations to-day being £50 5s. to £50 10s. cash. Manufactured copper still remains at £66 to £69, sheets and bottoms.

TIN weaker, with limited business doing at declining prices.

LEAD is quiet again, and rather lower in price on the week.

SPELTER keeps very firm, and higher prices are looked for.

CHEMICALS.

		£ s. d.		£ s. d.
Acid:	Carbolic Crystals lb.	0 0 11	to	0 0 11½
"	" Liquid gal.	0 1 2	—	.....
"	Citric lb.	0 1 7	—	.....
"	Oxalic "	0 0 3¼	—	.....
"	Sulphuric ton	1 10 0	—	.....
"	Tartaric lb.	0 1 4	—	.....
Alum:	Lump (powder 10/- ex.) ton	4 17 6	—	.....
Ammonia:	Carbonate lb.	0 0 3½	—	.....
"	Muriate (Grey) ton	22 5 0	—	.....
"	" (White) "	26 0 0	—	.....
"	Sulphate "	12 7 6	—	.....
"	Liquor lb.	0 0 3½	—	.....
Antimony	ton	.....	—	.....
Bleaching Powder	"	5 5 0	—	5 7 6
Bisulphide of Carbon	"	13 10 0	—	.....
Borax	"	30 0 0	—	.....
Benzole (90 %)	gal.	0 3 5	—	.....
"	(50/90 %) "	0 2 7	—	.....
Copper Sulphate	ton	24 10 0	—	.....
Copperas	"	2 0 0	—	.....
Kieserit	"	1 13 0	—	.....
Lead:	Nitrate "	22 10 0	—	.....
"	White Sugar "	24 0 0	—	.....
"	Brown "	19 0 0	—	.....
Potash:	Bichromate lb.	0 0 4	—	.....
"	Caustic ton	22 0 0	—	.....
"	Carbonate "	19 10 0	—	.....
"	Chlorate lb.	0 0 4¼	—	.....
"	Prussiate (Yellow) "	0 0 10½	—	.....
"	Sulphate (Basis 90 %) ton	9 10 0	—	.....
Precipitate:	Red lb.	0 3 1	—	.....
"	White "	0 3 2	—	.....
Salts:	Epsom Bags ton	3 0 0	—	.....
	Epsom Casks "	3 15 0	—	.....
	Glauber "	1 10 0	—	.....
Sulphur:	Sublimed Flowers "	9 0 0	—	.....
"	Recovered "	4 10 0	—	.....
Soda:	Ash deg.	0 0 1¼	—	.....
"	Caustic (White 70%) ton	7 17 6	—	.....
"	" " 60% "	6 17 6	—	.....
"	" (Cream 60%) "	6 5 0	—	6 7 6
"	Crystals "	2 7 6	—	.....
"	Bicarbonate "	5 5 0	—	.....
"	Hyposulphite "	6 5 0	—	.....
Solvent Naphtha	gal.	0 3 6	—	.....
Tartar, Cream of	cwt.	5 12 6	—	.....
Zinc Sulphate	ton	7 10 0	—	.....

Messrs. S. W. Royse & Co., Manchester, report as follows:—

CHEMICALS.—The firmness noted in our last is fully maintained. Bleaching powder is again a shade better, and the higher qualities of caustic soda have secured a further good advance. This is caused by short supply, some of the manufacturers having had difficulty in obtaining supplies of slack. Chlorate of potash is steady, at 4¾d. There has during this month been a good demand for oxalic acid at the reduced prices, consumers having delayed purchasing in order to take advantage of the fall. Acetates of lime are very firm. Acetates of lead are steady, but nitrate of lead is rather easier. Sulphate of copper is almost unobtainable for prompt delivery.

OILS.

		£ s. d.
Cocoanut:	Cochin per tun	26 10 0
"	Ceylon "	23 15 0
Cottonseed	"	22 0 0
Cod	"	19 0 0
Lard	"	37 10 0
Linseed	"	20 12 6
Palm, Lagos	"	25 10 0
Rapeseed:	English "	32 15 0
Seal:	Pale "	26 10 0
"	Brown "	19 0 0
Sperm	"	45 0 0
Whale	"	24 0 0
Turpentine	per cwt.	1 15 9
Coal	per gal.	
Petroleum	(Refined) "	0 0 6
"	Spirit "	

FOREIGN TELEGRAPHIC ADVICES.

(From our own Correspondents.)

PARIS, Jan. 16.—*Iron.*—Prices of bars and joists oscillate between 168s. and 176s. a ton here in Paris, where business is not brisk. In the provinces the markets are very firm. In the Nord bars are quoted 156s. The demand continues strong generally, but sellers are cautious, fearing further difficulties from the short supply of coal. Production is greatly restricted from this cause already.

BERLIN, Jan. 16.—*Bourse.*—The market for industrial securities is growing stronger again. Shares in collieries are quoted higher. The firmer tone generally prevailing indicates greater confidence in the industrial situation.

Metals.—The metal market is growing more active, and the weakness in prices observable a week ago has given place to a firm tendency. Mansfeld refined copper is steady at £61 to £62 10s. Best English brands, £61. Banca tin is quoted £107 10s. There is a brisk demand for spelter. The W. H. brand is quoted £27 10s.; other Silesian sorts, £26 15s. Lead is a little weak. Antimony regulus firmer.

Flax and Yarns.—In the Trautenau market business is again active. Buyers of flax are operating largely at the prices current a week ago. The demand for yarns is fairly brisk, the tendency of the market being in favour of sellers.

BRESLAU, Jan. 16.—*Coal.*—The scarcity of coal increases, and as the merchants control two-thirds of the output the industrial situation is becoming precarious. Polish coal is for the first time being imported into Silesia. A few sample truckloads of small have arrived here. The price varies from 5s. 3d. to 5s. 10d. on rails at Sosnowice. The labour market is assuming a less threatening aspect.

Iron.—The market is animated and buoyant, the demand for pig being very strong. Forge pig is dearer. A good deal of foreign pig is now being delivered here. A brisk trade is being done in finished iron and steel. Bars are selling a little above the official quotations. Common plates are selling freely at 240s., and thin sheets have been largely dealt in at 250s. a ton. Founders are very busy. Many have their order-books full for the next four months.

Zinc.—The market for zinc continues very active at last week's prices. The W.H. brand of spelter sells readily at £25. The zinc merchants are offering zinc dust at 85 per cent. of current zinc prices. Most works have sold the whole of their produce six months forward. The market is firmer for forward delivery.

DÜSSELDORF, Jan. 16.—*Iron.*—Large buying orders for spiegel pig are coming to hand from Belgium. The price for the 10 to 12 per cent. quality is very firm at 102s. Forge pig continues in brisk demand at 92s. Thomas pig at 82s. shows an upward tendency. Bars are in good demand for export. Angles are a little higher in price; latest price, 210s. Hoops, too, are a little dearer, 210s. having been paid. Rolled wire remains relatively low at 180s. According to a rumour current here, the wire syndicate is to be re-established.

HAMBURG, Jan. 16.—*Nitrates.*—The market is dull for Chili saltpetre. Spot goods are offered as low as £8 3s. For cargoes to arrive at the end of February or the beginning of March the price asked is from £8 5s. to £8 5s. 6d. a ton.

BRUSSELS, Jan. 16.—*Mining Legislation.*—The Federation of Belgian Miners have agreed with M. Paul Janson, the Deputy for Brussels, on the terms of a new Bill regulating the employment of labour in mines, to be laid before the House of Representatives on Monday next.

WE have received a copy of the "*Mechanical World* Pocket Diary and Year Book for 1890." In addition to the usual useful information contained in this yearly, there is some further information on triple expansion engines, casting, standard fittings, &c., together with an account of some more recent improvements in various branches of mechanical practice.

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HOME INDUSTRIES.

LONDON 16th January, 1890.

The Money Market.—The money market retains its firm tone, and while, from some points of view, the dearness of money is inconvenient, the maintenance of high rates is desirable for some time yet for the general security of the monetary position. The near approach to a money crisis at the close of the year was due to the fact that the previous efforts to avoid a too great weakening of the position of the Bank of England had not been sustained. Occasional attempts to protect the Reserve had been made, but so soon as the momentary danger passed, things were allowed to take their course, and at last got out of control. The outside market has now backed up the action of the Bank, and at the expense of a little inconvenience the money market bids fair to assume a more stable aspect. One unpleasant side of the picture has been seen this week on the Stock Exchange, where loans for carrying forward transactions into the new account have been charged for heavily. This has checked new speculative business, but a fair amount has been transacted. Consols have improved with the more settled feeling in the money market. Among home railway stocks those of the goods lines have shown little animation, the inclination being to wait for the dividend announcements. The Manchester, Sheffield, and Lincolnshire dividend was unexpectedly good, and the securities of that line had a rapid rise, part of which has since been lost owing to sales to realise profits. It was the same with the Brighton Railway stocks. American railways have been dull and rather out of favour, but Canadian Pacifics are in request. The decline in Mexican (Vera Cruz) rails continues, the traffic returns remaining obstinately bad. The movements in foreign stocks have tended upwards. Brazilians have recovered a little. Peruvians have improved on the signing of the grace contract, and Spanish are still sought for. Nitrate shares are still a falling market, and copper securities have weakened in sympathy with the price of the metal.

Companies.—The following companies have been registered since our last report:—The Government Guaranteed Railways and General Syndicate, Ld., with a capital of £10,000; John Anderson & Co., Ld., with a capital of £3,000, to carry on the business of sawmill engineers; The Honduras Corporation, Ld., with a capital of £62,500, to acquire mining rights, &c., in Honduras; The Leeds and Wakefield Breweries, Ld., with a capital of £200,000; The West Australian Exploration Company, Ld., with a capital of £20,000, to acquire mining rights &c.; The Sambas Exploration Company, Ld., with a capital of £300,000; The Transvaal Minerals, Ld., with a capital of £200,000, to carry on the smelting of iron ore acquire mining rights, &c.; The English and Continental Shipping Company, Ld., with a capital of £27,000; William Johnston & Co., Ld., with a capital of £250,000, to carry on the business of ship owners, &c.; The Syndicate of Electrical Engineers, Ld., with a capital of £10,000, to establish institutions for testing electric instruments, &c., for profit; The Sanitation Company, Ld., with a capital of £10,000, to carry on the business of sanitary engineers; Klerksdorp Elandslaagte, Ld., with a capital of £125,000, to acquire certain mining claims in South Africa; The Inventors' Bureau, Ld., with a capital of £5,000; The Great Western Colliery Company, Ld., with a capital of £300,000; The Midland Coal, Coke, and Iron Company, Ld., with a capital of £375,000, to acquire and work certain collieries, &c., in Staffordshire; The Automatic Fire Check Company, Ld., with a capital of £5,000, to carry on the business of manufacturers of fire checks; Richard Thompson & Co., Ld., with a capital of £2,100, to carry on the business of weaving and cotton cloths manufacturing; Bailey, Watson, & Berry, with a capital of £2,000, to carry on business as cotton and worsted spinners; Caylloma Silver Mining Company, Ld., with £250,000; The Cravenette Company, Ld., with a capital of £30,000, to carry on the business of waterproofers of cloths; The Grand Canyon Mining Company of Arizona, U.S.A., Ld., with a capital of £75,000; The Railway Supplies Company, Ld., with a capital of £25,000, to carry on the business of makers and dealers in all kinds of railway appliances; Healy Bros., Ld., with a capital of £30,000, to acquire the business of rope and twine manufacturers; The Peruvian Exploration Syndicate, Ld., with a capital of £20,000, to explore mines and grounds in Peru.

The Board of Trade Returns.—The returns for the month of December and for the whole of the past year are very satisfactory. The month's imports amount to £38,267,934, as compared with £37,940,625 in December, 1888, being an increase of £327,309, or 0·9 per cent. The exports were £20,903,353, as compared with £18,814,209 in December, 1888, being an increase of £2,089,144, or 11·1 per cent. This is a very marked advance in the latter case, and shows that the export trade is in a most satisfactory progressive condition. Higher prices are also being obtained, for the month's exports of iron and steel are valued at £2,508,030, an increase of 21·5 per cent., whereas the quantity only advanced by about 6 per cent. Nearly all the items show an advance. Machinery and millwork have risen from £1,101,988 to £1,325,675, or 20·3 per cent.; chemicals have increased by nearly 9 per cent.; coke, coal, and fuel, 21 per cent.; and copper, 128 per cent. Cotton piece goods have fallen off, but only infinitesimally. The year's exports were £248,091,959, as compared with £233,842,607 in 1888, being an increase of £14,249,352, or 6·1 per cent. The imports for the year amounted to £427,210,830, as compared with £386,582,026 in 1888, being an increase of £40,628,804, or 10·5 per cent. The exports of metals and articles made therefrom (with the exception of machinery) increased by £3,790,154; machinery and millwork, by £2,315,391; and chemicals, by £497,448. It is clear that 1889 has left little to complain of in the matter of foreign trade.

The Navy.—The new composite gun-vessel "Thrush" left Sheerness on Saturday for the official trials of her machinery, which took place in the North Sea, under the superintendence of the officials of the Medway Steam Reserve. The trial was of eight hours' duration, and was of a most satisfactory character, there being a total absence of hot engine-bearings or priming of the boilers. The engines developed 804·5 h.p., which was 84·5 h.p. in excess of that contracted for. The "Sparrow," sister ship to the "Thrush," also underwent her natural draught trial in the North Sea, with equally successful results. With a mean of 121lb. of steam in the boilers, the engines worked at 157·7 revolutions per minute, and developed 803·9 h.p.

Civil and Mechanical Engineers' Society.—On the 8th inst., at a meeting of this society, a paper, entitled "Notes on Labour and Prices in India," was read by Mr. H. H. Parkinson, A.M.I.C.E., late assistant chief engineer to H.H. the Gaekwar of Baroda. During the lecture the author said that the wages of the Indian labourer were only one-tenth of those in England. It is preferred to avoid carrying spoil more than 100 yards, and should filling be required at a greater distance than that, a fresh excavation would be opened. The bricks in use are of very inferior quality, and vary in price from 11s. to £1 per 1,000. There are three qualities of lime, burnt with coal, wood, or rubbish, costing 14s. 5d., 12s. 7d., or 9s. 9d. respectively per cubic yard. Brickwork may be estimated at 10s., and concrete at 5s. 9d., per cubic yard. Timber is mostly imported from Burmah, and wood, in roof trusses, &c., costs 5s per cubic foot.

MANCHESTER, 16th January, 1890.

The Ribble Bill.—The association of Preston ratepayers who are known as the "party of caution" intend to oppose the Bill promoted by the Corporation, and suggest the abandonment of all the works, with the exception of the dredging, which they think should be proceeded with. They contend that a coasting trade is all that can be cultivated at Preston. In view of the late Board of Trade inquiry, upon the report of which the proposed Bill is founded, it is hardly likely that the opposition will succeed.

A Fireless Motor.—It is stated that an extensive trial of the new tramway engine, in which the propulsion is due to ammonia in the form of gas, and to which we referred some months ago, is to be made at Bolton, where the gradients are heavy. The test is severe, but the owners—the Fireless Engine Syndicate—are determined to ascertain the true merits of the engine prior to putting it on the market.

Sewage Scheme.—The Hyde Town Council have determined to proceed with works to purify the sewage of the town. After inspecting a number of works they have determined to adopt the intermittent precipitation and filtration system pursued at Acton, in which magnetic ferrous carbon is used. Several other local bodies in the district propose to adopt this system.

The Late Mr. T. L. Daltry.—We regret to announce the death of Mr. Thomas Lewis Daltry, which took place on the 11th inst., in the thirty-sixth year of his age. Mr. Daltry was for some time editor of the *Mechanical World* and of the *Textile Manufacturer*, and was an engineer and inventor of considerable repute.

Watch Factory.—The new factory on the American system at Prescot, the erection of which was commenced last May, as noted in *Industries*, was formally opened by Lord Derby on the 11th inst. The company, which is responsible for the carrying out of the work, has for some months past been having watches made in some of the older workshops by special machinery, but it is now intended to put all the tools into the new works. Since the idea was first mooted it has been resolved to make the cases as well as the movements, so as to compete with the American and Swiss makers. Most of the employers in the district are shareholders in the new concern, and the present indications are of such a character that the promoters speak very confidently of future dividends.

The Linen and Jute Trades.—Travellers having now got back again on the road, orders have come in more freely, although the season has not yet opened out fully. Prospects, however, may be considered very good, as there is a distinct tendency on the part of retailers to keep bigger stocks, and the wholesale houses in accordance with this state of things have bought largely. A damask consisting of a silk and linen mixture, the product of French looms, has been shown lately, and the article is said to have sold well with American buyers. In this market, however, heavy and commoner varieties still constitute the bulk of the linen trade. Some of the heads of departments are away in the manufacturing districts. Others have returned and are now actively engaged in pushing sales. Prices are firm, the stiffness of jute having a tendency to make rates for linens steadier. Fancy jute fabrics promise well both in carpets and crumb cloths. Linen threads are in moderate request, and manufacturers are now obtaining more easily the rates which were established on the issue of the advanced lists last year.

GLASGOW, 16th January, 1890.

Pig Iron.—This has been a week of intense excitement in the iron market; a fall of about 6s. per ton, in the face of increasing cost and scarcity of fuel, seems to have taken most of the trade by surprise. The general impression left by the reports of the Birmingham meeting was good, but on the whole not favourable to any further rise in prices at present. The dealers and other outsiders in England, who have of late been the principal purchasers of warrants, seem to have held off from selling till after the Birmingham meeting, when they expected a strong market, but the result has been very disappointing to them, as our market was unable and unwilling to absorb, at the high prices, all the iron that came out on sale. As the prices drooped sellers became more urgent, and finally, in a state of semi-panic, Scotch and hematite warrants dropped on the 13th 2s. to 2s. 6d. per ton. On Tuesday they advanced again to above Monday's best, but close slightly lower.

Scotch Railways.—The Scotch railway traffic returns are still expanding. For last week the three great railways have all gained, the Caledonian by an increase of £5,000, the North British by £7,000, and the Glasgow and South Western by £3,000. A rumour prevailed in the end of last week that the Caledonian Railway Company had abandoned the Edinburgh underground railway scheme. This, however, is at least premature. The company, in spite of the opposition to their scheme which exists in Edinburgh, intend to proceed with the Bill.

The Coal Trade in 1889.—In their annual report, just issued, Messrs. D. M. Stevenson & Co., Glasgow and Leith, state the quantity exported in 1889 was 3,859,251 tons, an increase of 536,971 tons over the previous year. In regard to the trade of the year, prices, they say, have been much higher than in the previous year, the prices during the autumn being higher than has been the case for fifteen years.

Engineering.—The contract for the harbour tunnel to be constructed under the Clyde at Finnieston has been secured by Messrs. Hugh Kennedy & Sons, Partick. Messrs. Wilson & Simpson, C.E., are engineers. The tunnel will be in three divisions; two of the tunnels will be used for vehicles, and one for passengers. The operations will be begun immediately.—The erection of the new steel works of the Lanarkshire Steel Company, at Motherwell, has been begun. It is expected that they will be completed in three or four months.

Exhibition of Industrial Art.—A selection of exhibits from the Arts and Crafts Exhibition is to be opened free to the public on Saturday. A considerable part of the metal work, which was a feature of the Arts and Crafts this year, has been brought down.

(From our own Correspondents.)

LIVERPOOL, 15th January, 1890.

Appointment of the City Engineer.—On account of the appointment of Mr. Clement Dunscombe as engineer to the London County Council, Mr. Henry Percy Boulnois, borough engineer of Portsmouth, has been appointed as his successor. He is appointed as city engineer, gas inspector, and surveyor of buildings, at a salary of £850 per annum, with an annual increase of £50 until a maximum of £1,000 per annum is reached. He comes with excellent testimonials, and a record of former work which makes him well qualified to undertake the multifarious duties of his new office, and it was no compliment to him when the committee coupled his name with some others in the extraordinary selected list, which has justly given rise to surprise and indignation.

The Salt Trade.—The returns of salt exported from Cheshire during the last year show a serious diminution, the total amount being 745,111 tons, against 1,022,334 tons in 1888. There is a falling off of about 25,000 tons to the United States, and 15,000 tons to British North America; of 92,000 tons to Calcutta, 14,500 tons to Belgium, and about 22,000 tons to Russia and the North Sea ports.

Hydraulic Passenger Lifts at the Liverpool and London and Globe Offices.—These two lifts, which were fully described and illustrated in *Industries* a short time ago, have since been converted by Messrs. R. Waygood & Co. to high pressure lifts; and, instead of obtaining the very costly low pressure water from the Corporation mains, the supply is now obtained from the high pressure mains of the Hydraulic Power Company, and already the great economy of the latter is evident. Several other low pressure lifts are being converted, and all are anxious to avail themselves of the pressure from the new main which the company have at last been allowed to lay, in accordance with the recent agreement with the Corporation. In addition to the powers to be applied for in the next session to ratify their agreement, the company are seeking powers for laying down a similar system in Manchester.

LEEDS, 15th January, 1890.

The Iron and Steel Trades.—The confidence apparent in the quarterly meetings was reflected at our market yesterday. The new year has already seen a slight advance all round, and there are indications that before very long the prices of finished iron and steel will again rise from five to ten per cent. The iron and steel trades are very active, and manufacturers are almost daily asked to undertake fresh orders. Contracts are lost to the district, owing to the inability of makers to guarantee early delivery. Great

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pressure is also being put upon engineers to execute work at early dates. New orders for all kinds of locomotives and machinery are being received, not only for home, but also for abroad, among the foreign customers being India, Australia, Turkey, Paris, and Mexico. There is not quite so much doing as there was a couple of months ago in heavy machinery for shipbuilding purposes, shipbuilders having supplied their wants, and there being for the present a cessation in the placing of new contracts for ships, on account of the high rates obtaining for manufactured iron and steel. The engineering outlook is very satisfactory—that is, with reference to demand. At the time of writing almost every establishment is as busy as possible Better prices rule, though the increased cost of production, both in regard to raw material, fuel, and labour, has a tendency to keep down profits. In view of the revival that has overtaken the engineering and machine trade, workmen are trying to improve their position, and accordingly the Leeds Executive Council of the Amalgamated Society of Engineers have issued revised rules relating to the wages and working hours of members employed in the district.

THE COAL TRADE.—The steam coal trade continues to be exceedingly brisk, and there is a fairly good demand for fuel for domestic purposes. Coke is also in great request, and somewhat difficult to obtain.

SHEFFIELD, 15TH JANUARY, 1890.

RAILWAY MATERIAL.—Great activity continues in all the branches specially devoted to the manufacture of railway material. At the works of Messrs. Craven Brothers an order has been received from the Great Northern Railway Company for the supply of 1,000 low-sided goods waggons, of exceptionally strong and massive construction. No diminution is noticeable in the volume of orders for tyres, axles, springs, &c. In wheels, the old cast iron centre has quite given place to the new form, in which the centre and spokes are united by two washers, and at a welding heat pressed together by hydraulic power.

COAL AND COKE.—There is very little change to report in this district. The miners have now received advances of 30 per cent. over the wages paid in July last, and it is to be desired that no further disturbances will take place for some time to come. Good coke continues to be scarce.

IRON AND STEEL.—The iron and steel manufacturers exhibit no signs of diminishing their output. The armour plate mills are fully employed, and ship plates, girders, and boiler plates continue to give plenty of work. Steel castings are in great demand for almost all purposes where strength and lightness is required. Ironfounders are also well off for employment.

NORTH STAFFORDSHIRE, 15TH JANUARY, 1890.

THE IRON TRADE.—Orders and specifications are coming in pretty freely, as a result of the quarterly meetings held last week. There was a good attendance of local ironmasters at Birmingham, and a fair business was done at advanced prices, the selling price of bars being £9 10s. per ton. The demand for pig iron was good, at prices varying from 70s. to 80s. per ton. Large sales were effected in puddle mine and furnace mine at prices showing a very considerable advance on those ruling at the October meeting.

GENERAL.—The Midland Coal, Iron, and Coke Company, with a capital of £375,000, has been formed to take over the collieries and ironworks at Apedale, Chesterton, and Podmore, formerly carried on by Messrs. Stanier & Co. and Messrs. Cooper & Craig.

BIRMINGHAM, 15TH JANUARY, 1890.

THE IRON AND STEEL TRADES.—There is in this district a continued strong demand for all kinds of iron and steel, but perhaps less disposition on the part of buyers to enter into new contracts for forward delivery. Most of the mills and forges are very busy on old contracts, and doing their utmost to wipe them off the books. A few orders are placed at current rates, and sellers will not enter them for forward delivery except at higher prices. The advance of marked bars on the 1st inst. to £9 10s. per ton at works helped to steady the market on quarter-day, Thursday last, and a fair amount of business was done. Common bars are to-day difficult to obtain under £9 per ton, sheets £10 5s., hoops £9 5s. For pig irons, of Staffordshire make, the prices range from 115s. for cold blast to 65s. for cinder pigs, but there are few sellers. There is a great demand for steel in all forms, and all steel works are taxed to the uttermost. Galvanised corrugated sheets are about £16 per ton at works.

GENERAL TRADE.—Chain and cable makers are very busy, but report a falling off of inquiries from the shipyards. Admiralty contractors, too, report a limited demand. The nail and rivet trades are very brisk. Makers of weighing machinery are very busy on work which is the result of the coming into operation of the new Weights and Measures Act. Traders are anxious to have their machines and weighing tackle put into order. Axle manufacturers are briskly employed, and have advanced prices 5 per cent. Vice, anvil, and shovel makers are busy. The strike in the Stourbridge brick trade interferes with business in that centre, and it is feared that it will last some time, as the operatives are well supported by contributions from other workmen's unions and federations, and the masters appear to be very firm. Kidderminster carpet weavers are exceptionally well employed, prices of wool are firm, and the prospect generally, for Kidderminster trade, is very good.

CARDIFF, 15TH JANUARY, 1890.

COAL AND COKE.—On account of the strikes in Belgium, a large number of orders for Welsh coal have arrived from that country. This, in addition to the rather heavy ordinary demand, has sent up prices for steam coal still further, and as much as 15s. 6d. has been paid for second-class qualities. The wages question having now been practically settled, business can be negotiated on a healthy footing. For coke the demand during the past week has been extraordinary, and as much as 28s. and 29s. has been paid for furnace coke, foundry quality realising some shillings above this figure. Ironmasters complain that the high prices of coke and iron ore are consuming the profit which otherwise they would have made over the present high prices of pig iron.

IRON STEEL AND IRON ORE.—The quarterly meetings last week showed how far buyers had neglected to keep their stocks up to a reasonable point, and high prices were paid for both steel bars and rails for prompt delivery. Makers had little or no pig iron to offer. The supply of iron ore seems well nigh exhausted, and buyers who have not covered themselves are in a dilemma. In fact, even those who have bought find all manner of difficulties arising in Spain, especially in Bilbao, about shipment. Rubio ore is quoted 17s. to 17s. 6d. c.i.f. Cardiff, second class quality. Freights from Bilbao are 5s. 6d.

BARROW-IN-FURNESS, 15TH JANUARY, 1890.

IRON AND STEEL.—The iron trade of the West Coast district is in a firm position, although a depression has commenced in the warrant market, resulting in the lowering of prices about 3s. per ton. Makers, however, have not changed their quotations, and are still asking 82s. 6d. per ton for parcels of mixed Bessemer iron net f.o.b., and 81s. 6d. for No. 3 forge and foundry iron, and are selling their products at these prices. There is some prospect of an increased output of pig iron. Stocks show an increase on the week of 830 tons. There are 56 furnaces in blast in the district, and 23 are standing idle. Steel makers are very busily employed, and plenty of new orders are offering for rails, plates, angles, tinplate bars, hoops, blooms, castings, and forgings. Heavy rails are still quoted at £7 5s. per ton, and colliery rails at £8 10s. More orders are offering for steel shipbuilding material than makers can accept. Prices remain very firm all round. Iron ore is brisk, and the mines are producing a larger weekly tonnage than was ever previously the case, but the native supply has to be augmented by foreign importations on a large scale.

SHIPBUILDING AND ENGINEERING.—The Naval Construction and Armaments Company at Barrow have orders in hand for 30,000 tons of shipping and for 60,000 i.h.p. in machinery. The company expect shortly to supplement this work with other orders.

MIDDLESBROUGH, 15TH JANUARY, 1890.

PIG IRON.—The speculators have again been at work, and have made the pig iron market unsteady. From 65s. for No. 3 G.M.B. the price dropped to 61s., but steadied itself there, and then rose to 61s. 6d., with a strong tendency to rise. There is not much business done, as regular customers do not care to buy with the prices so unsettled. No. 1 stands at about 64s., and grey forge at 60s. to 61s. In warrants Connal's No. 3 G.M.B. are quoted at 61s. to 61s. 3d. cash. In hematite, East Coast brands are quoted at from 80s. to 82s. 6d. for makers' iron, mixed numbers. On Monday, the 13th inst., the stock in Connal's store amounted to 184,208 tons, as against 183,248 tons on the previous Monday, showing an increase of 960 tons.

SHIPMENTS OF PIG IRON.—The shipments of pig iron are improving. Up to the 13th of the month they amounted to 19,065 tons, 5,070 of which went to Scotland, 6,650 to other parts of England, 1,140 to Germany and Holland, and 6,205 to other foreign countries. This is better than last month, but not so good as during the similar period last year.

MANUFACTURED IRON AND STEEL.—In the finished iron trade there is plenty of work going on, but there are few inquiries. Prices remain much the same. Ship plates are at £8 5s.; ship angles, £8; common bars, £8, with the usual discount. In the steel trade there is a steady business being done, and prices remain much the same. Ship plates are quoted at £9; angles, £8 10s.; rails (heavy), £7 5s. per ton on trucks at works.

COAL AND COKE.—Coal is steady at improved prices. There is not much done, however, except in odd lots, and the price varies. Households are rather dull. Coke is as scarce as ever, and as high in price.

SUNDERLAND, 15TH JANUARY, 1890.

SHIPBUILDING.—The prospects of this local industry for the current year are good. No other shipbuilding centre is comparatively so well situated. Amongst the orders most recently received are two steamships for the British India Steam Navigation Company, Limited, the recipients being Messrs. Wm. Doxford & Sons, Gallion. It will be remembered the "Mombassa" for the same company was completed during the past year by Mr. James Laing, Deptford. The recent petroleum fire on the River Wear is giving some work to ship-repairing establishments, as, although the fire was of short duration, the damage was exceedingly great. The fire occurred on the 8th inst., and was occasioned by a heated rivet falling into the river, whose surface was covered with petroleum discharged from the steamer "Wildflower" along with the water ballast. Besides the "Wildflower," the steamers "Douglass" and "Deronda," and the tug steamer "Earl of Dumfries," were badly damaged.

SHIPPING.—The freight market has not rallied fully as yet, but there are signs of improvement in outward Mediterranean rates. The short supply of coal has unfavourably influenced the outward rates of freight to all parts, but an early recovery may be anticipated. Coasting business is somewhat of an exception, and has not suffered to the same extent. As usual at the turn of the year, coal shipments are below the average.

NEWCASTLE, 15TH JANUARY, 1890.

RAILWAY WORKMEN'S HOURS.—Dr. R. S. Watson, who was selected to arbitrate upon the claim put forward by the employés of the North Eastern Railway Company at their various Newcastle goods stations, for the reduction of the working hours from ten to nine per day, has just issued his award, from which it appears that the concession asked for is given to porters and grain warehousemen, while it is denied to trolleymen, loftmen, and stablemen. The award possesses special interest, on account of the fact that it marks the first introduction of the nine hours working day among railway employés.

WAGES OF SHIPBUILDING OPERATIVES.—An advance of 5 per cent. on piece prices has just become due to certain sections of the shipbuilding operatives in the Tyne yards as a result of an agreement entered into between the employers and the representatives of the men in November last. It may be stated that this advance which is given to the platers, riveters, caulkers, and anglesmiths connected with the Boilermakers and Iron Shipbuilders' Society, brings the current wages rates very nearly up to the figures which ruled in 1882. On behalf of the members of the Amalgamated Engineers' Society a notice has been sent to the engineering employers of the district claiming an advance of 2s. per week at the end of the month, and also intimating the desire of the men that after the period indicated the day's work shall on Saturday terminate at noon, making the working hours 53 per week instead of 54 as at present. It is understood that a meeting between the employers and the representatives of the men will be held in the course of a few days to discuss these questions of wages and working hours.

THE TIMBER TRADE.—Importations having for some time past almost entirely ceased, quietude now characterises this branch of business, and until the beginning of June no change in the direction of greater activity need be looked for. In the sawmills, however, there is a good deal doing, requirements for shipbuilding and housebuilding purposes being unusually large.

GLASS WORKS.—At the flint glass works the lull which usually follows the holiday period is now very generally felt, and the demand having declined, production has to a proportionate extent been restricted. In the plate glass works activity is still the feature, and bottle works are also very busy.

THE COAL TRADE.—The shipments of coal and coke at Tyne Dock for the week ending January 11th amounted to 101,918 tons, being an increase of 2,845 tons as compared with the shipments for the corresponding week last year.

DUNDEE, 15TH JANUARY, 1890.

JUTE AND FLAX TRADES.—The year has opened rather hopefully so far as the staple industries of this district are concerned. Prices of raw jute have, during the fortnight, tended against buyers, and there is a good demand for dock lots and near at hand parcels. Jute yarns are firmly held, but buyers are not operating largely. In the New York market burlaps are quoted ⅛c. above recent prices. Sacking and bagging are quiet, and tarpaulin is somewhat firmer. In consequence of an advance in the Russian Exchange there has been a rise in the price of flax. Stocks being low the shipment demand is good, but prices tend to restrict business. Flax and tow yarns have been rather easy. For linens some good American orders are reported, and manufacturers are well employed. There is more inquiry for sailcloth, and prices are firm.

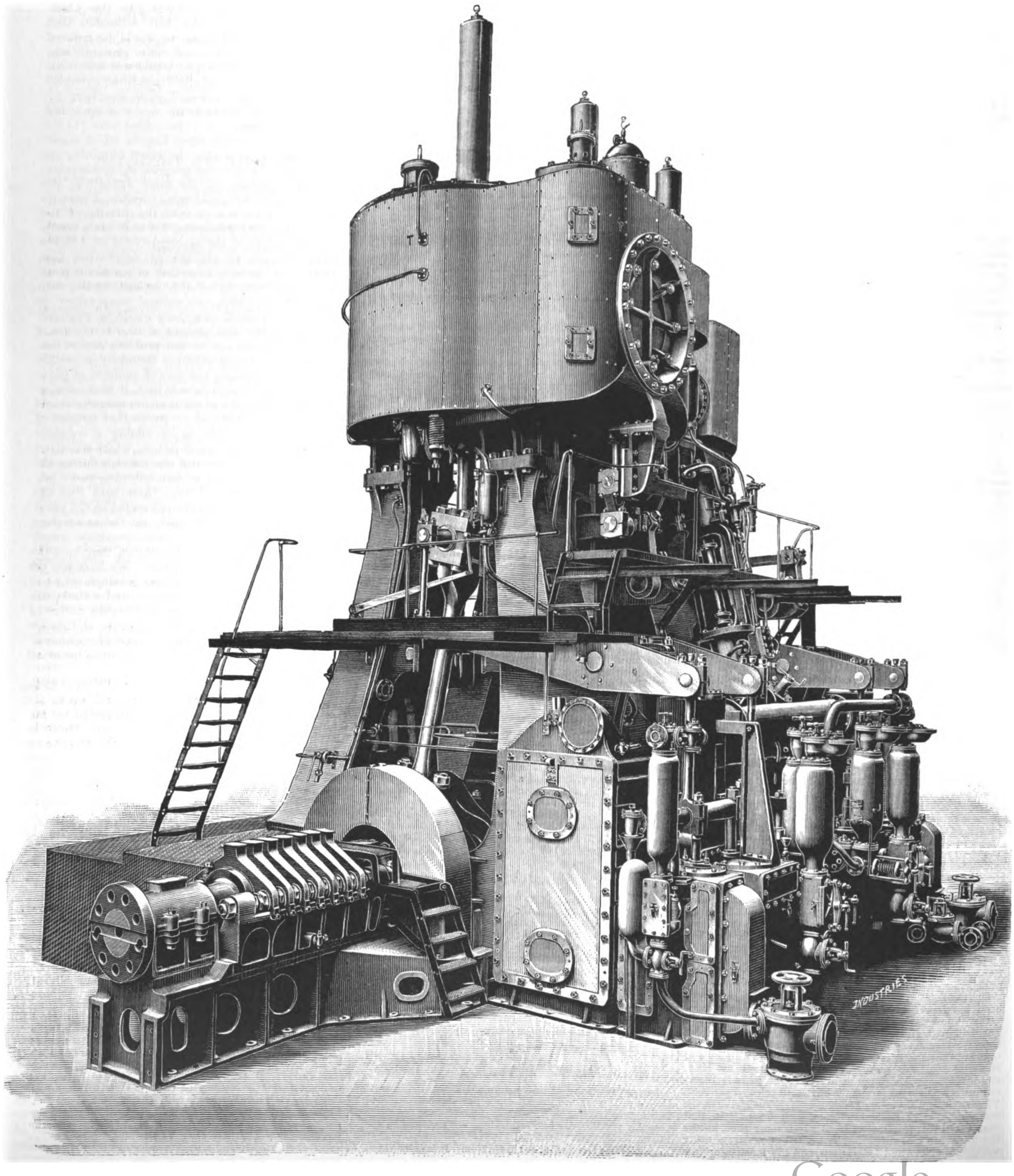
LIMITED LIABILITY COMPANIES.—Statistics published with reference to limited liability companies which have their headquarters at Dundee indicate that business during 1889 has been fairly prosperous. Five of the principal shipping companies, with a paid-up capital of which the par value is £500,325, showed at the close of 1888 a market value of £415,403. The market value at the close of 1889 was £435,050, an increase of £20,000. Nineteen finance and investment companies showed a fall in the market value of 2 per cent. during the year; but notwithstanding this fall the market price is still 50 per cent. above par. Eight cattle companies, with a paid-up capital of which the par value at the close of 1888 was £2,070,076, and the market value £394,456, show at the close of 1889 a par value of £1,925,210 and a market value of £381,715.

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TRIPLE EXPANSION ENGINES OF THE S.S. "STUTTGART."

CONSTRUCTED BY THE FAIRFIELD SHIPBUILDING AND ENGINEERING COMPANY, GOVAN, GLASGOW.

(*For description see page* 52.)



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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

Contents.

	PAGE
The Progress of Electrical Engineering in 1889	49
The Progress of Chemical Industry in 1889	50
Kuhlmann's Testing Machines (*Illus.*)	52
The Engines of the s.s. "Stuttgart" (*Illus.*)	52
Foreign Industries (Corres.)	54-55
The Manchester Association of Engineers	56
Notices of Meetings	57
Prices Current	57
Foreign Telegraphic Advices (Corres.)	57
Home Industries (Corres.)	58-59
The Duration of Our Coal Supply	61
Hours of Labour and Wages in the Paper Trade	62
Notes on Patents. I.—Rights of Employer and Workman	62
Coal, Iron, and Cognate Industries	63
The Royal Institution Lectures for Juveniles	63
The late Mr. Daniel Adamson (*Illus.*)	63
Letters to the Editor:—	
The Marking of Goods	63
Improved Chair and Sleeper	63
Steam Boiler Legislation	63
The Engines of the s.s. "Friesland" (*Illus.*)	64
Messrs. Mather & Platt's Alternate Current Dynamo (*Illus.*)	64
The Verity "Silent" Air Propeller (*Illus.*)	65
The Institution of Electrical Engineers (*Illus.*)	66
The Society of Chemical Industry	67
Notes	68
"Industries" Patent Record:—	
Applications, and Acceptances	69-70
Illustrated Abridgments	70-72

To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

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Industries:

FRIDAY, 17TH JANUARY, 1890.

THE DURATION OF OUR COAL SUPPLY.

IT is now almost a quarter of a century since Professor Jevons issued his book on "The Coal Question," and created so much interest on the subject that a Royal Commission was appointed to investigate it. Since that date our manufactures and population have gone on increasing, and it is necessary that the subject should be kept in mind, and that we should occasionally take stock of our coal supply, in order that we may anticipate, to a certain extent at least, the probable social and political consequences to ourselves and to the world of a partial exhaustion of our mines. Professor Jevons felt that these must be of an untoward, if not of a ruinous, character, and he wrote some solemn words of warning on the subject. He pointed out that, in the application of our Free Trade principles to our great national resources, we required to exercise great caution, for, while to part in trade with the surplus yearly interest of the soil may be unalloyed gain, to dispense so lavishly the cream of our industrial wealth is to be spendthrifts of our capital, as we part with that which will never come back. He reminded us of what is too often forgotten, viz., that after all commerce is but a means to an end—the diffusion of civilisation and wealth, and that to allow commerce to proceed until the source of civilisation is weakened and overturned is like killing the goose to get the golden eggs. He asked, moreover, the following momentous questions: Is the immediate creation of wealth to be our only object? Are the excellencies of Britain to be measured in tons and quarters, and our work in the world to be recorded only in her Custom House books? Have we not hereditary possessions in our just laws, our free and nobly developed constitution, our rich literature and philosophy, incomparably above material wealth, and which we are beyond all things bound to maintain, improve, and hand down in safety? And do we accomplish this duty in encouraging a growth of industry which must prove unstable, and perhaps involve all things in its fall? He came to the conclusion that the alternatives before us were simple. Our empire and race already comprise one-fifth of the world's population, and by our plantation of new States, by our guardianship of the seas, by our penetrating commerce, by the example of our just laws and firm constitution, and, above all, by the dissemination of our new arts, we stimulate the progress of mankind in a degree not to be measured. If we lavishly and boldly push forward in the creation and distribution of our riches, it is hard to over-estimate the pitch of beneficial influence to which we may attain in the present. But Professor Jevons was of opinion that the maintenance of such a position is physically impossible, and that we have to make the momentous choice between brief greatness and long-continued mediocrity. Neither of these alternatives was very pleasant to contemplate, and, in order that definite information might be obtained on the subject, a Royal Commission was appointed to investigate the whole question. Professor Jevons had estimated that in about one hundred years we would be reduced to sore straits for coal, and this prospect was sufficient to justify the alarm which was felt about the matter. The work of the Commission extended over five years, and embraced most searching inquiries into every department of the subject, but the two main questions to be solved were (1) the quantity of coal within these islands which might fairly be considered within the reach of mining appliances; (2) the rate and progress of consumption. This latter question was the more difficult of the two, as it involved a considerable number of assumptions. We need not go into the details of the figures of the Commissioners, but may state briefly that they estimated the aggregate total of 146,480 millions of tons as available at depths less than 4,000ft. At the same time they indicated the possibility of our working at still greater depths, even to 6,000ft., at which the natural temperature is 150° Fahr., in which case there would be rendered available an additional amount of 29,000 millions of tons. The calculation of the probable rate of consumption the Commissioners founded on certain assumptions regarding the rate of increase of population, and the result showed that, if that assumption were correct, the whole available quantity would be exhausted in 360 years. By another method of calculation—that is, by simply adding a constant quantity, namely, three million tons, which was about the average annual value of the increase during the previous fourteen years, to each following year's production—they computed from these data that the total supply of coal would be exhausted in 276 years. A third calculation was made on the assumption that the population would remain constant, simply oscillating without advancing, and in that case the coal would last over 1,200 years. We have not yet reached such a state of mental development as to justify this Spencerian assumption, and without this development it does not seem to be in the nature of the British people so to limit the rate of increase as practically to balance the decrease of population. The last calculation may, therefore, for all practical purposes be left out of account.

It is interesting to note how far the conclusions of the Commissioners have been verified up to the present time. This was recently attempted by Mr. Hall, one of Her Majesty's Inspectors of Mines, in his inaugural address as President of the Manchester Geological Society, and we will now proceed to quote a few of his figures and conclusions. The calculation of the Commissioners based on population he admits is difficult to follow, but, taking the various items into account, we must deduct at least 10 per cent. from the time named by them, which on the whole is not a very serious correction. By the second method of calculation, that of adding a constant quantity of three millions of tons to each year's production or consumption since 1869, in which year the coal raised amounted to 107 millions of tons—on this basis the production of 1888 works out to 164 millions of tons, and the actual statistics for 1888 show it to be 170 millions, which proves that the calculation of the Commissioners is only a little over three per cent. from the truth. But during the last ten years the average increase has been about four millions of tons per annum, and if we take this as what is likely to continue, then of course we must considerably reduce the time the coal fields are estimated to last. Whether it will continue is, however, a matter of speculation. Surely it is not beyond the bounds of possibility that other sources of energy besides that stored up in our coal fields may be taken advantage of. The applications of electricity, especially in the transmission of energy, open up great possibilities for the utilisation

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of wind and water power, and even possibly of chemical combinations which are at present utterly unknown to us. It may stimulate ingenuity if we clearly realise the position we are in, and have an idea of what store of coal is actually within our reach. Mr. Hall does not think that with our present appliances we can depend on working at the greatest depths mentioned by the Commissioners. The temperature, calculated upon an increase of one degree for every sixty feet, he finds to be under the mark, and that at 4,000 feet the temperature would be actually 130° Fahr. This, of course, can be reduced somewhat by efficient systems of ventilation, but the majority of workers find it distressingly hot while working in a temperature of 80 degrees. Mr. Hall therefore concludes that, with our present knowledge and appliances—which, however, must not be considered incapable of extension and improvement—that when temperature due to depth reaches 100° Fahr., coal cannot be worked except at a very great expense, if at all. The question of cost of production as compared with that in other countries will probably be the factor which will have the most effect on our coal production, for as foreign countries develop their resources and reduce their cost, while our resources are gradually being exhausted and the cost of production increasing, naturally our foreign trade will diminish, and with swift steamers it might even pay to import coal. Mr. Hall gives some figures to show that many foreign countries are reducing the cost of production per ton to very nearly our figure. With us there has been an increase of about 9d. per ton since 1869, an increase which seems to be due to higher payments for labour, but whether for higher wages, or to more labour being required by deeper mining, is not made quite clear, although it is probably due to both of these causes.

It is pretty evident that we cannot safely calculate on our coal fields lasting more than 200 years at the most. This may seen a long period, and sufficiently far distant to relieve our statesmen of all responsibility in the matter, but that is not so. We have accumulated an immense national debt; our industrial prosperity has encouraged the growth of population to a great extent, and made us dependent for a great part of our food supply on foreign sources; and these and other reasons compel us to depend on our industries. In the intervening 200 years we have time to put our house in order, and make arrangements for a changed set of conditions. If our statesmen are wise, they will draw our Colonies into closer connection with the mother country, and gradually we will find that the resources of those will make up for our deficiencies, and that we shall have a much more powerful Empire than we have at present, although the centre of gravity of its trade and industry may have shifted in the direction of the new countries, while the old may have become the centre of a higher culture in every department of literature, science, and art.

HOURS OF LABOUR AND WAGES IN THE PAPER TRADE.

Notwithstanding the strikes and other difficulties which have occurred recently—possibly in consequence of them—there are many signs that we are rapidly approaching a time when the relations of capital and labour, and all disputes between employers and employed, will be settled by friendly conference or by arbitration, or even possibly when these will be rendered unnecessary by a system of profit-sharing or co-operation which will give workmen a sufficient voice in the management to prevent all misunderstanding. Before such a system, however, can be entirely successful, there must be more attention paid to economic and social science in our schools and colleges, so that the different parties may be able to realise all the bearings of the subject, and not simply look upon it from their own individual, and therefore selfish, point of view. It is for this reason that we have in all discussions on technical education endeavoured to place it on a wider basis than is usual, so that it may not only fit masters and workers to apply science and art to their trades and professions, but also enable them to see how these are co-related to the social and economic aspects of their mutual interests. Those who are engaged in any department of industry will, we think, be willing to admit that their greatest difficulties do not arise on the scientific or technical side of their work, but on the economic, and, as we have often pointed out, the one-sided technical education which is now given is apt to intensify the evils from which we are suffering. From the elementary school to the university, the chief lesson which the students learn is to look after their own personal interests, without regard to the welfare of their neighbours or the consequences to society, and hence it is that our material progress has far outrun our social and moral, and brought us face to face with the serious problems which are now puzzling statesmen and philanthropists. As we have said, there are signs of improvement, but, like many other advances we have made, we are to a large extent blundering on to a better state of matters through the expensive school of trial and error instead of deliberately preparing those who are to take part in the struggle by a system of education which would fit them to appreciate the arguments and positions taken by each party, and not simply intensify that selfishness which is the root of many of our difficulties.

The special case to which we wish to direct attention is that of the papermakers in Scotland. A meeting of the master papermakers was recently held in Edinburgh, for the purpose of considering a circular which they had received from their workmen, requesting an abatement in the hours of labour, and desiring that they should stop work on Saturday at two p.m. instead of what had been the practice previously in their various mills. Not only was the request of the workmen agreed to as far as is at present possible, but, what was of much more importance, the spirit displayed by the great majority of the employers augured well for the harmony of their future relations with their workmen. Mr. John James Cowan, of Pennycuik, moved, "That the master papermakers of Scotland, having considered the memorial from their workpeople, received by them individually, express sympathy with the desire for shorter hours therein contained, and trust that the kindly and sympathetic relations which have existed between employers and employed in the past may continue." Mr. Cowan pointed out the great agitation which was everywhere being carried on in the labour world, and dwelt on the necessity for them doing all in their power to promote the good feeling which had hitherto existed between employers and employed; and he was supported by the large majority of the employers, and a considerable reduction of working hours was arranged for, although not to the full extent asked for by the men. At the same time it was unanimously agreed that the workmen's request was reasonable, and that all efforts be employed to meet their wishes, as soon as the arrangements at the different mills would allow it. That this will soon be done may be inferred from the further resolution, which was carried unanimously. This resolution stated, "That with a view to the speedy and effectual carrying out of the above, the master papermakers agree to unite with their workpeople in a trade organisation, and appoint a committee to take such action as may be needed to carry this into effect." This again is a step in the direction which we have advocated. Combinations of masters and trades unions must, we are afraid, at least for a considerable time, remain practically as they are. But there ought to be an intermediate body, composed of representatives of both, which would meet occasionally for the arrangement of all matters of dispute. By a process of evolution we would have ultimately a real Trades Guild, which would look after the interests of all concerned in it, whether employers or employed. In fact, it might gradually lead to the abolition of the distinction between these two classes, by giving all an interest in the success of the works, and virtually making them all employers. The masters are beginning to get over the feeling that it is beneath their dignity to sit in council with their men in many departments of industry. In the Scotch paper trade the employers had almost always been on terms of very close intimacy with their workpeople, but even in it are to be found a few who look upon an organisation between masters and men as impossible, and one of these spoke at the meeting, but he found himself in a very small minority. It was pointed out that if the interests of capital and labour were one, what they had to do was for both parties to exercise forbearance, and that the best way was to cultivate relations of friendship with their men, and treat them as their equals. Mr. John Cowan, of Beesluck, who is one of the oldest papermakers in Scotland, referred to the long experience he had had of the relations between masters and men in the papermaking trade, and said that from his boyhood one of the duties he had been taught was to mingle with their people, and to come to a knowledge of them in their houses in all their circumstances, and he added that he had more true and faithful friends among the working classes than in any class in society. Mr. Cowan is a representative of a former generation, but we are glad to see that all classes of society are beginning to recognise the truth of what Carlyle dwelt upon many years ago, that a cash payment is not in itself a sufficient discharge of the duty of employers—a little human feeling will go far to smooth over difficulties and prevent disputes, and we trust that the example of the Scotch papermakers will be widely followed.

NOTES ON PATENTS.

I.

RIGHTS OF EMPLOYER AND WORKMAN.

In the ordinary course of business one has frequently to study the relations between employer and employed. Although they necessarily have common interests, and their prosperity is affected by the same causes, yet it often happens that there is friction between them, arising in many cases from a want of consideration of one party for the other. Not infrequently they quarrel over the matter of a patent. In connection with this the question is often asked, Has an employer any legal right to the inventions of his workmen? It seems established law that *a master has not, by the mere contract of workmanship, any right to the inventions of his workmen.*

Employers entertain very different views in respect of the justice of this rule. Some consider it a great hardship that they are not entitled to the inventions of their workmen. To formulate the employer's "grievance," it amounts to this:—"My man made the invention while in my employment; he probably used my tools and machinery, and the invention was suggested to him by the work on which he was engaged." Some employers feel still further aggrieved when they find out that a patent has been applied for without their concurrence. They entertain a feeling that they have been overreached in the matter. If it were possible to analyse this feeling it would be found that these employers are acutely sensitive on the question of their authority. Letters Patent, in fact, give the workman certain rights against the whole world which raise him from a position of subserviency.

The workman, on his part, thinks it very hard that he is not allowed to have the full benefit of his invention, and that there should be the least hindrance to his obtaining the reward for his invention. Workmen, however, have frequently to consider whether their patenting an invention would cause any annoyance. This is not mere sentiment. We have known the case of a man losing his employment when he told his employer that he had taken out a patent for an arrangement. Two or three instances have come before our notice where employers have said, "We don't allow our workmen to take out patents!"

We have briefly stated the views entertained by employers and workmen when they have disagreed on this matter. In the majority of cases the parties agree on the subject, not from there being an actual contract between them, but from mutual interest. In several works a premium is given to the workman who makes any invention. In many cases, however, there is an actual contract entered into when the workman comes into the service of the employer. We have seen contracts where the whole of the inventions of the workmen belong to the employer. We have also seen cases where, in the event of an invention by a workman, the employer is merely to have a free licence. Where the employer by express contract becomes entitled to the invention, the patent must be applied for by the inventor. By the Patent Act of 1883, it is provided that any other person can apply for the patent jointly with the inventor. Nothing is more simple than that there should be an agreement between the employer and workman as to inventions. In drafting such an agreement great care should be exercised. It must be so drawn as not to stifle the inventive genius of the workman. The employer might with fairness have a licence, free from royalty, to use any invention made during the service of the man in his works. The man, we think, ought to have free disposal of the patent, subject to this exception. The agreement ought not to be too severe, as that would stifle the invention, or cause the inventor to evade the contract. An agreement properly made, taking into consideration the rights of employer and workman, is most likely to work to the interest of both. The suggested agreement would, of course, not be applicable where the employé is specifically employed for the purpose of making inventions. For instance, in large chemical works, sometimes five or six chemists are employed with the express purpose of experimenting. They are paid for making the experiments, and the results of their investigation naturally belong to the employer.

It may be worthy of notice that the Crown had, before the Patent Act of 1883, the right to use the invention of the subject, and even now inventors in the "services" have to obtain leave to patent their inventions.

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Up to the present we have been considering the inventions of the workman, and the employer's rights with relation thereto.

This must not be confused with the employer's inventions on which he may instruct his workman. It seems settled law that an inventor can obtain assistance to develop and bring his invention to perfection. It not infrequently happens that when an assistant is working out his principal's ideas, he not merely develops, but introduces some discovery of his own. It becomes then a very nice question as to whether he should join in applying for the Letters Patent. If it be a mere development, the inventor can fairly include it in his own invention. If the development constitutes a new departure, it would be certainly safer for the patent to be applied for in the names of the inventor and his assistant. The principal would, however, be most imprudent in adopting this course, unless a written agreement was drawn up, regulating their rights when the patent is granted.

The rights of co-patentees and co-owners of patents form the most unsettled branch of our patent law.

COAL, IRON, AND COGNATE INDUSTRIES.

The Board of Trade returns, of which we give some particulars herewith, are now published for the month of December and for the twelve months then ended. At the commencement of a new year and of a new decade —and that the last of the present century—some retrospect is desirable. We have already bestowed some considerable space to statistical and commercial summaries, and, except so far as our usual *résumé* of the Board of Trade returns is concerned, this article will be confined to a consideration of the "tone" of the markets in the various centres of the industries under review. The value of the imports for the month of December was £38,267,934, being an increase of about one per cent. on the total of December, 1888. The aggregate value for the past year was £427,210,839, being an increase of £39,575,096 as compared with 1888. The value of the exports for the month of December was £20,903,353, being an increase of 11 per cent. on the total of December, 1888. The aggregate value for the past year was £248,091,959, being an increase of £14,249,352 as compared with 1888. It may be noted that the figures for both imports and exports are higher than have hitherto been reached. The quantities of iron and steel exported during December and during the year show an increase, as compared with 1888, of 19,543 tons and 221,825 tons respectively, the values showing an increase of £141,364 and £2,736,735 respectively. With regard to the year's trading, it may be remarked that there has been an appreciable increase in our exports of raw iron to Germany, Holland, and Russia, and of railroad iron to Mexico, while under this latter head a heavy falling off is noticeable in our business with Japan and the United States, and there has also been a large decrease in the case of bar and angle iron with British East Indies and British North America. We utilise our tabular statement for a comparison of the aggregate exports for the past three years:—

	1889.	1888.	1887.
Pig and puddled	£2,987,546	£2,206,373	£2,741,507
Bar, angle, &c.	1,624,403	1,658,308	1,447,977
Railroad.....	5,339,304	4,669,215	4,617,460
Steel, unwrought	1,700,963	1,572,754	2,094,454
Coal.....	14,793,655	11,345,299	10,176,402

Turning to the home markets, we find a condition of things more satisfactory than has presented itself for some fifteen years. The revival which commenced in the latter half of 1888 has proceeded with leaps and bounds. At each of the quarterly meetings held during the year prices of finished iron and the crude metal have been advanced, and materials of all descriptions have partaken of the improvement. Scotch warrants, which in January were selling at about 44s., have this month reached 66s. Middlesbrough warrants have risen during the same period from 33s. 6d. to 65s. 6d., hematites from 45s. 6d. to 80s. Common bars have advanced from about £5 10s. per ton to £9 10s. per ton, steel rails from £4 10s. to £8 10s., and all through the category similar improvement in values can be recorded. There can be no doubt that works which were formerly entirely unremunerative to, or actually carried on at a loss by, their proprietors are now paying well. Others that succumbed to the pressure of the times have been re-started and reorganised. The shares of all public companies connected with these industries have greatly risen in price. On the crest of the wave of prosperity many private concerns have been launched under the Limited Liability Acts. The record of 1889 bears testimony to the inherent vitality in apparently moribund industries, and deals a severe blow to the pessimism of 1888. It is a remarkable fact that this change has been brought about by the adjustment of the laws of supply and demand rather than by the adoption of all or any of the panacea of trade faddists.

As is only just and right under the circumstances, the labour market has participated to the full in the improvement in trade. Since October, 1888, colliers' wages have been advanced 30 per cent., and those of ironworkers and blast furnacemen in proportion. We leave for a further article the consideration of future prospects.

THE LATE MR. DANIEL ADAMSON.

It is with great regret that we announce the death of Mr. Daniel Adamson, which took place at his residence, at Didsbury, near Manchester, on Monday, the 13th inst. It is not often that an engineer's name becomes a household word, or that the average citizen is cognisant of the standing of a technical or scientific man. But this was a distinction which was awarded to Mr. Adamson, especially in the north of England, and not so much from his brilliant inventions or high mental abilities as from his desire to benefit the world in general by overcoming natural surrounding difficulties. Of course this popularity was due to a large extent to the devotion which he showed towards the fortunes of the Manchester Ship Canal in its early days, but in other circles his reputation was made by the excellence of the boiler and other engineering work which he undertook. The practical introduction and commercial success of the modern methods of steel making were due, to a large extent, to the enterprise and courage of Mr. Adamson, as he was, we believe, the first to adopt Bessemer steel in the construction of steam boilers. Mr. Adamson has



always followed the developments of steel manufacture with characteristic energy and enthusiasm, and his services in that direction have been recognised on all hands, from Sir Henry Bessemer to the youngest member of the Iron and Steel Institute. Mr. Adamson only resigned the Presidentship of the Iron and Steel Institute a year ago, and he held a prominent position in several other societies.

It will be of interest to follow briefly the fortunes of Mr. Adamson from his youth upwards, in order to see by what steps a man of ability may rise from insignificance into a distinguished position. He was born in 1820 at Shildon, in Durham, and at an early age was apprenticed to Mr. Timothy Hackworth, of the Stockton and Darlington Railway, who was the first of a gradually lengthening list of locomotive superintendents, and a notable figure in early locomotive history. After a time he was appointed engineering manager of that railway, and in 1850 he left Durham to become general manager of the Heaton Foundry, Stockport. Shortly afterwards he started a works of his own at Newton, but soon removed to more extensive premises at Hyde, in Cheshire. Since that time the firm which he established, and now known as Daniel Adamson & Co., has rapidly increased in importance, and at present it is one of the largest establishments of the kind in England.

Mr. Adamson has in his time introduced many improvements in engineering practice. In 1862 he patented a special machine for drilling holes in boiler plates instead of punching them, and about the same time he adopted what is now known as the Adamson flange seam for the furnaces of internally fired boilers with the view of preventing their collapse.

In 1882 he commenced the agitation in favour of the construction of a ship canal for Manchester, and by his energies he aroused the interest of the population of Lancashire, and the burden of sustaining the Parliamentary inquiry practically rested with him alone at one period of the long and anxious struggle. After his efforts had been crowned with success the floating of the company by the aid of Messrs. Rothschilds was unfortunately attended with failure, and in the re-modelling of the board of directors and of the plans of the company Mr. Adamson felt himself compelled to withdraw. Since that time the ship canal has gone on satisfactorily, and all difficulties have been overcome, but the inception and the initial success was after all due to Mr. Adamson, who will be long remembered as a distinguished engineer of remarkable energy and inventive capacity, and in Lancashire, at least, as a high spirited benefactor in the public interest.

We give herewith a portrait of Mr. Adamson, which has been reproduced from a photograph taken by Messrs. Elliott & Fry.

Letters to the Editor.

IMPROVED CHAIR AND SLEEPER.

To the Editor of "Industries."

Sir,—Referring to the illustrated description given in your issue of last week of our improved chair and sleeper, permit me to point out that the new sleepers have been in use with ordinary chairs for two years on the North Stafford Railway at Stoke-on-Trent, and have given great satisfaction. In proof of this, I may add that we have received a large order this week from the same company.

Yours, &c.
(For the Chair and Sleeper Company, Limited),
J. W. White.

Widnes, January 15th, 1890.

STEAM BOILER LEGISLATION.

To the Editor of "Industries."

Sir,—The facts given in your leader on steam boiler legislation are calculated to cause some alarm among outsiders. The risk of a boiler explosion affects not only the owner of the same, but his neighbours. An idea has been prevalent that if a boiler was insured this was a guarantee against accidents happening. This, however, appears not to be the case. As a matter of business policy, most persons would think that a company insuring a boiler would make it compulsory that the owner should adopt such measures as the company's inspector considered necessary for its safety. You state that this is contrary to the companies' policies, but this appears to be a very bad principle to work upon economically. It follows that even if an inspector announces that a boiler will blow up after another day's use, that his employers are liable to pay the insurance on it if the owner chooses to risk continuing it at work. I understand that several boiler insurance companies have come to grief of late, and such regulations as these suffice to account for this result. A fire insurance company bases its premiums on the risks run by the property insured, and the same would be a good policy in the case of boiler insurance companies. If it be considered advisable to retain the clause you mention, namely, that the insured are under no obligation to adopt any suggestions in the insurance company's report, it would only be judicious to insist, if the advice given was not followed, that the premium should be higher than for new boilers which required no stipulations.

The "Charlesworth" boiler was fifteen or sixteen years old when it burst. During that time it had never been thoroughly examined, but after a preliminary and apparently superficial examination a policy was granted upon it. In the interests of the shareholders of the company no policy should be issued without a complete inspection. I gather from your remarks that the action of the Engine, Boiler, and Employers' Liability Insurance Company is not exceptional, but if this be the case the whole system is radically wrong.

Under these circumstances a boiler insurance company proceeds on the lines of a life assurance company. The latter does not guarantee the life of the assured, and the former does not pay any attention to the prospects of the life of the boiler. A distinction exists in the fact that the life office regulates its terms by the health of the man insuring, whereas the boiler office charges the same price for a good or bad boiler. In fire offices, the sensible plan also prevails of charging premiums according to the risks.

The utility of a boiler insurance company would be mostly evident if it would undertake that no explosion would take place with any boiler under its auspices. Railway collisions and some other engineering mishaps are unavoidable, but there is no reason whatever why any boiler should explode. All that is necessary is that it should be in good condition and under proper control. Neither of these qualifications should be difficult to attain.

Yours, &c.,
Policy.

London, 13th January, 1890.

To the Editor of "Industries."

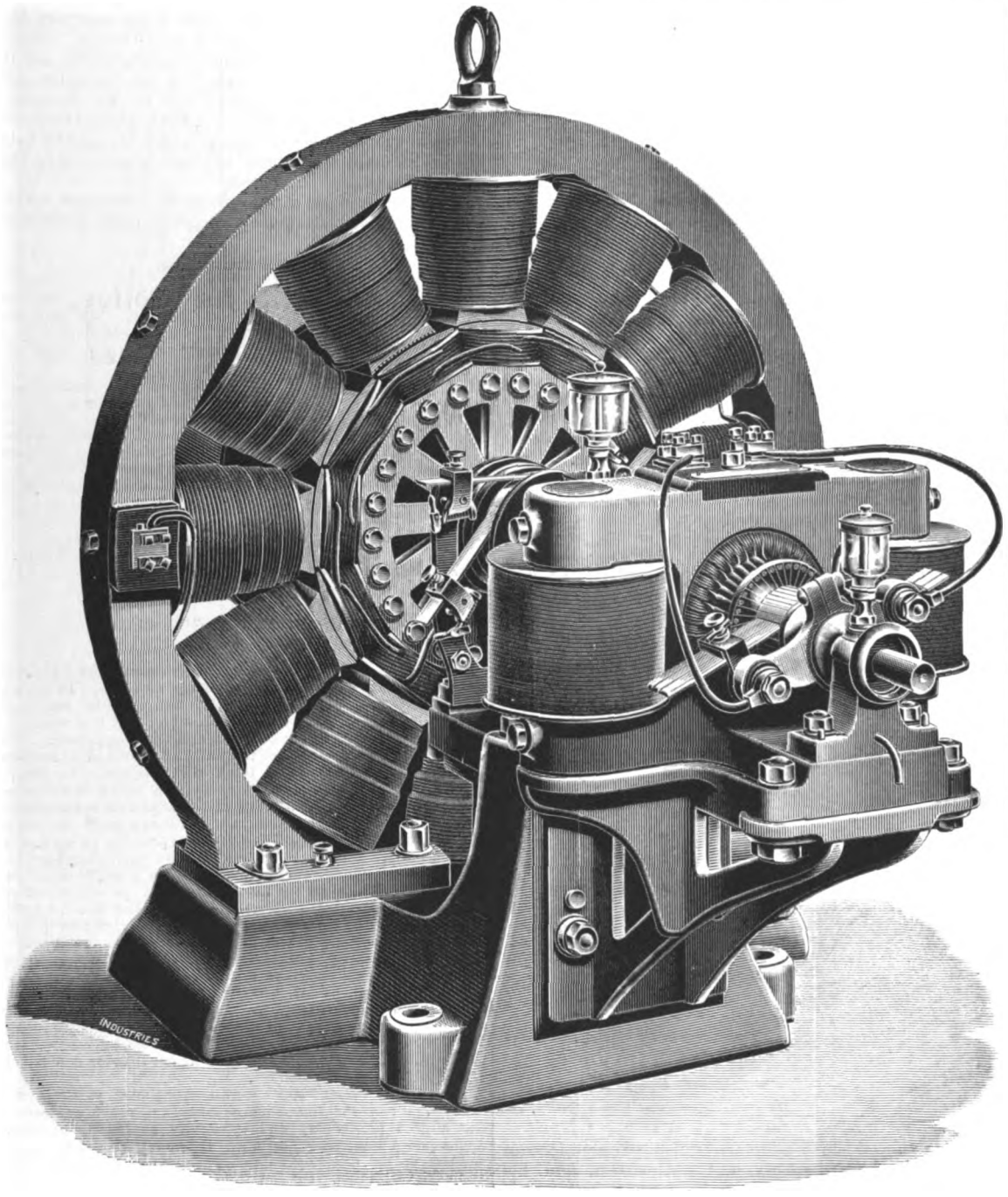
Sir,—I have read with pleasure your valuable article in your issue of last week on the above subject, and though I do not entirely agree with all it contains, I think it an admirable and opportune warning to steam users generally. Something must be done to keep down these disastrous explosions, and if steam users will not take warning and adopt means to reduce the number of explosions, someone else will, and then it will be too late either to attempt milder measures or to complain of the inconveniences attending Government interference.

I would here point out that you are in error in stating that only "three formal investigations have been held." Seven have been held to my certain knowledge. The "Charlesworth" and the "Development" cases, being fresh to the memories of your

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ALTERNATE CURRENT DYNAMO.

CONSTRUCTED BY MESSRS. MATHER & PLATT, SALFORD IRONWORKS, MANCHESTER.



readers, have not yet been formally reported on, while four other cases have—the reports of which are now before me. The first formal investigation was held in connection with No. 254 explosion, at Broxmoor, Staffordshire, in which case no penalty was imposed. The next was No. 355, in connection with an explosion on a fishing boat of Yarmouth, where the owner was fined or "ordered to pay" £20 for acts of his agents. The case was briefly as follows: The owner was advised to put in a new boiler by an inspecting engineer, but did not follow the advice. The foreman, however, knew that the skipper systematically wedged down the safety valve. The inspecting engineer was practically censured for his imperfect examinations, and for not remonstrating with the skipper for wedging down the valve. The next was No. 361, when a forge boiler exploded at Wallsend-on-Tyne, the owner being ordered to pay £50. The next is No. 367, at an iron foundry at Bromley-by-Bow, in which case the owner was ordered to pay £40, after promising to pay at least £100 to a youth who had lost his sight through the explosion. The other case, not yet reported, is that of a steam wherry at Newcastle-on-Tyne, where the owner was fined £65. In this case it would appear that one insurance company actually refused to insure the boiler on account of the weak firebox, which was said to be distorted and collapsed in four places. Another company was then called in who insured it, even in this condition. The latter company is now, I am informed, defunct; but does it not point to a very unhealthy state of things in boiler insurance competition? Would not a monopoly, with all its faults, be better than such a state of things?

Now, Sir, it is all very well to think these salutary lessons will eventually have a bearing on the minds of steam users; but how many steam users are there who hear about them? When the leading engineering journals of the day do not know of them, how can outsiders be expected to hear of them? An explosion occurs, all within sound hear of it, an investigation is held and reported in local papers. Then a few days elapse and all is over. Would not a more public announcement be of some use?

With respect to the inertness of the Board of Trade in these investigations, I would just remark that when the Act of 1882 was passed, it instituted an entirely new department and new work for the people who had to investigate these explosions, and, however skilful and experienced as marine engineers the Board of Trade surveyors may have been, they were at that time certainly unsuited for the work. But are the present reports of inquiries what they were then? Have they not gained experience since 1882, and shown that they have confidence to say who is the guilty party? The present condition of things is what has been asked for by many men in this district, namely, a proper use of the Act of 1882, and if it will not waken steam users to a sense of responsibility, their slumbering will assuredly strengthen the hands of those who intend to put in action that drastic legislation so much dreaded. I hope that the matter may be taken up by an abler and freer pen.

Yours, &c.,

S. BOSWELL.

Manchester, 13th January, 1890.

THE ENGINES OF THE S.S. "FRIESLAND."

As promised last week, we now give some further particulars of the engines of the s.s. "Friesland," which were illustrated in our issues of July 17th, 1889, and the 10th inst. The cylinders are 35½in., 56in., and 89in. in diameter respectively, and the stroke is 4ft. 6in. They are supported on massive cast iron columns at both front and back. The high and intermediate cylinders have piston-valves, while the low-pressure has a slide valve, the valve gear being the ordinary link motion. For stopping and reversing a Brown's steam and hydraulic starting engine is provided. The condenser is of the ordinary box type, having 8,000 sq. ft. of cooling surface, and a vacuum of 29in. was maintained when the engines were running full speed, and indicating about about 5,000 i.h.p. The air pumps, two in number, are worked from the H.P. and L.P. cross-heads respectively by the usual rocking arms and links, and are fitted with Kinghorn's patent valves. Two of Gwynne's centrifugal pumps circulate the water through the condenser, each of them being capable of doing the whole work. Weir's feed-pumps and heater are fitted, and also an evaporator by the same firm for supplying the boilers with fresh water, to make up the various losses which occur. An auxiliary condenser of 750 sq. ft. cooling surface is provided, into which the drains from steam heating pipes, galleys, &c., are led, thus saving the loss of a considerable amount of fresh water. The circulating water is supplied by a 5in. Gwynne's centrifugal pump. Steam is supplied by three double-ended and one single-ended boiler, having twenty-one furnaces in all, and working at 160lb. pressure. Though not worked on the forced draught system under air pressure, the boilers are entirely dependent for their air supply on four large double-breasted fans. This method enables steam to be maintained as steadily in hot calm weather as at other times; the discharge from the fans is so arranged as to give an even distribution of air over the whole stokehold.

For the steam trials, which took place in the last week in November, the ship was brought down by means of cargo and water ballast to her seagoing trim, and the speed obtained under these conditions was as follows:—Mean of six runs on measured mile, equal to 14·76 knots, the mean revolutions being 74 per minute. Then, on a continuous run of 12 hours' duration, the mean revolutions were 72·5 per minute, corresponding to a speed of 14½ knots. During the run the i.h.p. was 4,700, and the total coal consumed was 40 tons of Scotch coal.

On the first outward voyage from Antwerp to New York the weather was exceptionally severe, so that nothing in the shape of a record passage could be attempted; but on the homeward run the distance from Sandyhook to Flushing was accomplished in 9 days 13 hours 50 minutes, or at a mean speed of 14·3 knots per hour, thus making the fastest passage on record between these two ports.

MESSRS. MATHER & PLATT'S ALTERNATE CURRENT DYNAMO.

MESSRS. MATHER & PLATT, of the Salford Ironworks, Manchester, are now manufacturing an alternate current dynamo, which embodies several new features, and has given very satisfactory results in practice. As is the case with most alternate current machines in which the armature contains iron cores, the armature revolves and the magnets are fixed. The magnets are of wrought iron, and are arranged round the armature, exterior to it, and are attached to a massive cast iron ring which forms the yoke connecting the limbs. The attachment is so arranged that any of the magnet cores can be removed without disturbing the remainder or taking out the armature. The armature is constructed of two plates or discs keyed on the shaft, between which the armature cores are held by bolts. As with the magnets, any section of the armature can be removed without disturbing the remainder. Apertures in the discs allow free ventilation of the armature cores.

The magnets are excited by a Mather & Platt's "Manchester" dynamo, which is carried on a bracket bolted to the bedplate of the alternator, the armature shafts being coupled direct. The whole arrangement is exceedingly compact, occupying little floor space. The machines are manufactured under the patents of Dr. John Hopkinson and Dr. Edward Hopkinson, and are made in several standard sizes up to 100 Board of Trade units. For working with transformers they are constructed either for 1,000 or 2,000 volts, and from 8,000 to 12,000 alternations per minute, or with a "periodicity" of from 66 to 100. The machines can be run in parallel perfectly, and may be thrown into parallel working without the least danger, even when there is considerable difference between the electromotive forces at the terminals or when the machines are running at different speeds.

The machine illustrated is for an output of 1,000 volts and 30 amperes, at 800 revolutions per minute. The armature resistance is 0·55 ohms, and the resistance of the magnets 2 ohms. When working with full load the current through the magnet coils is 21 amperes, showing an electrical efficiency of over 95 per cent. Messrs. Mather & Platt have already constructed several of these machines for central station work, and have a number now in course of construction.

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IMPROVED "SILENT" AIR PROPELLER.

CONSTRUCTED BY MESSRS. B. VERITY & SONS, ENGINEERS AND ELECTRICIANS, LONDON.

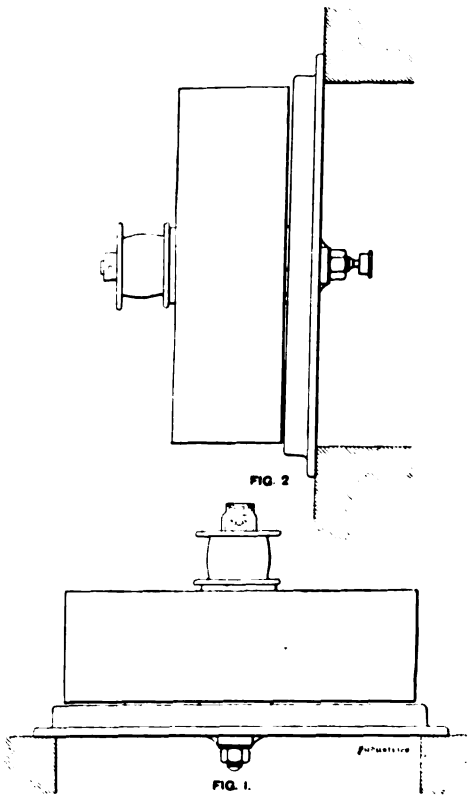


FIG. 3.

FIG. 4.

THE VERITY "SILENT" AIR PROPELLER

A FEW months ago Messrs. B. Verity & Sons, King Street, Covent Garden, London, brought out a new form of air propeller, which we here illustrate. In order that the efficiency of the propeller should be accurately known, and that intending purchasers should have some definite and reliable information to go on, Messrs. Verity asked Professor A. B. W. Kennedy to make a series of experiments from an impartial standpoint. The report of Professor Kennedy's experiments is here subjoined. We understand that these fans have been supplied to the Savoy Theatre, and that they are giving every satisfaction on account of their noiselessness and general efficiency. They are also being supplied to Mr. D'Oyly Carte's new theatre in Shaftesbury Avenue, where the electric lighting installation is also in the hands of Messrs. Verity. The fans are particularly adapted for being driven by small electromotors.

In Fig. 1 the fan is arranged in the ceiling of a room for extracting air from below. The spindle is vertical and is fixed, and the weight of the fan is carried by a hard steel disc. A very small amount of lubrication is necessary. In Fig. 2 the same fan is mounted on a horizontal spindle. In Figs. 3 and 4 the spindle revolves in two bearings carried by a ring frame which is made in halves and bolted together.

REPORT ON EXPERIMENTS ON TWO VENTILATING FANS (AIR PROPELLERS) AT THE WORKS OF MESSRS. B. VERITY & SONS, KING STREET, COVENT GARDEN, NOVEMBER 18, 19, 21, AND 25, 1889. BY PROF. A. B. W. KENNEDY.

I have pleasure in forwarding you the following statement of the results of the trials which I have made, at your request, of two patent ventilating fans constructed at your works.

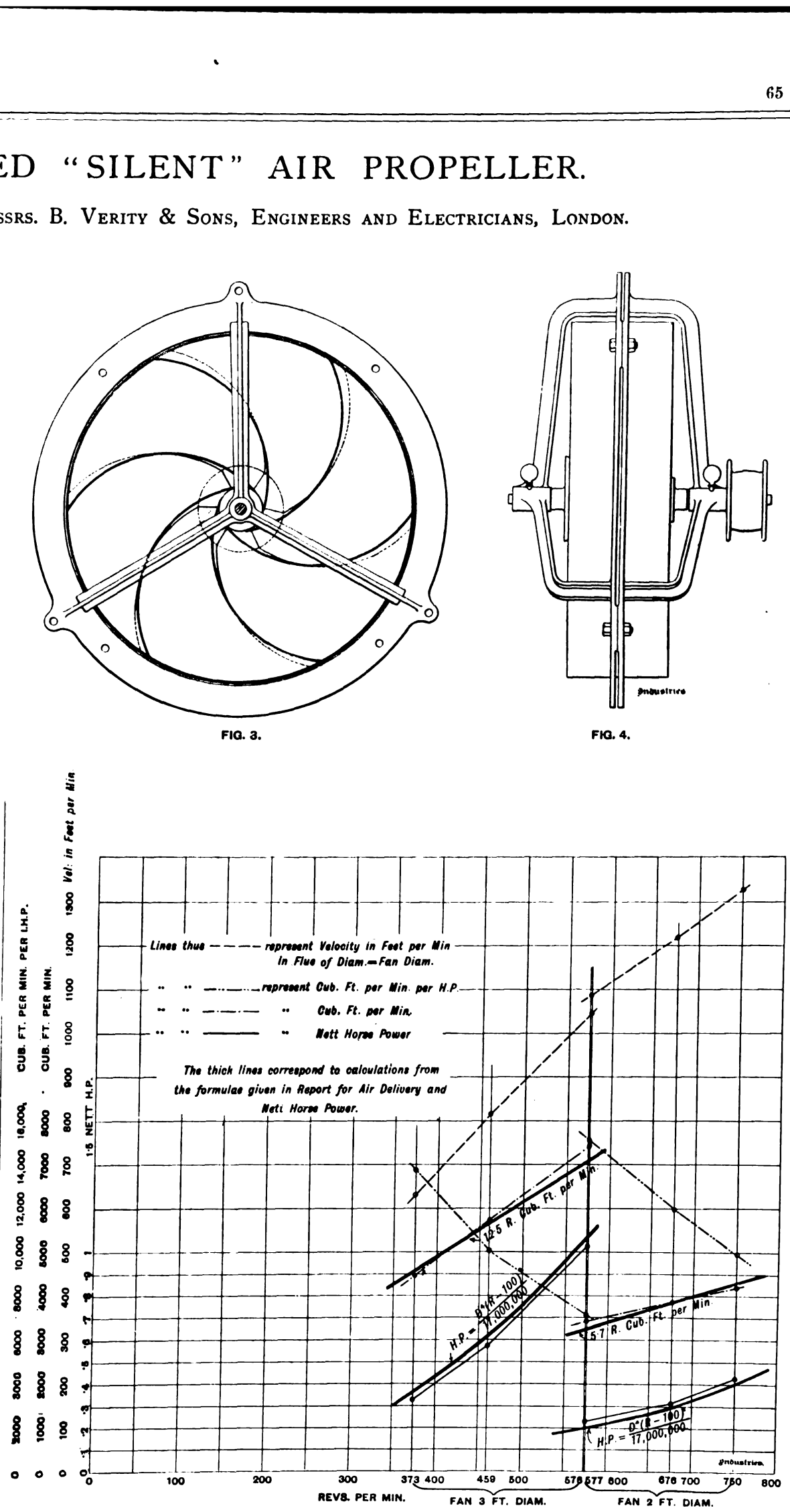
The fans which I tested were respectively 2ft. and 3ft. in diameter, and I conducted my experiments so as to determine the net horse-power required to drive each fan at three different speeds and the quantity of air delivered by each fan at each speed.

Each fan was arranged for testing at your works to my instructions. The tests were conducted in a large room, and the fan placed only a few feet distant from a window which had an area of about 16 square feet, and from which I had had the whole of the glass removed. The spindle of the fan was placed horizontally about 3ft. from the floor, and the fan frame was connected to one end of a zinc flue, 3ft. diameter and 10ft. 6in. long, the other end of which projected through a door freely into the open air.

The fan under test was driven by a small Immisch electric motor, the speed of which could be easily regulated by resistances, the current being obtained from the dynamo and cells in use at your works. The rate of speed by motor to speed of fan, in revolutions per minute, was about 2·6 in the case of the large and 2·0 in the case of the smaller fan.

The work done on the motor by the current was measured in watts by frequent readings of a volt and an ampere meter, both of Siemens' make. The revolutions made by the motor and by the fan were each taken by a hand counter every two or three minutes. The net work taken up by the fan I determined by a series of thirty-six short experiments, coming after the fan trials, in which a simple rope brake was substituted for the fan. The motor was driven at each of the principal speeds at which it was worked for the trials, and with as nearly as possible the same current at the same potential. Its mechanical efficiency under each set of conditions was therefore directly determined, and from this the net power necessary to drive the fan (including the power for driving the belt) has been found at once.

The measurement of the quantity of air set in motion by the fan was not quite so simple. I used for this purpose a 3in. fan anemometer kindly lent me by Mr. Bryan Donkin, Jun., an instrument which he had calibrated by direct experiment upon a large scale. I believe, therefore, that its readings, which I have corrected in accordance with Mr. Donkin's calibration, are practically correct, the error, if a sensible one, being probably in the direction of an under-estimate of the velocity. I placed the anemometer upon a slide on a bar crossing the flue horizontally about 5ft. 6in. from the fan. As the air in the flue at such a place (or indeed anywhere throughout its length) would have very different velocities at different radii in any cross section, I measured the



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velocity always in four different positions on the diameter—viz., at 1½in. from the edge, at 6in. and at 12in. from the edge, and at the centre. I allowed the anemometer to occupy each position for from 5 to 10 minutes at a time, during which interval the speed of the motor, the speed of the fan, and the electrical h.p. were each read at least twice. To calculate the quantity of air actually passing through the flue, I assumed that the velocity recorded by the anemometer in each position was the mean velocity of a cylinder of air whose mean radius corresponded to the position of the anemometer. The inner of these cylinders would be 6in. diameter, the next 18in. outside and 6in. inside, the next 30in. diameter outside and 18in. inside, and the outermost 36in. diameter outside and 30in. inside. By multiplying the velocity registered by the anemometer in each position by the area of the corresponding cylindrical ring and adding together all the products, there is obtained the total quantity of air delivered per minute. By dividing this quantity by the total area of the flue, we obtain the mean velocity of the air.

The principal results of the experiments, worked out in the fashion described, are given in Tables I. and II., and are also shown graphically in the diagram on page 65. The tables give the results so clearly that they do not need much explanation. It will be seen that in each case the efficiency of the fan, that is, the quantity of air delivered per effective horse-power, increases very rapidly as the speed diminishes, so that lower speeds are much more economical than higher ones. On the other hand, as the quantity of air delivered *per revolution* is very nearly constant (see last line of each table), the actual useful work done by the fan increases almost directly with its speed. Comparing the large and small fans with about *the same air delivery*, the former (running at a much lower speed, of course) is much the more economical. Comparing the two fans running *at the same speed*, however, the smaller fan is very much the more economical. Comparing the last lines in the two tables, it will be seen that the delivery of air per revolution of fan is very nearly indeed directly proportional to the area of the fan's diameter.

The last line but one in each table shows the motion given to the air (in feet) per revolution of fan, which may be called the effective pitch of the air propeller. It may be interesting for you to compare this with the very different actual pitch of the propeller blades.

In case it may be of use to you in the proportioning of these fans I append a few formulæ deduced empirically from the results of the experiments. The thickest lines in the diagram correspond to those formulæ and show clearly to what extent they accurately represent the results obtained.

The air delivered per minute by the 3ft. fan is nearly 12·5 R cubic feet (R being the number of revolutions made by the fan per minute). For the 2ft. fan the quantity is 5·7 R cubic feet. For either of these or any other *similar* fans of which the area is A square feet, the delivery will be about 1·8 A R cubic feet. Of course any change in the pitch of the blades might entirely change these figures.

The net h.p. taken up is not far from proportional to the square of the number of revolutions above 100 per minute. Thus for the 3ft. fan the net h.p. is—

$$\frac{(R - 100)^2}{200{,}000},$$

while for the 2ft. fan the net h.p. is—

$$\frac{(R - 100)^2}{1{,}000{,}000}$$

It will be noticed that the denominators of these two fractions are very nearly proportional inversely to the square of the fan areas or the fourth power of the fan diameters. The net h.p. required to drive a fan of diameter D feet or area A square feet, at a speed of R revolutions per minute, will therefore be approximately—

$$\frac{D^4 (R - 100)^2}{17{,}000{,}000} \quad \text{or} \quad \frac{A^2 (R - 100)^2}{10{,}400{,}000}$$

Of course, I have in all these cases rounded the figures off, but the formula in this simple form gives results which correspond very fairly with the average of the experimental results. They must only be applied, however, to fans whose blades are arranged similarly to the blades of those I tested, and which do not differ much from these in any of their proportions.

It is right that I should state that the fans worked exceedingly well throughout the experiments. There was not the least sign of heating of the spindle, even at the highest speeds. The 2ft. fan may literally be said to be absolutely noiseless at all speeds. The 3ft. fan was also noiseless up to over 450 revolutions per minutes. At 550 revolutions it gave a low roar, which, however, was hardly audible 12 yards away in the same room. It may therefore also be honestly called a noiseless ventilator.

TABLE I.

PRINCIPAL RESULTS OF EXPERIMENTS WITH VERITY AIR PROPELLER, 3FT. DIAMETER.

Speed of fan revolutions per minute..	576	459	373
Net h.p. to drive fan and belt	1·02	0·575	0·324
Cubic feet of air per minute	7,400	5,800	4,470
Mean velocity of air in 3ft. flue (feet per minute)	1,046	820	632
Cubic feet of air per minute per effective h.p.	7,250	10,070	13,800
Motion given to air per revolution of fan (feet)	1·82	1·79	1·70
Cubic feet of air per revolution of fan	12·8	12·6	12·0

TABLE II.

PRINCIPAL RESULTS OF EXPERIMENTS WITH VERITY AIR PROPELLER, 2FT. DIAMETER.

Speed of fan revolutions per minute..	750	676	577
Net h.p. to drive fan and belt	0·42	0·32	0·227
Cubic feet of air per minute.....	4,183	3,830	3,410
Mean velocity of air in 3ft. flue (feet per minute)	593	543	482
Mean velocity of air in flue, same diameter as fan	1,330	1,220	1,085
Cubic feet of air per minute per effective h.p.	9,980	11,970	15,000
Motion given to air per revolution of fan (feet)	1·77	1·81	1·88
Cubic feet of air per revolution of fan	5·58	5·66	5·90

THE INSTITUTION OF ELECTRICAL ENGINEERS.

At the meeting of this society, on the 9th inst., Dr. John Hopkinson, F.R.S., President, delivered his inaugural address, taking as his subject "Magnetism." We give the first part of this address, and the remainder will appear in our next issue.

As old as any part of electrical science is the knowledge that a needle or bar of steel which has been touched with a loadstone will point to the north. Long before the first experiments of Galvani and Volta the general properties of steel magnets had been observed—how like poles repelled each other, and unlike attracted each other; how the parts of a broken magnet were each complete magnets with a pair of poles. The general character of the earth's magnetism has long been known—that the earth behaves with regard to magnets as though it had two magnetic poles respectively near the rotative poles, and that these poles have a slow secular motion. For many years the earth's magnetism has been the subject of careful study by the most powerful minds. Gauss organised a staff of voluntary observers, and applied his unsurpassed powers of mathematical analysis to obtaining from their results all that could be learned.

The magnetism of iron ships is of so much importance in navigation that a good deal of the time of men of great power has been devoted to its study. It was *the* scientific study of Archibald Smith; and Airy and Thomson have added not a little to our practical knowledge of the disturbance of the compass by the iron of the ship. Sir W. Thomson, in addition to much valuable practical work on the compass, and experimental work on magnetism, has given the most complete and elegant mathematical theory of the subject. Of late years the development of the dynamo machine has directed attention to the magnetisation of iron from a different point of view, and a very great deal has been done by many workers to ascertain the facts regarding the magnetic properties of iron. The upshot of these many years of study by practical men interested in the mariner's compass or in dynamo machines by theoretical men interested in looking into the nature of things, is that, although we know a great many facts about magnetism, and a great deal about the relation of these facts to each other, we are as ignorant as ever we were as to any reason why the earth is a magnet, as to why its magnetic poles are in slow motion in relation to its substance, or as to why iron, nickel, and cobalt are magnetic, and nothing else, so far as we know, is to any practical extent. In most branches of science the more facts we know the more fully we recognise a continuity, in virtue of which we see the same property running through all the various forms of matter. It is not so in magnetism; here the more we know the more remarkably exceptional does the property appear, the less chance does there seem to be of resolving it into anything else. It seems to me that I cannot better occupy the present occasion than by recalling your attention to, and inviting discussion of, some of those salient properties of magnetism as exhibited by iron, nickel, and cobalt—properties most of them very familiar, but properties which any theory of magnetism must reckon with and explain. We shall not touch on the great subject of the earth as a magnet—though much has been recently done, particularly by Rücker and Thorpe, but deal simply with magnetism as a property of these three bodies, and consider its natural history, and how it varies with the varying condition of the material.

To fix our ideas, let us consider, then, a ring of uniform section of any convenient area and diameter. Let us suppose this ring to be wound with copper wire, the convolutions being insulated. Over the copper wire let us suppose that a second wire is wound, also insulated, the coils of each wire being arranged as are the coils of any ordinary modern transformer. Let us suppose that the ends of the inner coil, which we will call the secondary coil, are connected to a ballistic galvanometer; and that the ends of the outer coil, called the primary, are connected, through a key for reversing the current, with a battery. If the current in the primary coil is reversed, the galvanometer needle is observed to receive a sudden or impulsive deflection, indicating that for a short time an electromotive force has been acting on the secondary coil. If the resistance of the secondary circuit is varied, the sudden deflection of the galvanometer needle varies inversely as the resistance. With constant resistance of the secondary circuit the deflection varies as the number of convolutions in the secondary circuit. If the ring upon which the coils of copper wire are wound is made of wood or glass—or, indeed, of 99 out of every 100 substances which could be proposed—we should find that for a given current in the primary coil the deflection of the galvanometer in the secondary circuit is substantially the same. The ring may be of copper, of gold, of wood, or glass—it may be solid or it may be hollow—it makes no difference in the deflection of the galvanometer. We find, further, that with the vast majority of substances the deflection of the galvanometer in the secondary circuit is proportional to the current in the primary circuit. If, however, the ring be of soft iron, we find that the conditions are enormously different. In the first place, the deflections of the galvanometer are very many times as great as if the ring were made of glass, or copper, or wood. In the second place, the deflections on the galvanometer in the secondary circuit are not proportional to the current in the primary circuit; but as the current in the primary circuit is step by step increased we find that the galvanometer deflections increase somewhat, as is illustrated in the accompanying curve (Fig. 1), in which the abscissæ are proportional to the primary current, and the ordinates are proportional to the galvanometer deflections. You observe that as the primary current is increased the galvanometer deflection increases at first at a certain rate; as the primary current attains a certain value the rate at which the deflection increases therewith is rapidly increased, as shown in the upward turn in the curve. This rate of increase is maintained for a time, but only for a time. When the primary current attains a certain value the curve bends downward, indicating that the deflections of the galvanometer are now increasing less rapidly as the primary current is increased; if the primary current be still continually increased, the galvanometer deflections increase less and less rapidly.

Now what I want to particularly impress upon you is the enormous difference which exists between soft iron on the one hand, and ordinary substances on the other. On this diagram I have taken the galvanometer deflections to the same scale for iron, and for such substances as glass or wood. You see that the deflections in the case of glass or wood, to the same scale, are so small as to be absolutely inappreciable, whilst the deflection for iron at one point of the curve is something like 2,000 times as great as for non-magnetic substances. This extraordinary property is possessed by only two other substances besides iron—cobalt and nickel. On the same figure are curves showing on the same scale what would be the deflections for cobalt and nickel, taken from Professor Rowland's paper. You observe that they show the same general characteristics as iron, but in a rather less degree. Still, it is obvious that these substances may be broadly classed with iron in contradistinction to the great mass of other bodies. On the other hand, diamagnetic bodies belong distinctly to the other class. If the deflection with a non-magnetic ring be unity, that with iron, as already stated, may be as much as 2,000; that with bismuth, the most powerful diamagnetic known, is 0·999825—a quantity differing very little from unity. Note, then, the first fact which any theory of magnetism has to explain is: Iron, nickel, and cobalt, all enormously magnetic; other substances practically non-magnetic. A second fact is: With most bodies the action of the primary current on the secondary circuit is strictly proportional to the primary current; with magnetic bodies it is by no means so.

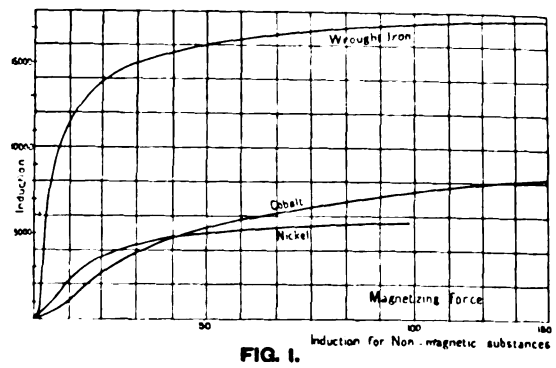


FIG. I.

You will observe that the ordinates in these curves, which are proportional to the kicks or elongations of the galvanometer, are called induction, and that the abscissæ are called magnetising force. Let us see a little more precisely what we mean by the terms, and what are the units of measurement taken. The elongation of the galvanometer measures an impulsive electromotive force—an electromotive force acting for a very short time. Charge a condenser to a known potential, and discharge it through the galvanometer; the needle of the galvanometer will swing aside through a number of divisions proportional to the quantity of electricity in the condenser—that is, to the capacity and the potential. From this we may calculate the quantity of electricity required to give a unit elongation. Multiply this by the actual resistance of the secondary circuit and we have the impulsive electromotive force in volts and seconds, which will, in the particular secondary circuit, give a unit elongation. We must multiply this by 10^8 to have it in absolute C.G.S. units. Now the induction is the impulsive electromotive force in absolute C.G.S. units divided by the number of secondary coils and by the area of section of the ring in square centimetres. The line integral of magnetising force is the current in the primary in absolute C.G.S. units—that is, one-tenth of the current in amperes—multiplied by 4π. The magnetising force is the line integral divided by the length of the line over which that line integral is distributed. This is, in truth, not exactly the same for all points of the section of the ring—an imperfection so far as it goes in the ring method of experiment. The absolute electromagnetic C.G.S. units have been so chosen that if the ring be perfectly non-magnetic the induction is equal to the magnetising force. We may refer later to the permeability, as Sir W. Thomson calls it; it is the ratio of the induction to the magnetising force causing it, and is usually denoted by μ.

There is a further difference between the limited class of magnetic bodies and the great class which are non-magnetic. To show this, we may suppose our experiment with the ring to be varied in one or other of two or three different ways. To fix our ideas, let us suppose that the secondary coil is collected in one part of the ring, which, provided that the number of turns in the secondary is maintained the same, will make no difference in the result in the galvanometer. Let us suppose, further, that the ring is divided, so that its parts may be plucked from one another, and the secondary coil entirely withdrawn from the ring. If now the primary current have a certain value, and if the ring be plucked apart and the secondary coil withdrawn, we shall find that, whatever be the substance of which the ring is composed, the galvanometer deflection is one-half of what it would have been if the primary current had been reversed. I should perhaps say approximately one-half, as it is not quite strictly the case in some samples of steel, although, broadly speaking, it is one-half. This is natural enough, for the exciting cause is reduced from—let us call it a positive value, to nothing when the secondary coil is withdrawn; it is changed from a positive value to an equal and opposite negative value when the primary current is reversed. Now comes the third characteristic difference between the magnetic bodies and the non-magnetic. Suppose that, instead of plucking the ring apart when the current had a certain value, the current was raised to this value and then gradually diminished to nothing, and that then the ring was plucked apart and the secondary coil withdrawn. If the ring be non-magnetic, we find that there is no deflection of the galvanometer; but, on the other hand, if the ring be of iron, we find a very large deflection, amounting, it may be, to 80 or 90 per cent. of the deflection caused by the withdrawal of the coil when the current had its full value. Whatever be the property that the passing of the primary current has imparted to the iron, it is clear that the iron retains a large part of this property after the current has ceased. We may push the experiment a stage further. Suppose that the current in the primary is raised to a

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great value, and is then slowly diminished to a smaller value, and that the ring is opened and the secondary coil withdrawn. With most substances we find that the galvanometer deflection is precisely the same as if the current had been simply raised to its final value. It is not so with iron; the galvanometer deflection depends not alone upon the current at the moment of withdrawal, but on the current to which the ring has been previously subjected. We may then draw another curve (Fig. 2) representing the galvanometer deflections produced when the current has been raised to a high value and has been subsequently reduced to a value indicated by the abscissæ. This curve may be properly called a descending curve. In the case of ordinary bodies this curve is a straight line coincident with the straight line of the ascending curve, but for iron it is a curve such as is represented in the diagram. You observe that this curve descends to nothing like zero when the current is reduced to zero; and that when the current is not only diminished to zero, but is reversed, the galvanometer deflection only becomes zero when the reversed current has a substantial value. This property possessed by magnetic bodies of retaining that which is impressed upon them by the primary current has been called by Professor Ewing "hysteresis," or, as similar properties have been observed in quite other connections, "magnetic hysteresis." The name is a good one, and has been adopted. Broadly speaking, the induction as measured by the galvanometer deflection is independent of the time during which the successive currents have acted, and depends only upon their magnitude and order of succession. Some recent experiments of Professor Ewing, however, seem to show a well-marked time effect. There are curious features in these experiments which require more elucidation.

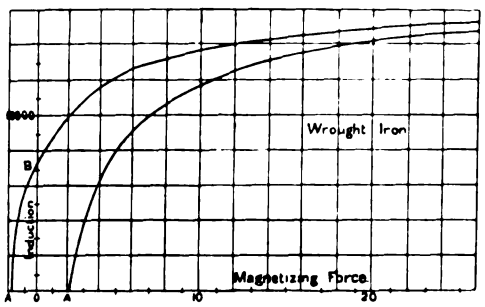


FIG. 2.

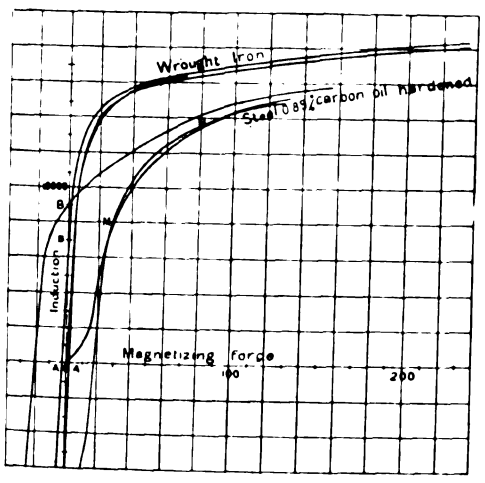


FIG. 3.

It has been pointed out by Warburg, and subsequently by Ewing, that the area of curve 2 is a measure of the quantity of energy expended in changing the magnetism of the mass of iron from that produced by the current in one direction to that produced by the current in the opposite direction and back again. The energy expended with varying amplitude of magnetising forces has been determined for iron, and also for large magnetising forces for a considerable variety of samples of steel. Different sorts of iron and steel differ from each other very greatly in this respect. For example, the energy lost in a complete cycle of reversals in a sample of Whitworth's mild steel was about 10,000 ergs per cubic centimetre; in oil-hardened hard steel it was near 100,000, and in tungsten steel it was near 200,000—a range of variation of 20 to 1. It is, of course, of the greatest possible importance to keep this quantity low in the case of armatures of dynamos, and in that of the cores of transformers. If the armature of a dynamo machine be made of good iron, the loss from hysteresis may easily be less than 1 per cent.; if, however, to take an extreme case, it were made of tungsten steel, it would readily amount to 20 per cent. In the case of transformers and alternate-current dynamo machines, where the number of reversals per second is great, the loss of power by hysteresis of the iron, and the consequent heating, become very important. The loss of power by hysteresis increases more rapidly than does the induction. Hence it is not well in such machines to work the iron to anything like the same intensity of induction as is desirable in ordinary continuous-current machines. The quantity O A when measured in proper units, as already explained—that is to say, the reversed magnetic force, which just suffices to reduce the induction as measured by the kick on the galvanometer to nothing after the material has been submitted to a very great magnetising force—is called the "coercive force," giving a definite meaning to a term which has long been used in a somewhat indefinite sense. The quantity is really the important one in judging the magnetism of short permanent magnets. The residual magnetism, O B, is then practically of no interest at all; the magnetic moment depends almost entirely upon the coercive force. The range of magnitude is somewhat greater than in the case of the energy dissipated in a complete reversal. For very soft iron the coercive force is 1·6 C.G.S. units; for tungsten steel, the most suitable material for magnets, it is 51 in the same units. A very good guess may be made of the amount of coercive force in a sample of iron or steel by the form of the ascending curve, determined as I described at first. This is readily seen by inspection of Fig. 3, which shows the curves in the cases of wrought iron, and steel containing 0·9 per cent. of carbon. With the wrought iron a rapid ascent of the ascending curve is made, when the magnetising force is small and the coercive force is small; in the case of the hard steel the ascent of the curve is made with a larger magnetising current, and the coercive force is large. There is one curious feature shown in the curve for hard steel which may, so far as I know, be observed in all magnetisable substances: the ascending curve twice cuts the descending curve, as at M and N. This peculiarity was, so far as I know, first observed by Professor G. Wiedemann.

I have already called emphatic attention to the fact that magnetic substances are enormously magnetic, and that non-magnetic substances are hardly at all magnetic; there is between the two classes no intermediate class. The magnetic property of iron is exceedingly easily destroyed. If iron be alloyed with 12 per cent. of manganese, the kick on the galvanometer which the material will give, if made into a ring, is only about 25 per cent. greater than is the case with the most completely non-magnetic material, instead of being some hundreds of times as great, as would be the case with iron. Further, with this manganese steel, the kick on the galvanometer is strictly proportional to the magnetising current in the primary, and the material shows no sign of hysteresis. In short, all its properties would be fully accounted for if we supposed that manganese steel consisted of a perfectly non-magnetic material, with a small percentage of metallic iron mechanically admixed



FIG. 4.

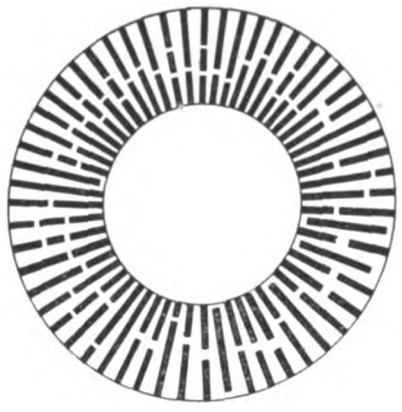


FIG. 5.

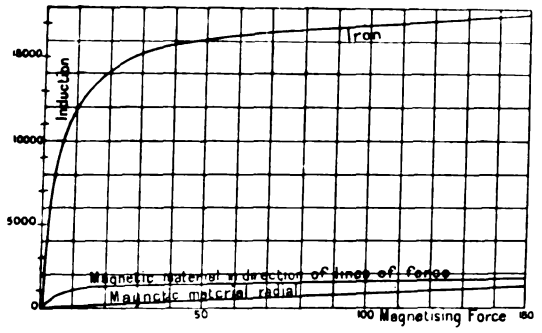


FIG. 6.

therewith. Thus the property of non-magnetisability of manganese steel is an excellent proof of the fact—which is also shown by the non-magnetic properties of most compounds of iron—that the property appertains to the molecule, and not to the atom; or, to put it in another way, suppose that we were to imagine manganese steel broken up into small particles, as these particles became smaller there would at length arrive a point at which the iron and the manganese would be entirely separated from each other: when this point is reached the particles of iron are non-magnetic. By the magnetic molecule of the substance we mean the smallest part which has all the magnetic properties of the mass. The magnetic molecule must be big enough to contain its proportion of manganese. In iron, then, we must have a collection of particles of such magnitude that it would be possible for the manganese to enter into each of them, to constitute an element of the magnet. Manganese is, so far as I know, a non-magnetic element. Smaller proportions of manganese reduce the magnetic property in a somewhat less degree, the reduction being greater as the quantity of manganese is greater. It appeared very possible that the non-magnetic property of manganese steel was due to the coercive force being very great—that, in fact, in all experiments we were still on that part of the magnetisation curve below the rapid rise, and that if the steel were submitted to greater forces it would presently prove to be magnetic, like other kinds of steel. Professor Ewing, however, has submitted manganese steel to very great forces indeed, and finds that its magnetism is always proportional to the magnetising force.

No single body is known having the property of capacity for magnetism in a degree which is neither very great nor very small, but intermediate between the two extremes. We can, however, mix magnetic and non-magnetic substances to form bodies apparently intermediate. It is, therefore, interesting to consider what the properties might be of such a mixture. It depends quite as much on the way in which the magnetic part is arranged in the mass, as on its actual quantity. Suppose, for example, it is arranged as in Fig. 4—in threads or plates having a very long axis in the direction of the magnetising force—we may at once determine the curve of magnetisation of the mixture from that of the magnetic substance by dividing the induction for any given force in the ratio of the whole volume to the volume of magnetic substance. If, on the other hand, it is as in Fig. 5—with a very short axis in the direction of the force, and a long axis perpendicular thereto—we can equally construct the curve of magnetisation. This is done in Fig. 6, which shows the curve when nine-tenths of the material is highly magnetic iron arranged as in Fig. 5, whilst the other curve of the same figure is that when only one-tenth is magnetic, but arranged as in Fig. 4. You observe how very different is the character of the curve—a difference which is reduced by the much less proportion of magnetic material in the mixture in the one case than in the other. One peculiarity of these arrangements of the two materials in relation to each other is that the resulting material is not isotropic—that is, its properties are not the same in all directions, but depend upon the direction of the magnetising force in the material. Of course, this is not at all a probable arrangement, but it is instructive in showing the character of the result as depending upon the construction of the material. Let us, however, consider the simplest isotropic arrangement; let us suppose that one material is in the form of spheres bedded in a matrix of the other: if the spheres are placed at random this is clearly an isotropic arrangement. The result is very different according as the matrix or the spheres are of the magnetic material. Suppose that the volume of the spheres is one-half of the whole volume. In Fig. 7 we have approximately the curve for

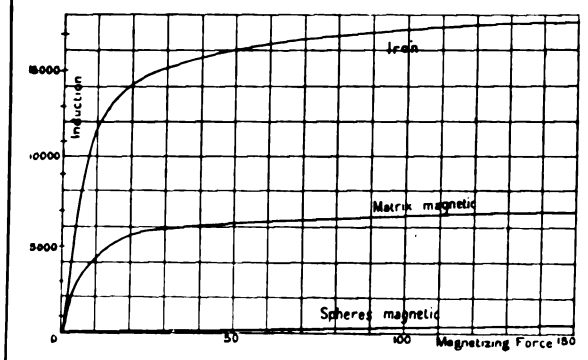


FIG. 7

iron, for a mixture of equal quantities of iron and a non-magnetic material, the spheres being non-magnetic and the matrix iron, and for a mixture, the spheres being iron, and the matrix non-magnetic. Observe the great difference. When the spheres are iron the induction is near four times the force for all values of the force. When the matrix is iron the induction is near 2-5ths of the induction when the material is iron only.

(To be continued.)

THE SOCIETY OF CHEMICAL INDUSTRY.

MANCHESTER SECTION.

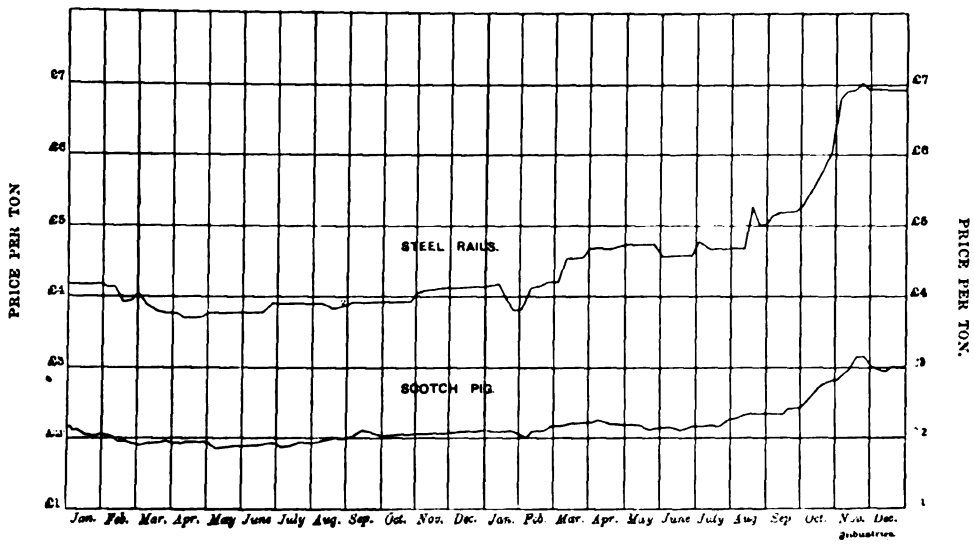
At the meeting held on the 7th inst., Dr. J. B. Cohen read the following communication from the Owens College Chemical Laboratory, on "A New Method of Estimating Sulphur in Iron and Steel."

After briefly describing the existing methods for the determination of sulphur in iron and steel, he called attention to the demand for rapid methods of analysis, and described a new process similar in principle to Eggertz's method, which consists in treating the metal with an acid and allowing the sulphuretted hydrogen evolved to produce a stain on a silver plate. In the new process a special apparatus is used, and the gas evolved acts on a piece of calico soaked in cadmium acetate, whereby stains of varying tints of yellow are produced. The stains are then compared with a standard series. The apparatus employed consists of a small flask, to which is joined a glass cylinder with a calico cover; there is a stoppered funnel at the side for admitting the acid. The method is stated to be equally applicable for large or small percentages, from ·002 to 1·5 per cent. of sulphur having been accurately determined. The process occupies half an hour.

Dr. Cohen and Mr. Brownsword also communicated a note on "The Nature of the Acid Distillate from a Rosin Still." The acid nature of the distillate from a rosin still is due to acetic acid, of which as much as 12 per cent.

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CHART SHOWING THE VARIATION IN THE PRICES OF STEEL RAILS AND SCOTCH PIG DURING 1888 AND 1889.



1888. 1889.

has been found, partly as free acid and partly as acetate of iron. The acid was identified by the preparation of glacial acetic acid, and the analysis of the silver salt, which gave the numbers required by theory.

Dr. Cohen and Mr. R. W. Oddy then read a paper on "The Strength of Permanganate Solution." The object of this paper was to observe the change taking place in potassium permanganate solution on keeping. A solution was prepared, strength 5 grams to a litre, and carefully titrated with (1) iron wire and H_2SO_4, (2) ferrous ammonium sulphate. The solution was then divided into two parts, one being kept in the dark and the other in the light for four months. The strength was then redetermined at intervals. The results were tabulated, and show that the change of strength does not exceed the limit of experimental error in analysis.

Dr. Cohen and Mr. Oddy then submitted a paper on "Estimation of Organic Nitrogen," a comparison of the (1) Dumas, (2) Wanklyn, and (3) Kjeldahl methods. The tests were made on isinglass, and the numbers obtained were (1) 15·22, (2) 12·75, (3) 13·5 per cent. N. They conclude that Wanklyn's method gives too low results, and Kjeldahl's method, though suitable for manures, also gives low results in the case of bodies only decomposed with difficulty.

A paper was then read on "The Estimation of Alkalies in Soda Ash in the Presence of Sulphites," by Dr. Cohen and Mr. J. Grant. The method consists in boiling the soda ash with a small quantity of hydrogen peroxide, whereby the sulphites are oxidised to sulphates; the alkalies are then determined by titration as usual. The authors have observed the action of hydrogen peroxide on the various indicators and on pure alkalies, and find that it does not interfere with the analysis.

The last paper was by Mr. J. A. Wilson, on "The Rate of Distillation of Acetic Acid." In the valuation of crude acetic acid and acetates, the substance is distilled with phosphoric acid, and the acetic acid in the distillate titrated with soda. The author finds that nine-tenths of the acid comes over in the first distillate, and can thus estimate the percentage without adding water and distilling again.

NEWCASTLE SECTION.

On the 9th inst. a paper by Dr. Lunge, on "The Gas Volumetric Analysis of Potassium Permanganate, Bleaching Powder, and Manganese Dioxide," was communicated to the Section. The method proposed is similar in principle to that employed for estimating urea in urine. To the side tube of a nitrometer is attached by india-rubber tubing a small flask, containing an inner tube. In the flask is placed a known weight of permanganate solution, bleaching powder, or manganese dioxide, and in the tube a solution of hydrogen peroxide made alkaline with soda. When the pressure in the apparatus has been brought to the normal, the two liquids are mixed, and the evolved gas allowed to depress the column of liquid in the nitrometer tube. After adjusting the level of the liquids in the two limbs the volume of evolved gas is measured.

This method gives rapidly very accurate results, and compares favourably with the processes of standardising permanganate with iron wire or oxalic acid, and also with Perrot's method for the estimation of chlorine in bleaching powder.

Notes.

SAFETY OF ELECTRICITY.

Mr. Ferranti and Mr. Ince are not usually troubled with a *cacoethes scribendi*, so we are agreeably surprised to find an able contribution from their pens in our contemporary, *Engineering*. It is a pity a few articles like these—technically correct as well as popularly written, and also written by acknowledged authorities—do not find their way into the daily press.

PROFIT SHARING.

The schemes for enabling workmen to participate in the success of their firm are gradually spreading, and although workmen occasionally try to take an ell when they are given an inch, yet no doubt eventually employés will come to see that the advantages of such systems of profit sharing are as great as they can desire. The latest example to employers was announced at the annual dinner given to their workmen by Messrs. Lee & Hunt, of the Arkwright Tool Works, Nottingham. The scheme practically comes to this: After working expenses have been paid, the firm are to receive 5 per cent. interest on their capital, and 10 per cent. of the surplus is to be put aside as a mutual reserve fund. Of the remainder, one half is to go to the firm and the other half is to be divided among the men according to their wages earned. Whether the plan will be accepted or whether the men will have some unfortunate squabble remains to be seen, but they will not be alive to their own interests if they find fault with offers like the above.

THE COMMERCIAL VALUE OF ORIENTAL LANGUAGES.

The Imperial Institute has been the means of establishing a "School for Modern Oriental Studies" in London. Some few of the Eastern languages have already been taught at University College and King's College, London, and arrangements have now been completed with these two colleges by which thorough instruction can be given in twenty of the principal Oriental languages. On the 11th inst., Professor Max Müller delivered an inaugural address of the school, at the Royal Institution, to a large and influential audience. After referring to what had been done in France, Russia, Germany, and Austria-Hungary, the Professor showed the grave importance of the study of the modern Oriental languages from political, diplomatic, and commercial points of view. With regard to the value which this school would have to the vast commercial interests of this country, we may remember that England rules over nearly 300 millions of people who speak Oriental languages, and she probably supplies the markets of nearly 1,000 millions of the people of the East. To say the least, it more convenient for many reasons that the sellers of goods should be able to speak the languages of possible customers, and therefore the commercial houses and the nations who go in for this class of study are, in the very nature of things, the most likely to succeed in their transactions. But whether it is better to educate a potential business man or commercial traveller at a school for languages, than to send an enterprising man to a distant country where he will have the chance of picking up the native tongue, is quite another thing. We all know that a man who learns French and German at college, and then goes to France and Germany, generally cuts a sorry figure. There is another phase of the subject which we might mention. Germans seem readier at picking up a foreign language than the English, and at first sight they therefore appear to have a better chance of business with these nations. There is a counterbalancing advantage on the side of the Englishman, and that is, the general superiority of the goods he offers. As long as this high character is maintained, so long will the disadvantage of his ignorance of native languages be a less felt drawback to his success.

A NEW TELEMETER.

A very ingenious telemeter, consisting of two pairs of coils forming a sort of induction balance, has lately been brought out. Two instruments like Professor Hughes' sonometer are used. An intermittent current is sent through the home and the distant fixed coils, and a telephone circuit is led through the home and distant movable coil. The home movable coil is turned till there is silence in the telephone, and the position of the distant coil is then known. It may be suggested that if the alternating or intermittent current could be made powerful enough and the telephone removed, the home movable coil, if free to move, would take up the same position as the distant coil—that is to say, it would set itself so that the mutual induction in the two pairs of coils balanced. This may some day be useful where alternating currents are available.

EXHIBITIONS AND THEIR TENDENCIES.

Of late years there has been an epidemic of Exhibitions. South Kensington for several seasons monopolised most attention, but in addition there have been many subsidiary shows. Most have been unimportant, with the exception of Manchester, Glasgow, and Paris, but the smaller kind still continue to crop up. There is no doubt that in very many cases the industrial sections are completely overshadowed by the attractions of switchbacks, toboggans, and sundry other popular amusements. A financial contemporary makes a very good suggestion in this connection, to the effect that the red-herring of terming such enterprises "Exhibitions" might be dispensed with, and that a speculator of enterprise might find it remunerative to start a show without any apology for exhibits, and have merely a well-laid-out site, with good bands and illuminated fountains, which have been found so attractive ever since the late Sir F. Bolton hit on the idea. This proposition, if carried out, would at least give some paying work for one or more of our electrical firms.

THE BRAZILIAN RUBBER MONOPOLY.

The Government of Para has recently granted to a native company the monopoly of the trade of the province, which has induced the American and French trades to protest against this unfair treatment of foreign firms, and we understand that the more important English houses are also taking a similar step. Although rubber is obtained from many tropical countries, and considerable quantities are exported from other parts of Brazil, and especially from St. Salvador, the best sort of caoutchouc is obtained from the province of Para, while inferior qualities are derived from the artocarp trees of the Gulf of Mexico and of Guatemala, and a small percentage of the supply of the better quality is contributed by the West Coast of Africa and Sumatra. The annual import from all sources to England amounts to about 11,000 tons, and of this quantity it is estimated more than half is derived from Para. This total by no means represents the extent of the industry in Brazil, as during the last year no less than 16,000 tons of rubber were shipped to other countries, of which about one-half was taken by the United States. It will be seen, therefore, that the threatened monopoly of this product by the Para Government may seriously effect the rubber trade of this and other countries, and it is thought that the move may increase the price of the raw product by 10–12 per cent. of the present quotations. It is to be hoped that the combination will stimulate the other countries to develop their resources, and in Borneo, where the *Urceola elasticæ* is known to yield a very satisfactory product, there seems to be an opening for further enterprise in this direction.

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Patent Record.

(Compiled from "The Illustrated Official Journal (Patents)."

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

27th December, 1889.

20765. Rhodes, G. G. ..... Superheating steam.
20768. Burgess, J. ..... Machines for cutting hay.
20773. Wadsworth, R. ..... Machines for spreading substances.
20775. Sutcliffe, H. ..... Measuring and pumping liquids.
20776. Rowan, F. J. ..... Drilling machinery.
20782. Leadbeater & Scott & Swift ..... Colliery rollers.
20783. Hall, R. ..... Propellers.
20784. Robertson & Mirrless Evaporating and distilling.
20785. Wade & Cherry ..... Pumping apparatus.
20790. Longridge, C. C. ..... Lubricating axles.
20792. Lusuardi & Falco ..... Pressure and vacuum gauges.
20794. Stock & Hausmann ... Roller flour mills.
20795. Downing, G. C. ..... Hydraulic propulsion of ships (*De Kunwald*).
20796. Strong, J. ..... High pressure sparger.
20800. Bradley, H. W. ..... Gas engines.
20803. Edwards, E. ..... Screw propellers.
20805. Lake, H. H. ..... Glass polishing machines (*Schefold & Penn*).
20806. Thomas, D. ..... Hydraulic lifts.
20808. Cole, A. C. ..... Projectiles (*Brewer*).
20809. Cole, A. C. ..... Presses (*Brewer*).
20811. Hill & Sinclair ..... Ice-making apparatus.

28th December, 1889.

20813. Hassel & Holt ..... Carding engine flats.
20820. Marcot, C. ..... Anvils.
20822. O'Connor, E. ..... Drying machines.
20827. Hunnable, A. ..... Propelling and steering ships.
20834. Bullough, E. J. ..... Brakes for tramcars.
20835. Stromeyer, J. P. E. C. Rails and sleepers.
20836. Stromeyer, J. P. E. C. Railway sleepers.
20837. Kincaid, S. B. ..... Signalling on railways.
20846. Haddan, R. ..... Sewing machines (*Engel*).
20854. Massey & Dunn ..... Lifts.
20855. Allaire & Gautier ... Rotary engine.
20857. Bracebridge, J. E. C.... Mounting heavy guns.

30th December, 1889.

20860. Thwaite, B. H. ..... Open hearth furnace.
20861. Hollanders & Leather Railway coupling.
20865. Patterson & Patterson Drilling rock.
20866. Hollingworth, E. ..... Looms.
20871. Allen, J. J. ..... Feeding printing machines.
20872. Longworth, J. ..... Pistons and cylinders.
20884. Cheetham, J. ..... Mules.
20886. Wilson, G. ..... Construction of wheel tyres.
20887. Fox, S ..... Railway underframes.
20888. Fox, S. ..... Bending channel iron.
20892. Abel, C. D. ..... Gas engines (*Gas Motoren Fabrik Deutz*).
20895. Watson, J. W. ..... Signalling at sea.
20900. Evans, T. ..... Steam motor, &c.
20904. Cooper, H. J. ..... Sifting apparatus.
20906. Lake, H. H. ..... Sewing machines (*Amborn*).

31st December, 1889.

20910. Yeo, W. B. ..... Compound engines.
20912. Mills, J. ..... Water tube steam generators.
20920. Nixon, R. B. ..... Elevators for raising grain.
20922. Stephenson, H. ..... Grinding mills.
20926. McDowell-Guajardo, J. A. ..... Spinning frames.
20928. Fitzpatrick, H. D. ..... Furnace grate bars (*Improved Zig-zag Grate Bar Company*).
20930. Hargreaves, W. ..... "Shaking machines" for cotton waste.
20931. Vos, J. E. ..... Shaping metal (*Weed*).
20935. Taylor, M. ..... Tramway couplings.
20937. Froggatt, C. ..... Fur cleaning machines.
20941. Talbot, J. S. ..... Machine for digging land.
20945. Helmore, F. G. ..... Hydraulic waterer and cleaner.
20952. Zerbe, J. A. ..... Transmitting motion.
20954. Wright, J. ..... Distilling or concentrating liquids.
20958. Haddan, R. ..... Mules (*Jaudeau*).
20959. Gibson, W. P. ..... Elevators.
20960. Gibson, W. P. ..... Safety appliances for elevators.
20966. Lake, H. H. ..... Dies for rolled forgings (*Gould Rolling Machine Company*).
20967. Lake, H. H. ..... Metal pipes (*Bayles*).
20968. Odell, J. B. ..... Type-setting machines.
20970. Pallister, E. ..... Projectiles.
20975. Rysselberghe, F. ..... Hydraulic motors.
20977. Johnson, W. ..... Drilling rock.
20978. Browning, J. ..... Machines for spinning metals.
20979. Beesley, F. ..... Ejector for breakdown guns.
20985. Woodroffe & Pendlebury ..... Mowing and reaping machines.
20986. Lake, H. H. ..... Furnaces (*Cornell*).
20988. Clarke, J. A. ..... Compound engines.
20989. Holmes, J. A. ..... Lubricators.
20990. Hussey & Hatch ..... Heating coils.
20992. Woodall, A. H. ..... Type-writing machines.

1st January, 1890.

3. De Negri, C. ..... Knitting machines.
9. Fisher & Richards ..... Slide valves.
10. Fisher & Richards ..... Controlling main engines.
11. Sample & Dick ..... Sea anchors.
13. Tolson & Tolson ..... Furnaces.
18. Craven, R. E. P. ..... Underframes of rolling stock.
20. Palmer, J. R. ..... Machine for cutting, grinding, and polishing glass.
21. Angus, R. ..... Apparatus for washing ores.
24. Olney, T. C. ..... Safety valves.
28. Cresswell & Heslop... Feeding printing presses.
32. Koch, P. ..... Machinery for facing screw-nuts.
38. Cooke, F. ..... Lubricators.

2nd January, 1890.

45. Ragg, A. E. ..... Drills for sowing seeds, &c.
47. Mason, W. F. ..... Furnaces.
49. McDonnell, J. ..... Lubricator.
54. Boult, A. J. ..... Pneumatic guns (*Eichbaum*).
61. Quick, G. ..... Ordnance.
62. Quick, G. ..... Breech mechanism for ordnance.
69. Bott, G. H. ..... Mechanism for starting vehicles.
73. Wilson, J. A. ..... Knitting machines.
74. Williams, R. H. ..... Ploughs.
75. Cooper, Roe, & Cooper Knitting machinery.
83. Williams, J. G. ..... Steam boilers.

3rd January, 1890.

105. Fraser, J. ..... Dynamometer.
106. Pilot, W. ..... Lubricators.
111. Butterworth & Butterworth ..... Machinery for straightening piece fabrics.
120. Jacob, F. W. ..... Rotary pumps.
122. Edwards, E. ..... Drilling rock (*Terp*).
125. Haddan, R. ..... Guns (*Pignat*).
127. Younger, A. ..... Regenerative heating furnaces. (5th June, 1889.)
131. Wells, C. ..... Steam engines.
132. Mewburn, J. C. ..... Compressed air motors (*Proell & Kummer & Co.*).
133. Gastrell, J. P. H. ..... Transmitting power.
136. Boyd, H. P. ..... Dies for forging screw threads.
140. Sleep & Sleep ..... Ploughs.

4th January, 1890.

145. Hutchison, M. ..... Steam boilers.
147. Newall, G. W. ..... Quadruple expansion engines.
156. Claridge, J. W. ..... Feeding furnaces with fuel.
157. Tillotson, M. ..... Couplings for shafts.
160. Hughes, G. ..... Steering gear.
161. Foden & Foden ..... Valves for pumping engines (*Attenbrow & Barratt*).
169. Robinson & Jackson ... Brick machines.
170. Anderton & Barlow... Screw-threaded spindles.
172. Finley, C. A. ..... Railway signal.
175. Mannesmann, R. ..... Electrical wires.
176. Imray, H. ..... Drawing metal tubes (*Moerchen*).
177. Johnson, S. O. ..... Steam jet pumps.
181. Shorter, F. ..... Locomotives.
185. Vogelsang, A. ..... Screw propellers.
187. Voilin, J. ..... Magazine firearms.
190. Talbot & Hardcastle Ingots of steel.
191. Talbot & Hardcastle Tubular ingots, &c.

ELECTRICITY.

27th December, 1889.

20797. Strode & Gill ..... Fittings for electric light.

28th December, 1889.

20856. FitzGerald & Hough... Voltaic batteries.

30th December, 1889.

20885. Price, H. S. ..... Fittings for electric lamps.

31st December, 1889.

20911. Woolf, A. E. ..... Storage batteries.
20918. Thompson, W. P. ..... Electric currents (*Stanley*).
20955. Wood, J. J. ..... Dynamo-electric machines.
20974. Rysselberghe, F. ..... Hydro-electric distribution.
20991. Jensen & Jensen..... Electric bells.

1st January, 1890.

29. Dardier, S. V. ..... Electrical deposition of metals.
42. Smith, W. S. ..... Electric cables.

2nd January, 1890.

58. Gardner, H. ..... Incandescent electric lamps (*Reid*).

3rd January, 1890.

113. Moseley, W. ..... Electric meters.
135. Atkinson, L. B. ..... Alternate current motors.

4th January, 1890.

180. Edwards, E. ..... Automatic telegraphs (*Cassalette & Kunhardt*).

CHEMISTRY.

27th December, 1889.

20787. Longshaw, J. ..... Treatment of spent acid.

30th December, 1889.

20862. Smith & Cresswell ... Nitrate of ammonia and bicarbonate of soda.

31st December, 1889.

20908. Mason, Warren, & Warren ..... Recovering soda.
20980-1. Newton, H. E. ..... Manufacturing gas (*Fuel, Gas, and Light Improvement Co.*).

1st January, 1890.

16. Smillie, J. ..... Preventing action of water on lead.
39. Friswell, R. J. ..... Dyestuffs.
44. Ball, S. J. ..... Charging gas retorts.

2nd January, 1890.

67. Parker, T. ..... Distillation of coal, &c.
70. Bang & Ruffin ..... Separating tin.
71. Bischof, G. ..... White lead.

3rd January, 1890.

128. Bang & Ruffin ..... Tinplates.
134. Friswell & Green ..... Colouring matters.

4th January, 1890.

149. Guthrie, H. ..... Treating sewage.
178. Richm, P. ..... Separating phenol and cresol from creasote.

MISCELLANEOUS.

27th December, 1889.

20802. Mills, C. K. ..... Regenerative gas lamps (*De Roest d'Alkenade*).

28th December, 1889.

20817. Smith & Sutcliffe..... Shuttles.
20848. Smith, A. ..... Artificial stone.
20850. Horn, W. W. ..... Coupling pipes (*Hattery & Van Liew*).
20851. Horn, W. W. ..... Nut lock (*Leep*).
20858. Bennett, W. A. ..... Packing for stuffing boxes, &c.

30th December, 1889.

20891. Punter, J. ..... Compensating expansion signal pulls.
20897. Bull, J. C. ..... Cartridges.

31st December, 1889.

20934. Bean, G. H. ..... Perpetual motion.
20936. Pinagel, L. ..... Freeing wool from grease.
20944. Vorwieger, F. E. ..... Shuttles.
20948. Reay & Co. ..... Filtering apparatus.
20969. Tighe, C. ..... Fog signalling.

1st January, 1890.

27. Clark, A. M. ..... Distilling crude petroleum (*Dull*)

2nd January, 1890.

82. Slingsby, R. ..... Magnesium lamps.

3rd January, 1890.

97. Walker, M. ..... Ventilators.
142. Chevallot, E. ..... Dyeing and waterproofing textile fabrics.

4th January, 1890.

189. Bray, G. ..... Fire escape.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form, of such opposition.

List published in the Patent Journal of 31st December, 1889.

Year 1888.

16850. Cleathero & Nichols.
18806. Stuttard.
18834. Wilkinson.
18932. Crawford.
18982. Roscow.
19004. Edwards (*Müller*).
19052. Wetter (*Rittmeyer & Co.*).
17043. Atkinson, Mori, & Walker.
18857. Lake (*La Société Anonyme des Parfums Naturels de Cannes*).
19039. Davis.
19069. Lorrain.

1889.

161. Willett.
618. Peberdy, Earp, & Parr.
1185. Lake (*Proprietors of the Copenhagen Horseshoe Manufactory*).
1400. Watkins.
1554. Banner.
1638. Hitchon.
1815. Louis.
1851. Gillett.
2136. Holtzapffel & Budd.
2417. Tilton.
2705. Sutherland.
2778. Hansell.
2806. Waldbaur.
3077. Hill & Hill.
3147. Leclercq.
3188. Defries.
3196. Dickinson.
3217. Tullidge.
3229. Clark.
3266. Foster.
3272. Thompson (*Westinghouse Electric Company*).
3321. Dickinson.
3330. Hartness.
3333. Shillito (*Geigy & Co.*).
3355. Hubbard, Mosely, & Fairfax.
3370. Lehmann.
3372. Hecq.
3378. Guttler.
3420. Sayers.
3468. Hoff.
3507. Bradley.
3511. Finch.
3517. Barfoot.
3547. Bromilow.
184. Weissenburger.
1090. Franklin & Dunkley.
1262. McLean.
1283. Ostlere & Strathern.
1345. Nicholson & Palmer.
1484. Onions.
1584. Greenham.
1674. Nicole.
1841. Lyle.
1881. Muir (*Haré*).
2225. Turner.
2654. Rutter.
2726. Rook.
2790. Horton.
3016. Samuelson (*Maffei*).
3144. Bell, Bell, & Bell.
3171. Tetlow.
3194. Armitage & Carter.
3207. Ashley.
3227. Von Lübhe.
3245. Smith.
3268. Clair & Clair.
3274. Brocklebank.
3275. Town.
3326. Smith.
3331. Adams.
3354. Ponton, Mosely, & Chambers.
3357. Leigh (*Clausen & Ehlers*).
3371. Ashley.
3377. Slow.
3391. Hislop.
3429. Cunnington.
3469. Huson & The Huson Motor Company, Ld.
3516. Ferrett.
3543. Bamford.
3557. Rogers.

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3563. Lord.
3581. Ritson & Jenkins.
3599. Romanel.
3621. Babbage.
3658. Challenger & Booth.
3760. Tebbutt.
3968. Patmore.
4310. Newbery.
4560. Leclercq.
5152. Atkins.
5290. Lorenz.
5353. Smith.
5484. Marshall&Fitzgerald.
5979. Lloyd & Priest.
6121. Knight.
6479. Hill.
6756. Molle.
7715. Hime & Noad.
9410. Parker.
11106. Baker.
13382. Beckers.
13765. Tall.
14274. Kinder.
14631. Gann.
15401. Boult (*Ferdinand-Louis Otto & Gustav Bernhard Schwerdtfeger*).
16562. Lake (*Hickmann*).
16654. Evanovitch.
16763. Popper.
17063. Ulffers.
17324. Brown & Gee.
17610. Lake (*Morgan*).
17920. White & Baker.
18116. Hornsteiner.
18118. Hornsteiner.
18199. Himmel.
18444. Watkin.
18497. Mason.
18587. Edwards (*Williams & Hewitt*).
18654. Gould & Ubrig.
18733. Marsden & Frost.
18754. Kerr & Kerr.
18794. Thompson (*Harder*).
18810. Moyer.
18819. Brown.
18825. Zirngibl.
18850. Heighington & Heighington.
18918. Saxl & Saxl.
18950. Fairweather (*Babcock & Wilcox Company*).
18966. Enholm.
18981. Dinneen.
18992. Thompson (*Mieck*).
19007. Stevenson (*Lund*).
19026. Lake (*Desouches*).
19067. Hawtin & Kent.
19158. Heinz.
3567. Moseley & Blundstone.
3608. Glitsch.
3634. Howes & Howes.
3674. Abel (*Siemens & Halske*).
3794. Phillips & Smith.
4265. Smith.
4498. Schlund.
4798. Rehkopf.
5197. Mewburn (*La Société des Générateurs à Vaporisation Instantanée, Système Serpollet*).
6186. Handley.
6696. Holmes.
7556. Teufel.
8174. Boult (*Josef*).
10503. Stevens.
13254 Saunders.
13727. Howse.
14041. Atkinson, Atkinson, & Goolden.
15183. Bénard.
15474. McGhie.
15825. Earl.
15989. Anderson & Dickinson.
16665. Thompson (*Erskine*).
16943. Seelby.
17144. Ainsworth & Ainsworth.
17696. Beeman.
18033. Emery.
18117. Hornsteiner.
18185. Chessbrough (*Felton*).
18264. Koch.
18466. Berry.
18504. Morell.
18630. Jucker.
18641. Valon.
18714. Scott.
18743. Pitt (*Dey*).
18788. Fitzpatrick (*Ripson & Frazer*).
18817. Birkbeck (*Schneider & Leidler*).
18846. Phillips.
18891. Spencer.
18913. Preston.
18919. Lake (*Conant*).
18953. Macaulay-Cruikshank (*Johnson & Smith*).
18973. Weldon.
18989. Smith.
18997. Boult (*Foeppl*).
19023. Löhnert.
19046. McGill.
19084. Schurer.
19160. Wilson (*Boas*).
20249. Crist & Covert.

List published in the Patent Journal of 8th January, 1890.

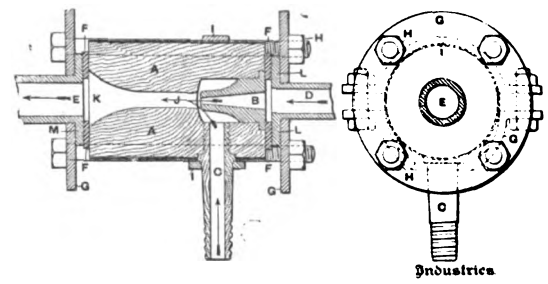
1889.

65. Dymond (*Bilharz*).
152. Hall.
153. Adams.
404. Comyn.
1045. MacVitie & MacVitie.
1232. Steele.
1390. Plumb.
1516. Strawson.
1679. Smitter & Duhamel.
1744. Tatham.
1988. Newton (*Nobel*).
2041. Straker.
2132. Doty.
2269. Bridewell. (21st August, 1888.)
2557. Rosser.
2623. Leisk.
2810. MacColl.
3162. Bussell.
3226. Lake (*Drappier*).
3343. Deer.
3428. Cooper.
3438. Davies.
3561. Hollingworth.
3580. Berry.
3617. Lester.
3630. Bayliss.
3676. Kennedy.
3696. Bobinson.
3700. Deeley.
3737. Marshall.
3757. Saunders.
3785. Vernon.
3788. Hall.
3949. Maynard.
4116. Dunlop.
4192. Siemens Bros. & Co., Ld. (*Taylor*).
4347. Homan.
4592. Shepherd.
5315. Brown.
5445. Chenaillier.
6934. White & White.
8645. Wheeler.
10280. Lake (*La Société Anonyme des Parfums Naturels de Cannes*).
12261. Appleby.
12860. Wrench.
94. Hargreaves Robinson, & Hargreaves.
246. Delle.
415. Salomon.
1078. Green & Green.
1241. Knowles.
1424. Hayes.
1561. Passenger & Haseltine.
1771. Willcox (*The Farbenfabriken vormals Friedrich Bayer & Co.*).
2247. Alvey, Grainger, & Ibberston.
2355. Waddell.
2603. Beaumont.
2674. Peddie.
2972. Richardson.
3216. Archer.
3254. Showell.
3407. Campbell & Boyd.
3434. Palfrey.
3529. Willcox (*The Farbenfabriken vormals Friedrich Bayer & Co.*).
3626. Gover.
3647. Mellor & Wilding.
3695. Tomlinson, Tomlinson, & Porter.
3716. Thompson.
3752. Haigh.
3768. Crook & Entwistle.
3786. Gosnell.
3867. Green.
4095. Poyser.
4167. Buttery.
4316. Carez.
4333. Batchelor.
4436. Prideaux.
4614. Boden & Boden.
5402. Wigzell.
6063. Lake (*Thomson*).
7411. Haddan (*Ludwig*).
10070. Atherton.
10997. King.
11220. Harrison.
11993. Burrows.
12414. Colligan.
13596. Cave.
13764. Tall.
14038. Everard.
14989. Hinde.
15289. Browne (*Kändler*).
15754. Bellini.
16248. Radford & Cutts.
16798. Capstick, Benn, Mitchell, & Smith.
17270. Silver & Cohen.
17639. Bates.
17914. Clark (*Schuckert & Co.*).
18004. Sloan (*Wilson & Brown*).
18183. Cheesbrough (*Felton*).
18596. Fruhinsholz.
18836. De Braam.
18849. Heighington & Heighington.
18974. Richter, Lowit, & Lowit.
19016. Lake (*Gould Rolling Machine Company*).
19126. Roscher.
19128. Bonne (*Meinecke*).
19161. Fowler.
19210. Morris.
19254. Kinney & Maw.
19274. Robbins & Rushton.
19300. Barnett.
19321. Brampton.
19332. Walmsley.
19352. Beatty. (2nd May, 1889).
19358. Leadbeater.
19413. Gans.
19421. Lake (*Robbins, Smith, & Graham*).
19436. Jensen (*Ubert*).
19439. Robinson.
19443. Lyons & Broas.
13792. Carr.
14923. Mathewson.
15066. Hannan (*Smith*).
15646. Tupper.
16005. Parkes.
16437. Marris & Cooke.
16964. Hamernik.
17109. Facer.
17572. Têhnik & Vaora.
17640. Thompson (*Hohn*).
17980. Cummings.
18053. Clarke.
18214. O'Neil.
18816. Birkbeck (*Jones & Jones*).
18901. Dreyfus.
18909. Morgan.
18979. Michl.
19004. White.
19021. Jensen (*The Pneumatic Dynamite Gun Company*).
19145. Herbertz.
19197. Davey.
19216. Patten.
19269. Erhard.
19282. Avet.
19301. Hemmings.
19323. Peters.
19350. Ristelhueber.
19353. Richards (*Bellamy*).
19363. Chenhall & Chenhall.
19415. Hooper & Hooper.
19435. Bates, Shaw, & Von Culin.
19437. Jensen (*Ubert*).
19442. Winchester.
19451. Hinrichs.
19496. Laffitte.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

Raising or Forcing Liquids.—*L. & L. Kern, Edenkoben, Germany.*—The appliance is constructed for raising hot, strongly acid, alkaline or muddy liquids, and for forcing them into filter presses. Fig. 1 is a vertical section and Fig 2 an end elevation of the appliance. The appliance works on the principle of an injector. The body A of the apparatus is an oblong block of wood protected upon the outside by iron as shown. This body has a longitudinal bore J of concoidal shape. Into the inlet side of the body is fitted a steam nozzle B of lead or other suitable incorrodible material. The apparatus has also a radial suction hole, into which is fitted a metallic tube C. The flanges L and



M of the pipes D and E are packed with india-rubber rings F F, and pressed against the ends of the block A by discs G and bolts H. The apparatus is placed outside the liquid to be raised, and as near to it as convenient, in order to obtain the maximum effect. Claim: (1) An ejector or injector, chiefly consisting of a hollow block of wood, into which is fitted a steam nozzle of lead or other suitable material; (2) the combination of an injector body A with steam nozzle B, suction pipe C, steam pipe D, discharge pipe E, and means for securing the said pipes to the body A; (3) the combination of a filter press with an injector as described.—No. 1563. January 29th, 1889. 8*d*.

Thrashing Machines.—*J. Johnson, Tarvin, Cheshire.*—The inventor describes a method of collecting the straw into bundles of a predetermined weight as the straw leaves the thrashing machine. For this purpose a suitable form of weighing apparatus is attached to the end of the thrashing machine. The straw is delivered to this weighing apparatus, and as the amount reaches the weight determined on the apparatus overbalances and discharges the straw. The weighing apparatus consists of four platforms, which revolve upon a shaft fixed laterally in the rear of the thrashing machine. These platforms alternately assume positions for receiving the straw, and are held in such positions by spring catches. The catches are adjusted to retain each platform until the load of straw accumulates to the weight determined on, when the platform falls, revolving upon the shaft and discharging the straw. As the straw is delivered from the thrashing machine it is beaten down on to the platforms by a batten beater oscillated by a crank, &c., actuated by a pulley fixed to the shaker spindle. Claim: The improved method and apparatus for collecting the straw (as it comes from the shakers of a thrashing machine) on to rotating arms, which are retained from time to time by a spring sliding bolt or other suitable contrivance until the load of straw overcomes the pressure or holding power of the spring or withdraws the bolt to release the rotating arm, and thus deliver the straw in uniform quantities.—No. 18300. December 14th, 1888. 6*d*.

Printing Machines.—*W. Rouse, Nottingham.*—The object of this invention is to put a lateral tension upon the paper in order to remove creases, &c. This the inventor does by the use of two rollers placed to revolve upon the edges of the paper with their axes in the same plane, but at an angle to each other. When working, the inclination of the rollers would be to travel towards the centre of the machine, but being fixed in stationary bearings they draw the paper out towards the edges of the printing machine cylinder. The rollers are mounted on frames which have both lateral and angular adjustments. These frames are mounted upon a slotted bar, and the whole is actuated by a cam motion, such that at each revolution of the cylinder the rollers are pressed against the edges of the paper. Claims: (1) The use of parallel or conical rollers, or wheels, in a straight line or at angles to the cylinder of the printing machine for the purpose described; (2) the use of adjustable bearings as herein described for the purpose of putting the rollers at any angle required.—No. 1474. January 28th, 1889. 6*d*.

Gaseous Fuel Furnaces.—*C. Imray, London.* (*E. R. Ware, Chicago, U.S.A.*).—Fig. 1 is a sectional elevation of the apparatus including the boiler, and Fig. 2 a sectional plan showing the gaseous fuel burner. A is an enclosing wall or casing, preferably of brick, with a suitable top forming an enclosed chamber. Within this casing is the boiler C, having an inner and outer shell, between which there is a water space C¹, the whole being of dome shape. D D is a fuel supply pipe projecting through the wall and through a semi-circular notch in the lower part of the boiler. The combustion of the gases takes place in the fire-pot E F, and from a specially constructed burner of the Bunsen type. The walls of the firebox are water channels, which communicate with the main body of boiler by the pipes M and N. H is the inlet pipe for the steam or water as the case may be, the outlet

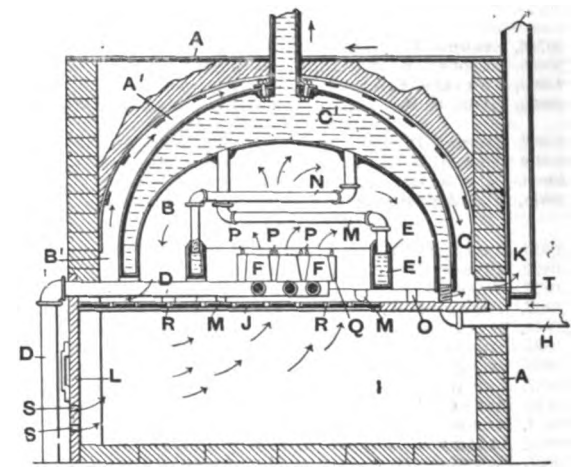


FIG. 1.

pipe being at the extreme top of the boiler. Beneath the heating chamber is a space I separated from the chamber only by a perforated sheet. From this space I air for the purpose of combustion is supplied through the holes in the perforated sheet. From the above description it may be understood that, when the fuel is ignited, the products of combustion will pass up through the passages which are formed by the fire-pot, and are surrounded by water spaces, thence into the upper central part of the inner heating chamber, which is formed by the inner wall of the dome-shaped boiler. From there it passes downwards, under the lower edge of the boiler, into the outer heating chamber constituted by the outer case of the boiler and the inner surface of the casing A. During this movement of the products of combustion, their heat will be in great measure absorbed by the boiler and its contents, the waste products of combustion passing out through the final out-

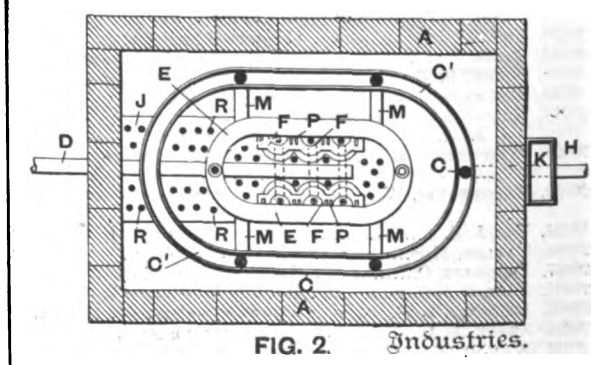


FIG. 2. Industries.

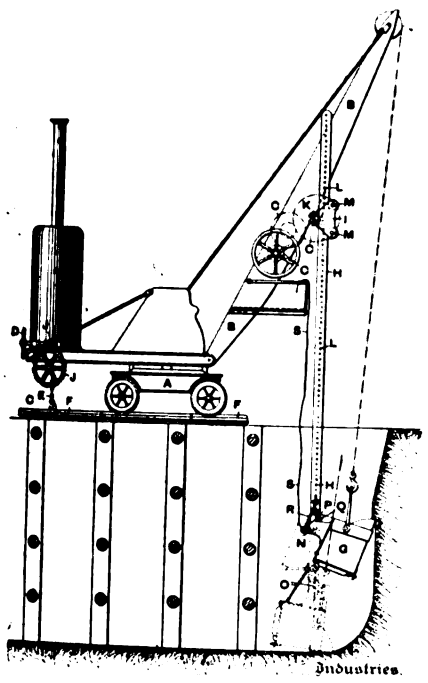
let T. Claims: (1) The combination in a heater of a dome-shaped combustion chamber, having a substantially continuous inner surface, a fluid fuel supply pipe, an inlet for the admission of air to the combustion chamber, and an outlet for the waste products of combustion, said outlet being located below the plane of ignition of fuel, whereby the waste products of combustion are compelled to pass out below the plane of ignition of fuel; (2) the combination in a heater of a combustion chamber, a boiler surrounding the combustion chamber, a heating chamber outside of the boiler, a fluid supply pipe, an air inlet and an outlet for the waste products of combustion, said outlet being located below the plane of ignition of fuel; (3) the combination in a heater of a boiler provided within an inner heating chamber, a heating chamber outside of the boiler, a passage for the products of combustion from the lower part of the inner chamber to the outer chamber, a fluid fuel supply opening into the inner chamber, an inlet for the admission of air to the inner chamber, and a final outlet for the waste products of combustion, said final outlet being located on a level or thereabouts with the point at which ignition of the fuel occurs; (4) in a heater, the combination with the boiler support and fluid supply, the dome-shaped boiler provided with an internal combustion chamber, having a substantially continuous inner surface, and arranged with its lower edge

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above the boiler support, of the enclosing casing, whereby there are formed two chambers below the boiler for the products of combustion from the combustion chamber.—No. 15,043. September 24th, 1889. 8*d*.

APPARATUS FOR REMOVING SCALE FROM BOILERS.—*R. Elliott, Newcastle-on-Tyne.*—The apparatus constituting this invention is designed for removing scale from the internal parts of boilers which are difficult of access or quite inaccessible to ordinary scaling tools. The apparatus consists of a chipping hammer head secured to a lever, which is pivoted in a frame and made to vibrate by a rod attached to the other end of the lever. The frame occupies a small space, and can be inserted in narrow channels or pipes by a rod connected to it. When at work a part of the frame rests against one side of the channel or pipe, whilst the chipping hammer is made to operate upon the opposite side by working the rod attached to the lever. Claim: The combination of parts constituting the improved apparatus for removing scale from the internal surfaces of steam boilers, as described.—No. 17379. November 2nd, 1889. 8*d*.

EXCAVATING CRANES.—*T. Whitaker, Horsforth, Leeds.*—These improvements are primarily designed to perfect the apparatus for excavating to a lower level than that on which the apparatus stands, and to facilitate the removal of the track from the behind to the front as the work proceeds. Referring to the illustration, A is the carriage and B the jib of an ordinary portable crane. To the tail of the crane is affixed transversely a drum operated by a hand-wheel D and worm and worm-wheel J. The drum carries two hoisting chains E terminating in hooks C which engage in a part of the track when it is to be removed. When the track has been raised by the hooks the crane is revolved upon its centre pivot and the track deposited in the front. The apparatus shown is particularly designed for excavating sewers. The scoop or bucket G is pivoted at the end of the arm H on the pin or pivot N. The bucket is held in a position beyond the end of the arm H by a small chain O, one end of which is attached to the bucket and the other end engages with a small catch P pivoted to the arm H. The catch P is held when the bucket is in the position shown in dotted lines by the bar or lever R, which can be withdrawn by the cord S. The arm H is formed with a series of teeth at each side which form racks L which gear with the wheels as shown. A small cradle M pivoted to the shaft K holds the racks in gear with the pinions. The bucket is held in the position shown in



dotted lines until it reaches the bottom of the excavation, when the catch P is released, and as the operations begin by hauling in the chain the bucket is pulled forward on its pivot N until it assumes the position shown in full lines at about right angles to its previous position. It is here stopped by a stop Q against the rod or arm H. As the excavation proceeds, the shaft H is permitted to pass in through the cradle M at a rate adjustable by a suitably contrived brake, thus causing the bucket to assume any position in its upward movement. The rack and wheels can be worked by a hand wheel, and thus the bucket made to assume any position for the purpose of discharge, &c. Claims: (1) The combination with a crane-navvy or ordinary portable crane of an auxiliary drum and winding chain affixed to the tail of the crane; (2) a bucket arm or excavating attachment for an ordinary portable crane having the bucket pivoted or hinged to the end thereof so as to excavate in a straight instead of a curved path; (3) in a crane-navvy such as described in my former patents Nos. 16701 of 1886 and 2757 of 1887 a bucket arm having a longitudinal slide or slot, in which the pivot rests or slides, in combination with the rack, wheels, and hand wheel.—No. 946. January 18th, 1889. 8*d*.

CENTRIFUGAL PUMPS AND FANS.—*H. A. Entwisle, Bolton.*—Certain improvements are here described to minimise the retarding action of the liquid or air in delivery. The revolving disc of the pump, with its circular or segmental blades, is enclosed between two cheeks bolted together and provided with inlet and outlet passages. The inlet passage is divided into two thoroughfares, one on each side, to allow of the liquid being supplied to the centre of the revolving wheel. These thoroughfares are each constructed of a spiral form to direct the liquid to the pump in a circular manner corresponding with the direction of the travel or circular motion of the revolving disc, thereby reducing the retarding action of the liquid. The revolving disc or wheel, with the circular or segmental blades, is mounted on a spindle or shaft held in suitable bearings and stuffing boxes on the sides of the pump. To reduce the back pressure on the blades they are provided near their outer extremity with curved projections, which are turned to the internal diameter of the casing. As soon as each of these projections pass the point dividing the outlet from the central portion of the pump the bulk of the blade is removed from the pressure of the liquid in the outlet pipe. Claims: (1) In centrifugal pumps and fans the use, construction, and arrangement of the spiral inlet passages as described for the purpose specified; (2) in centrifugal pumps and fans the use of the projections in combination with the blades or vanes for the purpose specified.—No. 1723. January 31st, 1889. 8*d*.

GRAIN CONVEYERS.—*J. Stevenson, London.*—This invention consists of an improved construction of conveyers, in which a flat or attenuated spiral is employed, attached by means of ordinary paddle-worm flights to a centre spindle. The periphery of the spiral is preferably thin, thickening towards the base, and may be formed of a steel bar. One claim is made.—No. 552. January 11th, 1889. 6*d*.

BRICK AND TILE MACHINES.—*L. B. Kennedy, St. Louis, U.S.A.*—Part of a machine is here illustrated, showing a system of levers for compressing and forming bricks. Bell-cranked levers C and D are pivoted upon the framing of the machine and operated by toggle levers K. The toggle levers K are worked by a pitman M and cam plate R. When the cam plate R is revolved upon the shaft L the cam S moves against the friction roll W and draws the pitman back. This motion straightens the toggles, as shown in Fig. 1, and raises the outer

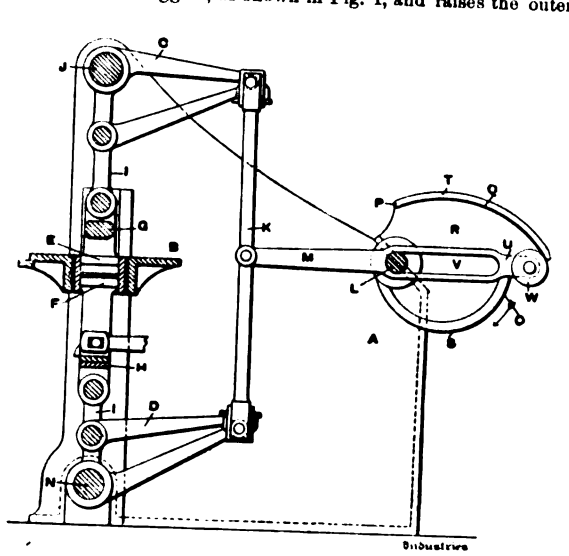


FIG. 1.

ends of the bell-crank levers, bringing the plungers E and F toward each other, and exerting the proper pressure on the clay to form a perfect and solid brick. A continued rotary motion of the cam plate now brings the friction wheel against the cam T, and causes the pitman to return to its former position, and at the same time eject the newly formed brick, as shown in Fig. 2. Claims: (1) In a brick machine of the character described, and the compression plungers of which are attached and operated by

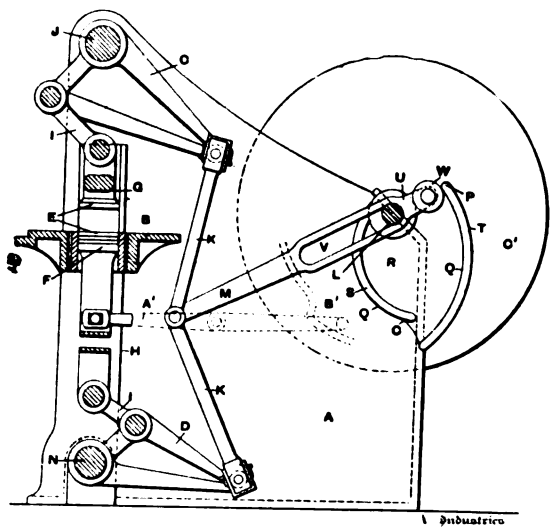


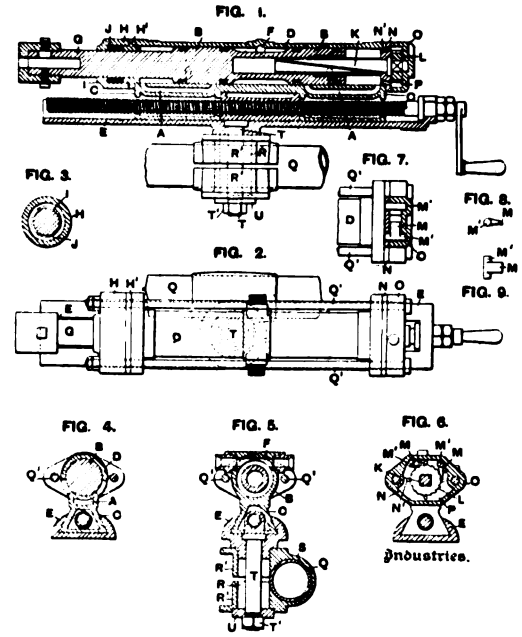
FIG. 2.

bell-crank levers, the said levers connected at their outer ends by toggle levers operated from a continuously rotated shaft; (2) in a brick machine, the angle or bell-crank levers C and D pivoted in the sides of the machine, said levers being connected to the plungers by means of links or knuckle-joints, which yield in opposite directions, the outer ends of the angle or bell-crank levers being connected by toggle levers operated from a continuously revolving shaft.—No. 17,121. October 29th, 1889. 6*d*.

SEPARATING CYLINDERS FOR GRAIN.—*P. van Gelder, Sowerby Bridge, Yorkshire.*—In separating and sieving apparatus of the description to which this invention relates, the material to be treated is kept in motion within a revolving or oscillating cylinder, which is perforated in a suitable manner. The dust and smaller grains pass through to the exterior of the cylinder, but after a short time of working the perforations become blocked by the grain, &c. To remove this blocking is the object of the present invention. The object is attained by the use of a row of wooden fingers, whose tips rest upon the cylinder in a line with its axis. The fingers are pressed against the cylinder with a yielding pressure, and so push the material wedged in the perforations back into the cylinder. To assist the fingers, radial brushes or whisks may be mounted inside the cylinders, to brush against its surface. Claims: (1) In combination with a sieving or separating cylinder for grain, seeds, or the like, a series of fingers spring pivoted or otherwise flexibly mounted side by side in proximity to the cylinder, and having their tips bearing with a yielding pressure upon the surface thereof; (2) in combination with a sieving or separating cylinder for grain, seeds, and the like, an inclined plate or series of inclined fingers located within said cylinder in such a position that material which has been carried by the rotation of the cylinder to a certain point is on falling backwards, led by said plate to the lower or comparatively unoccupied portion of the cylinder, instead of being permitted to fall again on to the material immediately below it.—No. 2611. February 14th, 1889. 8*d*.

SAFETY BRAKES FOR LIFTS, &c.—*C. Imray, London (A. Pifre, Paris).*—The safety brakes employed for the cages of lifts or mine shafts are usually so arranged that when the suspending rope or chain gives way, they act at once, gripping the guides and pressing against them with their full force. When an accident occurs during the descent of the cage, the stress resulting from stopping suddenly often deranges or fractures the brake mechanism. This is avoided in the present invention by causing the brake to act gradually and independently of the distance travelled by the lift. The brake is similar in shape to a blacksmith's tongs, whose jaws grip the side rails, and whose shanks are worked by springs. The springs act when the cable breaks, and cause the jaws of the brake to grip the rails, but the action of the springs are retarded by means of a dash pot or air buffer. Five claims are made.—No. 2,579. November 8th, 1889. 8*d*.

ROCK BORING AND DRILLING MACHINES.—*J. E. Powell, R. J. Powell, & W. Whitaker, Wrexham, Denbigh.*—The object of this invention is to simplify the construction of compressed-air rock drills and to render them more efficient. Fig. 1 is a longitudinal section of the apparatus; Fig. 2 a plan; Figs. 3, 4, 5, and 6 cross sections upon various parts of the apparatus. Compressed air for working the machine is applied through the inlet F, and admitted to the ends of the piston B by the ports A. The ports are formed in the dovetailed piece C, and so are protected from accidental damage. The ports are also uniform, in order that the piston B may be reversed in its cylinder, to equalise the wear and so make the parts wear longer. The piston rod G is packed by metal collars I, which are pressed against the rod by an indiarubber collar J. The piston B is rotated in a well-known



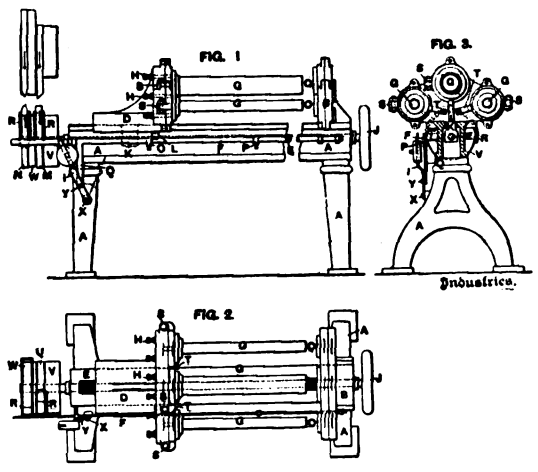
manner by means of the twist bar K, ratchet wheel L, and pawls M, Figs. 1 and 6. In order to obtain additional air space without lengthening the cylinder, the chamber P is connected to the cylinder by the holes N¹. Claims: (1) In a rock-boring or drilling machine, forming the ports within the dovetailed slide; (2) in a rock-boring or drilling machine, the use of metallic rings formed in segments, in combination with indiarubber or other elastic rings, for producing an air-tight joint where the piston rod passes into the cylinder; (3) in a rock-boring or drilling machine of the kind herein described, constructing and arranging the pawls which operate in conjunction with the ratchet wheel for turning the cutter, so as to be supported on both sides; (4) a new kind of clip, in which a single bolt and nut serves to lock the stretcher bar to the rock-boring or drilling machine; (5) the improved clip; (6) the rock-boring or drilling machine as described.—No. 18,284. December 14th, 1888. 8*d*.

ROTARY ENGINES.—*H. H. Leigh, London. (P. E. Don & M. J. A. Don, Bordeaux).*—The rotary engine here described works expansively without the aid of valves. It consists simply of a cylinder with inlet and outlet ports cut longitudinally in its side and close together, in combination with a piston of the following construction. The piston is carried by a piston shaft passing through and supported by the two ends of the cylinder, and placed eccentrically to the centre of cylinder. The part of the piston rod within the cylinder is enlarged by a collar or sleeve of metal of sufficient thickness to touch the interior of the cylinder at its nearest point, which is between the exhaust and inlet ports, and thus causes a steam-tight joint between the two. Through the centre of the collar and piston is cut a longitudinal slot, to admit a flat and rectangular plate of metal which constitutes the piston. This plate of metal is free to slide in the slot, to permit it as it is revolved to assume a position in the piston rod such that its edges always touch the sides of the cylinder, forming a steam-tight partition longitudinally in it. Steam is admitted to the cylinder upon one side of the piston collar, and acts upon the surface of a small

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portion of the sliding plate or piston protruding from the collar on that side. The piston and rod are thus caused to revolve, and in their movement more of the piston becomes exposed to the action of the steam until it reaches the position where the piston is in a line with the centres of the piston rod and the cylinder, and from there the surface again gradually decreases. The inlet port is placed so that the supply of steam is cut off by one edge of the piston after the other has travelled a certain distance, to use the steam expansively. Claim: In rotary engines a cylinder bored out to a closed symmetrical curve generated by the extremities of a right line of constant length compelled to pass through a point eccentric to the symmetrical axis so as to describe during a revolution a maximum and a minimum segment, in combination with a parallelopipedal piston adapted to exactly follow the path of the said right line, the generatrix of the said symmetrical curve.—No. .

Forming and Polishing Tubes.—*W. R. Comings, London.*—The process consists of the following operations:—First, in making the tubes according to this invention, the lapping or abutting edges of the materials are first bevelled. Then one or both of these edges are coated with a suitable cement or solder. The sheet material is then bent round a mandril of the proper diameter, which is then by suitable mechanism forced slowly through a heated die, which, acting by combined pressure and heat, causes the lapped edges of the material to become firmly cemented or welded together. After the mandril has forced the tube entirely through the die, its motion is reversed by suitable mechanism, and it returns at a quick speed, while the tube, catching against a shoulder or suitable grippers at the back of the die, is stripped off from the mandril and the process is recommenced. Or if it is desired to impart a high polish to the tube,



it is allowed to remain on the mandril till after the return stroke, the high speed of which imparts the extra finish desired; or it may be carried back and forward through the die any desired number of times, till the requisite surface has been obtained, when the stripping mechanism is thrown into operation and it is removed from the mandril. Fig. 1 is a side elevation of a three-mandril machine; Fig. 2 a plan of the same; Fig. 3 a sectional elevation of the end; Fig. 4 an end elevation; Fig. 5 a plan of the same; Fig. 6 a vertical section upon Fig. 4; and Fig. 7 a die formed of rolls. To one end of a bed plate A is bolted a strong bracket B adapted to support and hold the dies C at right angles to the length of the bed. The other end of the bed carries a sliding carriage D with a crosshead, which is at right angles to the bed and parallel with the die holding bracket B. The carriage D is driven backwards and forwards upon the bed by the screw E, which is itself driven by the belts M N. The belts M N are shifted by the adjustable tappets O P upon the rod F,

FIG. 6.

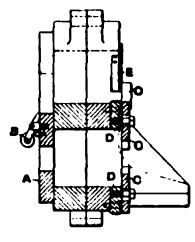


FIG. 4.

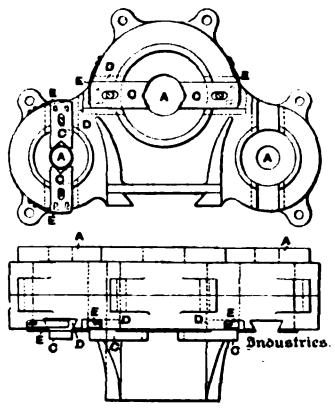


FIG. 7.

FIG. 5.

and thus the motion of the shaft is reversed. Heat is applied to the whole of the die, or an intense jet may be used simply at the point of lap. The operation of the machine is as follows:—The mandrils G G being stationary, the sheet material is bent round them and the cemented or soldered edges brought together and the machine started. The friction of the material upon the mandril carries it through the dies, while the heat and pressure causes the solder to melt and firmly unite the edges. When the tubes have been forced through the dies, the projection L on the carriage, acting upon the tappet P of the sliding rod F, shifts the belts and reverses the machine. As the mandrils return, the tube is stripped from the mandril by plates C (Fig. 4), held to their work by springs E. Claims: (1) The process of forming and polishing tubes which consists in first placing the material on a mandril having a reciprocating motion and then forcing it through a suitable die with or without an additional pressure roller for the seam; (2) the process of forming and polishing tubes which consists in first placing the material on a mandril having a reciprocating motion, and then forcing it through a suitable die with or without an additional pressure roller for the seam, and then automatically stripping it from the mandril; (3) in apparatus for forming or polishing tubes or the like the combination of a carriage carrying one or more mandrils with means for imparting a reciprocating motion thereto, and a bracket carrying dies corresponding with said mandril and adapted to polish the tube and strippers for stripping the tubes from said mandrils; (4) in apparatus for forming or polishing tubes or the like the combination with carriage D having projection L of a belt shifting rod F having adjustable stops *f f*¹ thereon, whereby the direction of travel of said carriage is reversed at any desired point; (5) in apparatus for forming or polishing tubes or the like the combination with the carriage D of the mandrils G hinged thereto and adjustable in relation therewith.—No. 17124. November 24th, 1889. 8*d*.

Mixing and Suction Valve.—*W. Fischer, Ludwigshafen-am-Rhein.*—The casing of this valve has two inlet and one outlet pipes, whose communication are controlled by means of a double-seated valve. The inlet pipes communicate to spaces arranged similarly to an ejector, one space surrounding the other in an annular form. A conical-shaped valve covers both outlets. When the valve is screwed off its seating the liquids flow in from both spaces, and that of the central space mixes with that from the annular. The central pipe may be constructed to adjust the area of the annular space, and so the proportion of the liquids. Claim: A mixing and suction valve, with two inlet passages and two tubular outlets, which latter have a valve seating formed at the ends, closable by a valve body common to both, and either the one slidable within the other or both fixed.—No. 9007. May 30th, 1889. 6d.

Vertical Boilers.—*J. H. Heck, Newport.*—The particulars of this invention are given in the following claims:—(1) The fitting of a tube or cylinder around the inside of all vertical boilers between the shell and the firebox or furnace, so as to divide the space between the sides of the firebox or furnace and the sides of the shell into two annular spaces, thereby increasing the circulation of the water in the boiler, through assisting the warmer and cooler currents of water and steam respectively to ascend and descend; (2) the fitting or perforation of holes in the said tube or cylinder in way of the manholes or hand holes in the shell, or of the hand holes opposite the cross-tubes of the firebox or furnace, so that the firebox, with its cross-tubes, can be properly scaled or cleaned; (3) the fitting of a bevelled or square angle covering plate to the end of the said tube or cylinder nearest the water level so as to stiffen the end of the said tube or cylinder, and to check any excessive upward movement of the water contained between the firebox or furnace side and the inner part of the said tube or cylinder.—No. 3478. February 27th, 1889. 6*d*.

ELECTRICITY.

Electric Lamp Holders.—*I. A. Timmis, London.*—The object of this invention is to increase the diffusion of the light of electric lamps. The lamp holder is constructed so that the lamp can be readily removed, and a reflector attached to the holder. The reflector is of circular form, and its under side convex and silvered. The edge is turned over downwards, and is either plain or serrated. It is fixed immediately over the lamp with its axis vertical. Claims: (1) The use of a convex silver glass reflector substantially as and for the purpose hereinbefore described; (2) the use of a holder constructed to hold the reflector close to the lamp bulb; (3) the use of a convex silvered glass reflector having a rim of clear or coloured glass.—No. 18010. November 12th, 1889. 6*d*.

Electric Railways.—*F. H. Reed, Jersey, & G. N. McKibbin, New York.*—This invention relates more particularly to rails and conduits upon that class of railways where electricity, derived from electrical conductors arranged in conduits along the line of railway, is employed as the motive power, &c. In carrying out the improvements it is preferred to lay on the cross-ties, under one of the track-rails, a continuous conduit constructed in two sections by a longitudinal division. On the top or crown of each of the halves or sections of the conduit is mounted one of the sections of a longitudinally divided track-rail. According to this construction there is an open slot or passage-way leading from the crown of the rail down into the conduit and extending along the centre track. In the conduits are arranged two conductors for forming the electrical circuit, electrical communication between them and the motor on the car being established and maintained by means of two conductors carried by the car and extending down into the conduits. The conductors on the car rub or roll against those in the conduits. This arrangement enables the conduits to be opened for inspection and repair without necessarily stopping the traffic on the road, inasmuch as the outer half or section of both the rail and the conduit may be removed and the inner halves or sections used as a temporary track for the wheels of the car. Seven claims are made for this form of conduit, for the methods of gaining access to it, and the means of draining it, &c.—No. 11615. July 20th, 1889. 8*d*.

CHEMISTRY.

Sulphite Cellulose.—*F. Salomon, Berlin, and H. Brüngger, Leignitz, Germany.*—In a previous patent, No. 13396 of 1888, a method is described of protecting the apparatus used in the manufacture of cellulose from the destructive action of the sulphite lye, the method consisting in depositing a protective coating or film on the internal surface of the apparatus from the salts contained in the lye. In the present invention the protective coating is formed from salts other than those in the lye, such as sulphite of lime, sulphites of baryta, &c. Claims: (1) The method of producing a protective scale or coating on the bare internal wall or surface of a steel or iron boiler employed in the manufacture of sulphite cellulose as herein-above defined, which consists in introducing into the boiler, being preheated or not, a solution of gypsum or other salt or salts which, when heated, will produce on the said internal wall or surface a deposit such as will not be attacked by heated sulphite lye, and afterwards heating the boiler until the formation of the desired scale or coating is completed; (2) for the purpose of allowing escape of gases or vapours during the production of a protective scale or coating whether according to the patent No. 13396 of 1888 or according to claim 1 of this specification, providing the boiling apparatus with a valve; (3) for the boiling of sulphite substances the use of a boiler or vessel constructed of iron or steel, and having on its internal surface a protective coating or scale produced from a substance (such as a solution of gypsum or other salt or salts) other than the sulphite solution to be treated.—No. 18003. December 10th, 1888. 8*d*.

Bleaching Fabrics.—*M. Zingler, London.*—The fibre, or fabric, is cleansed by soaking for one hour or more in a diluted solution of commercial sulphuric acid of 5 per cent. strength, neutralised by liquid ammonia. Next 10lb. of gelatine, or glue, are dissolved in eight gallons of water, to which is added 1lb. of commercial sulphuric acid; 5lb. of glycerine and 2lb. of liquid ammonia are then added, and digested slowly at about 150° Fahrenheit till the ammonia is evaporated. To this solution 5lb. of oleic acid are added, which previously have been saponified in five gallons of water, with 1lb. or more of bicarbonate of potash. These gelatinous and oleaginous compounds are mixed till the whole mass is thoroughly amalgamated. About 400lb. of the fibre, or fabric, are placed in the mixture, and the temperature is maintained for several hours at about 130° Fahrenheit. When dry the fibre, or fabric, is put into a solution prepared by boiling 5lb. of oxide of zinc for ten minutes in five gallons of water, in which 1lb. of permanganate of potash has been previously dissolved. After soaking for a short time the fibre, or fabric, is hung up to dry and calendered. Two claims are made.—No. 84. January 2nd, 1889. 6*d*.

MISCELLANEOUS.

Speaking Tubes.—*H. Garrard & C. Clarke, London.*—The purpose of this invention is to produce the mouth-pieces of speaking tubes with permanently attached whistles and indicating apparatus. The method of constructing a mouth-piece as described will be seen from the following claims:—(1) A speaking-tube mouth-piece having a whistle permanently fitted therein in such a manner that it may automatically lodge in the air passage through the mouth-piece and be capable of being removed therefrom by pressure upon a button while using the tube for speaking purposes; (2) an indicator for speaking-tube mouth-pieces consisting of a hinged plate raised by a current of air through the speaking tube, passing out by a vent hole normally covered by the hinged plate; (3) in a speaking-tube mouth-piece with a permanent whistle arranged to be moved away from, and to return automatically into, the air passage, the employment of a light chain connecting the whistle with the hinged indicator-plate for returning the indicator plate to its normal position when the whistle is removed from the air passage to use the tube for speaking purposes.—No. 2390. February 11th, 1889. 6*d*.

Driving Belts.—*F. W. Barker, London. (F. W. Nichols & J. E. Ingersoll, Adrian, U.S.A.)*—The particulars of the invention are given in the following claim: A means for preventing the slipping of belts consisting of two belts placed one above the other on the pulleys so as to form a double belt, both belts mounted loosely on the pulleys so that the inner belt will sag as the belts pass over the pulleys, and the outer belt will sag as the belts pass under the pulleys.—No. 17835. November 8th, 1889. 6*d*.

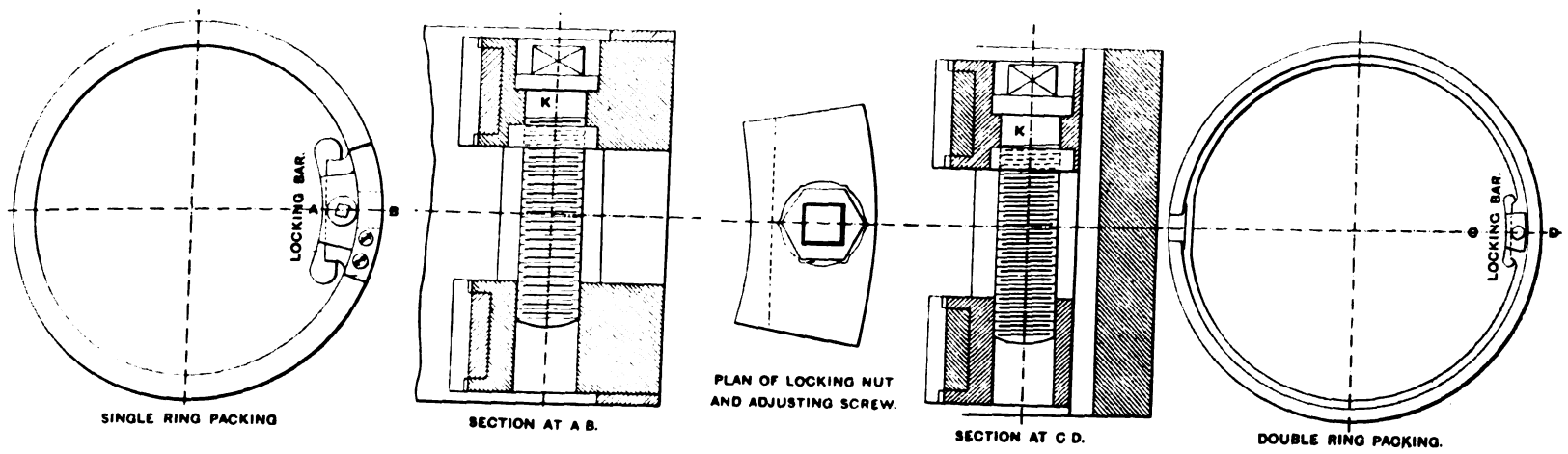
Fire Escapes.—*J. C. Hudson, London.*—A conbination of a portable fire escape and hose cart is here described. The hose cart is of the usual form of hand cart, with wheelbarrow handles. On the front end of the box of the cart the ladder is hinged. The ladder is of the telescopic class, and when closed is about three times the length of the cart. To bring the escape into use, the end of the ladder nearest the hinge is depressed, and pinned to the handles of the cart in any desired inclined position. The lengths of ladders may then be drawn out by ropes, until the escape is of sufficient height. Claims: (1) The manner of constructing a light portable escape on a cart with box or frame, with fulcrum and handles, to be run horizontally, and raised vertically from this position by means of the said fulcrum and handles; (2) the manner of securing the escape in that position, with facilities for altering the angle; (3) means of detaching the ladder from the cart; (4) props and stays below the box, that can be slid out to touch the ground and prevent the ladder falling over when extended.—No. 2,841. February 18th, 1889. 8*d*.

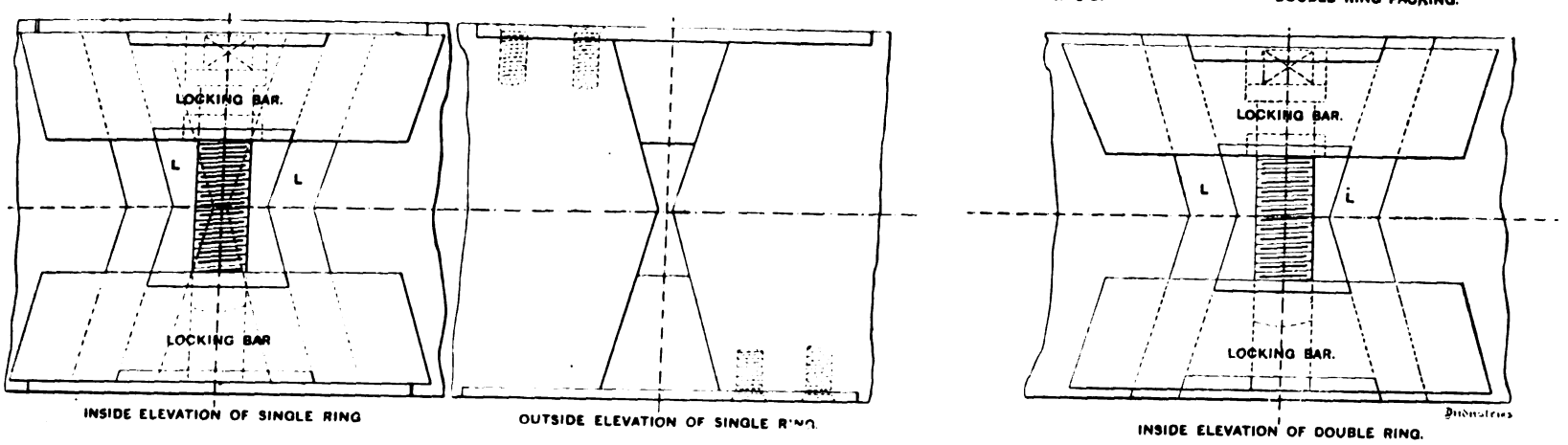
Oil Lamps for Railway Carriages, &c.—*J. H. Ross & E. E. Atkins, Birmingham.*—This improvement consists in arranging and constructing the burner, chimney, and reservoir in such a manner that the light will be drawn down below the burner, thus obviating a dark shadow being thrown underneath the lamp. The reservoir is of annular form, and has its centre concentric with the centre of the lamp. The burner is of circular form, and the wicks are conducted from the reservoir to the burner by tubes which turn downwards as they approach the burner and cause the wicks to project nearly vertically downwards. When the burner is lighted, the flame surrounds the chimney, whose end projects through and below the circular burner, and by heating it causes an upward draft in the chimney and the flame to be drawn down round the bottom and up the chimney, whilst a supply of air is induced through holes provided for the purpose. Claims: (1) An annular oil reservoir situated above a reflector, and carrying an open framing to support a central chimney and a ring to support a deflector and glass globe; (2) from the oil reservoir three or more wick tubes, or groups of wick tubes, converging towards the centre so as to present around the outside of the base of the chimney a circular wick or a circular row of wicks having the ends directed downwards; (3) within the perforated lower end of the chimney a refractory cylinder within the wick in combination with an air deflector outside the wick; (4) the chimney fitted to slide upwards and to be retained in its raised position so as to give access for kindling the lamp; (5) a ring of asbestos or porous mineral supported in contact with the ends of the wicks, so as to form an incombustible terminal to the wick.—No. 2019. February 5th, 1889. 8*d*.

Copies of the British specifications may be obtained on application to H. Reader Lack, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every 10d. or fraction of 10d. Remittances exceeding one shilling must be made by Post Office Order.*

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DOWNIE'S IMPROVED PACKING RINGS.





WORK IN THE ROYAL DOCKYARDS DURING 1889.

Under the present Board of Admiralty speed and economy in ship construction have taken the place of slow and expensive building. This laudable change has been brought about in the first place by an extensive reorganisation of dockyard management and supervision, and in the second place through the increased facilities afforded by the introduction of modern machine tools. Recent extensions and improvements made in the workshops, and the more extensive use of labour-saving appliances, has enabled the dockyard workmen to compete favourably with private establishments in the output of work, both as regards time and cost. Ships to be built economically must be built rapidly, otherwise they become obselete, in the present progressive age, before being placed on actual service. In defending the policy of rapid construction, an eminent naval authority stated a short time ago that huge "battleships and fast cruisers will be wholly useless in action unless they have been already some time in commission, and their officers and crews have had ample time to become acquainted with them and their peculiarities."

Rapidity of construction has been the policy pursued in the royal dockyards under the present *régime* during the year which has just closed, and the energies of the various naval establishments have been fairly well taxed between building, repairing, and completing vessels for actual service. The total tonnage launched from the five dockyards exceeded 36,000 tons, consisting principally of first-class gunboats and cruisers.

Of these vessels the "Blake," launched at Chatham, and the "Vulcan," launched at Portsmouth, are the first of two new and distinct types of warship, each embodying many novelties and special features to meet the demands of modern naval warfare. When complete the "Blake," as a fighting machine, will be the most powerful of her class in the world. Between perpendiculars she measures 375ft., and in extreme breadth 65ft. With natural draught 13,000 i.h.p. is to be developed, and 20 knots is estimated as the corresponding speed, while under forced draught 22 knots is expected with 25,000 i.h.p. Including armament and equipment the total cost of the "Blake" is estimated at £430,000. The "Vulcan" is of an entirely different type of vessel, and has been specially constructed to meet the requirements brought about by the increased development of torpedo warfare. She measures 350ft. in length and 58ft. in breadth, and is expected, with her powerful engines, to realise 20 knots on the measured mile, and 18 knots continuous steaming at sea. A workshop and laboratory will form a part of her equipment, and a large supply of torpedoes and gear for submarine mining will also be carried. Provision is made for the transport of no fewer than nine second-class torpedo boats, and means requisite for their repair on board will be supplied. The "Vulcan" is being rapidly pushed forward to completion for service with the Mediterranean Fleet. Her estimated cost, including machine gun equipment, is £292,100.

The particulars of the vessels launched during the year at the respective dockyards are stated in the following table:—

Chatham Dockyard.

Name of Vessel.	Official Designation.	Displacement.	I.H.P.
Blake	First-class protected cruiser	9,000	20,000
Seagull	Torpedo gunboat	735	4,500
Salamander	,,	725	4,500
Skipjack	,,	735	4,500
Sheldrake	,,	735	4,500
		11,940	38,000

Portsmouth Dockyard.

Barham	Third-class protected cruiser	1,830	0,000
Barrosa	,,	1,580	3,000
Beagle	Sloop	1,170	2,000
Vulcan	Torpedo depot ship	6,620	12,000
		11,200	23,000

Pembroke Dockyard.

Blanche	Third-class protected cruiser	1,580	3,000
Blonde	,,	1,580	3,000
Redbreast	First-class gunboat	805	1,200
Redpole	,,	805	1,200
Magpie	,,	805	1,200
Widgeon	,,	805	1,200
		6,380	10,800

Devonport Dockyard.

Lapwing	First-class gunboat	805	1,200
Ringdove	,,	805	1,200
Spanker	Torpedo gunboat	735	4,500
Speedwell	,,	735	4,500
		3,080	11,400

Sheerness Dockyard.

Name of Vessel.	Official Designation.	Displacement.	I.H.P.
Barracouta	Third-class protected cruiser	1,580	3,000
Basilisk	Sloop	1,170	2,000
Goldfinch	First-class gunboat	805	1,200
		3,555	6,200

The "Gossamer" and "Gleaner," first-class torpedo gunboats, built at Sheerness, will be floated out of dock during the present month.

In addition to the completion and preparation of the large contingents of vessels of all types which took part in the summer manœuvres, several armour-clads have undergone a thorough overhaul and refit. Among others may be mentioned the "Thunderer" and "Glatton," which have been fitted with new machinery at Portsmouth Dockyard, and the "Superb," with new triple expansion engines at Chatham; also the "Alexandria" and "Nelson," with new boilers, &c., at the same establishment. When completed these vessels will form valuable additions to the navy, and will equal in many respects the more recent productions of battle-ships.

The keels of about twelve new vessels of various types were laid down during the year in the different establishments, including three large battle-ships of 14,150 tons displacement and 13,000 i.h.p., and a large cruiser of 7,350 tons.

DOWNIE'S IMPROVED PACKING RINGS.

In the form of packing ring which we illustrate above the packing is made with either single or double rings, and the partings or cuts are directly opposite each other. The adjusting screw K acts upon the V pads L and draws them together, thus expanding the ring. Moving with the pads there are the locking bars, which prevent the rings from being extended by the steam should it get inside, while the V pads resist all compression. By a slight movement of the adjusting screw the ring can be made to fill the chamber exactly, and any wear can be taken up in a few minutes. The rings have no flanges, and will thus expand equally, and as no springs are used, the chambers will not get barrel-shaped. When fitted as a piston it can be left to float or made solid by making a joint on the junk ring. For piston valves it is usual to fix the ring, and it thus becomes a solid piston possessing the advantages of being adjustable. The packing and ring have been designed by Mr. Thomas Downie, and are being placed on the market by Messrs. H. & C. Grayson, shipbuilders and engineers Liverpool.

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PATENTS GRANTED AT HOME AND ABROAD

FROM 1864 TO 1889.

Year.	Great Britain.		Australasia.							Austria-Hungary.	Belgium.	British India.	Canada.	Cape Colony.	Denmark.	France.	German Empire.		Italy.	Natal.	Norway.	Portugal.	Russia.	Spain.	Sweden.	United States.		Year.
	Applications.	Seals.	New South Wales.	New Zealand.	Queensland.	South Australia.	Tasmania.	Victoria.									Applications.	Grants.								Applications.	Grants.	
								Application.	Grants.																			
1864	3260	2024	14	7	6	7	4	—	—	619	1753	24	145	—	—	5653	—	—	577	—	—	16	55	—	98	6932	5025	1864
1865	3386	2186	15	6	7	11	6	—	—	594	1662	36	162	—		5472	—	—	325	—	—	18	46	—	104	10,664	6616	1865
1866	3453	2124	22	9	5	12	4	—	—	526	1775	44	263	—	57	5671	—	—	312	—	—	8	45	—	129	15,269	9458	1866
1867	3723	2284	20	7	10	13	5	99	51	731	2022	21	218	—	68	6098	—	—	432	—	—	15	50	—	128	21,276	13,026	1867
1868	3991	2490	21	12	8	10	4	125	69	776	2033	40	546	1	100	6103	—	—	427	—	—	11	44	—	146	20,420	13,410	1868
1869	3786	2407	27	17	8	8	4	139	69	766	2052	48	588	—	—	5906	—	—	480	—	—	32	81	—	142	19,271	13,997	1869
1870	3405	2180	34	37	11	15	5	118	71	759	1523	43	556	—	—	3850	—	—	422	2	28	23	85	—	117	19,171	13,333	1870
1871	3529	2376	27	30	10	12	6	133	81	699	1482	55	509	—	—	2782	—	—	478	8	32	17	95	—	119	19,472	13,056	1871
1872	3970	2771	42	35	13	19	7	122	63	921	1921	71	671	1		4875	—	—	580	9	25	23	74	—	200	18,246	13,613	1872
1873	4294	2974	43	33	26	15	6	146	90	1256	2072	77	1016	2	127	5074	—	—	629	2	42	26	74	—	178	20,414	12,864	1873
1874	4492	3162	50	14	17	21	13	147	101	1321	2264	80	1218	—	147	5746	—	—	659	3	—	21	85	—	188	21,602	13,599	1874
1875	4561	3112	41	39	14	22	5	154	89	1175	2751	83	1266	—	154	6007	—	—	684	3	—	36	107	—	226	21,638	14,837	1875
1876	5069	3435	46	23	18	27	10	155	94	1295	2657	85	1337	1	—	6736	—	—	637	8	62	26	121	68	235	21,425	15,595	1876
1877	4949	3317	60	37	26	35	17	145	103	1234	2717	88	1277	2	—	7101	3212	190	765	6	99	28	128	142	261	20,308	14,187	1877
1878	5343	3509	49	50	26	63	15	147	94	1329	3151	86	1172	5	209	7981	5949	4200	845	6	96	33	138	111	285	20,260	13,444	1878
1879	5338	3524	58	46	17	51	9	158	99	1782	3142	79	1137	4	—	7828	6528	4410	901	4	123	40	154	425	327	20,059	13,213	1879
1880	5517	3741	89	80	45	56	18	176	132	2529	3061	101	1252	23	—	7660	7017	3966	949	3	109	61	165	528	406	23,012	13,947	1880
1881	5751	3950	104	77	55	81	16	197	135	2215	3191	157	1510	33	—	7813	7174	4339	1222	11	—	80	173	987	400	26,059	16,584	1881
1882	6241	4337	128	182	60	101	44	242	189	2377	3424	167	1846	50	279	7724	7569	4131	1168	19	183	87	177	—	440	31,522	19,267	1882
1883	5993	3962	144	233	77	105	45	249	—	2620	3691	181	2178	31	282	8087	8121	4848	1280	17	219	78	188	—	466	35,577	22,383	1883
1884	17,110	9984	181	358	75	108	41	295	—	2580	3675	157	2456	28	260	8250	8607	4459	1350	11	199	—	201	—	428	35,600	20,413	1884
1885	16,101	8775	161	322	54	—	24	457	—	2471	4078	168	2233	38	308	8696	9408	4018	1540	11	339	—	188	—	206	35,717	24,233	1885
1886	17,176	9097	207	504	116	—	49	485	—	2865	4325	209	2382	43	352	9011	9991	4008	1640	9	226	71	204	984	464	35,968	22,508	1886
1887	18,051	9410	—	545	148	—	49	677	—	2860	4337	218	2679	50	380	8863	9904	3882	1650	21	417	106	210	754	520	35,613	21,477	1887
1888	19,103	—	—	745	234	—	—	—	—	3503	4770	181	2401	70	424	8669	9869	3923	1680	30	401	—	—	—	494	35,797	20,506	1888
1889	20,992	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1889

PATENT STATISTICS 1864-1889.

The last quarter of a century has witnessed a remarkable increase in the activity of inventors, which is mainly attributable to the improvements effected in the laws which relate to invention throughout the civilised world. The figures in the accompanying table denote the number of patents granted (including patents of addition, in each State, and where it has been possible to obtain the necessary data the numbers of applications and grants) for each year, and have been arranged for the purpose of comparison in parallel columns.

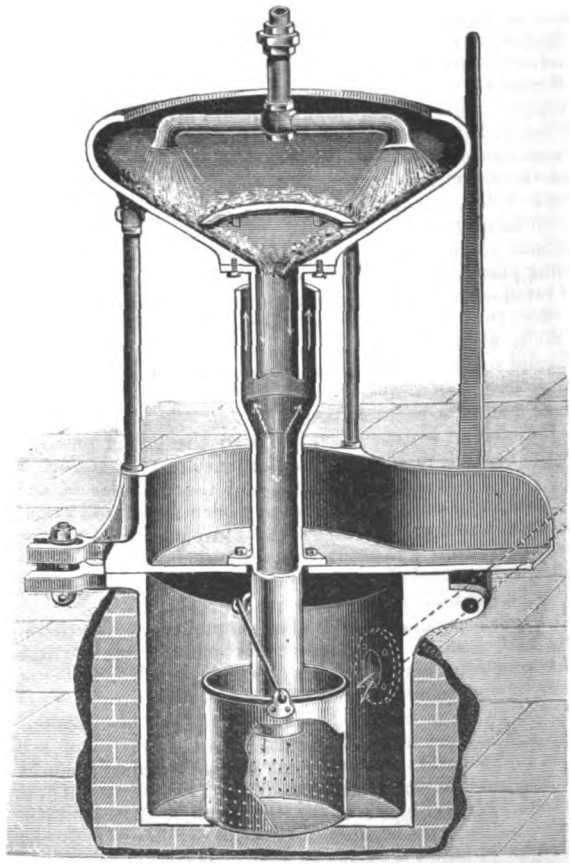
Broadly speaking, all patent systems may be divided into two classes, according as the official method of dealing with the application approximates to the American or English method. In the United States, as is well known, an application is subjected to a thorough investigation of its novelty by a careful comparison of the document with the specifications of a similar nature recorded in the office at Washington. The applicant may also be required to submit his invention to the ordeal of actual experiment in the laboratory to satisfy the examiner of its practicability. In spite, however, of the vigorous weeding out of worthless inventions consequent upon the application of so severe a combined test, the number of patents applied for (including re-issues and design patents) continued to increase until the year 1886, when the enormous total of 35,968 was reached, and a further increase is confidently predicted in the report of the United States Commissioner for the year 1887. The highest number of patents issued was in 1885, since which date a steady decrease has taken place, as may be seen on reference to the table. The total of patents issued for 1889 will be not less than 22,000, owing to the successful efforts made during the year to bring the work of the Office up to date; but with a normal working year it is probable that the tendency to decrease shown in recent years will reassert itself, and that the number of patents issued will bear an ever-decreasing proportion to that of the applications.

The fact that several countries, including Norway, Sweden, and Queensland, have in their recent legislation closely followed the German practice of examination for novelty, lends an additional interest to a perusal of the statistics of the German Patent Office since its establishment in 1877. The examination is an extension of the old Prussian system, which was based on a comparison of the application with the state of the art as disclosed in the Index of Specifications and Technical Periodicals contained in the library of the Commissioners of Patents in Berlin, and familiarly known in this country as *Schubarth's Repertorium*. The official practice, however, is entirely at variance with the more liberal traditions of the United States Patent Office, and the uncertainty which is experienced of an invention being treated on its merits, or of passing the frivolous objections which are constantly being raised, is the subject of much soreness and complaint amongst inventors, both here and on the Continent. It is not, therefore, surprising to find that the applications, which reached their maximum in 1886, have since shown a tendency to decline, while the grants have decreased at a more than proportionately rapid rate—the percentage having fallen from 59 per cent. in 1883 to 39 per cent. in 1887 and 1888.

The modifications introduced into the patent system of this country by the legislation of 1883–86 were generally in the direction of simplification of procedure and diminution of the initial cost of protection, and, with the exception of the suppression of the provisional document in cases where the application is not proceeded with, were not of fundamental importance. A careful study of the figures supports the view that the system of provisional protection supplies an equivalent for the official examination which prevails elsewhere. An inventor is enabled during the nine months to obtain a juster estimate of the market value of his invention than any official report could supply. On the other hand, if his search for prior anticipation has been defective, as it frequently is, he is enabled at any subsequent period during which his patent runs to disclaim the parts which have proved to be lacking in novelty. The same tendency which was observable in countries where a system of examination for novelty is in force appears to hold good here also, the percentage of patents sealed upon application having fallen from 69·1 per cent. in 1874 to 65 in 1883 and 52·1 in 1887. The rapid decrease since 1883 may be partly accounted for by the fact that owing to the non-publication of the provisional document an inventor feels at liberty to drop his application in order to make a second application at some more convenient time; but it is evident that the additions continuously made by inventors to the stock of public knowledge are steadily diminishing the chances of their successors in obtaining valid patents for their ideas. The truth of this deduction has been somewhat overlooked owing to the large increase in the numbers of applications, and the general prosperity of the patent industry, but it is one well worthy of the serious consideration of inventors. The remaining statistics call for no further comment, except that those for Russia do not include agricultural improvements, and that in some of the minor countries the figures must be taken as only approximately correct.

MACHINE FOR SEPARATING METALS FROM REFUSE.

We illustrate herewith a useful machine which has lately been invented by Mr. T. B. Sharp, of Birmingham, and placed on the market by Messrs. Fletcher Brothers, Borough Brassworks, Ashton-under-Lyne. It is intended for the separation of metals from earthy and other matters, and it may either be applied to the washing of ores, or for the recovery of brass turnings, &c., which accumulate on the floor of the machine shops. The earth or other refuse is fed into a hopper, in which a sparger rotates, as may be seen in the accompanying



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illustration. The spray of water whirls the particles round, and carries them down a feed pipe at the bottom. Here the stream, with the matter in suspension, meets a current of water which comes upwards through a similar pipe, and a sort of whirlpool is created. The upper end of the lower pipe is broadened and continued round the end of the upper feed pipe, and the water, together with the lighter particles, escapes through the annular space thus made. The heavier particles fall down the lower pipe and collect in the bucket at the bottom. The upward current of water enters the space in which the bucket is contained, and part of it passes through the perforations in the bottom of the bucket. The escaping water, together with the lighter particles, pass along a trough and over a weir. The function of the weir is to collect the suspended particles, and to afford the attendant an opportunity of ascertaining whether any metallic particles are coming over as well. The maximum specific gravity of the escaping particles is regulated by the head of the upward current of water.

We are informed that this apparatus has found great favour with a number of brass founders, and it is stated by them that they can wash as much machine-room refuse in four hours as used formerly to occupy a skilled washer a fortnight.

DODMAN'S HORIZONTAL ENGINE.

We illustrate herewith a neatly designed horizontal steam engine, which has been placed on the market by Mr. Alfred Dodman, engineer, King's Lynn. The cylinder is made of hard cast iron, and the bed is of box shape. The piston is of the Ramsbottom type, and the glands are bushed with gun metal. An equilibrium throttle valve and Porter's governor are fitted. The engine generally is finished in the best style, and its low price should give it a wide sale.

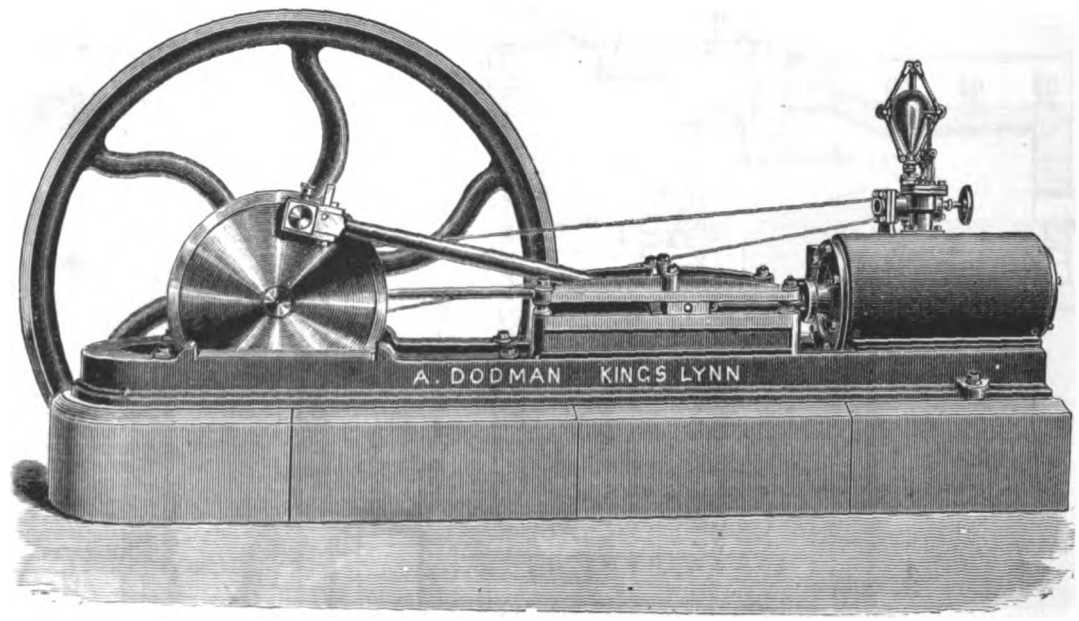
THE INSTITUTION OF CIVIL ENGINEERS.

At the seventh ordinary meeting of the session, on Tuesday, the 14th of January, the President, Sir John Coode, K.C.M.G., being in the chair, the paper read was on "Recent Dock Extensions at Liverpool, with a General Description of the Mersey Dock Estate, the Port of Liverpool, and the River Mersey," by Mr. George Fosbery Lyster, M.Inst.C.E.

The description of the dock extensions, which were more particularly the subject of this paper, was prefaced by some general remarks on the physical characteristics of the River Mersey and the trade of the Port of Liverpool. The geographical position of Liverpool, its unrivalled water frontage, and its proximity to the great manufacturing districts and to the coal and mineral fields of the north of England and Wales, could not fail to ensure its becoming a great port, and the result was seen in its continuous advance from the condition of a fishing village to that of one of the foremost seaports of the world. Its revenue at the beginning of this century, £23,380 on 450,060 tons, had increased, in 1889, to £990,000 from dues on 9,292,000 tons. The Mersey estuary was of peculiar form, roughly resembling a bottle, the wide upper estuary from Runcorn to Liverpool forming the body, and the six miles of narrows between Liverpool and Birkenhead the neck. The maintenance of the full capacity of the upper estuary was of vital importance to the port, and in this work the incessant changing of the low-water channel of the upper estuary was one of the prime factors. It was computed that on a spring-tide about 710,000,000 cubic yards, and on a neap-tide about 281,000,000 cubic yards, of water passed in and out at the mouth of the river at New Brighton. The ebb and flow of these vast quantities of water maintained channels through the wide sandbanks of Liverpool Bay. The principal channel was an excellent one as regarded width and direction; and as regarded depth, there was twice every twenty-four hours sufficient for the largest vessels, there being 10ft. of water on the bar at dead low-water of spring tides, giving 40ft. at high-water springs, and 30ft. at high-water neaps. Time was, however, now a most important element of successful trading, and the tendency was to increase the size of ships, so that a greater depth of water in the approaches to the Mersey was highly desirable, in order to avoid delay off the port. The attainment of such an end was, however, surrounded with physical and financial difficulties of no ordinary character; but the question was kept prominently in view, and the Mersey Docks and Harbour Board had recently decided to spend a certain amount of money on an experimental dredging of the bar by sand pumps. The first Liverpool Dock—the "Old Dock"—was constructed under powers obtained in the reign of Queen Anne, in 1708. The site was part of the old pool, a tidal creek on the right bank of the Mersey. This dock was the first wet-dock constructed in England, its area was four acres, and it had within it, on lowest neap-tides, 10ft. depth of water. Since the construction of the "Old Dock" others had been built from time to time as trade required, the site chosen for them being the river foreshore in front of the town of Liverpool. In the second quarter of this century, especially, many new docks were constructed by Mr. Jesse Hartley, dock engineer, to whose ability and practical knowledge Liverpool undoubtedly owed much of its commercial greatness. From 1845, also, Birkenhead, on the Cheshire or left bank of the Mersey, entered into competition with Liverpool. Docks on a very large scale had been laid out there, and already partly constructed, when, in 1858, the Mersey Docks and Harbour Board was incorporated by Act of Parliament to take over and manage as one concern the whole of the

HORIZONTAL ENGINE.

CONSTRUCTED BY MR. ALFRED DODMAN, ENGINEER, KING'S LYNN.



Liverpool and Birkenhead Docks, which, since the date named, had formed one estate. In 1871, although the Birkenhead Dock system had been for some time completed according to the Parliamentary plans, the Dock Board was urged to consider the desirability of commencing, without delay, further dock extensions on the Liverpool side of the river, on such a scale as would meet the pressing wants of trade, and provide for the growing requirements of shipping, which was everywhere advancing in size and tonnage. The result of this pressure was an exhaustive inquiry into the question by a Committee of the Board, with the outcome that the author was directed to consider and report as to the alterations and additions which might be requisite to meet the probable requirements of the great and increasing commerce of the port. Reports and plans were duly submitted by the author, showing schemes of dock extension both at the north and the south ends of the Board's Liverpool estate; and in the session of 1873 Parliamentary powers were obtained for the construction of new dock works, estimated to cost on the whole £4,100,000. The works referred to were designed to meet the wants of the port for some time in advance from the date of the Act. It was, therefore, provided that the expenditure was not to exceed £500,000 per annum, and, accordingly, the works had been spread over many years. The effect had been that, before any of the several new docks were opened, trade in its natural advance had been ready to fill them. The general design of the New North Docks comprised the enlargement of the Canada Basin, and the improvement of its entrance, so as to make it available for vessels of the largest class, and the construction of the following new docks:—The Langton Dock of 18 acres, serving as a half-tide dock, the Alexandra Dock and branches, 44 acres, and the Hornby Dock, 17 acres. The Canada basin and Langton entrances had been designed to give as direct a lead from the river as possible, so that vessels could pass quickly through, allowing of a large number docking on one tide. They had been found to work excellently; large steamers of 34,197 tons aggregate burden had been docked and undocked in one tide of two and one-third hours. A most important point in connection with the Canada Basin and approaches was that of depth. After careful consideration, it was decided to lay the sills of the entrances at the level of 12ft. below Old Dock Sill, or 2ft. below low-water of equinoctial spring-tides, and the floor of the basin and approaches at a level 2ft. lower. In order to ensure the maintenance of the required depth without dredging, special means had to be adopted to clear away the silt deposited every tide; and to this end sluicing-culverts had been constructed in all the walls of the basin, the flow of water from which cleared silt away for a considerable distance in front of the walls. To effect the removal of silt deposited beyond the range of the wall-sluices, sluice-pipes had also been laid under the floor of the basin; and these were fitted at short intervals with vertical branches having outlets through the floor of the basin. The outlets were closed by framed discs of greenheart, which effected the distribution of the sluicing water over the area to be cleared. The fairway to the basin was also maintained clear by sluices laid in the foundations of the north and south jetties, which, besides serving for this purpose, limited the area within which deep water had to be maintained, and acted as guides against which vessels entering or leaving the basin might bear. The Langton Dock had an area of 18 acres, and served as a vestibule for shipping, while its north and west quays were provided with sheds suitable for the discharge of vessels of the largest class. The graving docks, situate on the east side of the Langton Dock, were each 950ft. in length, but had intermediate gates in the centre, so that the inner chambers could be used as "long time," while the outer were used as "short time" docks. The graving docks were built entirely of concrete. A 30-ton hydraulic crane furnished means of handling screws, rudders, &c., and was so arranged as to be capable of being used at any of the four graving-dock chambers. At the entrance to the graving docks was an engine-house, which was the centre of power for the district; it contained hydraulic main engines, of 350 h.p., besides powerful engines and pumps for draining the graving docks of such water as could not be run off with the tide. On the south quay of the Langton Branch Dock was a hydraulic crane of 100 tons power, of a novel character, the lift being made by a direct-acting inverted hydraulic cylinder, a mode of working which permitted of nice adjustment of the loads. The Alexandra Dock, designed to accommodate the largest steamers, had a length of 1,600ft., and its quays were all provided with substantial sheds 95ft. wide in one span. The Hornby Dock was partly used as a timber dock, and partly for ordinary trade; for the latter purpose a shed 125ft. wide was now in course of erection on its south quay. The principal points of these northern docks were illuminated at night by electric lights, placed on masts 90ft. high. The total estimated cost of the whole of the works was £2,727,000, and, since their completion, they had accommodated sea-going ships of the largest class, with an aggregate of 18,000,000 tons. The new southern extension comprised a chain of docks from the Herculaneum, which had been constructed by the author in 1868, to the old Brunswick Dock. These new docks had been named the Harrington, Toxteth, and Union, the latter forming the link between the new system and the old. At the same time, the Herculaneum had been greatly enlarged, and, on its eastern and southern quays, special accommodation for petroleum had been provided by the excavation of casemates in the solid rock. The Harrington and Toxteth Docks were laid out for general trade, and were provided with first-class sheds, those on the western quays being single-storey sheds, 150ft. wide, whilst on the east side double-storey sheds of novel character had been erected, the width of these sheds being 95ft. The discharge of goods on to the floors of the latter sheds was effected by a number of hydraulic cranes mounted on the roof, and capable of dealing with any load up to 30cwt. Through the Union Dock, vessels which could not on neap-tides, by reason of their deep draught, get into the river over the Pluckington Bank and shallow sills of the older docks, were enabled to dock and undock through the chain of new docks into the river by the Herculaneum entrances, now deepened to 12ft. below Old Dock Sill. The level of the water in the older docks referred to would be maintained, when necessary, by impounding and pumping. The bulk of the excavation from these docks was a soft sandstone rock, and, no place of deposit being obtainable, it became necessary to send the rubbish to sea, which was done in steam hopper barges of 500 tons capacity. The estimated cost of the New South Docks was £1,372,000. By the north and south extensions, forming the subject of the paper, the area of the Liverpool Docks had been increased from 252 acres, the area at the time of the passing of the Act of 1873, to 363 acres, the present area, and the quayage from 18 miles to 24 miles.

A NEW FORM OF SIEMENS FURNACE.*

It would be necessary to write a complete history of the regenerative gas furnace to give any idea of the diversity and difficulty of the problems which Sir William and Mr. Frederick Siemens had to solve before their furnace, now so well known to iron and steel manufacturers, was made available for use in metallurgical operations. Amongst these problems may be instanced the preliminary heating of the gas as well as of the air, so as to introduce both of them into the heating chamber at a high temperature, the form necessary to be given to the regenerators in order that the heat should be deposited and recuperated in a methodical and rational manner, the arrangements for reversing the direction of the flame and for effecting a uniform diffusion of its heat throughout the heating chamber, all of which, simple as they now appear, involved a large amount of careful consideration on the part of the Messrs. Siemens. Besides these main features that had to be discovered and applied, we are also indebted to them for all the details that constitute the indispensable accessories used in the construction and working of the regenerative gas furnace. By their work the employment of reactions and metal-

* Paper read by Mr. John Head before the South Staffordshire Institute of Iron and Steel Works Managers on the 22nd inst.

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A NEW FORM OF SIEMENS FURNACE.

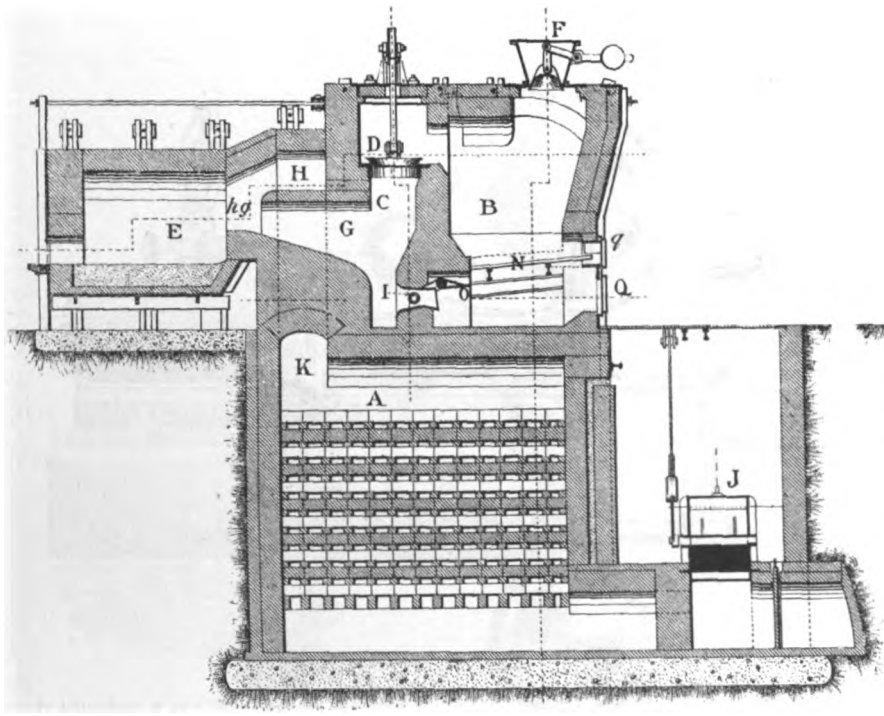


Fig. 1.

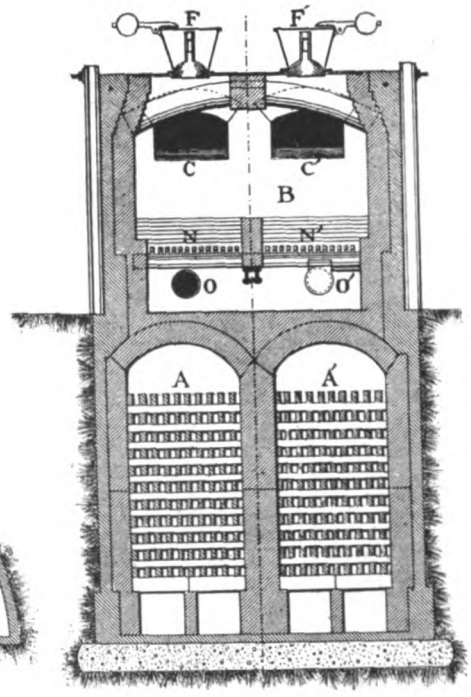


Fig. 2.

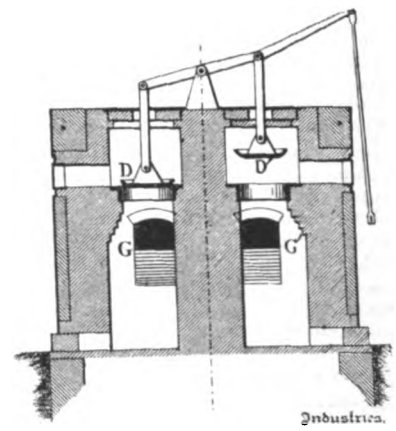


Fig. 5.

General Views of New Furnace, showing Longitudinal and Transverse Sections and Sectional Plans.

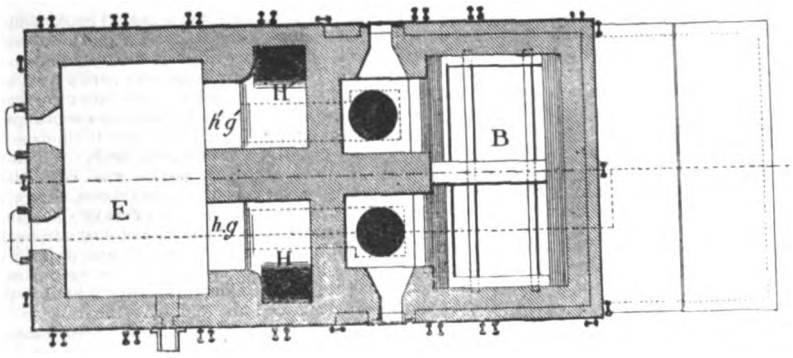


Fig. 3.

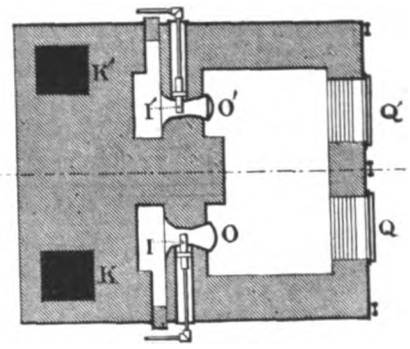


Fig. 4.

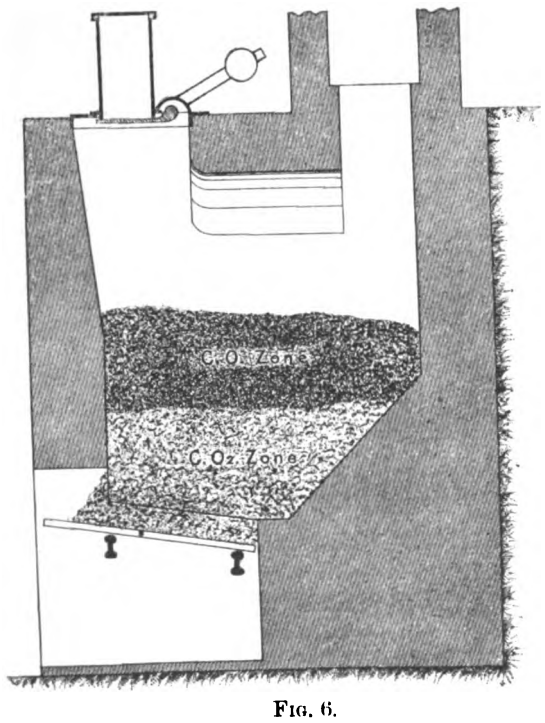


Fig. 6.

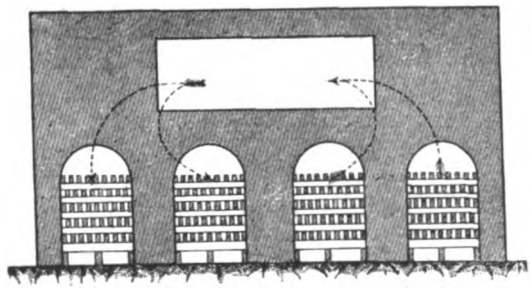


Fig. 7.

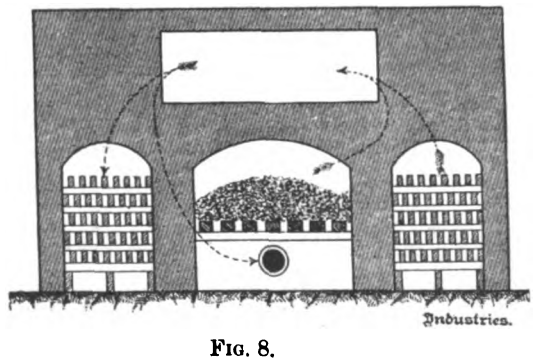


Fig. 8.

urgical operations, foreshadowed by chemical research, have been rendered possible and practicable, which, but for their furnace, could have had no practical application, and would therefore have been unavailable to manufacturers.

The great economical idea embodied and carried out in the regenerative gas furnace is perhaps best illustrated by comparison with such a meritorious invention as Neilson's hot blast stove. In this case the temperature of the blast was raised by means of fuel separately burned for that purpose, but in the case of the Siemens regenerative gas furnace the heat below the temperature of the work carried on in the furnace is impounded in the regenerators, and applied to heat up the gas and air supporting combustion. In high temperature furnaces the heat below the temperature of the work to be performed therein is by far the largest proportion of the total heat produced, and previously to the introduction of the Siemens furnace this heat had been lost by being allowed to pass away with the waste gases to the chimney. This circumstance was clearly explained by Lord Armstrong at the meeting of the British Association at Birmingham in 1865. By heating the inflowing gas and air the temperature of the flame in a furnace may be raised to almost any extent; in fact, the heat attainable under these conditions is only limited by the power of resistance of the materials of which the furnace is built, and thus the highest temperatures required in metallurgical operations are obtained with facility by the expenditure of a moderate amount of fuel, especially since the introduction by Mr. Frederick Siemens of the method of heating by radiation, by which means the durability of the furnace has also been much increased. In considering the details of construction of this ingenious apparatus it occurred to Mr. E. Biedermann and Mr. E. W. Harvey, who are on Mr. Frederick Siemens' technical staff, that possibly further economy in fuel might be realised by a re-arrangement of some of the parts of the regenerative gas furnace. Their attention was directed to the conversion of solid fuel into the gas in the producer and to the relatively high temperature at which the products of combustion passed from the furnace into the regenerators, as also to the chemical composition of these products, which temperature and gases they thought might be utilised in the gas producer. As is well known the production of carbonic oxide in the ordinary gas producer is the result of the decomposition of the carbonic acid formed in the first instance above the grate by incandescent carbon in the upper portion of the producer, according to the equation $CO_2 + C = 2CO$. Carbonic acid at a high temperature is produced with the development of heat in the lower layers of the fuel, which is transformed with the absorption of heat into carbonic oxide in traversing the red-hot fuel above, whilst hydrocarbons are distilled from the coal used, and leave the producer with the carbonic oxide produced. In the new form of Siemens furnace the gaseous products of combustion from its heating chamber are delivered under the grate of the producer. These gases consist of carbonic acid, water in the gaseous state, and nitrogen, all in an intensely hot condition. The production of carbonic acid may therefore be dispensed with (as a portion of the hot gaseous products of combustion are already in that state), provided the heat usually developed in its production and necessary for its conversion into carbonic oxide is compensated for by the heat brought in by the products of combustion. A producer so arranged will become a converter, in which the gaseous products of combustion will be reconverted into combustible gases without any diminution of the temperature of the solid fuel. Although such a result may appear at first sight paradoxical and unlikely, it has been proved by experience in the working of several furnaces during the past nine months, and may be explained by the presence in the burnt gases of a proportion of nitrogen large enough to carry the heat necessary for the reaction.

It is possible by a very simple reasoning to explain the cause and source of the economy realised in a new furnace. If oxygen be admitted below the grate of a gas producer filled with incan-

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descent coke (Fig. 6), carbonic acid will be formed in the lower zone and produce a certain quantity of heat. This carbonic acid will be decomposed in the upper zone, and absorb a portion of this heat. From this reaction it is seen that the weight of carbon gasified in the lower zone is equal to that of the carbon gasified in the upper zone, and if we suppress the production of carbonic acid and replace it by superheated carbonic acid from an external source of supply, half the fuel should be saved.

The furnace about to be described is provided with air regenerators only, but must be distinguished from furnaces in which the air alone is heated. Such furnaces are necessarily wasteful, as only a portion of the heat contained in the burnt gases can be theoretically recovered, and such a result is not attainable in practice. In the new furnace on the contrary the gases leaving the furnace are partly directed below the grate of the converter producer, and partly into an air regenerator, so that the whole of the heat is utilised as in the original Siemens furnace, but in a different manner. The air regenerators perform the same functions as formerly; but the heat which in the old furnaces was deposited in the gas regenerator is now utilised to bring about the conversion of the products of combustion into combustible gases, to distil the volatile material in the coal, and to raise these volatile constituents to a certain temperature before their arrival in the furnace chamber. The economy of the new Siemens furnace over the original form may rise as high as 50 per cent. when coke is the fuel employed. When coal is used the economy will be considerably increased, because the sensible heat of the gases necessarily lost in the original Siemens furnace is saved in this form, and the formation of tar and soot in the flues is avoided.

Figs. 7 and 8 show the relation which exists between the ordinary and the new type of Siemens furnace. In the first case the waste gases are directed through two regenerators, while in the second case the waste gases are partly directed through an air regenerator, and partly through a converter producer. In both cases the waste heat from the furnace is entirely utilised, leaving only heat sufficient for chimney draught; but as in the new furnace a portion only of the products of combustion passes away by the chimney, whilst the remainder returns to the furnace after passing through the converter producer, the heat necessary for producing draught in the chimney is diminished to the same extent. This represents a further saving in fuel. As there is no gas regenerator in the new furnace there is no loss of heat by radiation from it, and further economy is thereby also effected. In both furnaces there is reversal of the currents of air and gas so as to produce uniform diffusion of heat through the furnace chamber; in both, too, the air and gas are delivered into the furnace at a very high temperature.

This furnace may be constructed in various forms, the one shown in Figs. 1–5 having been used with success for heating and welding iron. It is a radiation furnace, heated by means of a horseshoe flame; this form of flame offers advantages in this as in ordinary regenerative gas furnaces, but its adoption is not obligatory, as the flame may be made to traverse the heating chamber from end to end in the usual manner. The same letters indicate the same parts in all the figures. AA^1 are reversible regenerators for air, on the top of which is built the gas producer or converter B, of which FF^1 are the charging hoppers and NN^1 the grates. The heating chamber E adjoins the producer and rests on the ground, or in some cases a pit may be provided below it. CC^1 are the flues leading the combustible gas to the furnace chamber E, the passage of the gas in these flues being controlled by the valves DD^1 at the two ends of a rocking-beam, so that the outlets are opened and shut alternately to convey the gas to one or other of the ports GG^1 of the heating chamber E. HH^1 are the air ports of the heating chamber, communicating through the flues KK^1 with the regenerators AA^1. II^1 are steam jets placed in the return flues for directing a portion of the waste products of combustion to the grates of the converter. J is the valve for reversing the direction of the air flowing into the furnace, and of the products of combustion through the regenerators to the chimney flue. OO^1 are hinged caps for alternately admitting and shutting off the products of combustion from the heating chamber to the converter. These caps are worked automatically by means of connections attached to the rocking beam, the same movement which closes D opening O^1, and that which closes D^1 opening O. Qq are doors for giving access to the grates of the converter for clearing them.

The *modus operandi* of the furnace is as follows:—Gas from the converter B passes through the flue C^1 and the valve D^1 to the gas-port G^1, and into the combustion chamber h^1 g^1. Air for combustion passes through the regenerator A^1, the air-flue K^1, and the air-port H^1 into the combustion-chamber, where it meets the gas from the converter, and combustion ensues. The horseshoe flame sweeps round the heating-chamber E, the products of combustion passing away by the second combustion-chamber h g, and going partly through the regenerator A and reversing valve J into the chimney-flue and partly down the flue G, whence they are drawn by means of the steam jet I through the capped inlet under the grates NN^1 of the producer B, there to be converted into combustible gases. From time to time the direction of the flame in the furnace is reversed by manipulating the rocking beam, carrying the valves DD^1 and the reversing valve J in the usual manner of working regenerative gas furnaces. An auxiliary steam jet is provided for the purpose of supplying atmospheric air to start the producer when the furnace is first heated up.

The new form of regenerative gas furnace has been applied in this country to the heating and welding of iron, to which uses its application is being extended in England and abroad, whilst furnaces are in course of construction to apply it for puddling iron and for copper and steel melting. Altogether, ten furnaces for these purposes are in course of construction, in addition to ten furnaces already at work for heating iron. The first furnace of this kind was constructed at the Pather Iron and Steel Company's works at Wishaw for welding iron, and much credit is due to the proprietors for having had the enterprise and public spirit to make the first application of this improved regenerative gas furnace. The working has been eminently satisfactory from the commencement. The success of the first application of the furnace proves the correctness of the principle upon which it is constructed and the means adopted for carrying it out. The results of working during the past nine months have shown an average saving of 5 per cent. in waste on the weight of the iron heated, and a saving of upwards of two-thirds of the weight of coal used, and a greater money saving, owing to the inferior quality of the fuel employed as compared with that used in their other furnaces fired with solid fuel. From the total saving thus realised should, however, be deducted the cost of raising steam, for which purpose the waste heat of the old furnaces is utilised. Allowing for separate boilers, the saving effected by the use of the new system in a furnace heating eight tons of iron per shift is nearly eighteen tons of coal per week, and the money saving in iron and coal exceeds £1,000 per annum

This new furnace has also been recently applied for heating billets by the United Horse Shoe Company of London, and in this case the results are quite as satisfactory or even better than those just given, as is shown by the accompanying table:—

	Date.	Number of Charges per Shift.	Duration of each Shift.	Weight of Billets Heated (30in. by 2½in. by 2¼ft.)	Average Time required for Heating to Welding.	
	1889.		a.m. p.m.	Minutes.	Tons. Cwts.	
a	Sept. 13	11	5·45 to 5·25	21	8 16	a
b	Sept. 14	6	6·0 to 12·15	20	4 16	b
c	Sept. 16	11	5·45 to 5·30	21	8 16	c
d	Sept. 17	11	5·45 to 5·30	26	8 16	d

Continued below.

	COAL.		
	Weight Used.	Used per Ton of Billets.	Quality.
	Cwts.	Cwts.	
a	17½	1·9	Newcastle small.
b	8	1·7	Newcastle cobbles.
c	17¾	2·01	½ Newcastle small. ½ London screenings.
d	18¼	2·08	London screenings.

It will be noticed from these results that in this furnace eleven charges are made in less than twelve hours, each weighing about 16cwt., and yielding in the finished state as horseshoe iron 15cwt. per charge, or 8·25 tons in the day. The amount of small coal used was about 18cwt. per shift. This is equivalent to 2cwt. per ton of iron heated, which, it will be admitted, is a most satisfactory result; in one case the consumption of coal was even reduced to 1·7 cwt. per ton, each billet coming out at a full welding heat and rolling into a sound bar. The coal used each day is indicated in the table.

The following are analyses of gas made in the converters at Pather and in London respectively:—

Pather Co. *From Wishaw Coal (nuts).*		United Horse Shoe Co. *Newcastle Cobbles.*	
CO_2	4·6	CO_2	4·5
O	nil	O	nil
CO	23·0	CO	22·5
H total	17·4	H	16·3
C vapour	1·5	CH_4	2·6
N	53·5	N	54·1
	100·0		100·0

From these analyses it will be seen that the proportion of CO_2 in the gas made in the converters is not greater than that made in the ordinary Siemens producer.

Besides the advantages in the saving of fuel and metal, it is desirable to call attention to the simplicity of design of the new furnace, owing to which its cost of construction is not much greater than that of a solid-fuel furnace, while its cost of maintenance is very much less. Its cost of construction is found to be about two-fifths of that of the old form of regenerative gas furnace, of the same productive capacity, with separate gas producers and gas regenerators, and the space occupied below ground is also considerably reduced. A saving of labour attends the employment of the new furnace, as, owing to the producer being connected with the furnace, the same men can attend to both, and the labour of firing is reduced in proportion to the reduced consumption of fuel.

In conclusion, the following advantages may be claimed for the new furnace as compared with solid-fuel furnaces used for heating and welding iron, viz.:—(1) A saving in fuel, amounting to, say, two-thirds in weight, and after allowing for raising steam in separate boilers, this saving is fully equal to 5cwt. of coal per ton of iron heated; (2) a reduction in the waste of iron equal to 5 per cent. upon the weight of metal heated; (3) a saving in labour and repairs which will probably compensate for the extra cost of the new furnace.

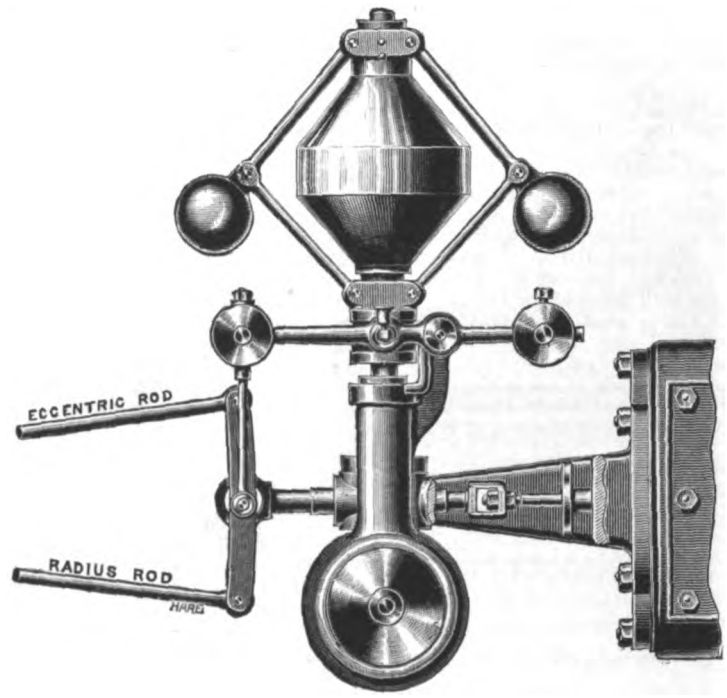
Taking a furnace to heat 10 tons of iron per shift, or 110 tons per week, the following calculation gives the money saving realised by the adoption of the new furnace:—

110 tons iron at 5cwt. per ton = 27½ coals saved at 6s...	£8 5 0
110 ,, ,, at 5per cent. = 5½ tons iron at £4	22 0 0
Being.....	£30 5 0

per week, or say, £1,500 per annum.

IMPROVED EXPANSION GEAR.

Constructed by Messrs. Ransome, Sims, & Jefferies, Engineers, Ipswich.



We illustrate herewith a new form of expansion gear for steam engines which has recently been brought out by Messrs. Ransome, Sims, & Jefferies, engineers, Ipswich. An independent gridiron expansion valve works upon the back of the slide valve, and is operated through a knuckle-joint by a link, one of whose ends is actuated by the cut-off eccentric and whose other end is pivoted to a radius rod. The travel of the valve is governed by the position of the link in relation to the knuckle-joint, and this position is varied according to the load on the engine by a sensitive governor to which the link is connected. The cut-off can by this mechanism be varied between wide limits of the stroke.

THE CHANNEL TUNNEL.

At the annual meeting of the Channel Tunnel Company it was agreed to deposit a Bill in Parliament asking for powers to construct the tunnel, and we understand that the Government has intimated its intentions of opposing it, so that its chances of passing are small. Sir E. Watkin, at the meeting, said he had no jealousy about the proposed bridge across the Channel, as he did not think it would interfere with the better means of communication offered by the tunnel, although he doubted whether the Great Powers of the North of Europe would permit the erection of piers and the obstruction of a bridge in the Channel, which was already dangerous enough. They could make the tunnel for one-tenth part of what the bridge would cost, and clearly it would be the least obstructive to navigation. At the same time, he had a perfect belief that there would be work enough both for the tunnel and the bridge, if the promoters of the latter could find the thirty-four millions necessary to make it.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

(FOR LATEST TELEGRAPHIC DESPATCHES SEE PAGE 81.)

PARIS, 21st January, 1890.

IRON.—The recent great rise in the prices of iron has visibly checked the current of business in the markets of the capital, where it has not been brisk for some months past. It is to be feared that building operations will be restricted to what is strictly necessary. With this prospect there is some doubt whether the high rate of £8 16s. for bars and joists can be long maintained. The situation is better in the provinces, where buyers are less reluctant to enter into fresh engagements. But even there founders are complaining of the check to business given by the recent rapid advance in prices. Production is in some districts retarded by the want of coal, and the cost has been considerably augmented by the high prices of the latter.

FRENCH EXHIBITIONS ABROAD.—An important meeting of Parisian manufacturers and merchants was held last week at the Hôtel Continental, for the purpose of nominating a committee to carry out the work of organising annual exhibitions of French manufactured goods abroad. The chair was taken by M. Watbled, Consul-General of France, who was supported by M. Pingot, French Consul at St. Petersburg, and M. Gründwald, Delegate Commissioner of the Russian Section at the Paris Exhibition. These gentlemen showed the necessity of giving a stimulus to French trade abroad. "It cannot be permitted," said they, "that Germany and England should carry on a trade with Russia to the value of 150,000,000 roubles annually, while the value of the commercial operations transacted with France scarcely reaches 12,000,000."

BERLIN, 20th January, 1890.

SILESIAN IRON IN 1889.—The record of the Upper Silesian iron industry in 1889 is in all points satisfactory in the highest degree. In that year we find, now that its history is being written, exceptionally important progress, both in the development of the industry and in the extension of the trade of that district. The total production of pig iron amounted to 480,147 tons against 421,939 tons in 1888, an increase of 10·6 per cent. This quantity was made up of the different classes in the following proportions, the figures in parentheses being the proportions in 1888: Spiegel and forge pig, 70·46 (71·8); Bessemer, 4·87 (6·4); Thomas, 19·17 (17·1); foundry, 5·49 (4·3). The proportion of Thomas iron steadily increases year by year. For complete statistics of the production of finished iron and steel we shall have to wait some weeks yet, but it is known that the business of the last quarter will compare very favourably with that of the corresponding period of 1888. In the first three quarters the make of half-wrought amounted to 9,456 tons, and that of finished to 240,880 tons, against 7,675 tons and 240,762 tons respectively in the previous year. In prices the rise in the second half-year was, for bars, from 150s. to 180s.; for boiler plates, from 195s. to 240s.; and for steel rails, from 130s. to 155s. a ton. In foundries and machine shops the year was a period of great activity.

THE PHOTOGRAPHIC EXHIBITION.—The International Photographic Exhibition at Breslau, which was formally opened on the 15th inst., is a very comprehensive and well-arranged undertaking. The leading idea is to show the progress of the art in the last fifty years. But the exhibits of recent work have an interest of their own, both as specimens of what may now be accomplished by means of the camera, and as a record of some recent important events. Güssfeld and Saltzmann show some fine photographs taken by command of the German Emperor on the occasion of his visits to Norway, Greece, and Turkey.

CORN MARKET AT MAGDEBURG.—A number of Magdeburg merchants and others interested in the corn trade have resolved to establish a corn market in that town. The market days will be Wednesdays and Saturdays.

THE INTERNATIONAL GARDENING EXHIBITION.—The preparations of the Great International Gardening Exhibition, to be held here from April 25th to May 5th next, are in a forward state. Applications for space may be made up to March 1st. This Exhibition, which is wide in its scope, will be one of considerable importance.

CELLULOID MANUFACTURE.—The firm of May & Co., celluloid manufacturers at Plagwitz and Eilenburg, has been turned into a share company, with a capital of one million marks. This company, which proposes to greatly extend the manufacture, will be known as the "Deutsche Celluloid-Fabrik."

CONSUMPTION OF SUGAR.—Official statistics for the years 1889, 1888, and 1887, just published, show the consumption of sugar in Germany to average 17·2lb. per head of the population per year during that period.

ELECTRICITY.—Dr. Werner Siemens has left the firm of electricians known by his name, and is intending to devote himself to scientific pursuits. The same course is being followed by his chief engineer, M. von Hefner-Alteneck.—It is intended to connect Berlin with Vienna by telephone. Lines already exist between Berlin, Dresden, and Breslau, and also between Vienna, Brünn, and Prague, so that the completion of the connection will not be a very costly matter.—The Allgemeine Electricitäts Gesellschaft has acquired the rights of the Sprague patents and of the Popp compressed air system for the whole of Germany.

VIENNA, 20th January, 1890.

BOURSE.—During the last week or so industrial securities have experienced great fluctuations. The shares of the Alpine-Montan Company decreased 2fl., those of the Prague Iron Industry Company 7fl., and the Rima Murany Works shares decreased by 2·50fl. Other shares increased, but prices were equalised shortly afterwards. The tendency is quiet at present.

COALS.—The situation does not change. An extraordinarily brisk demand is to be noted in the coke market. Russia is the best buyer, and is wanting coke for the working up of the large quantity of rails for the strategic railways. One hundred and eighteen thousand tons of rails and 11,000 tons of other materials are shortly to be delivered for this purpose.

IRON.—There is a sensible improvement in all branches of the iron industry as compared with the same period of many previous years. The brisk demand for pig iron is causing large imports, as the home works are not yet able to cope with the orders. Machine manufactories do not guarantee the term of delivery. The production of iron in the last six years is as follows:—

	Tons = 1000kg.					
	1884.	1885.	1886.	1887.	1888.	1889.
Pig iron	892,000	803,000	814,000	794,000	894,000	980,000
Finished iron...	720,000	640,000	640,000	630,000	710,000	780,000

The Austrian manufactory of arms was too small for the execution of all demands, and now the Hungarian branch already has plenty of orders on hand. The first thousand rifles are to be delivered by the Hungarian factory in June next. The Alpine-Montan Company is entering into a contract for twenty-five years with seven small works in the neighbourhood, for the purpose of using up the pig iron and of dividing the finished material in the proportion of 86 for the Alpine-Montan Company and 14 parts for the other works.

ELECTRIC LIGHTING.—On the 14th inst. the new installation at the Vienna Rathhaus was successfully opened. The general effect was excellent, and the authorities expressed themselves as highly gratified. The various parts of the building—banqueting hall, council chamber, galleries, and passages—are all liberally supplied with the new light. Altogether there are 955 glow lamps for the interior, and 160 glow lamps and 17 arc lamps for the outside.

BRUSSELS, 21st January, 1890.

THE COAL MARKET.—On account of further differences between masters and men the strike has opened out afresh in the Charleroi district. Coal is very scarce, of course, and it is totally impossible to settle any price. Coal and coke are arriving in considerable quantities from England and Germany. Scotch, South Wales, and Tyneside coal are all quoted at less figures than native coal, and the sellers are still able to obtain a large profit. With these supplies it is possible to carry on the industries of the country, but every reasonable being is sorry that the present state of things necessitates the introduction of a foreign article. Until the strike has ceased it is impossible to quote any prices or arrange any contracts.

THE IRON MARKET.—The situation of the iron trade becomes more difficult every day. A short time ago it was hoped that affairs would settle down on the resumption of work by the miners, but the new trouble has made the state of the market worse than ever. In fact the forgemasters and iron manufacturers have simply had to pass under the Caudine Forks of the foreign coal owner. The Association of Forgemasters at Charleroi have proposed that a council of four lawyers of repute shall be appointed to consider the possibility of a settlement of the present state of things, and whether anything can be done to force the completion of coal orders. The Congo Railway Company has ordered 1,500 tons of steel rails from Belgian steel works. The Société Cockerill has been able to beat Krupp in the securing of contracts for the supply of rails to Denmark.

DÜSSELDORF, 21st January, 1890.

COAL.—The dearth of coal is more and more keenly felt in all the manufacturing industries, the demand on the part of Belgian consumers, created by the colliers' strike, having seriously aggravated the difficulties of the situation. Though the market is, of course, very firm, no attempt is made to unduly force up prices. The following is the latest list issued by the Dortmund "Coal Club":—Gas coal, 14s. 6d. to 16s.; coking coal ("roughs"), 12s. to 13s., (large) 14s. to 16s., (washed nuts) 14s. to 16s.; dry burning ("roughs"), 11s. to 12s., (large) 16s. to 19s.; nuts, 17s. to 20s.; small, 10s. to 11s.; "smudge," 7s. to 8s.; blast-furnace coke, 26s. to 27s.; foundry coke, 27s. to 28s. 6d.; briquettes, 14s. to 16s. a ton.

IRON.—The efforts which are being made to increase the output of iron ore are beginning to tell on the production, and there are good grounds for believing that the supply in 1890 will be amply sufficient to satisfy the demand. In this fact we have one guarantee for the stability of the iron market. The supply of coal gives rise to some anxiety, but in other respects there is no reason for misgiving concerning the trade of 1890. At the present time the market is animated, and, as prices have steadied themselves, buyers regard the future with more confidence. Most of them have bought far forward, and as the manufacturers have in consequence plenty of work in hand, the market is not sensitive to small influences. Deliveries of foreign pig bought in the excited times of November are now being made in large quantities.

CYCLE EXHIBITION.—The second great exhibition of bicycles and tricycles, and "apparatus appertaining thereto," will be held in the Crystal Palace of Leipsic from February 22nd to March 12th, 1890. Much interest is manifested in this exhibition, not only by native manufacturers, but by their foreign rivals. The latter will be represented by the principal cycle-making firms of England, Austria, Holland, and Belgium.

LILLE, 21st January, 1890.

TEXTILE MANUFACTURES.—Business in linen goods is more active, the turnover at Armentières being from 10 to 12 per cent. greater than it was a week ago. But a comparison with the corresponding periods of the last three years is unfavourable to 1890. This is no doubt due in part to the fact that many commercial travellers and buyers' agents are laid up with influenza. At Roubaix, probably from the same cause, the market for woollen goods is less animated. Business in raw wool is for the moment somewhat slack, Australian being less inquired after, and prices a little weak. The proposal to tax foreign wool is being angrily opposed as inimical to the interests of French industry.

FLAX AND YARNS. The flax market is now active, Walloon, Douai, and De Bergères goods being largely dealt in. There is, however, a tendency to weakness in prices. The market is quiet for Russian flax. Buyers are unwilling to pay the high rates now prevailing. Italian hemp is becoming firmer in price. Business in tows is limited to the needs of the moment. Imported goods are a little dearer. There is not much doing in yarns, the market being thinly attended, a circumstance due chiefly to the influenza epidemic.

A SHUTTLELESS LOOM.—We have this week seen in action the shuttleless loom which seems destined to revolutionise the system of weaving. It is on view by ticket at No. 44, Rue Deregnaucourt, at Roubaix. It works easily, and produces fabrics of all kinds and in all materials in the most perfect manner and with great speed. The rate of production is a quarter of a yard a minute; this, with a width of 9ft., which it is capable of giving, is three-quarters of a square yard a minute, or 45 square yards an hour, for ordinary light goods. It is needless to say that this machine is exciting great interest in this district, its apparent capabilities being immense.

AMSTERDAM, 20th January, 1890.

THE CANAL BETWEEN GHENT AND TERNEUZEN.—This canal is going to be closed for forty-two days, from April 1st next, owing to repairing works at the great locks of Terneuzen.

RAILWAYS.—There is a dispute between the State and Dutch Railway Company concerning the proportion of expenses to be borne by each in the construction of the terminus for the railway from Maassluis to the Hoek von-Holland. The parties have agreed to submit their differences to arbitration.

DUTCH ENGINEERS FOR CHILI.—Consequent upon the recent visit by a Chilian State Commission to Holland in order to inspect the great works of hydraulic engineering, the Government of Chili has engaged two Dutch engineers, to whom important works are going to be entrusted. It has also appointed a Dutch gentleman, Mr. J. Kraus, to be a professor in hydraulic engineering at the University of Santiago.

TELEPHONES AT AMSTERDAM.—The Dutch Bell Telephone Company has decided to lay underground cables, if the necessary permission can be obtained.

NEW INDUSTRIAL COMPANIES.—Among the new industrial companies brought out recently in Holland, there are a Dutch boot and shoe factory, with a capital of £50,000, and an association of capitalists to carry on marble quarries in Spain. This venture, called "La Hollandesa," has a capital of £41,000.

SUGAR.—Most of the Dutch beetroot sugar manufactories are closing now, as the manufacturing time of about a hundred days has passed. Some of them, however, will be active until the end of February. When the Colonial Budget for 1890 was discussed in the Second Chamber of the Parliament, several members proposed new taxes on the cane-sugar industry. Mr. N. P. van der Berg, ex-president of the Java Bank, has given a warning against this proposal by giving a very interesting calculation of the cost of production of the Java cane sugar. There are 14 provinces in Java with 104 manufactories, of which the crop in 1888 was 3,922,630 piculs (one picul = 135·87lb.). The mean manufacturing price over 1888 was 11s. against 11s. 1d., 12s. 5½d., and 13s. 5d. in the years 1887, 1886, and 1885. A manufactory for treating 50,000 piculs wants a capital of about £50,000. The real figure ought to be taken as being 12s. 6d. per picul of Java cane sugar.

SLUICES OF YMUIDEN.—The Minister of Public Works has decided to give a depth of 10 metres (32ft. 10in.) to the sill of the new Ymuiden sluices. As in the meantime the new canal from Amsterdam to the Rhine will be ready, it is evident that an increase of the tonnage in the trade of Amsterdam is to be expected.

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PETROLEUM.—The three places in Holland where this oil is principally imported are Amsterdam, Rotterdam, and Flushing. In the first two places tanks have been erected, and Flushing will soon have a tank of 13,000 barrels. During 1889 there were imported in Rotterdam and Flushing about 673,963 barrels, against 467,936 barrels in the year 1888. In Amsterdam about 245,000 barrels of petroleum were imported in 1889, against 263,000 barrels in 1888. This decrease may be ascribed to the need of tanks in the beginning of the year 1889.

STRIKE AT GRONINGEN.—The large flax spinning mill of Mr. Dumonceau, at Groningen, has had to be closed owing to the strike of the hands. It is stated that the owner has paid away nearly £15,000 in wages in the last six years, whilst the capital invested only yielded an average interest of 3½ per cent.

THE LABOUR QUESTION.—The First Chamber of the States-General has passed the Government Bill to prolong to 1892 the State inquiry by a Royal Commission into the economic condition of the working classes.

ACCIDENTS IN FACTORIES.—In connection with the exhibition of appliances to prevent accidents to workmen in factories, which exhibition will shortly open in Amsterdam, it is proposed to found a national society having the same object in view. A great deal of public interest has been shown in this project, which is to be ventilated at a public meeting called for the end of this month. It is felt that in a country like Holland, where the legal liability of employers for compensation in the case of accidents to their artisans does not exist, and has no chance of being adopted, the employers themselves, recognising that they owe their workpeople a little more than bare wages, ought to combine at least to lessen the dangers to life and limb which exist in every factory more or less. It is proposed to found a society of employers upon the mutual plan, with a committee of experts, which would visit the factories of the members from time to time, reporting defects whereby dangers to life and limb are increased, and suggesting remedies. The society will also organise lectures and issue pamphlets, give rewards for useful inventions tending to minimise danger, award medals to employers who have the safest factories, and finally hold exhibitions of appliances with the same purpose.

THE SOUTH AFRICAN MAILS.—These mails will now leave Flushing for Cape Town, Natal, Port Elizabeth, the Delagoa Bay, &c., every fourteen days, but letters will not be forwarded by this route unless bearing the inscription "*viâ* Castle Line." The postage will be 5d. in the case of letters of ½oz., and 1d. for printed matter (1½oz. or under).

THE SUGAR TRADE IN EAST INDIA.—The First Chamber of the States-General has sanctioned the Government Bill which authorises the Governor-General to admit, temporarily, foreign vessels to the coasting trade to transport sugar in the season. Up to the present Dutch vessels only were allowed to engage in a coasting trade.

COPENHAGEN, 18TH JANUARY, 1890.

NORWEGIAN RAILWAYS.—The railways in Norway have an aggregate length of 1,562 kilometres, of which 1,494 kilometres are State railways, and the remainder, the Christiania-Eidsvold Railway, 68 kilometres. While in Sweden new railways are constantly being built, both State railways and private lines, this is not the case in Norway, though several new and important railway schemes are under contemplation. The general improvement in trade and industry has benefited the Norwegian railways during the past year, the takings for the first ten months amounting to 7,363,000kr., as against 6,616,000kr. for the corresponding period during 1888, or an improvement of about 11 per cent. The improvement is extended to the different lines, with exception of the Drammen-Skien line, where a slight reduction is noted. Rather more than two-thirds of last year's increase in takings come from the goods traffic, and consequently somewhat less than one-third from the passenger traffic. For the main line the working year 1888-89 gave a surplus of 884,000kr., so that the shareholders' dividend was raised 1 per cent., to 7½ and 6½ per cent. respectively for preference and ordinary shares. About 200,000kr. were expended in locomotives and carriages. The north line (Eidsvold-Drontheim), which, from a financial point of view, consists of various sections, also shows some improvement, the transport of sulphur ore having given considerable income; of its five sections, two, however, give no dividend to the shareholders, and the other three respectively 2·5 per cent., 1·8 per cent., and 0·8 per cent. The Meraker railway shows a considerable increase in income (about 14 per cent. as compared with 1888), but still only 2 per cent. dividend was available to the shareholders. The Kongsvinger railway has paid a dividend of 2½ per cent., showing a fair increase in takings. The Smaalens railway shows the greatest improvement in income, but the shareholders have to be satisfied with 0·8 per cent. dividend. The Christiania-Drammen railway pays its shareholders a dividend of 1 per cent., and the Drammen-Skien Railway, which is the only line showing a decrease as compared with the previous year, only sees its way to ¼ per cent. dividend. The Drammen-Randsfjord line shows steady progress, and the shareholders receive a dividend of 2·8 per cent. The Jäder railway shows a small surplus, which has been utilised to reduce the previous deficiency. The Bergen-Voss railway shows an improvement as compared with previous years, but no dividend was declared. It will be seen from these particulars that there is ample room for further improvement so far as the majority of the Norwegian railways are concerned, but as several of the more important industries of Norway are showing themselves capable of considerable development, such increase in traffic may be looked forward to with a certain amount of confidence.

EXPORT OF ICE FROM NORWAY.—The export of ice from Norway shows, as might be expected, a steady increase, as the consumption, no doubt, becomes greater and greater in various industries. The exports during the past years are estimated at—

290,000	register	tons	during	.....	1889
244,000	,,	,,	,,	.....	1888
266,000	,,	,,	,,	.....	1887
254,000	,,	,,	,,	.....	1886
228,000	,,	,,	,,	.....	1885

The economical result of last year's ice shipping is also considered satisfactory. Prices were in February 4s. per ton f.o.b.; they then declined to 3s. 6d., rose during July and August to 4s. 6d.-5s., but declined again to as little as 2s. in October-November.

EXPORT OF TIMBER FROM NORWAY.—The past year has been a good year for the Norwegian timber industry, and the best hopes are entertained as to the future. Last shipments will probably exceed those of the previous year by about 5 per cent. The export during the first ten months of last year shows that England headed the list of customers with 1,119,827 cubic metres, the next being France with only 154,029 cubic metres.

THE SPIRIT INDUSTRY IN RUSSIA.—As the export premium on refined spirit has not brought about the expected increase in the export the Government has decided to grant a premium in the refining itself, which will be paid to the producers of refined spirit for the loss of spirit through the refining process. This system will, it is anticipated, encourage the home industry in various ways.

THE PAPER INDUSTRY IN SWEDEN.—The stagnation which has been prevailing for several years in the Swedish paper industry was last year transformed into a very considerable activity, so that the mills could hardly keep pace with the demand. A result of this better feeling has naturally been an extension of old mills and the erection of new works. At the same time the German competition is apparently becoming keener, and the Germans seem able to undersell the Swedes.

MADRID, 20TH JANUARY, 1890.

QUICKSILVER IN SPAIN.—The production of quicksilver in the Almaden mine for the year 1889 has been 49,477 flasks, as compared with 53,109 in 1888. The diminished production is not to be attributed to any other cause but to the mistake of the Government in the administration—viz., in placing the management of the mine in the hands of the administrative employers instead of leaving it to the engineer. The mistake was so great that it was soon found out, and it had to be corrected almost at once; the want of technical knowledge on the part of the "red tape" parties hindered everything.

THE EXPORT OF PIG IRON FROM BILBAO.—The export of pig iron from Bilbao to foreign markets during last year was only 73,524 tons. Of ores England and Scotland took 2,770,125; Germany, 740,000; and France, 378,347 tons.

IRON ORES AT BILBAO.—It is wonderful how persistently every piece of ground in the vicinity of Bilbao, within eight or ten miles, is taken possession of on account of the supposed iron ore mines underneath. It seems very likely that it will result in a great waste of money in the majority of cases.

ANTIMONY ORE.—The engineer of the Zalamea prospecting company reports that in a recent visit to the spot he has found in the antimony lode of the mine "La Moderna," a vein of nearly pure sulphuret of antimony of 2ft. in thickness.

THE TRANSATLANTIC STEAMSHIP COMPANY.—The Transatlantic Company, who own a very large number of steamers, and who have the entire contract with the Government for carrying the mails, have printed their report and balance-sheet for the last year. The company has not been paying a dividend for five or six years, and, according to the report, some years more will pass before the profits can be devoted to such a purpose. In the meantime private lines of steamers are competing with those of their fleet with regard to the American ports, and altogether the appearance of the business of the Transatlantic Company does not look reassuring.

NEW YORK, 11TH JANUARY, 1890.

THE COAL MARKET.—The demand for anthracite is dull. There is still no demand for domestic sizes, and the boom in iron keeps up some activity in manufacturing sizes, though this affects the retail business but little. Reports from almost all the selling centres are discouraging. Many of the principal agents are discounting a winter without any cold weather, and are cutting down expenses until spring. A few have closed their offices and suspended their travelling agents, and more are talking of doing the same thing. The supply of bituminous is still less than required, and prices are varying considerably in consequence.

THE IRON AND STEEL MARKET.—The new year opened with iron and steel in a better condition than was ever known before. The price of iron is not only high, but the amount produced is enormous. Our markets are being practically supplied by our own furnaces, and the price of iron is as low at some of them as in Great Britain, while steel rails are the same price here as abroad. The market for pig iron is distinctly dearer, and while quotations are nominally $18, $19, and $20, at tide, it is almost impossible to place a fair-sized order without paying a half-dollar per ton advance, and there is every prospect of this amount being doubled in a few days. Materially more advantageous prices are not looked for, as the present advance no more than offsets the recent advances in fuel, freight, ores, &c. The actual gain as compared with this time last year is about $2 per ton, and from the lowest prices ruling during the year from $3 to $3·50, but were it not for the enormous development of resources during the last few years prices would have gone much higher. In manufactured iron business has hardly commenced yet, although most of the leading mills resumed work on the 6th inst. The feeling as regards prices is very firm, and full quoted rates are demanded on new business. The demand is not very heavy, as the majority of large consumers have already placed their orders for January and February delivery. Prices are firm at 2c. per lb. for bars, 2·35c. for iron plates and angles, and 30c. to 40c. more per hundred pounds in steel. The demand for steel rails is not large, although there is no scarcity of work. Prices for rails are $35 per ton at mill. The demand for steel in other shapes is very heavy, and more than offsets any dulness in other departments. Billets are nearly a dollar dearer, $38·50 to $39 per ton delivered being inside quotations.

THE METAL MARKETS.—The copper market has been quiet, but prices are well maintained. Lake copper for January delivery is quoted at from 14·40c. to 14·50c. per lb., while casting brands are worth 13c. Tin has been dull, spot selling at 21·20c. per lb. The plate trade has been the dullest known for a long time, as practically nothing has been doing. Lead is inactive, and is quoted at 3·90c. to 3·92½c. per lb. There has been considerably more activity in spelter; prices are slowly rising, closing quotations being 5·45c. per lb. Antimony is a little more active, and prices are steady.

A NEW FREIGHT LINE.—The sailing of the steamship "Brookfield" marked the second move in the development of the Reading Railroad's project to establish a Transatlantic freight line from this port. The Reading proposes to furnish better ocean facilities, not only for local shippers, but for general merchandise from the West, which can be obtained by its new York and Erie connections and through an agreement with the Baltimore and Ohio. There is a large river frontage at Port Richmond which is controlled by the Reading Company, the wharves of which have heretofore been allotted to individual coal operators. A consolidation of these privileges will leave ample wharfage for the new freight line. The first of the line sailed on December 10th; the "Gordonia" will sail on January 27th; and the "Ambassador" on February 20th. The company proposes chartering vessels coming here to unload, and send them away with a full cargo, intending to employ most of those coming from the Mediterranean with iron ore.

A NEW ROUTE TO NEW YORK.—Preparations are being made to run an experimental train over the Baltimore and Ohio's new road from Bound Brook to Kill von Kull. The company has had considerable trouble in building this road, and it has been able to complete it only after a number of lawsuits have been decided in its favour. A number of drawbridges had to be built, and owing to the wet weather and high tides construction has been considerably delayed. The bridge across the Kill von Kull is being pushed forward as rapidly as possible. Cofferdams are now erected, and bulwarks and piers are being extended into the water. When the bridge is finished across the Kill a through route will be opened to Staten Island, and passengers will be transported to New York by boat.

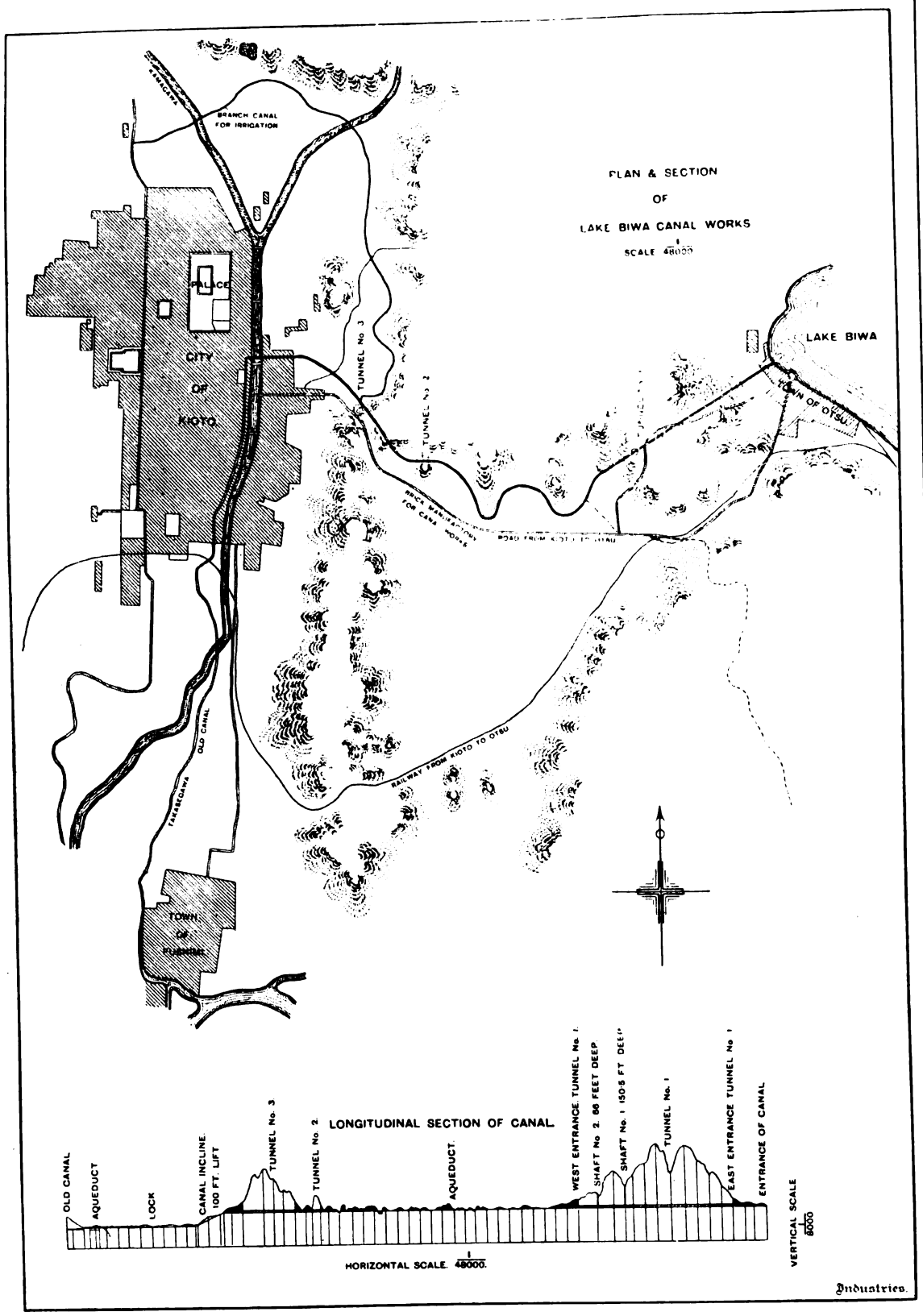
CHICAGO'S ELEVATED ROAD.—The franchise granted by Chicago for an elevated railroad through the south division is believed to be in reality intended to furnish terminal facilities in the heart of the city for one or more Eastern trunk lines. Negotiations, it is said, have been in progress with the Canadian Pacific and the Baltimore and Ohio Roads. It is intimated that the former, should it be able to secure this entrance into the city, would build a line across the State of Michigan to a connection with the elevated road at the Indiana State line.

AN EXTENSIVE STEEL PLATE CONTRACT.—One of the largest contracts for steel ship plates ever made in America was concluded a few days ago by the American Steel Company with a representative of Mr. Andrew Carnegie. The contract calls for above 5,000 tons of steel plate, amounting to over $300,000. It will furnish plates enough for seven steel vessels to be built during the coming year at Duluth, Minn. An option was given for steel enough for three more vessels, and this will probably be closed in a few days, making the entire order 7,200 tons.

KANSAS SUGAR.—The State sugar inspector of Kansas has filed his annual report concerning the sorghum sugar industry in Kansas. The grand total of the sugar manufactured this year was 1,293,275lb., as against 693,274lb. manufactured last year. In addition, the inspector states that fully 200,000lb. more sugar will be obtained from the "second," which will take a month or six weeks longer to get out.

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A NEW JAPANESE CANAL.



A NEW JAPANESE CANAL.

THE important works which have been carried on for nearly five years under the charge of Mr. Tanabe Sakuro, a distinguished graduate of the Imperial College of Engineering, Tokio, for connecting the city of Kioto with Lake Biwa, and thus opening up a waterway direct to the sea at Osaka for a very important district in Japan, are now approaching completion, and a more detailed description of them than we gave in our recent review of canal engineering for the year just closed may interest our readers, not only on account of the works themselves, but also because they afford an example of what is being done by the young Japanese engineers who have received a good training in Western methods. The map given above shows the district between Lake Biwa and Kioto, and the line of the canal, which joins an older one at Kioto, which again is connected with the river called the Kamagawa, leading direct to Osaka. The longitudinal section shown is that between Lake Biwa and the old canal, and gives some idea of the work involved.

The proposal to construct a boat canal from Lake Biwa to the Bay of Osaka is a very old one, dating as far back as the twelfth century, when Kioto became the chief seat of the Central Government. Up till 1868, when the revolution occurred which overthrew the feudal government and restored the Mikado to his position as actual as well as nominal head of the Government, the matter had not got beyond the proposal stage. Since that event, and in consequence of the seat of the Government having been removed to Tokio, it became necessary to take steps to fill the void thus caused by creating industries and encouraging trade and commerce, and this has been done with very considerable success. There is a railway from Kobe direct to Kioto, with connections in various directions, and commerce has developed to a very considerable extent, while many new industries have been started and old ones revived. It was felt, however, that something else was wanted in the way of water-carriage, and in 1885 the canal we are about to describe was commenced, chiefly through the efforts of the present governor of Kioto, Mr. Kitagaki, and it is now almost completed. In addition to providing a waterway from Lake Biwa to Osaka Bay, it will also supply water power for manufacturers, irrigation for rice fields, and such water works as are necessary for sanitary improvements.

Lake Biwa is the largest lake in Japan, having an area of nearly 500 square miles, and it lies at a height of 280ft. above the sea level. It is distant from Kioto, at the point where the canal joins it, $6\frac{7}{8}$ miles, and on that length there is a fall of 143ft. The entrance to the canal from the lake is being formed by reclaiming about 1,000ft. of the lake, and forming a breakwater to protect it and ensure still water within. The material for these works is the *débris* from the canal and the tunnel. From this point there is a stretch of 600 yards of open canal, varying in breadth from 28ft. to 19ft., and with a depth of 5ft., and it is provided with a regulating lock and sluice gate, by which the flow through the canal is maintained constant at the rate of 300 cubic feet per second. Then comes tunnel No. 1, which is 2,680 yards in length, and is the second longest in Japan. It is of horseshoe section, with a breadth of 16ft. and a height of 14ft., of which 6 is the depth of waterway. It passes through the range of Nagarayama, consisting of clay, slate, hornstone, sandstone, quartz, porphyry, and is being lined throughout with masonry and brickwork. There is no tow-path, the canal boats being intended to be drawn by a chain. The canal was laid out very correctly, as the headings met almost exactly, a feat of which Mr. Tanabe, the engineer-in-chief, has reason to be proud. From the lower end of the tunnel there is a stretch of open canal of about three miles, sometimes in cutting and embankment, but mostly in the form of a trough along the hill slope, where the outer portion is in many places more or less partly formed by artificial embankments. Thence to the basin of Kioto there is a range of hills, called Hino-oka-yama, which is pierced by tunnels No. 2 and 3, of 137 and 934 yards in length respectively, and of the same shape and dimensions as No. 1. Just below No. 3, at a distance of about $5\frac{1}{4}$ miles from Lake Biwa, the canal is divided into two. One branch, which is designed for navigation, descends about 120ft. in a distance of 1,800ft. to the plane of the city, a slope of 1 in 15. The boat traffic at this point is worked by an inclined plane, the boats being put into a wheeled cradle, which is pulled up and let down by means of a wire rope worked by the water power from the canal above. From the foot of this plane there extends a stretch of canal 60ft. wide and 5ft. deep, for a length of a mile and a quarter, and it then joins the Kamagawa—the river which provides the existing waterway to Osaka Bay. Between the canal and the river there is a regulating lock. The total length of the main canal is thus $6\frac{7}{8}$ miles, and the slope ranges from 1 in 2,000 to 1 in 3,000, excepting the incline already mentioned, and the lower reach of the canal, where it is almost level.

The second branch of the canal, from the fork at the head of the incline, leads northwards through a tunnel 150 yards long, and winds along the face of the hills, and then crosses the valley of the Imperial Tombs by a handsome aqueduct 300ft. long and consisting of fourteen arches, passes through another hill by means of a tunnel 200 yards long, crosses two rivers—the Takano and the Kamo, 160 and 150 yards wide respectively, and terminates at Kogawa, the north extremity of the city of Kioto, the length of the branch being $5\frac{1}{4}$ miles. This branch is intended chiefly for irrigation and for water power, and will be used for many manufacturing purposes. It is intended to utilise it largely for generating electricity, which may be distributed to different parts of the town, for lighting, propelling cars, &c. In these respects some of the Japanese towns have made much more progress than people in this country imagine.

The total estimates for the works amount to a million and a quarter silver dollars. Of this about one-third was a gift from the Emperor, and a quarter from the Central Government, while the remainder is to be raised by local taxation of Kioto and neighbourhood. When the work has been completed it will do much to further the trade and commerce of Kioto, and its design and execution reflects much credit on Mr. Tanabe Sakuro, the engineer-in-chief.

WE have received the Telegraph Manufacturing Company's Wire Catalogue. Besides prices of wires and cables, the catalogue contains a large number of tables of resistances, and of useful formulæ for quickly finding the sizes of wire needed for any work.

MESSRS. ARCHIBALD SMITH & STEVENS, hydraulic engineers, Janus Works, Battersea, have forwarded us their new illustrated catalogue of self-sustaining lifts and hoists. Several improvements have been introduced into their apparatus lately.

THE "PRACTICAL ENGINEER" POCKET BOOK AND DIARY.—We have received a copy of this little annual for the present year, and we can strongly recommend it to our engineering readers. It is arranged in a handy form, and contains a large amount of information of daily use to the engineer in a very concise and convenient shape. At the end of this book is a useful diary.

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Notices of Meetings.

SOCIETY OF ARTS.—Monday, January 27th, 8 p.m. Cantor Lectures: "The Electromagnet," by Silvanus P. Thompson, D.Sc., M.I.E.E. Wednesday, January 29th, 8 p.m. "The Utilisation of Blast-furnace Slag," by Gilbert Redgrave.

INSTITUTION OF CIVIL ENGINEERS.—Friday, January 24th, 7.30 p.m., Students' Meeting. Paper to be read: "The Up-keep of Metalled Roads in Ceylon," by Thos. H. Chapman, Stud.Inst.C.E. Tuesday, January 28th, 8 p.m., Ordinary Meeting. Resumed Discussion upon the paper by Mr. George Fosbery Lyster, on "Recent Dock Extensions at Liverpool," and, time permitting, paper to be read on "Bars at the Mouths of Tidal Estuaries," by Mr. W. H. Wheeler, M.Inst.C.E.

PRICES CURRENT, 22ND JANUARY, 1890.

Quotations at per ton, unless otherwise specified.

PIG IRON.

Messrs. Raby, Fell, & Co., Manchester, quote as follows:—

Middlesbro' Warrants, No. 3		58/7½	Cash
Scotch Warrants, m/n		60/4½	„
Hematite Warrants, m/n		75/4½	„
Stocks in Stores { Scotch	918,605.—Dec. for week,	6,747	Tons.
Middlesbro'	183,508.—Dec. „	700	„
Hematite	185,986.—Dec. „	354	„

Exclusive of stocks in makers' yards.

	No. 1.	No. 3.	
Coltness	80/6	72/6	f.o.b. Glasgow.
Gartsherrie	79/-	72/6	„ „
Dalmellington	71/-	70/-	„ Ardrossan.
Eglinton	65/6	64/6	„ „
Glengarnock	78/6	70/-	„ „
*Derbyshire	—	72/6	f.o.t. Works.
*Lincolnshire	—	71/-	„ „
*Lancashire	—	73/-	„ „

*Forge quality, about 1s. per ton less.

Market improving.

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	81/-	74/-

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.

Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.	Best. £ s. d.	
Middlesbro' Bars	8 2 6	8 12 6	f.o.t. wks.
„ Angles	7 17 6	8 2 6	„
„ Plates	8 5 0	8 15 0	„
Staffordshire Bars	9 7 6	9 17 6	London.
„ Angles	9 7 6	9 17 6	„
Crown Sheets	9 0 0	9 10 0	„
„ Hoops	8 10 0	9 0 0	„
"Siemens-Martin" Steel Boiler Plates		10 5 0	„
„ Ship and Girder		9 5 0	„

Market steady; prices firm.

METALS.

Spelter: Ordinary	£25	7	6	to	£25	10	0
Copper: British Cakes and Ingots	58	0	0	„	59	0	0
„ Chili Bars, G.O.B.'s	49	5	0	„	.....		
„ Other sorts, G.M.B.'s (equal to Chili Bars)	49	5	0	„	.....		
„ Manufactured (strong)	66	0	0	„	.....		
Lead: Common Pig	15	12	6	„	15	17	6
„ English Sheet	16	2	6	„	16	7	6
Tin: Straits	94	0	0	„	94	10	0
„ Australian	94	5	0	„	94	15	0
„ English Ingots	99	10	0	„	100	0	0

Messrs. Carrick & Brocklank, Manchester, report as follows:—

COPPER: The high rate of discount keeps copper slightly depressed, though the market closed firmer yesterday. Forward Chili bars are worth £49 15s. to £50. Manufactured copper is still quite firm at £66 for sheets and £69 for bottoms, and all the manufacturers are extremely busy.

TIN is practically unchanged, but it is worth a trifle more than when we last wrote. There is a good business doing in English tin.

LEAD is slightly lower, although a considerable business has been done during the last fortnight.

SPELTER: There is a good demand for this metal, and the price is well maintained; nevertheless, there is a little weakness, probably in sympathy with other metals generally.

CHEMICALS.

		£	s.	d.		£	s.	d.
Acid: Carbolic Crystals	lb.	0	0	11	—	.....		
„ „ Liquid	gal.	0	1	2	—	.....		
„ Citric	lb.	0	1	7	—	.....		
„ Oxalic	„	0	0	3½	—	.....		
„ Sulphuric	ton	1	10	0	—	.....		
„ Tartaric	lb.	0	1	4	—	.....		
Alum: Lump (powder 10/- ex.)	ton	4	17	6	—	.....		
Ammonia: Carbonate	lb.	0	0	3½	—	.....		
„ Muriate (Grey)	ton	22	5	0	—	.....		
„ „ (White)	„	26	0	0	—	.....		
„ Sulphate	„	12	2	6	to	12	5	0
„ Liquor	lb.	0	0	3½	—	.....		
Antimony	ton	.....			—	.....		
Bleaching Powder	„	5	2	6	—	5	5	0
Bisulphide of Carbon	„	13	10	0	—	.....		
Borax	„	30	0	0	—	.....		
Benzole (90 %)	gal.	0	3	7	—	.....		
„ (50/90 %)	„	0	2	9	—	.....		
Copper Sulphate	ton	24	10	0	—	.....		
Copperas	„	2	0	0	—	.....		
Kieserit	„	1	13	0	—	.....		
Lead: Nitrate	„	22	10	0	—	.....		
„ White Sugar	„	24	0	0	—	.....		
„ Brown „	„	19	0	0	—	.....		
Potash: Bichromate	lb.	0	0	4	—	.....		
„ Caustic	ton	22	0	0	—	.....		
„ Carbonate	„	19	10	0	—	.....		
„ Chlorate	lb.	0	0	4½	—	.....		
„ Prussiate (Yellow)	„	0	0	10½	—	.....		
„ Sulphate (Basis 90 %)	ton	9	10	0	—	.....		
Precipitate: Red	lb.	0	3	1	—	.....		
„ White	„	0	3	2	—	.....		
Salts: Epsom { Bags	ton	3	0	0	—	.....		
Casks	„	3	15	0	—	.....		
„ Glauber	„	1	10	0	—	.....		
Sulphur: Sublimed Flowers	„	9	0	0	—	.....		
„ Recovered	„	4	10	0	—	.....		
Soda: Ash	deg.	0	0	1½	—	.....		
„ Caustic (White 70%)	ton	7	17	6	—	.....		
„ „ { „ 60%)	„	6	17	6	—	.....		
„ „ (Cream 60%)	„	6	7	6	—	6	10	0
„ Crystals	„	2	10	0	—	.....		
„ Bicarbonate	„	5	5	0	—	.....		
„ Hyposulphite	„	6	5	0	—	.....		
Solvent Naphtha	gal.	0	3	6	—	.....		
Tartar, Cream of	cwt.	5	12	6	—	.....		
Zinc Sulphate	ton	7	10	0	—	.....		

Messrs. S. W. Royse & Co., Manchester, report as follows:—

CHEMICALS.—The position in the alkali markets is hardly so healthy now as last week. Bleaching powder has given way somewhat, and though the high prices for caustic soda are maintained, supplies being so limited, there are few buyers. Soda ash continues scarce, makers being fully engaged for some weeks ahead, and higher prices are being asked for soda crystals. The excitement in acetate of lime has somewhat abated, but the position is very firm; acetate of soda is, however, dull; acetates of lead steady. All carbolic acids are quiet. Benzoles are tending upwards. Solvent naphtha and creosote are moving off briskly. Sulphate of copper is scarce on spot, and little obtainable for next month.

OILS.

		£	s.	d.
Cocoanut: Cochin	per tun	26	0	0
„ Ceylon	„	23	15	0
Cottonseed	„	22	0	0
Cod	„	19	0	0
Lard	„	37	10	0
Linseed	„	20	10	0
Palm, Lagos	„	25	10	0
Rapeseed: English	„	32	10	0
Seal: Pale	„	26	10	0
„ Brown	„	19	0	0
Sperm	„	45	0	0
Whale	„	24	0	0
Turpentine	per cwt.	1	15	9
Coal	per gal.			
Petroleum (Refined)	„	0	0	5½
„ Spirit	„			

FOREIGN TELEGRAPHIC ADVICES.

(From our own Correspondents.)

PARIS, Jan. 23.—*Iron.*—The market here is quiet, and the prices of bars and joists rarely rise above 160s., though quoted 168s. in the official lists. The demand has slackened a little in the Haute-Marne. In the other markets of the provinces the current of business is brisk, and everywhere prices are firm. Plates are much sought after. In the Nord bars and joists are quoted by some manufacturers 160s.

Metals.—The "booming" tendency of the metal market has run itself out, and a reaction has set in. Copper has lost some of last week's advance, Chili bars being now quoted £54. Tin prices have given way considerably, Banca being quoted £103, and Straits £100. Lead has receded to £14 8s. free at Havre. Spelter maintains its ground, Silesian being firm at £26 delivered at Havre.

BERLIN, Jan. 23.—*Metals.*—The metal market is moderately active. For copper prices tend in favour of sellers, Mansfeld refined being quoted £61 to £62 10s.; but tin has given way, and still shows a declining tendency. Banca is quoted £104 to £106. Lead is firm at last week's prices. The same may be said of spelter. For antimony regulus the market remains unchanged.

BRESLAU, Jan. 23—*Iron.*—The base price for bar iron has been advanced to 210s. a ton. Boiler plates and thin sheets are also quoted higher, the former selling at 250s., and the latter 260s., a ton. The demand is strong for all classes of iron. The blast furnaces are now working more regularly.

Zinc.—The zinc market is somewhat disturbed by a partial strike among the zinc workers of this district for an advance in wages. Their demands have been in part conceded. Spelter prices are, for the W. H. brand, 505s., 500s.; refined, 480s., 476s.; ordinary, 476s., 420s., according as the dates for delivery are less or more distant. Zinc dust is quoted 410s. to 420s.

Paper Prices.—At a meeting of the members of the Silesian and Saxon Papermakers' Convention, held in Dresden, it was resolved to make a considerable advance in the prices of printing and writing papers to cover increased cost of production due to higher wages and dearer coal and raw materials.

DÜSSELDORF, Jan. 23.—*Coal.*—The coal market is again disturbed by the prospect of another strike of colliers, the latter having given notice, through their representatives, that after February 15th they will demand a 50 per cent. rise in wages. The quotations for coal to-day do not materially differ from those of a week ago. Within the last eight or ten days a large quantity of coal has been sold for export to Belgium.

Iron.—The price of spiegel pig has been advanced 1s. a ton. The demand for forge pig is very brisk, but foundry is less inquired after. The market is very active for finished iron and steel. Bars, angles, and hoops are a little dearer. The following are the latest quotations: Ordinary spiegel pig, 103s.; Rhenish-Westphalian forge, 92s.; Siegen forge, 93s.; foundry No. 1, 102s.; Thomas, 82s.; Bessemer, 93s. to 96s.; bars, 205s.; angles, 215s.; hoops, 212s. 6d. a ton.

HAMBURG, Jan. 23.—*Nitrates.*—The market is dull for Chili saltpetre, and prices are weak. Spot goods are offered at £8 2s., and February and March arrivals at £8 3s.

BRUSSELS, Jan. 23.—*Bourse.*—Industrial securities have fallen heavily within the last few days, and the downward movement continues. The drop has been greatest in the shares of the colliery companies, but iron and steel shares have followed at not long intervals. Shares in glassworks have, however, held their position in the market. These changes are a significant commentary on the industrial events of the last few weeks.

CHARLEROI, Jan. 23.—*Iron.*—The current of business in the iron market is greatly obstructed by the uncertainty of the coal supply. Naturally prices tend upwards, but sellers are reluctant to enter into fresh engagements. Dealings are most active in plates, which are very firm at 184s. a ton for the No. 2 quality.

Glass.—The production of the glassworks is greatly restricted by the want of fuel. A further advance in the price of glass to cover the increased cost of coal is under consideration, and will probably be agreed to within the next few days.

GHENT, Jan. 23.—*Flax and Yarns.*—The market is now well supplied with home-grown flax, and the demand is brisk. Prices remain unchanged. There is but little doing in Russian flax. The demand for yarns is slack, but prices are firm both for flax and cotton.

English Coal.—A firm of English coal importers is offering Welsh coal at 22s. 6d. to 23s., Newcastle coal at 19s. 4d. to 20s., and Scotch coal at 18s. 6d. a ton. A large trade is being done at these prices, Belgian and French coals being scarce.

SHIPBUILDING NOTES.

ON the 16th inst. Messrs. Russell & Co., Port Glasgow, launched the "Glen Cona," a large four-masted sailing ship of 2,500 tons net register. Her dimensions are:—Length, 213ft.; width, 42ft.; depth, 24ft. 6in.

ON the 21st inst. Messrs. Richardson, Duck, & Co. launched from their yard at Stockton an iron screw-steamer of the following dimensions, viz.: Length over all, 280ft. 3in.; breadth, extreme, 36ft. 6in.; depth, moulded, 19ft. 1½in. This steamer, which has been built to the order of Messrs. Burdick & Cook, of London, is classed 100 A1 at Lloyd's, and has been built under special survey. She has a short break poop, raised quarter-deck, long bridge from after end of engine room to foremast, topgallant forecastle, and cellular double bottom fore and aft for water ballast. Her engines are by Messrs. Blair & Co., Ld., and have cylinders, 21½in., 35in., and 57in. in diameter, by 36in. stroke. As the vessel was leaving the ways she was christened the "Eugenie."

WE have received a copy of a new catalogue which is now being issued by Messrs. R. E. Crompton & Co., Ld., Chelmsford. The book is got up in exceptionally good style, and is full of the very best photo-engravings of the various machines and apparatus manufactured by this well-known firm.

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HOME INDUSTRIES.

LONDON 23rd January, 1890.

THE MONEY MARKET.—While the money market remains firm, the fear of gold withdrawals keeping it stiff, the competition among discounters for the few bills which are offered has led to a slight falling away in discount rates. There is no actual change in the monetary position. The dearness of money continues to restrict dealings on the Stock Exchange, but there have been a number of important movements. The most pronounced have occurred in South American securities, a sudden drop in the premium on gold at Buenos Ayres having given a fillip to all Argentine stocks. Brazilians, too, have improved, as the progress of time does not reveal any immediate likelihood of political or financial disturbance. Still, unless the decree relating to foreign capital in Brazilian enterprises can be explained away, as most of the reported eccentricities of the Provisional Government have been, an awkward time may be in store for shareholders in industrial undertakings in the new republic. Another movement in foreign stocks of some interest is the rise in Egyptians, owing to the approach of an agreement with France with regard to the conversion of the privileged debt. The market for home railway stocks has been uncertain, and the movements have been of little account. American railways have been firm, but Canadians are hardly in such favour as they have been. An unexpectedly good traffic return on the Mexican Railway has led to a rally in the securities of that line. Nitrate shares are still falling, and mines are a weak market.

COMPANIES.—The following companies have been registered since our last report:—Fraser & Chalmers, Ld., with a capital of £525,000, to carry on the business of mining machinery manufacturers; Aqueous Works and Diamond Rock Boring Company, Limited, with a capital of £25,000, to acquire certain patents; The Clutha Gold Mines, Ld., with a capital of £100,000, to acquire mines, &c., in the Transvaal; Argentine Inter-Provincial Railway Company, Ld., with a capital of £1,200,000, to construct, &c., railways in the Argentine Republic; La Plata Mines, Ld., with a capital of £100,000; The Louis d'Or (Main Reef) Gold Mining Company, Ld., with a capital of £80,000; The Jerram Sewing Machine Company, Ld., with a capital of £4,000; Fowler, Lancaster, & Co., Ld., with a capital of £22,000, to carry on the business of electrical engineers; The Caribbean Syndicate, Ld., with a capital of £20,000, to acquire lands, &c.; Kilburne Colliery Company, Ld., with a capital of £20,000; Fry, Janson, & Co., Ld., with a capital of £20,000, to carry on the business of ironmasters, general engineers, &c.; The Danube Bridges and Kustendje Harbour Works Company, Ld., with a capital of £500; The London Paper Mills Company, Ld., with a capital of £75,000; New Asbestos Company, Ld., with a capital of £120,000; The Glyncorrwg Colliery Company, Ld., with a capital of £200,000; The English Lager Beer Brewery, Ld., with a capital of £100,000; South Metropolitan Brewing and Bottling Company, Ld.; The Bristol Channel Steam Tug Owners' Association, Ld.; The Minerals and Fuller's Earth Syndicate, Ld., with a capital of £2,000; The Anglo-Dutch Borneo Goldfields, Ld., with a capital of £60,000; The Anglo-Dutch Borneo Diamond Fields, Ld., with a capital of £60,000; The Harmony Goldfields, Ld., with a capital of £1,000,000; The Globe Mill Company, Ld., with a capital of £140,000, to acquire certain patents; The Cantabrian Copper Mines, Ld., with a capital of £100,000; The Electrical Engineering Corporation, Ld., with a capital of £150,000; The Posman Syndicate, with a capital of £25,000, to prospect, examine, and explore countries; The Southern Africa Syndicate, Ld., with a capital of £1,000, to prospect, examine, and explore in South Africa.

ENGINEERING.—It will be remembered that some eighteen months ago we mentioned that a great increase in their business had made it necessary for Messrs. Davey Paxman & Co. to enlarge their works, and that new and large buildings were erected to take the place of the old pattern shop, which was then cleared and added as an extension of the foundry. We are glad to be able again to note that this firm is extending its works still further, and is again adding to the foundry and its already very large boiler shops.

SHIPPING.—Freights have shown a firmer tone, and rates have advanced. American business has been large, at the full advance for January and early February loading, but the demand has fallen off for later dates. A large fleet of steamers has been chartered for grain, general cargoes, and cotton, besides a few oil boats. Coal prices continue very high, and great difficulty is experienced in obtaining coals for bunkers or cargo. In shipbuilding activity prevails, and orders are booked from week to week, but in small numbers, as prices keep beyond the ideas of prudent owners, and considering the heavy increase made in the tonnage afloat during the past two years, the probable decrease of earning power, and present increase of working cost, there exists little encouragement to order new boats. The work secured by builders will keep them busy well into the third quarter of the year. Good second-hand boats are still inquired for, but at less money.

THE NAVY.—Messrs. Richard & Henry Green have received an order from the Admiralty to construct a steel steam water-tank and fire-float vessel for service at Sheerness Dockyard. She is similar to two steamers already built for the Admiralty, and will be placed on her station at the end of the present year. The machinery and pumps will be supplied by Messrs. Hawthorns & Co., of Leith.

INDIAN STATE RAILWAYS.—The Secretary of State for India is advertising for tenders for ironwork and steelwork for roadway bridges for Bibinani Crossing, Bolan Road, Beluchistan. Tenders will be received up to the 28th inst. The present requirements are 8 spans of 77ft. 6in. in the clear, 2 spans 23ft. in the clear, and certain additional ironwork at the connections of some of the spans, including all rivets, bolts, nuts, &c., required to complete the erection of the bridges in India, together with an allowance for waste, &c., of 10 per cent. of bolts and 50 per cent. of rivets on the net quantities required. The 77ft. 6in. spans consist of two lattice main girders 8ft. 9in. deep, cross girders, and trough flooring, together with fenders at the sides of road, handrail standards, and handrails. The smaller spans consist each of four 16in. rolled joists carrying trough flooring, fenders, and handrails. The larger spans are carried on expansion rollers of Bessemer steel supported on cast iron bedplates. All holes, which are to be riveted in India, are drilled. The contract includes three sets of hand-made tracings as the work is constructed. The approximate weight of one span of 77ft. 6in. is 53¼ tons, and of one 23ft. span 8¼ tons. Quick delivery is desired, and the contractor must state the time in which he undertakes to complete. Prices to be for delivery f.o.b. London, Birkenhead, and one other port to be named by contractor.

CYCLE SHOW AT THE CRYSTAL PALACE.—The Thirteenth Annual Exhibition of Bicycles, Tricycles, and Accessories, which will this year take place at the Crystal Palace, opens to-morrow, the 24th inst., and promises to eclipse all its predecessors as regards the number of machines to be shown. Not only will the entire floor of the Palace and courts be covered by exhibits, but this year the large Concert Hall has had to be thrown open to this use; even then the space appears insufficient, as many manufacturers have been compelled to curtail their exhibits.

MANCHESTER, 23rd January, 1890.

AN IMPROVED GASHOLDER.—The members of the Manchester District Association of Engineers visited Northwich on the 19th inst., where a new gasholder had just been filled. The holder is made on a new principle—the invention of Mr. William Gadd, C.E., of Manchester—and entirely obviates the use of the columns ordinarily employed. Spiral ways or guides are fitted inside the well, and the bottom of the inverted portion of the holder is provided with runners, which press upon the guides. As the gas enters the holder it lifts the upper portion, which receives a spiral instead of the usual sliding motion. The Northwich holder is a two-lift one, each lift being 20ft., the diameter being 60ft. While it has been filled, the severe gales of the past few days have tested its endurance. The work has been carried out by Messrs. Clayton, Sons, & Co., of Leeds, to the designs of Mr. Thomas C. Newbigging, C.E., of Manchester.

THE SALT TRADE.—The exports of salt from the Cheshire district do not point to a great success of the Salt Union. They reached in 1889, 745,111 tons; in 1888, 1,022,334 tons; and in 1887, 994,726 tons. The falling off is general to all the large markets, but it is stated that a much better tone is now observable, and that the demand is much greater.

PREFERENTIAL CLAIMS FOR RENT.—At a conference of various Chambers of Commerce in the North held in Manchester, on the 21st inst., it was resolved that landlords should not have power of distraint for rent in advance, nor when more than twelve months in arrear, nor in case of bankruptcy. It was also agreed that the power of distraint ought not to extend to the recovery of any sum paid as rent for power or machinery; and that in case of bankruptcy the claims should rank in the following order: The costs of the petition and administration of the estate; the claims of the landlord subject to only six months' arrears and not to the hire of power or machinery, or to an amount beyond that realised by the distress and paid over after deducting the cost of any goods delivered to the tenant within three months of the petition. The claims of the general creditors are placed last, and the landlord can claim as such for such amounts as are not preferential.

LOCAL RAILWAY BILLS.—The various local railway bills have been advanced a stage by passing the examiners of the House of Commons. The North West Central Railway, to which we referred a few weeks since, has been lodged. The capital is fixed at £2,000,000, and the borrowing powers at £666,664. The new loop line of the Manchester, Sheffield, and Lincolnshire Railway Company, which gives them access to the station belonging to the Midland Railway Company, is making rapid progress. At the Manchester end some heavy bridge work will be requisite in order to double the existing viaduct.

THE IRON TRADE.—After the free buying of the last few weeks the market here is somewhat dull. The heavy fall in warrants, although undoubtedly speculative in character, induces buyers to postpone purchasing, and as makers are well filled with orders they are indisposed to offer iron at lower rates. The result is that little business is being done except in small lots. Finished iron is in better request and prices are fully maintained. Steel bars and forgings are also very well ordered, and there is a good trade being done in steel plates.

THE LINEN AND JUTE TRADES.—In the linen, as well as other departments of Manchester trade, the principal interest of the week has been centred in the great sale of heavy goods, formerly included in the stock of Messrs. Samuel Fletcher, Sons, & Co., which began on Monday, and was at its height on Tuesday. Buyers from all parts of the kingdom flocked to this city for the occasion, and a very extensive business resulted. Messrs. Rylands were the purchasers of the stock, which is variously estimated at from £30,000 to £40,000 in value. The home trade in linens keeps satisfactory, and a better demand has been noticeable of late. Nothing, however, of a definite nature can yet be said concerning the extent of the orders received, as we have not got into full activity. Prices keep firm, and linen threads sell well at the figures previously given. There is a good inquiry for jute fabrics, which sell extensively in this market.

GLASGOW, 23rd January, 1890.

PIG IRON.—This week has again been a disheartening one for holders of warrants. Daily the price came down under the pressure of heavy sales, till at last a number of holders began to feel that there must have been something wrong in their calculations, and the lower the price went the greater was their anxiety to get out. On Monday, the 20th, hematite and Cleveland experienced a fall of about 2s. 6d. per ton, Scotch giving way about 1s.; and the following day there was a further fall in every description of warrants, but things rallied fairly in the afternoon. On Tuesday the market was fairly brisk, and though at the opening of the market there was a good deal of selling, there was less disposition to break rates.

SHIPBUILDING.—The recent falling off in the number of new orders in the shipbuilding trade may, perhaps, be explained by the great decline which has taken place in colonial freight rates. In November, 1888, the rate from London to Melbourne was 63s. 6d.; the present rate is 40s. At the same date rates to the River Plate were 37s. 6d.; now they are 26s. 6d. Since November of last year Cape steam rates have fallen from 50s. to 39s., and in other directions there is a proportionate falling off. Under these circumstances shipowners can scarcely be expected to increase their tonnage.—Messrs. Denny Brothers have booked an order for a large steamer for the Union Steamship Company. The vessel will be similar to one now in the hands of the same builders for the same owners.—Messrs. W. B. Thomson & Co. have secured a contract to build a steamer of about 900 tons for Messrs. M. Langlands & Sons, Glasgow. The vessel is to be employed in their trade between Leith, Dundee, Aberdeen, and Liverpool, and is to be fitted with triple expansion engines and every modern improvement.

COALS.—Specifications are issued for contracts of over 103,000 tons of coals for the Swedish railways, consisting of about 100,000 tons of locomotive coal and 3,000 tons of gas coal, anthracite, &c. The coal is deliverable at the following Swedish ports: Stockholm, Göteborg, Malmö, Stugsund, Sundsvall, and Trondhjem. Lochgelly is the Scotch coal specified, while South Yorkshire, Edmonds, Wombwell, &c., and West Hartley, Davison's, Hastings, &c., are specified in English coal.

ENGINEERING.—A contract for 18,000 tons of cast iron pipes for Queensland, which has been in the market for some time, has been secured by Messrs. Robert Maclaren & Co., of the Eglington Iron Works. The goods will probably be shipped by the Shire line of Messrs. Thomas Law & Co.

THE FORTH BRIDGE.—The Forth Bridge was tested on Tuesday, a train weighing 2,000 tons being run over it slowly. The train was composed of 100 loaded coal waggons.

LABOUR.—Another agitation among the sailors and ship hands generally on the Clyde, for a further increase in wages, is on foot. An advance of 5s. per month has been conceded to the firemen on some of the lines, and this has apparently suggested a demand by the seamen for a similar rise. These demands are being granted in several instances.

THE EDINBURGH EXHIBITION.—The committee of the Exhibition are prepared to consider tenders for the working of the electric railway which they have decided to lay down in the grounds. The railway will be used for many practical purposes, and not merely as a show piece.

(From our own Correspondents.)

LIVERPOOL, 22nd January, 1890.

IMPORTANT DOCK IMPROVEMENTS.—At the last meeting of the Dock Board the Works Committee recommended the raising of the quay of the Queen's Dock, and the erection thereon of a single shed, at an estimated cost of £49,500. If the scheme is carried out, the depth of the water in the dock can be raised if necessary to 30ft. by means of the pumps at the Coburg Dock, which are used for this purpose in the system of the old South Docks. These pumps, with the present proposed outlay and the amount spent annually in the working of the pumps, represented a capitalised value of £175,000. The Committee further recommended the acceptance of the tender of the Linde British Refrigeration Company, amounting to between £5,000 and £6,000, for the supply of machinery for the new Woodside Foreign Animals Wharf, to be erected at a cost of about £10,000.

LARGE IMPORT OF FOREIGN CATTLE AND DEAD MEAT.—During the past week twelve steamers, from different ports in America and Canada, landed 2,435 cattle, 18,803 quarters of beef, and 60 carcases of mutton, showing an increase over the imports of the previous week of 1,312 cattle, 8,127 quarters of beef, and 28 carcases of mutton.

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THE STRIKE IN THE GRAIN TRADE.—Owing to the strike of the grain carriers at the North and South Docks, large quantities of wheat remain on the quays, consignees being unable to find men to fill it in the bags. As a consequence, grain ships are now ordered to the Waterloo Dock, where different conditions of labour prevail, and which is consequently not affected by the strike. At the South Docks some of the men have resumed work at the former rate of wages, and it is thought that the strike will collapse within the next few days.

THE LIVERPOOL TRAMWAYS AND OMNIBUS COMPANY.—According to the half-yearly report of the directors, just issued, a dividend of 5s. per share is recommended, the gross profits (notwithstanding the increased expenditure in men's wages, Sunday labour, &c., amounting to from £5,000 to £6,000) amount to £25,561 for the six months. Better trade, good weather, &c., have done much to make a marked improvement in the traffic receipts.

SHEFFIELD, 22ND JANUARY, 1890.

NEW RAILWAYS.—The Manchester, Sheffield, and Lincolnshire Railway Company have commenced work upon a most important section of line from Beighton to Chesterfield, passing through Staveley. When completed, the line will prove of great service in further developing the deep coal seams of North Derbyshire. It will also tap the well-known Staveley Coal and Iron Company's works. This line will also serve several other collieries and works. Another important line already well advanced is the Dore and Chinley Railway, which is under the care of the Midland Company. The very heavy tunnelling and cutting through the Derbyshire rock is proceeding rapidly.

IRON AND STEEL TRADES.—There is no particular change to note at present. Local makers of bar and merchant irons are working to their full capacity. The steel casting manufacturers are well employed. Some good orders are to hand from the Tyne for ship scantlings. There is an excellent demand for steel for engineers' tools.

NORTH STAFFORDSHIRE, 22ND JANUARY, 1890.

THE IRON TRADE.—There seems somewhat of a lull in the trade, but it is regarded as being only of a temporary character. Makers have orders on their books to keep them going for many weeks. Specifications and new orders are not so plentiful however. There is no change in prices, bars selling at £9 10s. per ton.

THE MOSSFIELD COLLIERY EXPLOSION.—The inquest on the bodies of those killed in the recent explosion at the Mossfield Colliery is now being held, and is exciting the keenest interest amongst the mining population of this district. Every effort is being made by the coroner and the legal gentlemen engaged in the case to elucidate the whole of the facts, and, if possible, to arrive at the origin and cause of the accident. Explorations are still being conducted, but it seems unlikely that it will be practicable to enter the pit where the explosion is supposed to have originated for some time to come, and until this is done all the bodies cannot be recovered.

LEICESTER, 22ND JANUARY, 1890.

WOOL SPINNING AND YARN TRADES.—The local wool market remains quiet. The turnover is restricted, but both holders and users are sanguine that the late higher and firmer prices will continue. Though buyers are compelled to come into the market frequently, they are diffident of engaging in any speculative transactions to any great extent. Deep-stapled Leicesters, average quality, make up to 29s. per tod, and superior to 31s. 6d. per tod. Spinners are all fairly busy, but offers of new contracts are mostly at too low a price to be accepted freely.

HOSIERY TRADE.—Though there is an absence of wintry weather, the year's trade has opened well so far, and most departments of the trade are well off for business. The prospect of a good spring trade is very encouraging.

BOOT AND SHOE TRADE.—An excellent commencement of the year's business has been made. All the factories are in full work, and considerable difficulty is experienced in keeping the staffs up to the required strength. Orders are coming to hand freely, and the outlook for some time is very cheerful. Leather merchants are having a busy time. The turnover is good, and contract orders are freely booked. The market is firm.

CARDIFF, JANUARY 22ND, 1890.

COAL AND COKE.—The steam coal market is not quite so brisk, on account of the cessation of orders from Belgium, where the strike is at an end, but the general condition of the market is extremely healthy, colliery proprietors having as much as they can do to keep pace with the ordinary demand. The output is not as large as it might be, on account of the restriction to supply by the workmen, who are perhaps unwittingly the main factors in keeping capitalists from over-supplying the market, and are instrumental in keeping prices at their present high level. Prices are firm, steam coal, which a few years ago was sold as low as 7s. 3d., being now sold at 14s. First qualities are quoted at 16s. to 16s. 6d.; second, 15s. to 15s. 9d.; and third, 13s. 6d. to 14s. 6d. House coal finds a ready sale, and for coke the demand is extraordinarily active. Several cargoes of Welsh coke have been despatched to the West Cumberland ports for the blast furnaces in that district. This, in addition to a good demand from abroad, as well as for local consumption, keeps prices up. 25s. to 26s. at the ovens is readily obtainable for furnace coke, and foundry coke (Hood's) realises as much as 32s. to 34s. f.o.b.

IRON AND STEEL.—The inquiries for pig iron have not been heavy, but, as makers are all heavily sold, this seems to have no effect on the market, quotations for hematites being firmly maintained. It is generally expected that, on account of the violent fluctuations in the warrant market, there will not be much upward movement in prices during the remainder of the month, but when buyers can hope for a concession in price is difficult to indicate on account of the high prices demanded for coke, ore, &c. For steel bars the demand continues active, current quotations being £7 15s. to £7 17s. 6d. Steel rails show a steady improvement, and, on account of the stocks being almost exhausted, great difficulty is experienced by buyers in getting orders executed for slightly defective or odd parcels, which usually are a drug on the market. Amongst local iron and steel masters the question of fuel is not so important as it is in the Midlands and Northern districts, as almost without exception the large iron and steel manufacturers in the neighbourhood are the owners of extensive collieries, so it simply becomes a question of a reduced surplus of coal for sale on the open market. With regard to coke this is only partially the case, but where ironmasters do not make sufficient for their own wants they have taken precautions to secure the bulk of their supplies for the ensuing year from local coke makers. The scarcity of iron ore is, however, giving rise to serious apprehension. Ironmasters in this district are entirely dependent upon supplies from Spain, and although they appear to have covered themselves for more than half their wants during the ensuing year, speaking generally, they find considerable difficulty in getting delivery of what they have purchased. The sellers in Spain are using every endeavour to evade delivering the ore sold at low prices, and as the shipments from Bilbao are exceedingly small on account of the bad weather, it is clear that when the present stocks are exhausted some of the blast furnaces will have to be damped down on account of scarcity of ore. Meantime deliveries are being made from Benisaf, Carthagena, and Seriphos (Greece). At the last-named port an exceedingly lumpy and pure ore is being shipped, far superior to the Rubio and Campanil of Spain, which is deteriorating in quality. The red hematite ore from the Seriphos district contains only about 4 per cent. of silica, and is all lumps. Rubio ore is quoted at 17s. 6d. c.i.f. Cardiff or Newport, 18s. 6d. Middlesbrough, 18s. 9d. Glasgow, 18s. 6d. Ardrossan and Ayr, 18s. 3d. Tyne Dock, 18s. 6d. Bo'ness and Grangemouth, on the basis of 50 per cent. metallic iron. Seriphos ore is sold at 18s. 6d. Cardiff or Newport, 19s. 3d. Middlesbrough, 19s. Tyne, on the basis of 50 per cent iron and manganese. The freight market is inactive on account of the closing of the Black Sea and Baltic, but as chartering for those trades has now commenced there is every prospect of better business.

BARROW-IN-FURNESS, 22ND JANUARY, 1890.

IRON AND STEEL.—The positon of the hematite pig iron trade is more remarkable than ever this week. Warrants have been as low as 72s. 6d. and 73s. 6d., at which prices business has been done; but makers are quoting 82s. for mixed numbers of Bessemer iron and 81s. 6d. for No. 3 forge, and business has been done at these figures. There is no belief entertained in the permanency of the depression in warrants, and the action of the "bears" is unexplainable. In the meantime, however, there is an increase in stocks held during the week to the extent of 1,305 tons, but this to some extent is explained by the fact that speculators are buying at low prices and holding for better ones. Stocks have increased from the beginning of the year to the amount of 1,625 tons, and they now stand at 383,272 tons. Steel makers are exceptionally well off for orders, and prices are quoted at very firm rates. Heavy sections of rails are quoted at £7 5s. per ton, and light and colliery sections at £8 10s. Ship plates are in brisk request on local as well as on general account, as also are angles and other classes of steel shipbuilding material. The price of steel plates is £8 15s., and of angles £7 15s. per ton. Boiler plates are brisk at the advanced price of £12 5s. per ton. Blooms, slabs, billets, and tinplate bars are a very active trade at £7 per ton, while hoops have advanced to £10 10s.

SHIPMENTS OF IRON.—Shipments are shown to be on a smaller scale than last year. The pig iron shipments for last week from West Coast ports were 7,255 tons of pig iron and 8,839 tons of steel, a total of 16,094 tons, compared with 24,242 tons in the corresponding week of last year. The total shipments to date this year have been 51,238 tons, compared with 60,163 tons in 1889, a decrease of 8,925 tons.

MIDDLESBROUGH, 22ND JANUARY, 1890.

PIG IRON.—There is a great disturbance in the pig iron market. The "bears" have managed to pull down the prices, and the consequence is that hardly any business is being done. Merchants quote 58s. 6d., but makers will not quote below 60s., and most of them not even that. They have plenty of orders booked, and look for an improvement shortly. Warrants have been fluctuating from 57s. 6d. to 58s. per ton. Connal's store has not changed much during the week. On the 20th inst. the stock amounted to 183,508 tons, a decrease of 700 tons over the week. In hematite iron, East Coast brands are subject to fluctuation also. Nominally, they are 81s. per ton mixed numbers, but business has been done at 3s. per ton less.

SHIPMENTS OF PIG IRON.—The shipments of pig iron have fallen off considerably as compared with those of last year, but they are much about the same as those of last month. Up to the 20th inst. they amounted to 25,763 tons, as against 25,707 tons to similar date last month, and 41,857 tons to the 20th of January last year. The decline is in both home and foreign shipments. Of course the weather has been very stormy, but the Scotch shipments have been affected more by the ups and downs of the Scotch market.

MANUFACTURED IRON AND STEEL.—There is a much easier feeling in manufactured iron and steel. The work in hand is sufficient, but the outlook is not so encouraging. There is a lack of inquiry, and prices are not, therefore, so stiff. Iron ship plates are at £8; ship angles, £7 10s.; bars, £8 per ton, less the usual discount. Steel ship plates, £9; ship angles, £8 10s.; rails (heavy section), £7 per ton f.o.t. at works.

SUNDERLAND, 22ND JANUARY, 1890.

SHIPBUILDING AND MARINE ENGINEERING.—The steady increase in the cost of labour must tend to prevent additional orders being placed by shipowners. The members of the Amalgamated Society of Engineers on the Tyne and Wear, who asked for 2s. per week increased pay and one hour less work, have been offered 1s. increase to commence with the first pay in February. It is not yet known whether this counter-offer will be accepted. On Monday the drillers at Mr. John Dickinson's Palmer Hill Engine Works came out on strike because a delegate to the trade society had been dismissed, and so far no settlement is reported. A short strike also occurred at Messrs. S. P. Austin & Sons' Panns shipbuilding yard.

SHIPPING.—Outward freights have not improved, but are on the contrary somewhat easier, there being a large supply of tonnage and coal still being scarce. Some shipowners are in reality laying up some of their steamers for a week or two, and hope by not pushing for freights to assist a general improvement. Coal shipments here have not yet reached an average, due entirely to a short supply. There is evidently a growing feeling amongst the miners to obtain higher wages, 15 per cent. increase being demanded, but it is a very questionable policy. Homeward freights are not especially from the United States, so promising, a large amount of tonnage having been taken up.

NEWCASTLE, 22ND JANUARY, 1890.

THE IRON TRADE.—The iron works in the district continue to be busily employed, and prices are well maintained. A steady trade for some months to come is assured, as manufacturers, without exception, have booked forward orders. The blast furnaces at Low Walker, which were "damped down" some time ago, are about to be re-started by Messrs. Bell Brothers. A large quantity of fuel has been stored at the works during the past few weeks, and a cargo of Spanish ore is now being discharged at the jetty. It is understood that deliveries of ore will be continued without intermission till a large stock is accumulated, as the furnaces, when once re-started, are to be kept going so long as there is a demand for the product. Hematite iron is the article that is in future to be produced at these furnaces, and, so long as the steel trade holds good, the demand for that commodity is not likely to show any falling off.

ENGINEERS' WAGES.—In response to their demand for a wages advance of 2s. per week, from the 30th inst., the operative engineers have received from the employers an offer of 1s. per week. The men's decision with regard to the acceptance or refusal of this offer has not yet been made known. With reference to the claim of the same body for a reduction of the working hours from 54 to 53 per week, the employers say that under present circumstances they see no reason to make any alteration in the hours of work.

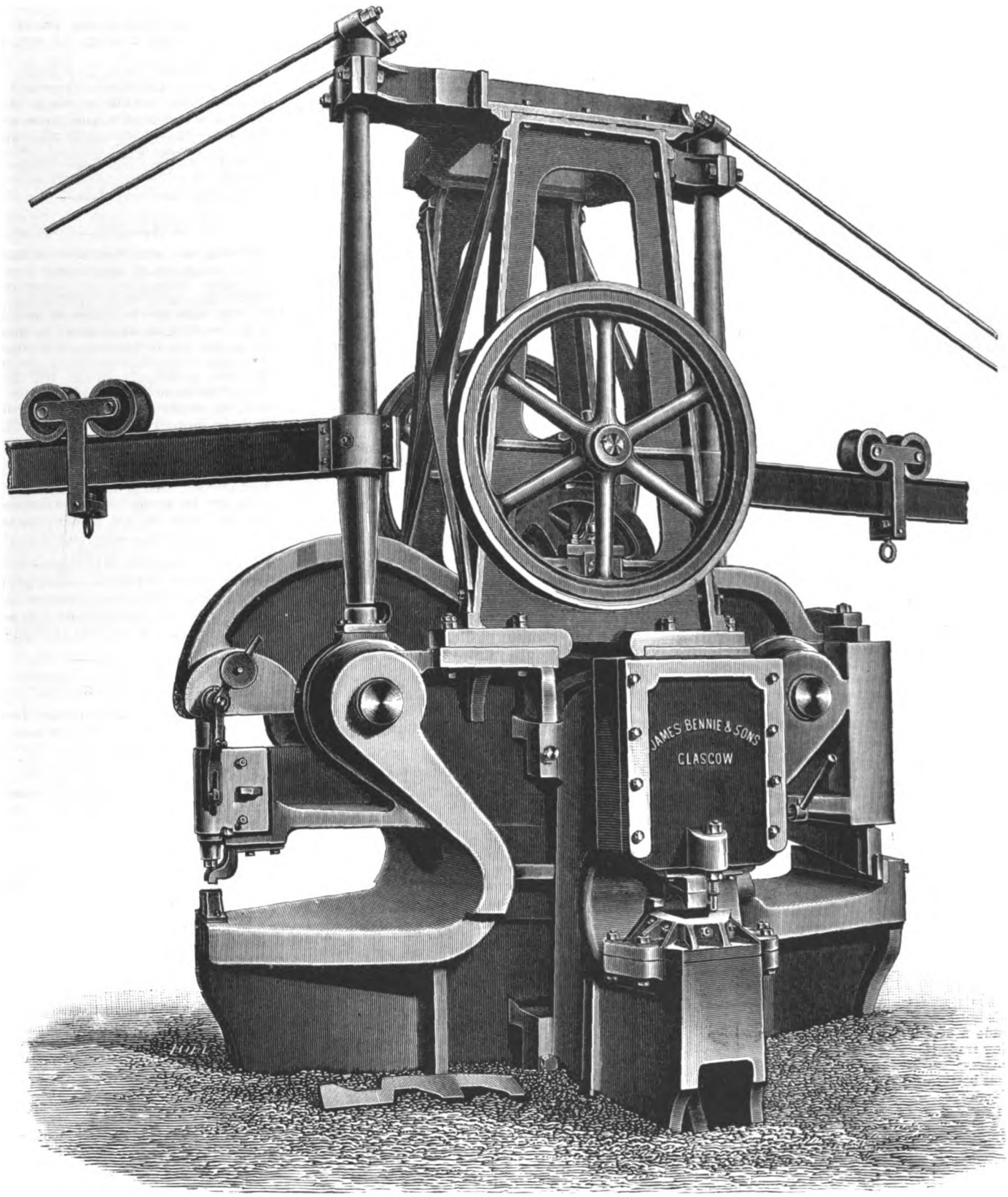
LABOURERS' WAGES.—The case of the shipyard and engine shop labourers, who have asked for a wages advance of 15 per cent., has been considered by the employers, with the result that they have refused the all-round advance asked for, but have at the same time intimated their willingness to revise existing rates, with a view to give an advance in certain cases. It is not yet definitely known what action the labourers will take with reference to this offer.

THE COAL TRADE.—A movement to demand another advance of 20 per cent. on wages rates is reported to have been commenced among the Northumberland miners. A largely attended meeting of coalowners was held at the Coal Trade Office, Newcastle, yesterday, to consider a claim from the Durham miners for a wages advance of 15 per cent. After a discussion with the miners' deputation which was in attendance, the owners informed the latter that they could not accede to the application. The shipments of coal and coke at Tyne dock for the week ending January 18th amounted to 110,461 tons, being a decrease of 9,359 tons as compared with the shipments for the corresponding week last year.

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LARGE LEVER PUNCHING MACHINE.

CONSTRUCTED BY MESSRS. JAMES BENNIE & SONS, CLYDE ENGINE WORKS, GLASGOW.



LARGE LEVER PUNCHING MACHINE.

THE increase in the size of plates commonly used for shipbuilding has brought about the development of plant of corresponding size and power. In many shipbuilding and engineering establishments the pressure of work this winter has compelled many firms to spend considerable amounts of capital in heavy plant. Boiler-making tools of large size for manipulating the enormous plates that now enter into the construction of a modern marine boiler for engines of 4,000 h.p. and upwards have especially undergone recent development. The mere size of such machinery has brought about, as a necessary consequence, development in design, the main ideas being, of course, to secure great strength with simplicity of working parts. The large lever punching machine which we illustrate above has just been made by Messrs. James Bennie & Sons, Clyde Engine Works, Polmadie, Glasgow. The machine is capable of punching 1¼in. holes through a 1½in. plate. The gap on the punching end is 42in. deep, so that a hole can be punched in the centre of a plate 7ft. broad. A very broad shearing slide is also fitted, the blades of which are 3ft. long. A separate arrangement is fitted at the side for punching out at one stroke large square holes in stringer plates and also limber-holes or small man-holes. When placed in position the machine is sunk sufficiently to permit the punching to take place at a convenient level. Cranes are attached to the machine, for manipulating plates up to 2 tons in weight. A special high frame on the machine supports the cranes, and thus makes the whole plant quite self-contained. A considerable number of the leading shipbuilders have recently introduced punching and shearing machines of this size and design—for example, Messrs. Armstrong, Mitchell & Co., of Newcastle, and the Fairfield Shipbuilding Company, of Glasgow.

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As we go to press early with certain of our advertisement pages, all Alterations to Standing Advertisements should reach the Publisher not later than 2 o'clock on Wednesday afternoon in each week.

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

Contents.

	PAGE
Work in the Royal Dockyards during 1889	73
Downie's Improved Packing Rings (*Illus.*)	73
Patent Statistics—1864-1889	74
Machine for Separating Metals from Refuse (*Illus.*)	74
Dodman's Horizontal Engine (*Illus.*)	75
The Institution of Civil Engineers	75
A New Form of Siemens Furnace (*Illus.*)	75
Improved Expansion Gear (*Illus.*)	77
The Channel Tunnel	77
Foreign Industries (Corres.)	78-79
A New Japanese Canal (*Illus.*)	80
Notices of Meetings	81
Prices Current	81
Foreign Telegraphic Advices (Corres.)	81
Shipbuilding Notes	81
Home Industries (Corres.)	82-83
Large Lever Punching Machine (*Illus.*)	84
Large Railway Trucks for Mineral Traffic	85
The American Navy Proposals	86
Arbitration among Scotch Miners and Papermakers	86
Electric Light Regulations	86
International Joule Memorial	87
Letters to the Editor:—	
Steam Boiler Legislation	87
The Marking of Goods	87
The Chilian Government and Import Duties	87
Bleichert's Wire Rope Tramways	88
The Sun and Planet Motion	88
The Watt Anniversary at Greenock	88
Testing the Forth Bridge	88
The Institution of Electrical Engineers (*Illus.*)	89
Graphic Constructions for Dynamos and Motors—II. (*Illus.*)	90
The Physical Society	92
Notes	92
"Industries" Patent Record:—	
Applications, and Acceptances	93-94
Illustrated Abridgments	94-96

To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

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Industries:

FRIDAY, 24TH JANUARY, 1890.

LARGE RAILWAY TRUCKS FOR MINERAL TRAFFIC.

THE question of the adoption of larger railway trucks for heavy goods traffic has again been brought into prominence, as one of the industrial problems of the day, by the meeting, held last week at Düsseldorf, of the Verein Deutscher Eisenhuttenleute, an association of German engineers and ironmasters similar to our Iron and Steel Institute. At the meeting a paper dealing with the subject exhaustively was read and discussed, with the result that the following resolution was passed unanimously, namely: "That this meeting is of opinion that it is desirable, in the interests of industry, commerce, and agriculture, to make the carrying capacity of railway waggons for heavy goods as large as possible, and in this opinion it recommends the Prussian State railway authorities to make a trial of 30-ton trucks without delay." It is scarcely possible to exaggerate the importance of this resolution. It is the formal expression of the opinion of a well-informed body of men, and it foreshadows immediate action in the direction indicated. The necessity for reducing the cost of transport makes itself felt more and more every year. The very life of manufacturing industries in some localities depends upon this necessity being promptly met. Competition has grown exceedingly keen, and will grow yet keener as Continental industry develops itself. How severely this competition is felt is significantly shown by some of the remarkable events of the last two or three years. Looking back over that period, we see large works transferred to the sea coast to escape the cost of land carriage, which, in the altered conditions of trade now prevailing, had become too burdensome. In other instances works have been carried beyond the seas and set up in foreign lands for like reason. Not less significant is the agitation, which is steadily growing, for the improvement and extension of the inland waterways. On the Continent, particularly in Germany, this movement has already made great progress, and it must be admitted that in this country considerable advances have been made in the same direction. The Congress, held some time ago in the Hall of our own Society of Arts, showed that the representatives of British industry are favourably disposed towards this solution of the problem, and are, moreover, resolved to work vigorously to obtain it. The question is, therefore, one of the deepest interest to the railway companies, whose future is largely bound up with it. In such circumstances it is not surprising to learn that certain of the most enterprising among them, notably the Midland, have begun to put to the test of experience the suggested reform in the design and construction of heavy goods trucks, and we may expect that the resolution arrived at last week in Germany will serve as a stimulant to further effort in the same direction. If our own companies delay, they will find themselves, instead of leading the way, compelled to follow in the wake of our foreign rivals in trade.

What is the nature of the progress made in the last twenty-five years? An exhibition of disused locomotives, if such exist, would show a constant increase in the weight and power of those engines. This augmentation of the tractive power on railways rendered it possible to add to the length of the trains, and accordingly we find in connection therewith a larger number of waggons coupled together. In this way power was economised and time saved. But the practicable limit has been reached in this direction. The longer the train, the greater is the friction on curves. Other disadvantages have made themselves seriously felt. The longer trains now run require more room at the stations, and a great extension of the sidings. Moreover, the work of shunting is rendered more difficult and long, and, as a consequence, the traffic is in a greater degree impeded. Another consequence of coupling together a large number of trucks is that the latter are subjected to rougher treatment in sorting and shunting, to stand which they have to be built of greater strength. But to obtain this additional strength their weight must be increased, so that the proportion of deadweight to carrying capacity, or paying load, undergoes augmentation. The ten-ton trucks now in use weigh from 5 to 7 tons. These, and some other considerations which might be mentioned, show that if economy of transport is to be found it must not be sought for in a further increase in the capacity of the trains. This is generally admitted by the railway authorities, and hence it is that we see them striving after improvement in the direction of greater truck capacity. The proposal is not altogether new. Some experience has already been gained to guide and support opinion in this matter. Twelve-and-a-half ton trucks, and even larger, are now running in an isolated way—that is, mixed up with others of smaller dimensions—over the lines of this country. In Germany a good many "12½-tonners" may be seen in the Breslau district, and in Luxemburg trucks of 15 tons for mineral traffic are common. With regard to the latter, Herr Schwabe, a high authority in this matter, estimates that by their use an annual saving of some 19,000,000 marks is effected. Everywhere the experience gained, in Europe as well as in the United States of America, confirms the opinion that the end proposed may be attained through a change of this character. We discussed several months ago some of the advantages of larger trucks; but we did not then go beyond a capacity of 15 tons. Now the project includes trucks of double that capacity. There may be some who deem it prudent to effect the change gradually, by first bringing into use the intermediate sizes. But we believe that all that can be said in favour of the 15-ton truck applies equally to that of 30 tons. Here again we have experience to fall back upon, both American and European; for, besides the common use of these larger trucks in the United States, we can point to some trials of a successful character now in progress on the Midland Railway in this country. As the result can hardly be doubtful, it seems desirable to take the whole step at once rather than to proceed tentatively. That such is the opinion of the members of the German technical association already mentioned is shown by the resolution at the meeting on the 12th inst.

Objections urged against the adoption of these heavy loads are that correspondingly heavy rails will have to be used, and that the wear and tear of the permanent way will be much increased. These objections are not founded on truth. Manifestly a truck body having a capacity of 30 tons will not be set upon two axles. The construction adopted will probably be that of the bogie-carriage, through which the weight will be better distributed over the rail. With such an arrangement the rail need not be more severely strained than now with the 10-ton

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waggon. As for the wear and tear, there is no reason to believe that it would be greater with the heavier load when the latter is better distributed. It is not unreasonable to hope that it would be less. Anyhow, the loss incurred in this direction will be far from neutralising the gain. The wear and tear of the rolling stock will certainly be less, for we may safely assume that some improvements will be introduced into the design and construction of the new waggons. The barbarous system still in vogue of building trucks without spring buffers will surely not be continued. The violent and destructive thumpings to which our ears have grown accustomed will have no place in the new system. Besides, these bufferless trucks uselessly lengthen the train, as far as its carrying capacity goes, for they have to be loosely coupled together to enable them to get round the curves. Four inches between the trucks—that is, between the projecting ends of the side frames—is, for a train of fifty trucks, a clear loss of some seventeen feet, or, roughly, one truck's length in fifty. Probably the best system would be that of the central buffer. These are, however, matters which we do not intend to discuss now. For the present our object is merely to awaken an interest in the question which the action of our neighbours the Germans has made urgent.

THE AMERICAN NAVY PROPOSALS.

The news which has come from America regarding the proposal to increase the navy to a very large extent is a very curious commentary on the proceedings of the Pan-American Congress which has been engaged in sketching a constitution for both the American continents. This constitution would for ever render war impossible within its scope, and would make a composite dominion so strong and self-contained that no foreign enemy would ever dare to attack it. Arbitration and conciliation were to be the means in the future of settling all difficulties, and even before we have had a definite statement of the results of the Congress the world is startled by the most stupendous programme of warlike armament ever submitted by a constitutional Government. These proposals involve very great issues, economic, industrial, and political, and therefore should demand the closest attention of all whose opinions are likely to exercise any influence in the matter.

Mr. Secretary Tracey has submitted to the Naval Committee, after a consultation with the Shipbuilding Policy Board, in regard to the needs of the service, a report which recommends the construction of 92 vessels of different types and sizes. These will be built in fourteen years, and will cost, together with their maintenance during twenty-four years, 380,000,000 dollars. The scheme comprises 10 battle ships of 10,000 tons, 5,000,000 dollars each; 8 of 8,000 tons, 5,000,000 dollars each; 12 of 7,000 tons, 4,500,000 dollars each; 5 of 6,000 tons, 3,500,000 dollars each; 10 rams of 3,500 tons, 1,800,000 dollars each; 9 armoured cruisers of 6,250 tons, to make 19 knots an hour, 3,300,000 dollars each; 4 protected cruisers of 7,400 tons, to make 22 knots an hour, 3,500,000 dollars each; 2 protected cruisers of 4,000 tons, to make 19 knots an hour, 2,050,000 dollars each; 5 special cruisers of 1,200 tons, to make 18 knots, 500,000 dollars each; 15 torpedo cruisers of 900 tons, to make 22 knots an hour, 500,000 dollars each; and 3 artificers' ships, 2,000,000 dollars each. This programme is almost enough to take one's breath away, and those who have drawn it out have displayed a keen perception of the American character, which always goes in for something big, but which often sticks over trifles. The authors of the Report no doubt thought that they had discovered a solvent for some of the economic, industrial, and political problems which have for some time been puzzling American statesmen.

We have little hesitation in inferring that the huge surplus revenue with which the Americans have been blessed—or possibly cursed—for some years past is the direct cause of the programme. That surplus has been the despair of several administrations, and the difficulty increased as the National Debt was being paid off; but now a scheme has been brought forward which is meant to please all parties, by getting rid of the burden of the surplus, providing a large navy without incurring any extraordinary expenditure—in short, to prove that America is a great nation. The national vanity will be pleased, and it is just possible that in a fit of spread-eagleism—unless in the meantime common sense returns—the country may be involved in measures which will have immense consequences to the whole civilised world. The proposals have evidently been made for the purpose of perpetuating the present economic conditions of the country, and in the interests of monopolists who are becoming immensely rich as a consequence of the tariff which at present prevails, and they justify the fears of those who have always been opposed to the present fiscal system. It is a comparatively simple thing inaugurating a system of Protection, but it is very difficult to get rid of it. Everywhere vested interests are created, and these are able either directly or indirectly to bring sufficient influence to bear on the legislature. That they have done so most effectually in America is shown by the proposals we are considering, for if they are carried out they will commit the country to a policy of increased Protection for at least fourteen years. At the end of that time possibly the greater number of the ships will be of little use, so rapidly do things move at the present day, and then will again come the necessity for increased expenditure, not only for renewals, but also for the fixed charges which necessarily accompany the maintenance of a large fleet.

The policy involved in the programme will also have a powerful effect on the industrial future of America. In his message to Congress the President asked the legislators to consider the matter of the tariff with a view to reducing the receipts of the revenue as closely as possible to the wants of the Government, but he added that the changes should be made so as not to impair the just and reasonable protection of home industries. He made several proposals, which, however, did little but touch the fringe of the surplus. He moreover indicated that the Southerners should go in for iron-making and shipbuilding on a larger scale than they had hitherto attempted, and he stated that the protective system should be fairly applied even to the products of farms. This is quite logical, but it is practically impossible. Shipbuilding and engine-making can only be developed slowly, and we have no hesitation in saying that, if the proposed programme is carried out, the majority of the ships and engines will find their way to the scrap heap before many years. No doubt experience will be gained, but it will be at a terrible cost. The resources of the country are now sufficiently developed to allow shipbuilding, and the industries connected with it, to progress in a natural manner, and we trust that, before committing themselves to a policy which binds them to what may be a disastrous line of action, the people of America will carefully consider the question in all its bearings, and not allow themselves to be carried away by the proposals of politicians who are evidently influenced, either knowingly or unknowingly, by the monopolists, who are likely to enrich themselves at the expense of the country.

We might enlarge on the political aspects of the question, but that is outside of our sphere except so far as it affects industry and commerce. It must be quite evident, however, that if America becomes a warlike country, with a large navy and a powerful army, she is bound to depart from those peaceful ways to which so much of her prosperity is due.

ARBITRATION AMONG SCOTCH MINERS AND PAPERMAKERS.

The arbitration and conciliation movement is spreading rapidly. A few days ago Provost Black, of Airdrie, stated at a public meeting that he had recently attended a conference of delegates from the coalmasters and miners of the Airdrie and Slamannan districts, on which an understanding had been arrived at by which he was fain to believe that strikes among the miners would in future be prevented by an amicable arrangement between all the parties interested. It is stated that the basis of the arrangement is to the effect that each party shall have at least one fortnight's warning, and that in the event of the delegates being unable to adjust their differences the whole matter will be referred to arbitration. It is understood that the two last strikes had cost the district £100,000. We are glad to observe that the operative papermakers have fully appreciated the spirit of the masters' resolutions to which we recently alluded. At a meeting held a few days ago they unanimously expressed their gratitude to the employers for the manner in which they had met their request for a reduction of the weekly working hours. They further recommended, in order to overcome the difficulties attending common action on the part of the competing mills, that the Masters' Association be extended so as to include all the mill proprietors of the United Kingdom, and expressed the hope that a *modus vivendi* may be attained between a National Masters' Association and the National Union of Paper Mill Operatives. If this arrangement be carried out, it will be uncommonly like a trades guild; and if carried on, not only in the interests of the employers and the workmen, but also in that of the public, it would be another great step in the organisation of industry.

ELECTRIC LIGHT REGULATIONS.

The electric light seems doomed to be hampered by all sorts of vexatious restrictions, legal and not legal, but those proposed by the Board of Trade do not seem to be generally unnecessarily stringent, and may be welcomed as being likely to lessen the risks due to extreme negligence on the one hand, without hampering solid work on the other. There are, however, several points which need discussion, as it is not too late for any alterations to be made. The terms used are defined first. Low pressure supply is defined as 300 volts on a direct current, or 150 effective volts on an alternating. This seems somewhat hard on alternating currents. The subject may be looked at from several points of view, viz.: Danger to life from shocks from touching exposed fittings, danger to life from touching parts supposed to be insulated, and danger from fire caused by excessive leakage.

Danger to life from shocks from touching one exposed place needs another earth somewhere else in both cases, as the capacity of a consumer's alternating circuit is small if he has his own transformer. We do not know whether 300 volts direct is dangerous to life, by action on the muscles or otherwise; probably it is absurdly safe; but as a consumer would be connected with a large network of wires, there is much more likelihood of some other point being earthed, so that he gets a shock, than there is with the alternating secondary circuit. It is, therefore, much less likely that he will get a shock from the alternating current. If a consumer gets hold of two bare leads, the alternating current might certainly be more dangerous at the same pressure. This is the only point against the alternating current. As to fire, or danger from bad insulation, there is much more chance of the direct current breaking it down, as there is more chance of another leak elsewhere. A couple of leaks are much more likely to occur on a large system than a small one. We therefore think that, when fed from a transformer on the premises, the alternating current should at least be on the same terms as the direct. We may add that there seems to be nothing against a consumer transforming up again to anything he likes on his own premises. It is satisfactory to see the term "pressure" adopted instead of "electromotive force" or "tension."

A great deal of space is devoted to regulations as to safety. Rule 2, viz., "A high pressure supply shall not be delivered to the terminals on any consumer's premises except . . . .", is vague. The terminals should be more fully defined as the terminals connected to the consumer's wires.

The current in a given wire is limited by the rise of temperature. This is a much better way than by the current density. No wire is to rise 30° F. above the air, and any current density consistent with this may be used. In practice the current density is kept much below this to prevent excessive drop on the lamp terminals. This, like a good many other things commonly met with in rules and in specifications, might be left to the contractor. It would not pay to run hot leads. A check is, however, put on careless house wiring.

According to Rule 5, all high pressure conductors must be encased in iron pipe of at least ¼in. wall, earthed every 100 yards. This will press somewhat hardly on the use of bitumen culverts, and a ¼in. wall pipe seems scarcely necessary when a cable is already lead covered. A continuous metal casing, or a casing earthed at frequent intervals, may also give some trouble by electrical surgings with alternating currents. The protection which is given to underground mains against gasmen with picks or prodders is, of course, important; but for small leads we think a quarter of an inch too large a minimum thickness. Ordinary wrought iron gas pipe should be available. Where cast iron is used this thickness is, of course, advisable.

Rule 6 provides that no high pressure lead shall have an insulation of less than 50 megohms per mile. We trust the last expression may be altered into megohm miles. This degree of insulation seems too high to insist on just yet, as a contemporary has already pointed out. The question of insulation of a whole system of mains is difficult to discuss. If the object of such a rule is to guard against cables breaking down, the insulation demanded is very unnecessarily high. Here, again, it is best to leave the matter to the contractors or undertakers; it concerns only their pockets. To avoid bad places in a cable is another matter, but bad places soon get weeded out, and after that it does not matter what the insulation is. A general leakage of a fraction of an ampere from one set of leads to the other does not matter in the least. It is difficult to see how danger to life can come into the question at all. At most, all that is wanted is to prescribe a suitable automatic leak finder at the central station. The insulation in megohm miles even means little unless the pressure under which the measurement is taken is mentioned. Again, if the insulation of separate conductors is to be 50 megohm miles, the insu-

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lation of the inner conductor of a concentric main should be 100 megohm miles.

Rule 7 provides that where concentric conductors are not used there shall not be an earth leakage of more than ·04 ampere direct or ·02 ampere alternating. This would be a most unnecessary and vexatious rule. In an alternating system of any size the capacity current would be more than ·02 ampere. The rule does not say whether the leakage current is measured with the other side artificially earthed or not. As we have already said, the general leakage through the earth does not really matter to anybody. Of course, it might affect telephones or telegraphs if very excessive, but unless there is a fault, and a really local earth current, which it is, of course, to the undertaker's interest to avoid, this is unlikely. As to danger to life, if by earth current is meant, as we suppose, the current measured between one side and an artificial earth, a man putting himself in place of the galvanometer would get through him ·04 ampere or less according to the pressure. Taking a man's resistance as 1,000 ohms, this would be no worse than touching both poles of a 40 volt circuit. If his resistance were more than 1,000 ohms he would only get a minute burn, as the resistance of the body is mostly at the surface. The alternating ·02 would thus correspond to 20 volts held with a good contact. Apart from this, there seems no chance of a man's getting a shock from underground wires. It would therefore seem a great pity to enforce Rule 7.

Rule 8 provides against sparks between the insulating coverings of oppositely charged conductors. It is difficult to conceive how such sparks could possibly be produced. We have often heard accounts of curious sparks produced by alternating currents, but they have never borne investigation. We have been told, however, on the best authority, that these sparks do occur.

Rule 14 provides that sub-stations "must be established on suitable premises in the sole occupation of the undertakers." This would preclude the central station people from renting a basement only; they must occupy the whole of the premises. This is probably a slip. The rule also assumes an attendant at each sub-station, which seems quite unnecessary, at least in the case of transformers.

Rule 16 provides that all high pressure conductors, fuses, switches, and the transformer itself must be enclosed in metal casing, at least a quarter of an inch thick, connected to the earth. This would be a very expensive regulation to follow. The leads would not be considered efficiently protected by ordinary wrought iron gas piping, and special cast pipes would have to be used The only use the metal casing could be would be to confine the smoke if some turns of the primary or secondary were short-circuited and were burning out. Any non-inflammable case would do this, as once a coil or two begins to heat the neighbouring insulations will char, so that the fault spreads till the fuse goes. We think it would be perfectly safe to specify a fireproof case. Some may prefer to build a brick recess or little cellar, or to use a stoneware case. We do not know if open circuit transformers will ever come into use, but they could not well be put in cases of ¼in. metal. There seems to be no need for these restrictions when the transformer is out of doors, but still on the consumer's premises. It may be very much to the point, however, to insist on some sort of conducting screen efficiently earthed, to avoid any chance of shocks.

There are two omissions in the rules as to consumers' premises. Nothing is said about the insulation between the primary and secondary or between the primary and earth in the transformer, except the rule as to the leakage current of ·02 amperes; and, though there is a provision that there shall be means to prevent the secondary being dangerously charged, there is nothing said about safety appliances to prevent an accidental earth on one or other of the secondary leads.

It is provided that if the undertaker suspects a fault on a consumer's premises, he may inspect, and if there is a fault, he may cut off the supply. This is very important. Direct supply companies will do this in their own interests. There is nothing to make the company do so, however, when house transformers are used, as an earth then does not matter to them, and they have no means of knowing there is a ground on their system till an accident happens. The undertaker has the right of cutting off the supply if the resistance of the leak is under 5,000 ohms.

The second division refers to regulations as to supply, and seems to be very much what is wanted. Low pressure supply may vary three per cent. each way, which is somewhat excessive, and high pressure two per cent. It is as well to be lenient to the undertakers, at least at first. Two per cent. each way on high pressure circuits is more serious, as losses in the transformers have to be added to that. It is, however, to the interests of the supply companies to keep uniform pressure, so it is very advisable not to lay down strict rules on the subject. It is not as if electric lighting had some monopoly.

On the whole, as we have already said, the rules may be considered well drawn up and to the point. They are, however, too severe as to safety. Electric lighting ought to be quite safe, and we would like to see rules whose enforcement would make it a great deal safer than gas; but the industry has already been so throttled and tied down that it is a pity to stifle it any more by any unnecessary or exaggerated precautions. A gas supply is more dangerous than an electric, but we are not obliged to put the meter in a fireproof chamber, or to take correspondingly elaborate precautions against fires, poisoning, and explosion. Any one can fix a swinging bracket so that the flame can be left playing against a wooden partition. There are no automatic arrangements specified for cutting off the supply if an unlighted jet is left on, or for indicating a leak in a main. Of course when electric light is as familiar as gas, all these regulations will be swept away as unnecessary, but gas was not hampered by them at the outset. On the other hand, regulations which will make accidents from electric light wires practically impossible are much wanted, and if the Board of Trade rules err on the side of strictness, it is easy to make them more workable and still abundantly safe.

INTERNATIONAL JOULE MEMORIAL.

The Council of the Royal Society have appointed a committee to set on foot a memorial to the late James Prescott Joule, and they have resolved to raise a fund for establishing a memorial of an international character commemorative of the life work of Joule, which shall have for its object the encouragement of research in physical science. We are glad that the Royal Society have taken these steps for honouring the work of our illustrious countryman, and, although this work has been done in England, we feel sure that it is right to establish the memorial on an international basis. There has been, in the history of science, no research which has had more important results on the industrial community, and it is highly proper that those who appreciate the value of the labours of their fellow-men in furthering progress should contribute to a fund which has for its object the commemoration of the discoverer of the universal law of the Conservation of Energy. Not only is the scientific and industrial value of Dr. Joule's work felt by the engineer, manufacturer, and the worker in applied science, but the economist and philanthropist and politician will all admit that material benefits have already flowed from his discoveries by promoting economy in all the principal industries of mankind. It is by the work of masters like Joule that the world can realise the worth of the scientific progress of the age, and by contributions to the Joule Memorial Fund testify to the appreciation of the improved conditions under which man now labours and lives.

Sir Henry E. Roscoe has volunteered his services as honorary secretary to the fund, and will be willing to receive donations addressed to the International Joule Memorial, Royal Society, Burlington House, London, W.

Letters to the Editor.

STEAM BOILER LEGISLATION.

To the Editor of "Industries."

Sir,—The thanks of the whole boiler insurance world at least, to say nothing of that perhaps not insignificant crowd of persons who unfortunately own boilers, are due to you for your exceedingly able and temperate leader, referring to a dangerous and misleading article, entitled "Boiler Explosions and the Board of Trade," which appeared in your contemporary *Engineering* of the 3rd inst.

Many of its readers would recognise the arguments of Mr. Lavington E. Fletcher, manager of the Steam Users' Insurance Association of Manchester, in the said article, and feel sure that the author of it, whoever he may be, was simply pouring out the treasures of that gentleman's mind. They would also feel that the dignity and fairmindedness of your contemporary was at stake in allowing an *ex parte* statement, of so malignant and false a character, to be published in its columns without that correction and revision which everything that appears as an editorial should command.

Sir William Fairbairn, Mr. Hugh Mason, M.P., and Mr. Lavington E. Fletcher have for the last nineteen years held themselves to have the entire right of road on the subject of boiler inspection, and, since the Steam Users' Association became a boiler insurance company, on that of boiler insurance also. When they went for boiler inspection only, no other company had sufficient inspectors, and, to injure their then competitors, Sir W. Fairbairn, then president of the Steam Users' Association, did not flinch from stating, before the Select Committee on Boiler Explosions, in 1870, that "In fact, judging from the number of efficient inspectors employed by the first and largest insurance company in Manchester, where more than 10,000 boilers are enrolled, the number of inspectors is probably in the ratio of one to about 1,000 boilers. We have about 2,000 boilers and seven inspectors. I think the insurance company which was the first that was formed has upwards of 10,000 boilers, and it is a question with me whether they have any more inspectors than we have for the 2,000 boilers. From this it will be noticed that thorough inspection is out of the question." Now, the truth is, that at that time the Steam Users' Association had five or six regular inspectors, and one or two occasional inspectors, all of whom resided in Manchester, whereas the Boiler Insurance and Steam Power Company, Limited (the company referred to), had twenty-seven regular inspectors and two occasional ones, resident in different centres, such as London, Edinburgh, Glasgow, Manchester, Birmingham, Bristol, Dundee, Belfast, &c., so as to save time and travelling expenses.

Although Sir William Fairbairn's attention was drawn to the falsity of his statements, he never corrected or withdrew them, and they have formed the nucleus of many a pithy sentence in the Steam Users' Association notes, and published in the daily papers of the last nineteen years. In fact, this huge, gratuitous, and mischievous falsehood is the base of nearly all assertions that are so glibly made by those who know nothing of the pains and labour taken by the engineers of boiler insurance companies to thoroughly do the work they undertake.

In the article in your contemporary, to which I have already alluded, it is said: "We have previously pointed out in these columns that it is cheaper for insurance companies to take the risk of a few explosions than to faithfully inspect every boiler enrolled on their books." This has been the parrot cry of all the officials, travelling agents, and employés of the Steam Users' Association since 1870, with the honourable exception of the late Mr. Peacock, whose sense of truth and fairmindedness would not allow him to be the mere ignorant mouthpiece and tool of any man.

What has been the experience of the Mutual Boiler Insurance Company, the English and Scottish Boiler Insurance, and the Newcastle Boiler Insurance Company? Has it paid them to neglect inspection? Will it pay any remaining struggling company left in the field?

In face of the result of the last formal investigation at Newcastle upon the explosion on board the s.s. "Perseverance," how long will it take to put the company involved into difficulties? It will either have to give such inspection as the oldest and wealthiest companies, and charge at least double its present rates, or it must collapse. These formal investigations, which are now being put in force—largely, I believe, through the influence of your valuable journal—will so open the eyes of the public that they will soon discover the reliable boiler insurance companies, and will also be able to gauge the spurious philanthropy of those who are always forcing Governmental harass and worry upon them in the shape of compulsory inspection of steam boilers by the Board of Trade. At that investigation the Scottish Boiler Insurance and Inspection Company, Limited, declared, both through their manager, Mr. J. D. Young, and through their counsel, Mr. Henderson, "that they undertook no duty to the insured, no duty as to the superintendence of these boilers. . . . The mere fact of their sending in these reports, as I have stated, does not mean that they undertake to relieve the owners of the duty of looking after his boilers. These inspections are made primarily for the safety of the insurance company itself, but, having made this inspection, they are quite willing, so far as in their power, to afford the owner any information which may be of use to him in keeping the boiler in a safe condition."

When the boiler inspector turns out to have been originally a "jobbing blacksmith" the owner will have to be thankful for small mercies in regard to advice and inspection. This was the opinion of the Court, as shown by the following judgment: "But we do think, in the interests of human life, and as a safeguard against insurances effected by immoral or careless owners, that they (the Scottish Boiler Insurance Company) should in future, if they can, by a thorough inspection, satisfy themselves that the boiler they are going to insure is as safe as it can be."

Comment on such a judgment is superfluous, and it behoves the smaller insurance companies to put themselves on a proper footing with regard both to the quality of their inspectors and their inspections, or the reason for their existence will have passed away.

Yours, &c.,

Boiler Inspector.

Manchester, January 20th, 1890.

THE MARKING OF GOODS.

To the Editor of "Industries."

Sir,—The Trade Marks Act has been of benefit to the manufacturers in England, and it would seem advisable to have it adopted elsewhere. I see from your recent Copenhagen letter that a local brewery exports "Bavarian beer" to Brazil. The same sort of thing exists in various other industries—Belfast hams are imported to that town from Denmark, and Aberdeen granite is largely derived from the Baltic. It must be just as well in the long run if the origin of every product were candidly acknowledged. If the things are good in themselves, it does not much matter to the user whether they are derived from Turkey, Toronto, or Timbuctoo.

Yours, &c.,

A. Rose.

London, 20th January, 1890.

THE CHILIAN GOVERNMENT AND IMPORT DUTIES.

To the Editor of "Industries."

Sir,—It will no doubt interest manufacturers and others to know that the Chilian Government, being desirous to encourage mining, agriculture, and other industries, has decreed that from the 1st of January, 1890, the following manufactures shall be admitted free from import duties into the Republic:—

(1.) All machinery and tools for the use of agriculture, mining, trades, and industries.

(2.) Pipes and tubes of composition, copper, iron (galvanised or ungalvanised), elbows, joints, tees, and other materials connected with these.

(3.) Iron or steel wire (galvanised or ungalvanised) up to No. 14 inclusive, and also copper, for the transmission of electricity.

(4.) Instruments for telegraphs and telephones, iron or steel posts, and other utensils for the permanent way of steam, horse,

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or portable railways; also wheels, axles, and hoops for railways, and cars for portable railways.

(5.) Iron in sheets.

Having resided on the west coast of South America for twenty-three years, I shall be happy to give any further information in my power to any of your readers.

Yours, &c.,
J. Harris.

Devonshire Road, Forest Hill, London, S.E.,
21st January, 1890.

BLEICHERT'S WIRE ROPE TRAMWAYS.

To the Editor of "Industries."

Sir,—I should be obliged if any of your readers could give me some particulars through the medium of your journal as to the practical success in working of Bleichert's patent system of wire rope tramways; also as to where the plant can be obtained in this country.

Yours, &c.,
Inquirer.

London, 21st January, 1890.

THE SUN AND PLANET MOTION.

To the Editor of "Industries."

Sir,—In the report in the daily press of the "James Watt Anniversary Dinner," held on Saturday last in the Grand Hotel, Glasgow, the Chairman, Mr. Ebenezer Kemp, is represented as having said: "But for James Watt's invention of the separate condenser, the sun and planet motion," &c. In crediting the inventive genius of Watt with the sun and planet motion, Mr. Kemp is giving expression to the not always discriminating popular belief in such matters. The sun and planet motion was amongst the earliest inventions of William Murdoch, who was frequently spoken of by Sir William Fairbairn as "the most distinguished veteran of mechanical engineering;" while James Nasmyth, in his "Autobiography," refers to the "vast series of workshops of that celebrated establishment [the Soho Works], and to the special machine tools, which, I believe, were chiefly to be ascribed to the admirable inventive power and common-sense genius of William Murdoch."

Watt, in his patent, dated 25th October, 1781, had five distinct methods of obtaining the circular motion. The fifth in the specification was the sun and planet motion of William Murdoch, and was the method finally adopted in the Soho machinery in preference to the four devised by Watt. It is thus referred to in a letter by Boulton:—"Mr. Watt's packet is not ready. I am to wait till his drawings [of the rotary motion] are completed, which he is executing himself. There was some informality in those sent from Soho. Besides, he has another rotative scheme which I could have told him of long ago, when first invented by William Murdoch, but I did not think it a matter of much consequence." Further, Dr. Smiles, on the authority of Mr. Joseph Parkes himself, relates in his "Lives of Boulton and Watt":—"At an interview which Mr. Parkes had with Mr. Watt at Heathfield, at which Murdoch was present, Murdoch spoke of the sun and planet motion as his invention, which Watt did not contradict."

The sun and planet motion is not the only invention of William Murdoch's erroneously attributed to James Watt.

Yours, &c.,
Alex. Murdoch.

2, Berlin Place, Pollockshields, Glasgow,
January 20th, 1890.

THE WATT ANNIVERSARY AT GREENOCK.

The Watt Anniversary Lecture, under the auspices of Greenock Philosophical Society, was delivered on the 17th inst. by Mr. James Riley, general manager to the Steel Company of Scotland. The subject was "Steel: Its Manufacture, Properties, and Uses." Mr. Riley spoke of the various constituents of steel, and the methods employed in the production of steel in ancient and modern times. Afterwards he went on to speak of the Siemens process, and we quote from this part of his lecture in full as follows:—

Suppose for our present purpose we fully examine the materials charged into a Siemens furnace when working a charge by the Siemens (or scrap and ore) process, the steel to be of ordinary ship quality. Usually the charge consists of 75 per cent. pig iron and 25 per cent. of good scrap steel. As I want to impress you with the amount of precision and care which the steel maker must exercise, I will give you the weights of the elements which go to make up one ton of the pig iron used and one ton of the steel produced:—

	Hematite Iron. Cwt.	Qrs.	Lb.	Oz.		Mild Steel. Cwt.	Qrs.	Lb.	Oz.
Iron	18	2	21	8	...	19	3	9	9
Carbon	0	2	17	15	...	0	0	4	1
Silicon	0	1	19	8	...		trace.		
Sulphur.....	0	0	0	14	...	0	0	1	1
Phosphorus ...	0	0	0	14	...	0	0	1	1
Manganese ...	0	0	22	7	...	0	0	11	3
Copper	0	0	0	14	...	0	0	1	1

All the steel made in this country for engineering or constructive purposes is required to pass certain definite tests of strength and ductility. For instance, steel for shipbuilding, when tested for tensile strength, must break when subjected to a load of not less than 27 or more than 31 tons per square inch, and previous to rupture there must be an elongation of not less than 20 per cent. on 8in. of length of the tested piece—in other words, the tested piece of steel which measures 8in. in length must measure not less than 9⅗in. before it breaks under the pulling stress applied to it. Now variations in any of the elements which are in combination with the iron have a distinct influence on the behaviour of the steel under test, as well as in other respects, and I think you will be somewhat astonished at the effects produced by small variations in composition. For instance, Siemens steel of the composition I have given would probably satisfy the tests named, but if the amount of carbon present were increased by only two parts in ten thousand, it would probably require a greater load than 31 tons to break it, and might not stretch the required 20 per cent. on 8in., and would be liable to rejection by the surveyor. Now, these two parts in ten thousand mean by actual weight less than half a pound of carbon to the ton of steel. Seeing, then, that the influence of carbon is so great, you will readily understand that it demands careful attention when making the steel, and that it is to the contents of this element the steel maker principally looks to enable him to furnish metal of any desired tensional strength; thus, carbon steel—as I may term it—reaches its greatest tensile strength when it contains about 1 per cent. of carbon; it then has an elastic limit of about 30 tons with an ultimate tensile strength of about 60 tons on the square inch of sectional area; it will then, however, have but little ductility, and will be comparatively brittle. In working our charge, we can, if we exercise due care, control the amount of carbon, silicon, and manganese in the steel, but we cannot remove the sulphur and copper, and only by special means the phosphorus. Now, as all these elements are more or less objectionable, it is better to take care that they are not present in the materials we put into the furnace; hence the importance of the preliminary analysis of materials, which is strictly performed in all well-managed works. Proceeding, the lecturer described the method of charging the furnace, and referred to the invention of Mr. Henderson, of Glasgow, regarding the method of producing ferro-manganese, by which the manufacture of mild steel became possible.

And now I should like to speak of one of the most important inventions of recent times, one which has had great and far-reaching effects on the iron and steel trades of this country and of the Continent—I mean what is known as the "basic process" for the production of steel. As you probably know, much the larger portion of the ores of iron found in Great Britain contain phosphorus, and the iron made from them is unfit for the manufacture of steel by the ordinary Bessemer or Siemens process. For many reasons, therefore, it was important that a method should be discovered by which such pig iron could be so treated as to produce good, useful steel. Many of the most eminent metallurgists gave their attention to it, and at length, after many partial successes, this was fully accomplished by what is known as the Thomas-Gilchrist or basic process. The basic process has been useful to the world in general, but as yet has been sadly disadvantageous to Great Britain. To my mind, this is in part due to the distrust which has attended the use of basic steel in this country, a distrust which will not easily be removed from the basic-Bessemer process, but for which there is no ground in connection with the open-hearth basic process. The whole of the operations in the basic-Bessemer process are of such a character as to render it peculiarly easy to produce metal which shall not be thoroughly homogeneous and of a perfectly reliable character. I know, and frankly admit, that by the exercise of the greatest skill and care this can be avoided and thoroughly good steel be produced, and I am glad to state that evidence of the truth of this remark has been furnished in the steel sent out from works in the West of Scotland, yet none the less do I assert that only in the open-hearth furnace can the basic process be conducted with such uniformity, regularity, certainty, and comparative ease as will warrant that firm confidence in results which has been developed with regard to acid steel of high quality.

A great deal has been said and written of late of the advantages to be derived from the use of aluminium in the manufacture of steel; but so far as my experience goes—and I must say that is now of considerable extent—I think this usefulness is considerably overrated. It is true that the use of aluminium in the molten steel greatly increases its fluidity and reduces its melting point, and thus enables one to make castings which shall be sound, and which, being cast at a lower temperature, shall be less subject to the hot cracks due to contraction. But then equally good results can be, and are, obtained without its use, as I have demonstrated to more than one of its advocates. Further, our experience leads us to the conclusion that the strength and ductility of steel are not improved by additions of aluminium, even if they are not slightly impaired. Thus, then, as this metal is as yet a very costly one (although daily becoming less so), it is only in a tentative, careful manner that I would use it. Chromium has been largely made use of as an alloy with steel, particularly for purposes of war, as, for instance, in shot and shell, armour-plates, &c. Like aluminium it is somewhat expensive to use, its first cost being considerable, and the loss by oxidation being great. Considerable care and skill are required in the production of chrome steel to get the necessary amount of chromium present, together with a reasonable amount of carbon. The effects of chromium in steel are shown in increased hardness and strength, with some loss in ductility, in increased facility for hardening and tempering in water or oil, and also in great difficulty in machining. In working this steel at the hammer or rolls care must be taken that the masses of steel are heated very gradually, and not to a very high temperature.

But to my mind the most important of these alloys, and the one which is likely to prove of greatest interest, because of its probable great utility, is that which has been termed ferro-nickel or nickel-steel. Nickel can be allowed with iron or steel to any extent. No serious difficulties are met with in doing this; no special plant is required, the ordinary means for producing steel being ample in this case. Most remarkable properties are possessed by this steel, properties which vary to a very large extent, according to the contents of nickel. When present to the extent of not more than, say, 7 per cent., the effects are a great augmentation of the hardness and tensile strength, a very considerable raising of the elastic limit, and much less corrodibility. Think for a moment of the immense revolution which has been made in engineering and shipbuilding—especially the former—by the command of steel of the latter description. By its means you have been able to accomplish the very great developments which have been achieved during the past dozen years. You have been able to make boilers which will stand pressures previously utterly out of reach. In nickel steel you have the means placed in your hands of nearly doubling your pressures without increasing the weight or dimensions of your boilers. The possibilities which are here presented to the engineer I leave you to imagine; but perhaps I ought to say before leaving this matter that already the probability of the introduction of nickel steel into the industrial arts has developed considerable excitement amongst the owners of mining property where nickel is found, and I anticipate that in no long time the supplies of this metal will be so much increased that it will be possible to supply the steel at prices which will not be considered at all unreasonable.

TESTING THE FORTH BRIDGE.

On the 21st inst. the Forth Bridge was preliminarily tested. Two trains, each consisting of three engines and fifty waggons laden with coal, and weighing 1,800 tons, steamed slowly across the bridge from the South Queensferry end. The two trains, each of which was 1,000ft. in length, moved slowly along, periodically stopping to enable the engineers to examine the levels and deflections. The trains proceeded as far as the middle of the north cantilever, and then returned slowly to the south end. The following is the official report:—"Sir John Fowler and Mr. Baker, engineers of the Forth Bridge, have to-day tested the two 1,700ft. spans by placing on the centres two trains, each made up of fifty loaded coal waggons and three of the heaviest engines and tenders, the total load thus massed upon the spans being the enormous weight of 1,800 tons, which is more than double what the bridge will ever be called upon in practice to sustain. The observed deflections were in exact accordance with the calculations of the engineers, and the bridge exhibited exceptional stiffness in all directions."

The test by the engineers was preparatory to the passing of the first engine over the structure to-day, with Mr. Thompson, chairman of the company, and Lord Colville; and every part of the bridge will be in order for the visit of his Royal Highness the Prince of Wales on the 4th of March. It may be interesting to mention that during the heavy gale of Sunday, when the wind gauges on Inch Garvie recorded a pressure of 37lb. per square foot, the maximum lateral movement of the centre cantilever was less than 1in.

The Deptford Electric Light Station.—We have heard many reports about the Deptford Station, but they are generally not sufficiently authenticated for publication. We have recently been informed on good authority that the telephones are disturbed to a serious extent, the disturbance being sensible even at Paris when "put through." It is rumoured that the railway companies may prevent the use of the mains along their viaducts owing to the disturbance. The action on the telephone circuits was mentioned at the Board of Trade inquiry, but no measures were then taken as to the matter.

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INSTITUTION OF ELECTRICAL ENGINEERS.

CONTINUATION OF PRESIDENTIAL ADDRESS.

(*Concluded from page 67.*)

In speaking of the properties of bodies which, like manganese steel, are slightly magnetic, it may be well here to enter a caution. But little that is instructive is to be learned by testing filings, or the like, with magnets, as these show but little difference between bodies which are slightly magnetic and those which are strongly magnetic. Suppose the filings to be spheres, in the following table are given comparative values of the forces they would experience in terms of μ, if placed in a magnetic field of given value, μ having its ordinary signification—that is, being the ratio of the kick on the galvanometer when a ring is made of the material of the filing to the kick if the ring is made of a perfectly non-magnetic material:—

μ.	Attraction.	
1	0	
1·47	0·18	Non-magnetic body.
3·6	1·2	Manganese steel with 12 per cent.
5	1·5	Manganese steel with 9 per cent.
10	2·1	
100	2·8	
1,000	2·98	

Now bodies in which μ is so small as 3·6 belong distinctly to the non-magnetic class; but the test with the magnet would very markedly distinguish them from manganese steel with 12 per cent. of manganese. The distinction, however, between $\mu = 3·6$ and $\mu = 1,000$ is comparatively small; whereas under the conditions of experiment, μ is much more than 1,000 for most bodies of which iron is the principal constituent.

The effect of stress on the magnetic properties of iron and nickel have been studied by Sir W. Thomson. A fact interesting from a broad and general point of view is that the effects of stress are different in kind in the case of iron and nickel. In the case of iron, for small magnetising forces in the direction of the tension, tension increases the magnetisation; for large forces, diminishes it. In the case of nickel the effect is always to diminish the magnetisation.

When one considers that the magnetic property is peculiar to three substances—that it is easily destroyed by the admixture of some foreign body, as magnanese—one would naturally expect that its existence would depend also on the temperature of the body. This is found to be the case. It has long been known that iron remains magnetic to a red heat, and that then it somewhat suddenly ceases to be magnetic, and remains at a higher temperature non-magnetic. It has long been known that the same thing happens with cobalt, the temperature of change, however, being higher; and with nickel, the temperature being lower. The magnetic characteristics of iron at a high temperature are interesting. Let us return to our ring, and let us suppose that the coils are insulated with a refractory material, such as asbestos paper, and that the ring is made of the best soft iron. We are now in a position to heat the ring to a high temperature, and to experiment upon it at high temperatures in exactly the same way as before. The temperature can be approximately determined by the resistance of one of the copper coils. Suppose, first, that the current in the primary circuit which we use for magnetising the ring is small; that from time to time, as the ring is heated and the temperature rises, an experiment is made by reversing the current in the primary circuit and observing the deflection of the galvanometer needle. At the ordinary temperature of the air the deflection is comparatively small; as the temperature increases the deflection also increases, but slowly at first: when the temperature, however, reaches something like 600° C., the galvanometer deflection begins very rapidly to increase, until, with a temperature of 770° C., it attains a value of no less than 11,000 times as great as the deflection would be if the ring had been made of glass or copper, and the same exciting current had been used. Of course a direct comparison of 11,000 to 1 cannot be made: to make it we must introduce resistance into the secondary circuit when the iron is used; and we must, in fact, make use of larger currents when copper is used. However, the ratio of the induction in the case of iron to that in the case of copper, at 770° C., for small forces is no less than 11,000 to 1. Now mark what happens. The temperature rises another 15° C.; the deflection of the needle suddenly drops to a value which we must regard as infinitesimal in comparison to that which it had at a temperature of 770° C.; in fact, at the higher temperature of 785° C. the deflection of the galvanometer with iron is to that with copper in a ratio not exceeding that of 1·14 to 1. Here, then, we have a most remarkable fact: at a temperature of 770° C. the magnetisation of iron 11,000 times as great as that of a non-magnetic substance; at a temperature of 785° C. iron is practically non-magnetic. These changes are shown in Fig. 8. Suppose now that the current in the primary circuit which serves to magnetise the iron had been great instead of very small. In this case we find a very different order of phenomena. As the temperature rises the deflection on the galvanometer diminishes very slowly till a high temperature is attained; then the rate of decrease is accelerated until, as the temperature at which the sudden change occurred for small forces is reached, the rate of diminution becomes very rapid indeed, until, finally, the magnetism of the iron disappears at the same time as for small forces. Instead of following the magnetisation with constant forces for varying temperatures, we may trace the curve of magnetisation for varying forces with any temperature we please. Such curves are given in Figs. 9 and 10. In the one diagram, for the purpose of bringing out different points in the curve, the scale of abscissæ is 20 times as great as in the other. You will observe that the effect of rise of temperature is to diminish the maximum magnetisation of which the body is capable, slowly at first, and rapidly at the end. It is also very greatly to diminish the coercive force, and to increase the facility with which the body is magnetised. To give an idea of the magnetising forces in question, the force for Fig. 8 was 0·3; and as you see from Figs. 9 and 10, the force ranges as high as 60. Now the earth's force in these latitudes is 0·43, and the horizontal component of the earth's force is 0·18. In the field of a dynamo machine the force is often more than 7,000. In addition to the general characteristics of the curve of magnetisation, a very interesting, and, as I take it, a very important, fact comes out. I have already stated that if the ring be submitted to a great current in one direction, which current is afterwards gradually reduced to zero, the ring is not in its non-magnetic condition, but that it is, in fact, strongly magnetised. Suppose now we heat the ring, whilst under the influence of a strong magnetising current, beyond the critical temperature at which it ceases to have any magnetic properties, and that then we reduce the current to zero, we may in this state try any experiment we please. Reversing

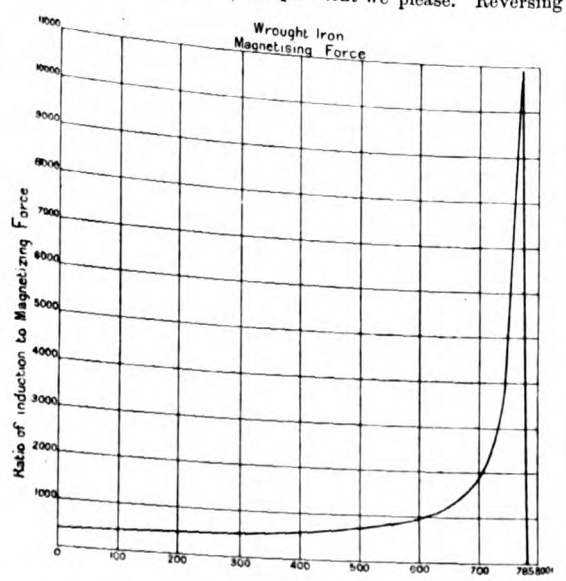


FIG. 8.

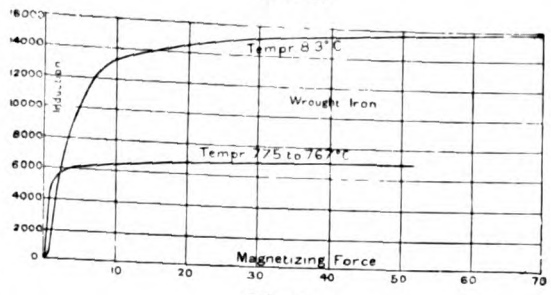


FIG. 9.

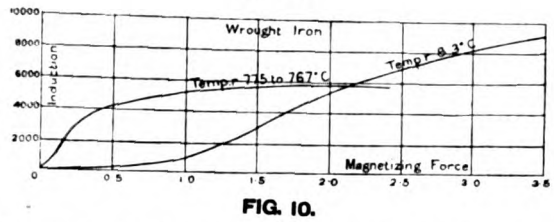


FIG. 10.

the current on the ring, we shall find that it is in all cases non-magnetic. Suppose next that we allow the ring to cool without any current in the primary, when cold we find that the ring is magnetised; in fact, it has a distinct recollection of what had been done to it before it was heated to the temperatvre at which it ceased to be magnetic. When steel is tried in the same way with varying temperatures, a similar sequence of phenomena is observed; but for small forces the permeability rises to a lower maximum, and its rise is less rapid. The critical temperature at which magnetism disappears changes rapidly with the composition of the steel. For very soft charcoal iron wire the critical temperature is as high as 880° C.; for hard Whitworth steel it is 690° C.

The properties of an alloy of manganese and iron are curious. More curious are those of an alloy of nickel and iron. The alloy of nickel and iron containing 25 per cent of nickel is non-magnetic as it is sure to come from the manufacturer; that is to say, a substance compounded of two magnetic bodies is non-magnetic. Cool it, however, a little below freezing, and its properties change: it becomes very decidedly magnetic. This

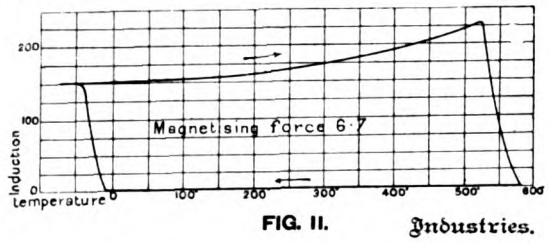


FIG. 11. Industries.

is perhaps not so very remarkable; the nickel steel has a low critical temperature—lower than we have observed in any other magnetisable body. But if now the cooled material be allowed to return to the ordinary temperature it is magnetic; if it be heated it is still magnetic, and remains magnetic till a temperature of 580° C. is attained, when it very rapidly becomes non-magnetic, exactly as other magnetic bodies do when they pass their critical temperature. Now cool the alloy: it is non-magnetic, and remains non-magnetic till the temperature has fallen to below freezing. The history of the material is shown in Fig. 11, from which it will be seen that from −20° C. to 580° C. this alloy may exist in either of two states, both quite stable—a magnetic and a non-magnetic—and that the state is determined by whether the alloy has been cooled to −20° C. or heated to 580° C.

Sudden changes occur in other properties of iron at this very critical temperature at which its magnetism disappears. For example, take its eletrical resistance. On the curve Fig. 12 is shown the electrical resistance of iron at various temperatures, and also the electrical resistance of copper or other pure metal. Observe the difference. If the iron is heated, its resistance increases with an accelerating velocity, until, when near the critical temperature, the rate of increase is five times as much as the copper; at the critical temperature the rate suddenly changes, and it assumes a value which, as far as experiments have gone, cannot be said to differ very materially from a pure metal. The resistance of manganese steel shows no such change; its temperature coefficient constantly has the value of ·0012, which it has at the ordinary temperature of the air. The electrical resistance of nickel varies with temperature in an exactly similar manner. Again, Professor Tait has shown that the thermo-electric properties of iron are very anomalous—that there is a sudden change at or about the temperature at which the metal becomes non-magnetic, and that before this temperature is reached the variations of thermo-electric property are quite different from a non-magnetic metal.

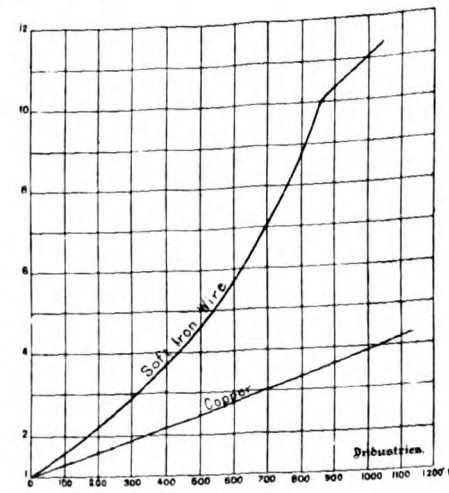


FIG. 12.

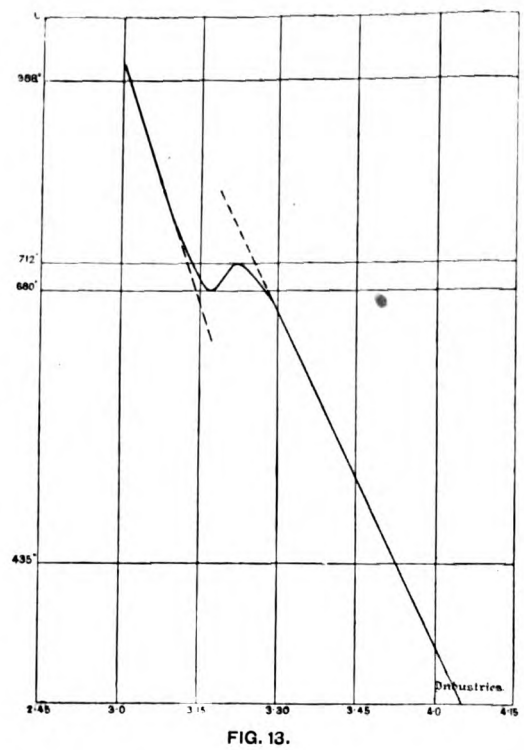


FIG. 13.

Professor Tomlinson has investigated how many other properties of iron depend upon the temperature. But the most significant phenomenon is that indicated by the property of recalesence. Professor Barrett, of Dublin, observed that if a wire of hard steel is heated to a very bright redness, and is then allowed to cool, the wire will cool down till it hardly emits any light at all, and that then it suddenly glows out quite bright again, and afterwards finally cools. This phenomenon is observed with great difficulty in the case of soft iron, and is not observed at all in the case of manganese steel. A fairly approximate numerical measurement may be made in this way: Take a block of iron or steel on which a groove is cut, and in this groove wind a coil of copper wire insulated with asbestos; cover the coil with many layers of asbestos; and finally cover the whole lump of iron or steel with asbestos again. We have now a body which will heat and cool comparatively slowly, and which will lose its heat at a rate very approximately proportional to the difference of temperature between it and the surrounding air. Heat the block to a bright redness, and take it out of the fire and observe the resistance of the copper coil as the temperature falls, due to the cooling of the block. Plot a curve in which the abscissæ are the times, and the ordinates the logarithms, of the increase of resistance of the copper coil above its resistance at the temperature of the room. If the specific heat of the iron were constant, this curve would be a straight line; if at any particular temperature latent heat were liberated, the curve would be hori-

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GRAPHIC CONSTRUCTION FOR DYNAMOS.

—	Through Armature between Shunt Terminals.	In Shunt between Shunt Terminals.	In External Circuit between Machine Terminals when		In Series Coils when	
			Series Coils inside Shunt Terminals.	Series Coils outside Shunt Terminals.	Inside Shunt Terminals.	Outside Shunt Terminals.
E.M.F. . . .	E	$\epsilon = E \mp AR$	$e = \epsilon$	$e = ar = \epsilon \mp ar_s$	Included in $(E \mp e)$	ϵ or e
Resistance . .	R	$\rho = \frac{\epsilon}{\alpha}$	$r = \frac{e}{a}$	$r = \frac{e}{a}$	Included in R	r_s
Current . . .	A	$\alpha = \frac{\epsilon}{\rho}$	$a = A \mp \alpha = \frac{e}{r}$	$a = A \mp \alpha = \frac{e}{r}$	A	a
Turns of coils	τ	. . . .	. . . .	. . . .	t	t

N.B.—Where the double sign $\mp$ occurs, − is to be used for generators and + for motors.

Equivalent shunt current $\alpha^1 = \alpha + A\frac{t}{\tau}$ when series coils are inside shunt terminals.

" " $= \alpha + a\frac{t}{\tau}$ " " outside "

The curve co-ordinating E and α^1 will be called the E/α^1 curve.

" " E " A " " E/A "

" " e " α " " e/a "

The straight line co-ordinating ϵ and a will be called the ρ line.

" " " $(E - \epsilon)$ and A will be called the R line.

" " representing the external resistance will be called the r line.

The height of intersection of E/α^1 curve and ρ line or $\rho\frac{\tau}{\tau + t}$ line will be called E_k.

The slope of the E/α^1 curve at the height E_k will be called k.

zontal so long as the heat was being liberated. If now a block be made of manganese steel, it is found that the curve is very nearly a straight line, showing that there is no liberation of latent heat at any temperature. If it is made of nickel steel with 25 per cent. of nickel, in its non-magnetic state, the result is the same—no sign of liberation of heat. If now the block be made of hard steel, the temperature diminishes at first; then the curve (Fig. 13) which represents the temperature bends round: the temperature actually rises many degrees whilst the body is losing heat. The liberation of heat being completed, the curve finally descends as a straight line. From inspection of this curve, it is apparent why hard steel exhibits a sudden accession of brightness as it yields up its heat. In the case of soft iron the temperature does not actually rise as the body loses heat, but the curve remains horizontal, or nearly horizontal, for a considerable time. This, again, shows why, although a considerable amount of heat is liberated at a temperature corresponding to the horizontal part of the curve, no marked recalescence can be obtained. From curves such as these it is easy to calculate the amount of heat which becomes latent. As the iron passes the critical point it is found to be about 200 times as much heat as is required to raise the temperature of the iron one degree centigrade. From this we get a very good idea of the importance of the phenomenon. When ice is melted and becomes water, the heat absorbed is eighty times the heat required to raise the temperature of the water one degree centigrade, and 160 times the heat required to raise the temperature of the ice by the same amount. The temperature of recalescence has been abundantly identified with the critical temperature of magnetism.* I am not aware that anything corresponding with recalescence has been observed in the case of nickel. Experiments have been tried, and gave a negative result, but the sample was impure; and the result may, I think, be distrusted as an indication of what it would be in the case of pure nickel. The most probable explanation in the case of iron, at all events, appears to be that when iron passes from the magnetic to the non-magnetic state it experiences a change of state of comparable importance with the change from the solid to the liquid state, and that a large quantity of heat is absorbed in the change. There is, then, no need to suppose chemical change; the great physical fact accompanying the absorption of heat is the disappearance of the capacity for magnetisation.

What explanations have been offered of the phenomena of magnetism? That the explanation must be molecular was early apparent. Poisson's hypothesis was that each molecule of a magnet contained two magnetic fluids, which were separated from each other under the influence of magnetic force. His theory explained the fact of magnetism induced by proximity to magnets, but beyond this it could not go. It gave no hint that there was a limit to the magnetisation of iron—a point of saturation; none of hysteresis; no hint of any connection between the magnetism of iron and any other property of the substance; no hint why magnetism disappears at a high temperature. It does, however, give more than a hint that the permeability of iron could not exceed a limit much less than its actual value, and that it should be constant for the material, and independent of the force applied. Poisson gave his theory a beautiful mathematical development, still useful in magnetism and in electrostatics.

Weber's theory is a very distinct advance on Poisson's. He supposed that each molecule of iron was a magnet with axes arranged at random in the body; that under the influence of magnetising force the axes of the little magnets were directed to parallelism in a greater degree as the force was greater. Weber's theory thoroughly explains the limiting value of magnetisation, since nothing more can be done than to direct all the molecular axes in the same direction. As modified by Maxwell, or with some similar modification, it gives an account of hysteresis, and of the general form of the ascending curve of magnetisation. It is also very convenient for stating some of the facts. For example, what we know regarding the effect of temperature may be expressed by saying that the magnetic moment of the molecule diminishes as the temperature rises, hence that the limiting moment of a magnet will also diminish; but that the facility with which the molecules follow the magnetising force is also increased, hence the great increase of μ for small forces, and its almost instantaneous extinction as the temperature rises. Again, in terms of Weber's theory, we can state that rise of temperature enough to render iron non-magnetic will not clear it of residual magnetism. The axes of the molecules are brought to parallelism by the force which is impressed before and during the time that the magnetic property is disappearing; they remain parallel when the force ceases, though, being now non-magnetic, their effect is nil. When, the temperature falling, they become again magnetic, the effect of the direction of their axes is apparent. But Weber's theory does not touch the root of the matter by connecting the magnetic property with any other property of iron, nor does it give any hint as to why the moment of the molecule disappears so rapidly at a certain temperature.

Ampère's theory may be said to be a development of Weber's: it purports to state in what the magnetism of the molecule consists. Associated with each molecule is a closed electric current in a circuit of no resistance; each such molecule, with its current, constitutes Weber's magnetic molecule, and all that it can do they can do. But the great merit of the theory—and a very great one it is—is that it brings magnetism in as a branch of electricity; it explains why a current makes a magnetisable body magnetic. It also gives, as extended by Weber, an explanation of diamagnetism. It, however, gives no hint of connecting the magnetic properties of iron with any other property. Another difficulty is this: When iron ceases to be magnetisable, we must assume that the molecular currents cease. These currents represent energy. We should therefore expect that, when iron ceased to be magnetic by rise of temperature, heat would be liberated; the reverse is the fact.

So far as I know, nothing that has ever been proposed even attempts to explain the fundamental anomaly, Why do iron, nickel, and cobalt possess a property which we have found nowhere else in nature? It may be that at lower temperatures other metals would be magnetic, but of this we have at present no indication. It may be that, as has been found to be the case with the permanent gases, we only require a greater degree of cold to extend the rule to cover the exception. For the present, the magnetic properties of iron, nickel, and cobalt stand as exceptional as a breach of that continuity which we are in the habit of regarding as a well-proved law of nature.

After the delivery of this address, Sir William Thomson said the President had done well to emphasize the marvellous properties of iron, nickel, and cobalt, but he thought these properties were not quite so much isolated as would appear from the address. Faraday showed the continuity between paramagnetic and diamagnetic bodies, and that all substances are susceptible to magnetism when subjected to sufficiently intense magnetising forces. He had also compared the relative susceptibilities of materials such as glass, bismuth, wood, &c.; but the absolute determination of their susceptibilities still presents a large field for interesting and valuable research The fact that the magnetic properties of such substances could be compared was itself of immence importance, whilst Tyndall's observations on the properties of bread, Iceland spar, &c., which can be made, or are naturally magnetically anisotropic, further enhances the interest connected with the subject. As regards the President's remark that Poisson's theory gave no hint of hysteresis, this he thought was open to question, for the theory refers to coercive force, and this is hysteresis under another name. Coming to the subject of recalescence, Sir William said this was of immense importance, and one of the wonders duly accentuated by the President. In this connection he wished to add that most of the work on the latent heat of iron, about the temperature at which the recalescence occurs, had been done by the President himself. The region about the ripple in Fig. 13 requires further investigation, and, if possible, a cycle such as Andrews used in his experiments on evaporation and condensation should be devised. The material exists in two or more different states at the same temperature, and if the effect is reversible then the iron should cool whilst heat is being supplied to it. In conclusion, Sir William suggested that several physical properties of the material should be tested statically whilst it was kept at temperatures little above and little below the critical one, and also during the various states in which the material exists at the same temperature.

Professor Ewing, in commenting on the enormous amount of hysteresis exhibited by the alloy of nickel and iron (Fig. 11), said he had looked for hysteresis in similar alloys and found none; now he saw why he found none, for his experiments were made between ordinary atmospheric temperatures and 212° F., whilst Dr. Hopkinson, by increasing the range of temperature, had passed the critical points and shown the hysteresis to be very great. In his own (Professor Ewing's) experiments on iron, he found that by tapping a rod whilst subjected to magnetising force, a permeability of 20,000 could be obtained.

The discussion was continued last evening.

* I have only recently become acquainted with the admirable work of M. Osmond on recalescence. He has examined a great variety of samples of steel, and determined the temperatures at which they give off an exceptional amount of heat. Some of his results are apparent on my own curves, though I had assumed them to be mere errors of observation. For example, referring to my Royal Society paper, there is, in Fig. 38, a hint of a second small anomalous point a little below the larger one. And, comparing Figs. 38 and 38A, we see that the higher the heating, the lower is the point of recalescence; both features are brought out by M. Osmond. The double recalescence observed by M. Osmond in steel with a moderate quantity of carbon I would explain provisionally by supposing this steel to be a mixture of two kinds which have different critical temperatures. Although M. Osmond's method is admirable for determining the temperature of recalescence, and whether it is a single point or multiple, it is not adapted to determine the quantity of heat liberated, as the small sample used is enclosed in a tube of considerable mass, which cools down at the same time as the sample experimented upon.

GRAPHIC CONSTRUCTIONS FOR DYNAMOS AND MOTORS.

By Professor Robert H. Smith.

II.

(*Continued from page* 43.)

When the magnet-winding is compound or shunt the following very simple graphic method may be used to obtain the various characteristics of dynamos and motors from the fundamental curve co-ordinating the whole e.m.f. and the magnet ampere-turns. It will be found convenient to suppose this curve reduced in horizontal scale so that its horizontal ordinate will represent a current of such magnitude that if it acted in the shunt coils it alone would give the whole actual ampere-turns. This current will be called the "equivalent shunt current."

The above table gives the nomenclature that will be used in explaining the constructions.

The whole ampere-turns are $(\alpha\tau + A\,t)$ in the case of the series coils being inside the shunt terminals. The curve co-ordinating this with E the whole e.m.f. generated in the armature is reduced horizontally by dividing every horizontal ordinate by τ, the number of turns in the shunt coils; so that the horizontal ordinates become $\left(\alpha + A\frac{t}{\tau}\right) = \alpha^1$, and the curve will be called the E/α^1 curve. When the shunt is between the brushes the E/α^1 curve has its horizontal ordinates equal to $\left(\alpha + a\frac{t}{\tau}\right)$.

The former case is shown for a generator in Figs. 5, 6, and 7 on the next page. A straight line is drawn through the origin at the slope ρ. For each possible shunt current α this line gives the corresponding value of ϵ, the e.m.f. between the shunt terminals.

Now, suppose two actually corresponding or simultaneous values of E and ϵ taken. Take the point on the $E\,\alpha^1$ curve at height E, and the point on the ρ line at height ϵ; and join these points. The slope of this line is $R\frac{\tau}{t}$, because the difference of heights is $(E - \epsilon) = AR$, and the difference of horizontal distance is $(\alpha^1 - \alpha) = \left(\alpha + A\frac{t}{\tau}\right) - \alpha = A\frac{t}{\tau}$, and $\frac{AR}{A\frac{t}{\tau}} = R\frac{\tau}{t}$.

This slope is constant for all values of E, ϵ, and A. Therefore any number of pairs of corresponding values of E and ϵ can at once be found by drawing a number of parallel lines at this slope between the ρ line and the E/α^1

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GRAPHIC CONSTRUCTION FOR DYNAMOS.

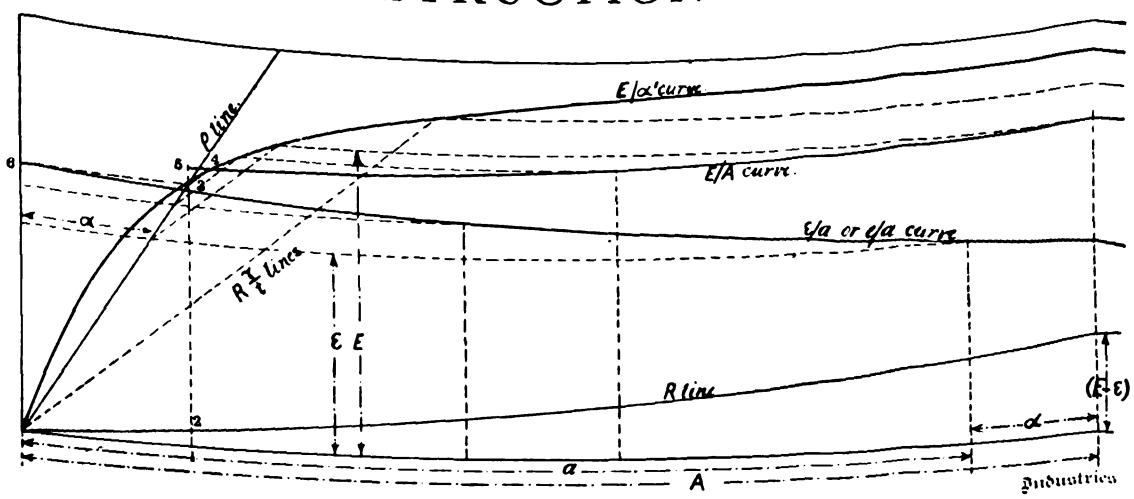


FIG. 5.

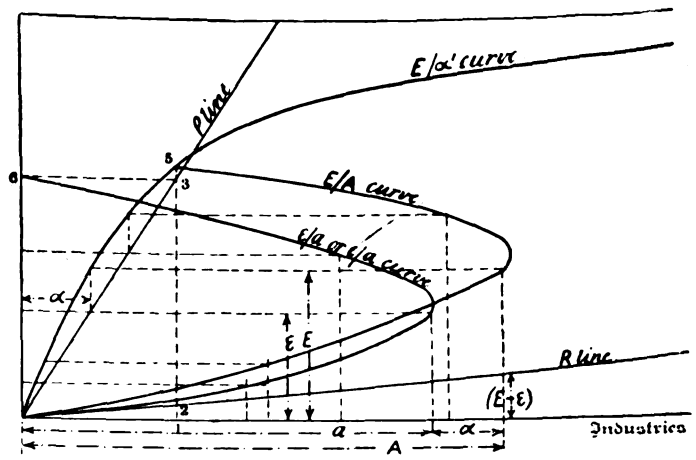


FIG. 6.

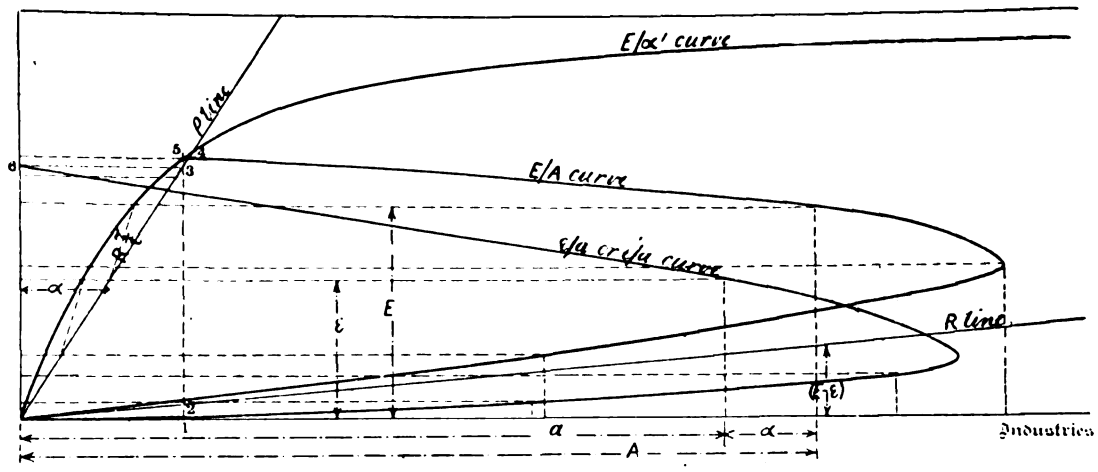


FIG. 7.

ference of height of the ends of each such value of $(E - \epsilon)$ and E/α' curve) gives the corresponding value of A, this difference of height is to be taken with the dividers. The straight line $R = (E - \epsilon)/A$ having been drawn, the point on it having this height $(E - \epsilon)$ is found by help of the dividers set as above, and the horizontal distance of this point is the corresponding value of A. A vertical being drawn through the E point on the E/a' curve, the intersection gives the corresponding point of the E/A curve—i.e., the "internal characteristic." From this point is set backwards towards the left hand the simultaneous value of a, taken by the dividers from the ϵ point on the ρ line. This gives the value of $a = A - \alpha$, and a vertical being drawn downwards to the horizontal drawn at the level ϵ, the intersection gives the simultaneous point of the "external characteristic" ϵ/a or e/a. Any desired number of points of the two characteristics can be found very quickly in this manner.

The "shunt generator" is merely a particular case of this construction. In it $t = 0$, and therefore $R\frac{\tau}{t} = \infty$; that is, the lines at this slope are to be drawn *vertical*. Fig. 6 shows the construction, which requires no further explanation, because it is identical with that of Fig. 5, except in the above particular.

The "shunt" machine is the one limit of the range of applicability of this construction. At the other limit we have the "series" machine. For this the construction is, of course, not required; but it may be well to point out that it would fail at this limit, because the ρ line becomes vertical, and the $R\frac{\tau}{t}$ line becomes horizontal; the value of $(E - \epsilon)$ becomes continually zero—in fact, there exist no shunt terminals between which to take ϵ.

It may also be noted that the initial slope of the E/α' curve must be steeper than the ρ line, because this line must intersect this curve in order that the construction should be possible. The meaning of this is that a compound wound generator will not begin to work until a certain limit of speed is passed, the initial slope of the E/α' curve being proportional to the speed.

It is important to distinguish between the two cases in which (1) slope $R\frac{\tau}{t} < \rho$ (see Fig. 5), and (2) $R\frac{\tau}{t} > \rho$ (see Fig. 7).

The limit of case (2) is the shunt machine, Fig. 6. Referring to Fig. 7 it will be seen that if $R\frac{\tau}{t}$ be greater than the initial slope of the E/α' curve, then for $\epsilon = 0$ we have also $E = 0$. But if $R\frac{\tau}{t}$ be less than this initial slope, we obtain a finite minimum value of E when $\epsilon = 0$, this corresponding to short-circuiting with zero external resistance betweens the terminals, the magnets then being excited by the series coils only. In either case, so long as $R\frac{\tau}{t} > \rho$, the value of $(E - \epsilon)$, and, therefore, also the value of A, reaches a maximum where the $R\frac{\tau}{t}$ line cuts the E/α' curve at a point where this curve is parallel to the ρ line. The maximum value of a, the external current, is reached at somewhat lower values of E and ϵ. Passing upwards from the position of maximum A, the value of $(E - \epsilon)$ continually decreases until that limiting position of the $R\frac{\tau}{t}$ line is reached which makes the difference of level of its intersections on the ρ line and the E/α' curve, that is, makes $(E - \epsilon)$ correspond on the R line to a horizontal distance A equal to a, the horizontal distance of the lower intersection (on the ρ line). This position is marked on Fig. 7 by the points 1, 2, 3, 4, where 1, 2, 3 are on the same vertical line, 3, 4 is at inclination $R\frac{\tau}{t}$, and 12 equals the difference of level between 3 and 4. Point 5 on the vertical 1, 3, and on same level as 4, is the final point of the E/A curve, and point 6 in the vertical axis, and on same level as 3, is the final point of the ϵ/a or e/a curve. Note that in this case these final values of E and ϵ are both *below* the crossing of the E/α' curve and the ρ line.

In the shunt machine Fig. 6, point 5 coincides with point 4.

If the $R\frac{\tau}{t}$ be a less slope than that of the line joining the origin with the touching point of the tangent of the E/α' curve parallel to the ρ line, then the values of $(E - \epsilon)$ and of A decrease from the very beginning; that is, both the curves E/A and ϵ/a, starting far to the right hand, run continuously towards the left hand. The ϵ/a curve starts from the horizontal axis.

If $R\frac{\tau}{t}$ be little more than ρ, then the value of E changes very little, while ϵ increases from 0 up to its maximum value, and while A and a increase to their greatest and again decrease to their final values.

The smaller the internal resistance R is made, it is clear from the construction that the greater becomes the range of A and a for given small variations of E and ϵ. With this kind of machine there is no other way of keeping ϵ fairly constant under large variations of a.

Turning now to the case in which $R\frac{\tau}{t} < \rho$, we find that this must be again divided into two sub-cases: (a) wherein $R\frac{\tau}{t}$ is greater than the slope of the E/α' curve, where it crosses the ρ line; and (b) wherein $R\frac{\tau}{t}$ is less than this slope.

The value of E and the slope of the E/α' curve at this crossing with the ρ line are among the most important quantities as regards the working of dynamos, whether generator or motor. Therefore the special names E_k and k will be used to indicate them. Note that E_k increases and k decreases as the speed of rotation increases, E_k in a greater ratio than the speed. If the curve followed Fröhlich's formula, the value of k would be in simple inverse proportion to the speed, and the value of E_k would be a constant multiple of the speed minus a constant amount.

If $k < R\frac{\tau}{t} < \rho$ (see Fig. 5), then E reaches a maximum limit when $\epsilon = 0$. From this limit as ϵ increases E and $(E - \epsilon)$, and consequently A and a continually decrease. The other limit is reached as in the previous case, when the difference of level between the ends of the $R\frac{\tau}{t}$ line gives a value of A upon the R line equal to the value of a obtained from the ρ line. In Fig. 5 this limiting position is indicated by the points 1, 2, 3, 4, 5, 6, the ends of the E/A and ϵ/a curves being 5 and 6. In this case, the final value of ϵ is less than E_k, as in Fig. 7, but the final value, and indeed all values, of E are greater than E_k.

(To be continued.)

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THE PHYSICAL SOCIETY.

At a meeting of this Society on the 17th inst., Dr. S. P. Thompson made a communication "On Electric Splashes," and illustrated his subject by beautiful experiments on the production of Lichtenberg's figures. The author has recently investigated these phenomena as modified by varying the conditions under which the figures are obtained, and has arrived at the following conclusions. First, the nature of the dielectric plate does not change the character of the figures produced; and secondly, the nature of the powders used seems to have no material effect on their shape. In the course of his experiments he has found a mixture of sublimed sulphur and lycopodium to give better figures than the red lead and sulphur usually employed, and also that a large and highly polished knob is advantageous, particularly when the Leyden jar is charged negatively. Sometimes when obtaining negative figures, nebulous patches occur, and these were attributed to the so-called electric winds sent off from roughnesses on the knob when not sufficiently well polished. If instead of bringing the knob in contact with the plate, it is only brought near to it, then a peculiar figure closely resembling a "splash" results. A positive splash consists of short lines radiating from the point of approach, whilst a negative splash is made up of more or less rounded spots which become elongated in a radial direction as their distance from the centre of the splash increases. Negative splashes are, however, much more difficult to produce than positive ones. When viewed in the dark, the discharge producing the splash is seen to consist of a bundle of small sparks which branch outwards on approaching the plate. In conclusion, the author remarked that roughnesses on a conductor produce more electric wind when the conductor is charged negatively than when positively charged, and he invited the opinions of members as to the causes of the differences observed between positive and negative electricity.

A paper "On Galvanometers," by Professor W. E. Ayrton, F.R.S., T. Mather, and W. E. Sumpner, D.Sc., was read by Professor Ayrton. In fitting up the physical laboratories of the Central Institution of the City and Guilds of London Institute, the authors have had occasion to obtain galvanometers of various types and patterns, some of which have been made to special designs, and specimens of instruments embodying recent improvements were exhibited at the meeting. The question as to whether fairly sensitive galvanometers should be astatic or non-astatic was answered in favour of the former system, from the fact of its being less affected by external magnetic disturbances, and the greater ease with which great sensibility may be obtained. The usual method of placing the mirror inside the coil was shown to be undesirable, and in the newer forms of instruments Mudford's improvement of placing the mirror outside the coils has been adopted, the space near the axis of the coil being nearly filled with wire. It was also shown that if wire be wound in a certain approximately spheroidal space near the magnets, then these convolutions will tend to oppose the more distant portions of the coil; however, by winding the two parts in opposite directions they conspire to deflect the magnet. Details as to methods of supporting the coils were then discussed, and the importance of fitting them in boxes mounted on hinges or otherwise, so as to be readily removable, was pointed out. A galvanometer devised for teaching purposes, and provided with variable damping arrangements, was described, in which the damping is effected by enclosing the mirror in a glass cell, whose sides can be caused to approach or recede by turning a milled head outside the instrument. This arrangement enables the damping to be varied between wide limits, and its effect on the swing produced by a given discharge can be determined. The instrument is also serviceable both as an ordinary damped galvanometer, or as a fairly ballistic one. In measuring quantities of electricity by the first swing of a galvanometer needle, a correction has usually to be introduced for damping; this correcting factor is simple enough when the damping is small, but becomes more complicated as the damping increases, and to facilitate the calculations a table of values of the factor for various values of λ (the logarithmic decrement) has been calculated. From this it appears that for values of λ less than 0·5 the value of the factor is very nearly $(1 + \frac{1}{2}\lambda)$, the correction usually employed. Improvements in methods of insulating the coils and terminals of galvanometers required for insulation tests were next described, the principle of which may be gathered from Figs. 107 and 108 in Professor Ayrton's "Practical Electricity." A special form of instrument for high insulation work was exhibited, in which the copper resistance of the coils is nearly 400,000 ohms, and the shortest path along which surface leakage can take place from the coils to the base of the instrument is between 30in. and 40in. of ebonite artificially dried by sulphuric acid. This is attained by supporting the coils from two corrugated ebonite rods which depend from a brass ring carried on the top of three corrugated pillars fixed to the base plate. The instrument was constructed to the drawings and specification by Messrs. Nalder Bros., but the method of supporting the coils was suggested by Messrs. Eidsforth & Mudford. With reference to the proportionality of deflection to current in reflecting galvanometers, it was pointed out that ordinary instruments may differ as much as 2 per cent. within the limits of the scale, hence showing the necessity for calibration when any approach to accuracy is desired. Galvanometers of the D'Arsonval type sometimes differ from proportionality quite as much as the one above referred to, but by fitting such instruments with curved pole pieces, and allowing the coil to hang freely from the top suspension, a proportionality true to less than 0·15 per cent. has been attained over a scale about 30in. long. Coming to the question of sensitiveness, the importance of keeping the wire as close as possible to the magnets was brought prominently forward, as well as the necessity of reducing the "figures of merit" of various instruments to the same standard in comparing their sensibilities. The standard adopted as most convenient and closely approximating to practical usage is arrived at by supposing the distance of the mirror from the scale to be equal to 2,000 scale divisions, and the sensibilities for current and quantity are given as *scale divisions per micro-ampere* and *scale divisions per micro-coulomb* respectively. The period of oscillation is also taken into account. A table showing the resistances, sensibilities, coefficients of self-induction, and volumes of the coils of various instruments, together with the relations existing between them, accompanies the paper, and from this it appears that in the best astatic double-coil instruments of from 10,000 to 30,000 ohms resistance the number of scale divisions per microampere may reach 400 times the resistance to the $\frac{2}{3}$th power ($400\ R^{\frac{2}{3}}$), when the period is ten seconds. In obtaining data of various instruments the authors have consulted, among others, Professor Threlfall's paper on "The Measurement of High Specific Resistances," in the *Phil. Mag.* for December, 1889, and noticed two serious errors. The first of these makes an instrument constructed according to Messrs. Gray's pattern nine times less sensitive than it actually was, whilst the sensibility of a form recommended in the paper is given seventeen times too great.

On account of the lateness of the hour, the discussion was adjourned till the 6th prox.

Notes.

ELECTRICAL ACCIDENTS IN NEW YORK.

The *Standard* and *Daily News* are keeping up the supply of electrical accidents in the United States. Their latest report is about a damp horse smelling a damp lamp-post, and is not so impossible as usual. In the interests of electrical progress in Great Britain, it would be well to allow a technical man to see these telegrams before they are published, for no one knows how much damage may be done to a cause by the spreading broadcast of a number of reports apparently prejudicial to its interests.

INSTITUTE OF MARINE ENGINEERS.

A meeting of the Institute of Marine Engineers was held on the 13th inst., when a paper on "The Marine Engine Considered as a Machine" was read by Mr. J. Hawthorn. The meeting was specially for junior engineers and graduates. Mr. Hawthorn began by pointing out the importance of mathematics to the engineer who wished to understand the leading principles underlying the structural arrangement of the engine, as well as those involved in proportioning the strengths of the various parts. The conversion of the motion of the piston and piston rod into that of the crank shaft, being the primary object, was referred to first, and the power exerted by the piston when impelled by the force of the steam was considered, and the losses due to resistance and friction consequent upon the change of motion from reciprocating to rotary were pointed out. The guides and guide shoes, the crossheads and connecting-rod motions, and the several and appointed duties of these details were referred to and discussed, as well as the forces at work acting to give the change of motion; this was illustrated by a diagram of the parallelogram of forces giving the direction of the resultant force. The turning effort on the crank shaft and the stress on the material of the shaft at various parts of the stroke were illustrated, and the formula for calculating the diameter of the shaft was shown reduced to its elements, and analysed. The transmission of the motion from the crank shaft to the propelling apparatus by and through the intermediate shafting and coupling bolts was next dealt with, and the shearing action on the bolts, with the method of determining the section of iron or steel to resist fracture and ensure safety, was pointed out. The duty of the propeller, the effective and resisting forces at work in the propeller itself, as well as the vessel to be propelled, were analysed, and the net power available for moving the vessel through the water at a certain rate of speed was obtained from assumed data. The power expended in working the pumps, especially the circulating pump, was shown and illustrated by an example worked out from rules and assumed data, and the lecturer closed by expressing the hope that he had given some ideas which might be productive of good to some of the juniors present, and, although he made no claim to originality in what he had put before the meeting, he wished to interest and draw out the younger members and graduate section of the Institute and lead them to think about the theoretical as well as the practical side of their business.

AMALGAMATION OF ELECTRICAL INTERESTS.

The United Engineering Company, Limited, have amalgamated with Messrs. Statter & Co., of West Drayton, under the title of the Electrical Engineering Corporation, Limited. The Corporation has thus large works at West Drayton for engines and heavy electrical plant, and a smaller works in Lambeth for switches and accessories, and offices in Victoria Street. Messrs. Statter, Manville, & Madgen are managing directors.

THE OIL TRADE.

At present we hear a great deal about the tendency towards a national organisation of our different industries so that the claims of employers and employed in all parts of the country may be duly considered. It is quite evident however, that if we are to retain Free Trade—and of that there can be little doubt—the movement must become international, as indeed it has already become in some departments. The latest example is that of the Scotch oil trade. A few days ago the representatives of the Scotch companies met in London the representative of the large syndicates which control the whole of the American oil trade, to consider the claim of the Scotch companies for a rise in the prices of scale and candles. After fully discussing the subject it was agreed to defer the decision until the American representative had visited the Continent and made inquiries into the conditions of the trade in the different countries. Improved communication and the telegraph has compressed the globe into a very small part of its former dimensions, and made each country to a large extent dependent on what is being done in every other country with which it has business relations.

THE COTTON TRADE.

Quite a revolution has taken place in the business of cotton buying in Liverpool. The custom was for all users of cotton to purchase their requirements through brokers. It was quite the exception for a spinner to buy direct from a merchant. The Oldham Cotton Buying Company, however, has now been in operation for some time, and the results of the past three months are noteworthy. This company, it may be observed, acts for spinners, but is "boycotted" by the Liverpool Brokers' Association. The cash turnover for the three months ending last Saturday was £610,000, the number of bales bought being 67,000, against 52,750 in the corresponding quarter of last year. The trade profit was £2,587, and, after allowing for share interest, the sum disposable is £2,550, out of which the directors recommend a payment of 7s. per £100 of members' purchases. It is an open secret that many members of the Liverpool Association do business with the Cotton Buying Association, though it is contrary to the rules of the former association. Recently the directors have been considering complaints anent the irregularities. The feature of the market since the turn of the year is the advance in cotton caused by the speculative manipulation of jobbers. Merchants who sold for forward delivery in October last have had to buy spot cotton in Liverpool to meet their engagements, and in this way prices have been advanced. Spinners, it may be said, have "cornered" merchants, for the former as a body are well bought for the greater part of the season. In the meantime, spinning as a trade is remunerative, and satisfactory prices are being declared. Weaving, as distinct from spinning, continues a lean trade, for while yarn advances, cloth keeps all but stationary.

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Patent Record.

(Compiled from "The Illustrated Official Journal (Patents)."

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

1889.

16776A. Alzugaray, J. B. ..... Universal furnace. (24th October, 1889).

6th January, 1890.

197. Lacey, R. G. ..... Sea anchor and oil distributors.
201. Tomlinson, J. D. ..... Cylinders for breaking fibrous material.
203. Howells, S. J. ..... Sea-oiling apparatus.
207. Whiteley & Whiteley... Spool winding machines.
209. Mayall, R., Jun. ..... Looms.
210. Thorp, T. ..... Pressure gauge.
212. Schloesser, G. H. ..... Paper-making machinery.
213. Macintire, J. ..... Steel and iron.
214. Canet, J. B. G. A. ..... Gun mounting.
220. Cutlan, F. ..... Nailing machine for boots.
221. Kenyon, Barnes, & Kenyon ..... Mangling machines.
227. Lake, H. H. ..... Railway vehicles (*Brill & Brill*).
236. Smith, C. ..... Projectiles (*Margary*).

7th January, 1890.

250. Roche & Roche ..... Cleaning tram lines.
255. Miles, S. J. ..... Furnaces.
256. Halladay, W. H. ..... Saw sharpening machines.
257. Halladay, L. P. ..... Saw swages.
258. Halladay, L. P. ..... Saw sharpening machines.
262. Butterworth & Butterworth ..... Tentering machines.
263. Seketeházy, J. ..... Portable framework for bridges.
266. Brock & Romero ..... Air pump.
267-8. Wise, W. L. ..... Manufacture of bricks (*Gregg*).
269. Lake, H. H. ..... Sewing machines (*Seam Machine Company*).
271. Justice, P. M. ..... Elevators (*Otis*).
277. Washburn, Croft, & Wheeler ..... Machines for working vegetable fibre.
284. Thompson, W. P. ..... Loading ships (*Paterson & Wade*).
285. Canet, J. B. G. A. ..... Mountings for guns. (8th June, 1889.)
286. Clark, A. M. ..... Rotary engines (*Almond & Freligh*).
288. Talbot, D. H. ..... Machines for stacking hay.
291. Rowe, R. ..... Forced draught fans.
293. Lake, H. H. ..... Cotton gins (*Chase*).
296. Groth & Constantine ... Post marking machines.
305. Clark, A. M. ..... Lace-making machinery (*Casse*).
306. De Susini, P. ..... Ether vapour engine.
307. Imray, J. ..... Piston rod packing (*Martin*).

8th January, 1890.

314. Holland, P. ..... Armour plating for ships.
319. Grimshaw, W. D. ..... Boiler furnaces.
321. Parker, C. F. ..... Air signal for collieries.
324. Siddall & Chadderton Carding engines.
329. Lister, H. ..... Looms.
331. Priestley, Pearson, & Hirst ..... Steam engines.
335. Hitchon, A. ..... Beaming yarns.
344. Craig, G. ..... Coke ovens.
345. Horn, W. W. ..... Car axle lubricator (*Sherman & Mitchell*).
346. Bryden & Stansfield ... Mules.
351. Jones & Jones ..... Machinery for rolling metal.
354. Olpherts, W. G. ..... Chair sleepers.
362. Bellis, Morcom, & Pain Steam boilers.

9th January, 1890.

366. Ormondroyd, G. ..... Spinning machinery.
368. Logier, E. ..... Rail chair.
371. York Street Flax Spinning Company, Ld., & McKibbin ..... Wet spinning frames.
373. Hunt, G. H. ..... Furnaces.
374. Turton & Sons, Ld., & Roberts ..... Railway springs.
375. Whiteley, Whiteley, & McKay ..... Machines for dyeing yarn.
385. Birtwisle, W. ..... Mowing machines.
388. Houghton, J. ..... Endless chain brake.
389. Kenyon, J. H. ..... Looms.
390. Tweedale, S. ..... Carding engines.
393. Wilson, R. C. ..... Evaporation of brine.
396. Glaze, W. ..... Lubricating wheels and axles.
398. Wild, W. ..... Evaporation of liquids.
409. Hay & McIntyre ..... Lubricating engines.
410. Lyon, J. G. (of the Firm of Gourlay Brothers & Co.) ..... Steam engines.
414. Tangye & Floyd ..... Differential pulley blocks.
415. Tangye & Floyd ..... Pulley blocks.
416. Guy, C. W. ..... Extracting the juice of sugar cane.

10th January, 1890.

434. Jackson & Carter ..... Manufacture of articles from metal.
437. Hattersley & Hill ..... Looms.
439. Laffon, D. ..... Segment wheel and expanding axle box.
443. Wild, J. ..... Governors.
447. Ward, H. E. ..... Manufacture of axes.
449. Jones, W. P. ..... Breechloading small arms.
451. Yeadon, J. ..... Looms.
456. Marshall & Burgon ..... Friction driving gear.
457. Richardson, H. ..... Weighing machine.
464. Jackson, C. L. ..... Mandrels.
468. Harrington, G. F. ..... Firearms and projectiles.
470. Hickling, W. E. ..... Sewing machines.
472. Jones, C. ..... Furnaces for treating refuse.
474. Blagburn, C. ..... Treating liquids and solids with gases.
483. Bergman, O. W. ..... Firearms.
496. Lucas, A. H. ..... Hulls and keels for steamships.

11th January, 1890.

500. Gimson, Gimson, Gimson, & Gimson ..... Edge setting and burnishing machines.
506. Linkleter, J. ..... Sea anchors.
508. Maule, W. ..... Pinion cutting tool.
510. Wilson, T. E. ..... Concentration of liquids by evaporation.
518. Ball, W. ..... Glands and stuffing boxes.
522. Godchaux, P. A. ..... Printing in colours. (4th October, 1889.)
524. Lawson, G. ..... Boiler furnaces.
525. Thomson, T. ..... Submarine tunnels.
526. Thompson, W. P. ..... Matrice making machines (*Landsberg & Köhler*).
527. Harry, R. H. ..... Band saw machines.
528. Norton, T. ..... Vices.
535. Rhodes, G. ..... Boiler furnaces.
536. Holt, J. ..... Potato diggers and separators.
537. Thompson, W. P. ..... Tuyeres for blast furnaces (*Kromberg*).
548. Haddan, R. ..... Removing timbers from mines (*Kirschniok*).
549. Hewins & Hardy ..... Stopping and starting tramway cars.
553. Ellis, J. D. ..... Manufacture of metallic tubes, &c.
554. Candy, F. J. ..... Collapsing boats.
558-9. Wheeler, N. ..... Sewing machines.
562. Walker, B. ..... Forging presses.
565. Correll, F. ..... Collecting and removing floating débris in rivers.
567. Serrin, L. M. V. ..... Weighing machines.

ELECTRICITY.

6th January, 1890.

217. Binswanger & Croft ... Arc lamps.
232. Hopkinson, Hopkinson, & Grindle ..... Dynamo-electric machines.

7th January, 1890.

241. Whalley, A. ..... Telephone switchboards.
249. King, W. F. ..... Dynamo-electric machines.
272. Haddan, R. ..... Electromagnetic despatch apparatus (*Williams*).
274. Natterer, A. ..... Electric bells.
302-3. Lake, H. H. ..... Secondary batteries (*Alexander*).

8th January, 1890.

350. Epstein, L. ..... Batteries.

9th January, 1890.

402. Graf, F. A. ..... Electric clocks (*Nahler*).
425. Richardson & Moon ..... Electric mains.

10th January, 1890.

475. Sack, J., and the Firm Von Maltitz & Ziesel ... Telegraphic communication.
488. Sappey, M. ..... Primary batteries.

11th January, 1890.

534. Binswanger & Coates ... Electrical switches.

CHEMISTRY.

6th January, 1890.

237. Brown & Irvine ..... Extracting gold.

7th January, 1890.

260. Stears, J. ..... Gas making.
283. Smith, A. T., Jun. ..... Hydrochloric acid, &c.
309. Kay, T. ..... Treatment of sewage.

8th January, 1890.

316. Chaster, J. E. ..... Extraction of metals.
343. Cotton & Crowther ..... Making gas.
357. Wöhle, Irwine, & Jacob Dextrine.

9th January, 1890.

381. Townsend, O. C. ..... Nitrate of potash.
411. Hennebutte, H. J. E. ... Sulphate of copper.
419. De Lambilly & Chabrier Ammonia and cyanogen.
424. Smith, W. J. ..... Ore concentrating machinery.

10th January, 1890.

448. Spence, Spence, & Esilman ..... Alum.

11th January, 1890.

530. Christy & Carter ..... Separating iron from bones.
552. Sellar, W. C. ..... Gas producers.
560. Twynam, T. ..... Copper.
569. Kern & Sandoz ..... Blue colouring matter.

MISCELLANEOUS.

6th January, 1890.

200. Walker & Brown ..... Drying or carbonising fabrics.
204. Lord, C. H. ..... Shuttles.
206. Gronwald & Oehlmann Sterilising apparatus.

7th January, 1890.

280. Robson, J. ..... Protecting iron surfaces from corrosion.
299. Driggs, W. H. ..... Percussion caps for projectiles.

8th January, 1890.

358. Bedingfeld & Jones ..... Sights for small arms.

9th January, 1890.

427. Hudson, P. V. ..... Sounds transmitted through water.

10th January, 1890.

438. Worsley, J. E. ..... Cleaning firearms.
480. Devonshire, E. ..... Purifying water.

11th January, 1890.

502. Thompson, J. K. ..... Briquettes of coal.
540. Wade, J. L. ..... Lubricating oil.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form, of such opposition.

Year 1888.

14400. Hutchinson. 14444. Helwig. 14614. Royston.

1889.

116. Stone.
252. Salomon.
360. Wallace.
438. Kirkaldy.
564. Laffitte.
595. McDonnell.
1038. Rees.
1119. Fairbairn.
1317. Robinson.
1395. Strawson.
1480. Wright, Alderton, & Philpott.
1659. Trueman.
1709. Johnson & Johnson.
1952. Merryweather.
2148. Wilson.
2176. Rawson.
2295. Reynaud.
2331. Dowland & Mills.
2581. Hopcraft.
2719. Ponton, Mosely, & Chambers.
2780. Ponton, Mosely, & Chambers.
2846. Wortley.
3103. Hibbert.
3302. Harrington & Hopper.
3503. Smith.
3570. Okes.
3613. Drautz.
3657. Granger.
3722. Houghton.
3736. Vassel.
3793. Adamson, Gillies, & Johnston.
3821. Williams.
3830. Jackson.
3861. Harrington.
3899. Chavasse.
3909. Hattersley & Hill.
3913. Hetherington.
3934. Willcox (*Farbenfabriken vormals Friedrich Bayer & Co.*).
4012. Strawson.
4028. Northorpe.
4036. Mosely.
4061. Black.
4089. Barber.
4117. Packard.
4139. Jewell, Garnham, & Joyce.
4172. Green.
4222. Price.
4227. Dempster & Dempster.
4244. Polysius.
4340. Halpin & Willans.
4402. Aspinall.
5001. Elourd.
5051. Parker & Taylor.
5567. Smith.
6369. Boult (*Eichbaum*).
6831. Knight.
7020. Kimpton.
8393. Tenner.
10703. Woodsford.
10923. Hale.
11354. Joel (*Sacco*).
11939. Whitehouse.
12281. Street.
12316. Angel.
12520. Barrett. (11th March, 1889).
121. Boult (*Capitaine*).
262. Von Susskind.
393. Littler.
466. Duke, Briggs, & Macpherson.
656. Dines & Gatward.
1092. Monmon & Dorigny.
1171. Jerson.
1334. Stuart & Harrop.
1402. Devonshire.
1574. Dabault.
1627. Hearnden.
1663. Gerstner.
1812. Symington.
2029. Dunkley.
2168. Thompson (*Tudor*).
2186. Hinchliffe & Ross.
2313. Lawrence.
2414. Hiatt & Nash.
2672. Williams.
2723. Hart.
2777. Green.
2781. Ponton, Mosely, & Chambers.
2942. Hall.
3298. Jordan.
3502. Greenway, Babcock, & Radcliffe.
3582. Woodgate.
3616. Cockburn.
3702. Coltman, Coltman, & Coltman.
3745. Domeirer.
3819. Fletcher & Clare.
3820. Williams.
3826. Barraclough.
3831. Heselwood.
3864. Lawson & Lea.
3907. Parker & Rees.
3912. Hawthorn & Liddell.
3919. Molyneux.
3936. Channon.
3969. Silverlock.
4005. Hall.
4021. Burwell.
4032. Mathewson.
4037. Hannay.
4065. Davidson.
4106. Donaldson.
4121. Demmin.
4148. Barraclough.
4168. Parlby.
4213. Lane.
4225. Irving.
4242. Bally.
4254. Mills (*Hoffmann*).
4342. Marque.
4774. Butlin.
5003. Pasquier.
5052. McIntyre.
6261. Meriton.
6677. Ingram.
7000. Cox.
7288. Woodward.
9569. Carrod.
10759. Massey.
11175. Booth.
11540. Lilwall.
12211. Holt.
12286. Forbes.
12460. Elliott.
12547. Schleicher.
12925. Gimson & Challinor.

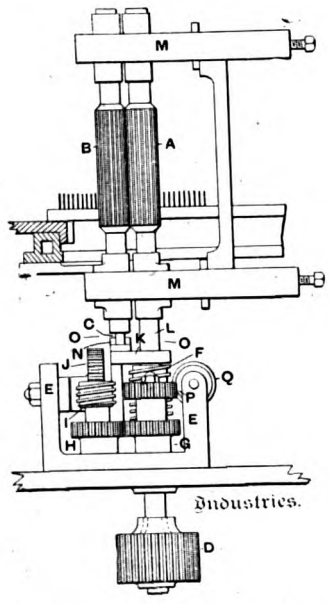
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12973. The Water Softening Company, Ld., Easton, & Carrod.
15070. Bobo.
15675. Burney & Goodridge.
15826. Boult (*Kiel*).
16109. Gubbins.
16264. West.
16774. Maddern.
17037. Stiner.
17151. Walker.
17645. Burgon.
18039. Rosier.
18878. Miller.
18431. Inwood.
18501. Smith.
18669. Ulrich.
18843. Pritzuis.
18977. Baumbach.
18996. Edgerton.
19258. Wheatley (*Hawthorne, Hawthorne, & Foote*).
19376. Gronwald & Oehlmann.
19406. Lary.
19420. Lake (*Tesla*).
19477. Savage.
19540. Thompson (*Latulip & Leonard*).
19582. Justice (*Mott & Hibbart*).
19590. Wallace.
19596. Lake (*The Newhaven Clock Company*).
19694. Pope.
19704. Kiesow.
19706. Kiesow.
19720. Steinberg.
19728. Thomson, Mylne, & Alliott.
19747. Fischer.
19817. Wiggin.
19836. Schneider.
19837. Schneider.
19844. Howard.
19858. Drenckham.
19861A. Logan. (10th December, 1889).
19883. Pumpelly & Thomason.
19925. Crane.
19946. La Dow.
19952. Foran.
13440. Morris.
13812. Woodsford.
14670. Freeman.
15541. Baker.
15736. Wyman.
15985. Lake (*Brisker*).
16206. Stewart.
16603. The Maschinenbau Anstalt Humboldt & Schmidt.
17523. Lake (*Barnes*).
17918. Knight & Hoyes.
18076. Lake (*Tibbits*).
18200. Chenu.
18478. Youngs & Brown.
18617. Reiser.
18756. Scherer.
18944. Royston (*Dickson & Frost*).
19119. Sears (*Baker, partly*).
19270. Murphy.
19291. Ferraz.
19382. Goddard.
19412. Walder & Leiser.
19426. Lake (*Tesla*).
19481. Andersen.
19546. Schneider.
19547. Moser.
19589. Doring & Siegert.
19591. Tfhnik & Vavra.
19621. Dennes & Rose.
19637. Peberdy, Earp, & Parr.
19701. Zuccarelli.
19705. Thomsen.
19715. Edwards (*Voigt*).
19722. Glasson. (8th May, 1889).
19731. Boult (*Fricke & Schütz*).
19804. Allison (*The Coloradо and New York Heating, Cooling, and Power Company*).
19852. Prosser & Carter.
19861. Logan.
19869. Tilghman.
19880. Crœlius.
19899. Thompson (*Parrish*).
19936. Wall.
19948. Grillo & Schroeder.
19961. Condon.
20016. Hass.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

Combing Machines.—*F. Illingworth, Bradford.*—Certain improvements are here made in the operation of the drawing off rollers of combing machines of the "Noble" class. The object is to distribute the wear and tear of the fluted part of the rolls over the whole surface. The illustrations give an elevation of a pair of drawing off rollers with the improved apparatus attached. The fluted drawing off rolls are mounted in the frame of the comb, and driven by the spur wheel D connected by the usual train of gearing to the driving shaft. To distribute the wear upon the surfaces of the rolls, they are given an up and down motion in the direction of their axes. On the driving spindle L of the fluted roll A is secured a worm F which drives



through the set of gear wheels and worm Q, P, G, H, and I, the gear wheel J. In the gear wheel J is secured a pin which works in a horizontally cut slot in the saddle-shaped piece K. The saddle-piece K is supported by its lugs to the spindle L, and the worm F which is fixed to the spindle L is between the lugs. The spindle of the other roller B is secured to the top lug of the saddle piece K by a slotted clip N. Thus as the roller A revolves, the gear wheel J also revolves, and the pin secured to it causes the saddle-piece K to rise and fall. The saddle piece K in rising and falling moves the rollers A B with it, the former being moved by the lugs of the saddle piece working against the worm F fixed to its shaft. Claim: The combination of the worm F secured on the spindle L with the saddle K and intervening worms and wheels and the slotted clip N.—No. 1212. January 23rd, 1889. 6*d*.

Appliance for Cutting Milling Tools, &c.—*T. Gare, Stockport.*—The appliance is made for use upon lathes, to which it can be readily fitted. Figs. 1 and 2 show the appliance fitted to a screw-cutting lathe without gap. Upon the cross feed slide rest B of the lathe is a carrier or support F on which the object G to be cut is mounted on a stud H. One end of the support F is hinged to the adjustable slide T, and the other end carries a pin L for tracing the former M upon the adjustable bracket O. The tool P which operates upon the object G to be cut is fixed to a mandril B', and caused to rotate between the centres of the lathe. The object G is moved against the rotating tool P by the cross

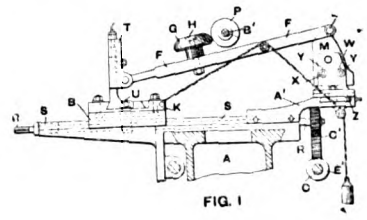


FIG. 1

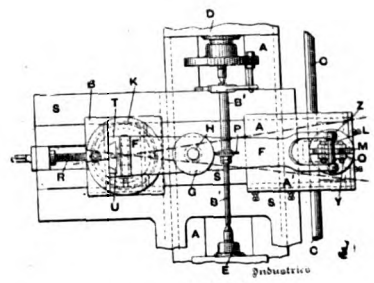


FIG. 2.

feed screw R worked automatically from the back shaft C. The stud supporting the object G may be provided with a division plate, to effect the proper number of cuts in the object. Figs. 3 and 4 show a modification of the apparatus fitted to work in the gap of a lathe. The principle of the apparatus is the same as already described. The hinged end of the support F is made vertically adjustable on the bracket U which overhangs and is radially adjustable on the cross feed slide rest B. The former is in this case one of a number cut from a disc Q supported upon a spindle. Use can thus be made of either former by turning them upon the spindle. By adjusting the brackets U and O the support

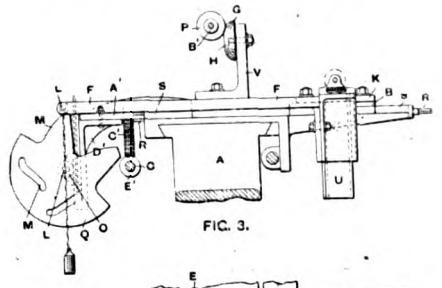


FIG. 3.

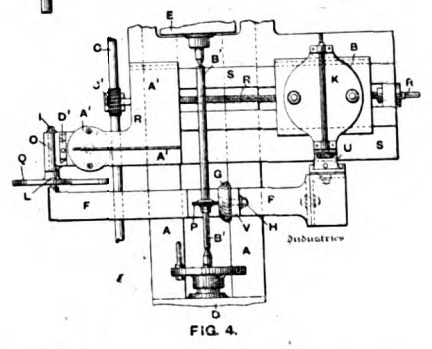


FIG. 4.

F may be fixed and the object G cut at any desired angle. To cut twist drills the blanks are moved forward against the cutter by a screw of the desired pitch actuated by weight and cord. Claims: (1) The employment of a carrier or support F, adapted to bring the object G to be cut against a milling tool P, rotating always in the same position with reference to the figures generally; (2) the combination with a sliding rest B of a carrier or support F as specified in the preceding claim, one end of which is hinge-like attached thereto and the other end thereof controlled by a former M; and (3) and (4) referring to the method of cutting twist drills and support for cutting differently shaped cutters.—No. 872. January 17th, 1889. 8*d*.

Damping Warps in Looms.—*J. Grime & T. Atkinson, Accrington.*—This invention renders the use of loose steam for damping the warps unnecessary. The improved appliance consists of a hollow cylinder extending across the loom and under the warp between the warp beam and the healds. The hollow cylinder is filled or partially filled water with soap or glycerine, and it has a slot extending lengthwise along its upper surface. Through this slot is inserted a bar of wood covered with flannel or other porous material, the upper edge of the bar projecting beyond the circumference of the roller. The warp passes over and bears upon the upper edge of the flannel covered bar, and the water or liquid contents of the cylinder ascends the flannel covering through capillary attraction, saturating the flannel, and by contact between bar and warp, damping and softening the latter. Claim: The improved apparatus wherein is comprised a liquid-containing vessel and a device for conveying the liquid to the warps through capillary attraction for the purposes aforesaid.—No. 3239. February 23rd, 1889. 6*d*.

Veneer Saws.—*D. P. A. Mersing, Galatz, Roumania.*—This improvement enables vertical veneer saws to cut in both directions, upward and downward. This is attained by the use of peculiarly formed saw teeth. The teeth have an M shape, and between the teeth are clearance spaces nearly the width of the teeth. The teeth are set so as to cross the plane of the saw at both points. The inner and outer parts of their legs are the cutting surfaces, and they are bevelled in opposite directions to cut in the manner described. One claim is made for the form of tooth described.—No. 17199. October 30th, 1889. 6*d*.

Rolling Mills.—*J. Jardine & J. T. Brassington, Motherwell.*—The novelty in this invention is the employment of hydraulic mechanism for regulating the distance of the moving rolls from the fixed rolls and sustaining the stress on them due to the work being performed. In the accompanying illustrations Fig. 1 is a transverse vertical section of the mechanism applied to a horizontal mill, and Fig. 2 is a modified form of the hydraulic cylinder as applied when the head of the housing is cast specially. Referring to Fig. 1, A is the hydraulic cylinder firmly attached to the steel or iron piece B, which is let into the housing in a step-like manner. In the hydraulic cylinder works the ram D, which is connected by the shaft E to the upper block F of the bearing of the upper roll G. The lower half of the bearing H is supported by a ram L, whose under surface is constantly exposed to the full water pressure from the accumulator supplying the water to work the mechanism. The area of the under surface of the ram L is sufficient to raise the weight of the upper rolls, the ram D, and their connections. The water is regulated to and from the cylinder A by the valve C, which is operated by a hand lever O. A spring loaded safety valve P is placed to relieve excessive pressure in the cylinder. To raise the rolls the hand lever O is

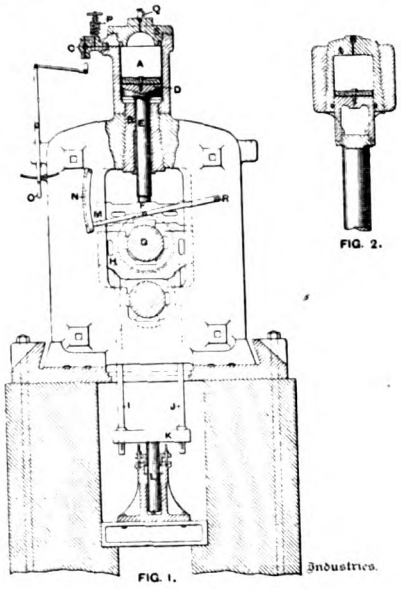


FIG. 1.

FIG. 2.

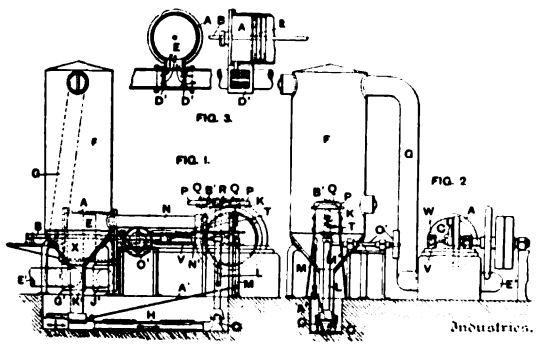
moved to a position which communicates the cylinder with the exhaust passage. The pressure on the top of the ram D is thus removed and the roller is pushed up by the lower ram L. When the height required is reached the handle O is moved to central position and all communication to the cylinder closed. To lower the rolls the handle O is moved to a third position, and the full pressure of water admitted to the top of the ram D, and so the rolls are pressed down. Claims: (1) In rolling mills the use of hydraulic cylinders such as A to depress the upper roll and resist its upward movement while passing metal as determined by the position of valves or cocks, or valve or cock such as C, together with any ordinary and well-known means of holding up and lifting the lower sliding blocks or chocks carrying the lower bearings; (2) in rolling mills the use of hydraulic cylinders such as A to depress the upper roll and resist its upward movement while passing metal as determined by the position of valves or cocks, or valve or cock such as C, together with lower hydraulic rams such as L for holding up and lifting lower sliding blocks or chocks; (3) in rolling mills the use of hydraulic differential pistons such as D with water pressure above and below, controlled by a cock or cocks such as C, so as to depress, resist, or lower an upper roll operating on the water communication above and below by a cock or cocks such as C; (4) the combination of parts forming the improved hydraulic adjustment for rolling mills as shown in the accompanying drawings whether applied to horizontal or vertical rolls.—No. 1986. February 4th, 1889. 8*d*.

Appliance for Removing Screw Propellers.—*J. Bower, London.*—The appliance is intended for removing propellers from their shafts while standing in dry docks, &c. The appliance consists of two rectangular pieces of metal placed face to face between the boss and bearing of the propeller. In the faces of the blocks are recesses to receive a tapered pin, which is driven down between the blocks to separate them and so force the propeller off. Two pairs of blocks are used, one on each side of the shaft, and the blocks are connected to rods which are held together in pairs by clams. The ends of the rods rest upon the ground to support the blocks in their place whilst the tapered pins are driven in. Claims: (1) In a device for removing screw propellers and wheels from shafting, the combined arrangement consisting of two or more sets of "dies" and taper pins, each set consisting of two dies or blocks and one taper pin, with legs welded on to the dies or blocks, with or without wedges; (2) in a device for removing screw propellers and wheels from shafting, the employment of dies or blocks with or without legs and taper pins as described.—No. 4702. March 18th, 1889. 8*d*.

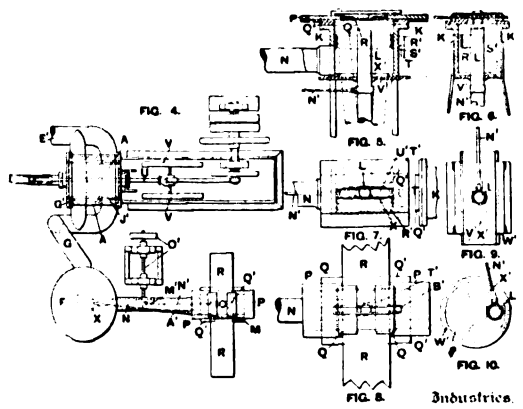
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RAILWAY SLEEPERS AND CHAIRS.—*J. Woodward, Dublin.*—The sleepers consist of an inverted T-shaped length of wrought iron, of suitable proportions. In the upper flange of the sleeper are cut two notches for the reception of the chairs. These notches are cut only half way down the flange. Each chair has upon its sides grooves to receive the edge of the notch, and under the chair is a deeper groove, to pass over the half of the flange not removed. The chair is placed in the notch, and afterwards bolted to the bottom part of the inverted T-shaped sleeper, on which it rests. Three claims are made for the sleeper and chair described, and the use of a bolt at the top edge of the chair for securing the rail in the chair.—No. 6,752. April 20th, 1889. 6*d.*

SAND BLAST MACHINERY.—*J. C. Peacock, Birmingham.*—In conducting the sand blast process a stream of sand is projected by a jet of air produced by an air compresser or exhauster, and forced against the surface of the glass. Improvements are here introduced in certain parts of the machinery used in the above-described process. Fig. 1 shows a side elevation, Fig. 2 an end elevation, and Fig. 4 a plan of the complete apparatus. Referring to the figures, A is the cylinder of an exhauster, E its piston having a rod which passes through both ends and supports the piston centrally on slides at each end. Under the exhauster cylinder A are valve boxes fitted with Indiarubber flap valves D^1 (see enlarged view Fig. 3). Placing the valves underneath the cylinders prevents the sand passing into the cylinders. F is a wrought iron reservoir or air chamber connected to the exhauster by a pipe G leading to the valve box. E^1 is a pipe conducting the exhaust from the exhauster. The



bottom part of the air chamber X forms a chamber for the sand which falls to the pipe K^1, and thence through the sand valve into the pipe H. The sand valve is opened by a lever M and connecting rod A^1. A current of air is admitted immediately below the sand valve and carries the sand along the pipe H into the bell-mouthed end of the pipe L. A second pipe admits air to the bell-mouthed end of the pipe L, and carries the sand up the pipe to the glass being operated upon. The tube L is mounted on trunnions to enable it to be oscillated at the top end, as shown by the dotted lines Fig. 5. The glass R being operated on is held in position by the Indiarubber flaps Q and the sliding pieces P, which are strapped together by B^1. The sand, after operating upon the glass, is carried back to air chamber F by a pipe N, where it falls to the bottom X, and the air is drawn off by the exhauster. Claims: (1) Improvements in machinery used in the sand blast process hereinbefore

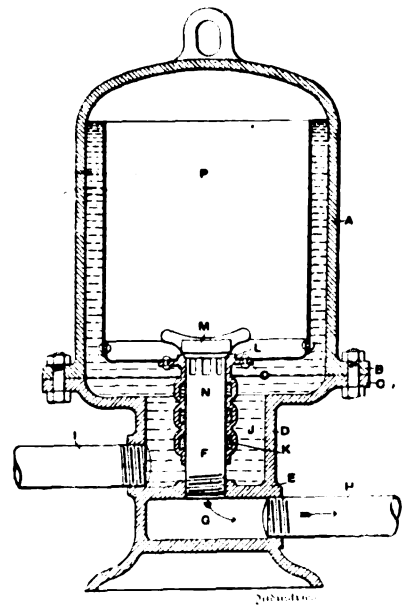


described and illustrated with the accompanying drawings, that is to say, the construction of the piston employed in the exhauster which is evenly balanced and forms a floating mass in the cylinder, a continuous rod which is a little cambered and supported on slides at each end of the cylinder; (2) the construction and arrangement of parts of the machinery used in the sand blast process hereinbefore described and illustrated, where a sheet of glass or other material of any size or shape may be placed on the upper surface of a rectangular or other shape box, and operated upon by a constant stream of sand drawn by the air from the exhauster, and equally distributed on the surface of the glass by a vibrating or oscillating pipe, having a to and fro, or an angular, or a circular, or a semi-circular, motion caused by the said pipe L sliding in the slot X^1 shown at Figs. 9 and 10 and working on trunnion arms, or by other means; the motion which is obtained by a disc and lever, a rack and pinion, or other mechanism.—No. 18728. December 22nd, 1888. 8*d.*

GATE VALVES.—*J. Dewrance, London.* (*R. M. Pratt, Hartford, U.S.A.*).—The invention refers to that class of valves known as straight-way gate valves. The valve chamber is provided with ports and a gate for opening and closing the ports. The gate is of a tapered cross-sectional form, and its seatings are made removable, being held in position between the body and the gate by a holder which may be removed by removing the bonnet or cover of the valve chamber. The gate is raised and lowered by a screw passing through the valve chamber cover. Claims: (1) The improved gate-valve, constructed substantially as herein described, and having removable seats and a removable seat-holder or seat-holders held down by the bonnet; (2) in a gate valve provided with removable seats, mounting such seats in a removable seat-holder or carrier; (3) in a gate valve provided with removable seats, mounting such seats in grooves in the valve body, the same being held down in the said grooves by means of a removable seat-holder or frame; (4) in a gate valve provided with removable seats, mounting each seat in a separate seat-holder or plate adapted for being removed together with the seat from the valve body.—No. 2757. February 16th, 1889. 8*d.*

BELLS FOR SIGNALLING.—*C. Parkin, Liversedge, Yorkshire.*—The striking mechanism of the bell is combined with an index-hand, which registers upon a dial the number of strokes made on the bell. The index hand and striking hammer are operated simultaneously by a suitable arrangement of ratchet wheel pawls and levers, which are worked by the operator pulling a lever the required number of times.—No. 17,048. November 23rd, 1888. 6*d.*

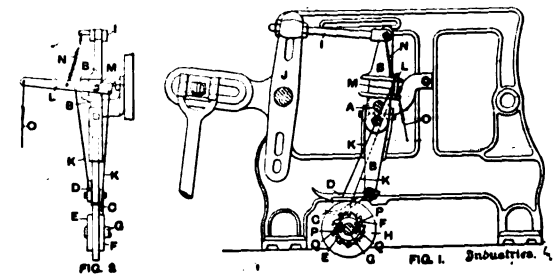
STEAM TRAPS.—*B. Thoens, New Orleans, U.S.A.*—This invention relates to steam traps for discharging the water of condensation from radiators, steam heating coils, and other steam apparatus. The apparatus consists of an outer closed vessel A, and an inner vessel P, opened at the top and free to slide up and down upon a tube F. The sleeve K of the vessel P is fitted with packing material to make a liquid-tight joint, and the top edge of the sleeve is bevelled to form a seating for the valve-shaped top of the tube F. Openings N are cut in the top edge of the tube F to form communication between the vessel P and exhaust pipe H when the former is depressed. The trap works as follows:—The trap being empty, the vessel P, with its sleeve, sinks down by gravity, leaving the passages N open or exposed. As steam enters by the inlet pipe I the air is driven out of the trap, and the incoming water accompanying the steam gradually fills the well or chamber D, and rises in the casing A, thereby lifting the vessel or float P until the openings N are closed by the sleeve, as shown in the drawing. As the water continues to enter, it rises around the float and enters the same by flowing over its top, until the weight of water therein becomes sufficient to depress the float, whereupon the water passes through the openings N, and thence through the tube F and chamber G into the outlet pipe H. If the water ceases to flow, the steam will blow what



remains in the float out through the pipe F until the float becomes light enough to rise and close the openings N, after which the parts remain in that position until more water accumulates, when the operation is repeated. Claims: (1) A steam trap, having a closed chamber, an inlet pipe, a vertical tube or pipe rising therein, connected to an outlet pipe, and having openings at its upper end, and an open float rising and falling on the vertical tube or pipe to cover and uncover said openings; (2) in a steam trap, the combination with a closed casing, having a pendant well, of a vertical tube or pipe rising in the well and having openings at its upper end, a sleeve rising and falling on the tube or pipe, an open float carried by the sleeve, and inlet and outlet pipes; (3) in a steam trap, the combination of a closed casing, having a pendant well provided with a bottom wall, a tube tapped through said wall, rising therefrom and having openings and a valve at its upper end, a sleeve rising and falling in the well on the tube and having a valve seat on its upper end, an open float carried by the sleeve, and inlet and outlet pipes; (4) a steam trap, consisting of a horizontal plate, formed with a central pendant well having a bottom wall, a closed bell-shaped casing surmounting the horizontal plate, a float located in the bell-shaped casing and open at its top, a vertical tube secured to the bottom wall of the well, rising in the latter above its horizontal top plate and having its upper end provided with a valve and lateral orifices, a sleeve extending down into the well from the bottom wall of the float, sliding up and down on the valved pipe, and having its upper end opening through the bottom wall of the float and there provided with a valve seat.—No. 16,204. October 15th, 1889. 6*d.*

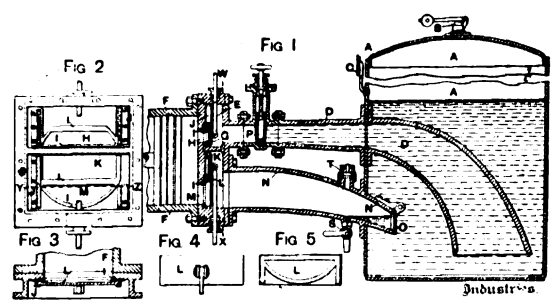
RAILWAY CARS FOR CONVEYING SHIPS.—*W. Smith, Aberdeen.*—The object of this invention is to provide a car whereon the ship will be practically waterborne, at the same time permitting the necessary flexibility of the car vertically and laterally. A series of hydraulic cushions are employed to line the sides and bottom of a cradle-like superstructure of the car. These cushions are formed of flexible and compressible U-shaped tubes: they are filled with water, and the weight of the vessel pressing on them is thus counteracted by the hydrostatic pressure due to the water in their vertical parts. The cradle-like superstructure for supporting the hydrostatic cushions are formed of U-shaped sections, each of a width and shape to correspond to the sectional outline of the ship at the part to which it is applied. The several sections are hinged together by tranverse hinges at the base, so as to maintain an invariable distance apart, whilst permitting flexture of the series in the vertical plane. The superstructure is carried upon a wheel base running upon several parallel lines of rails. The wheel base is composed for each pair of rails of trucks extending the whole length of the car, the trucks being coupled together so as to maintain an invariable distance apart whilst permitting free swivelling or lateral motion guided only by the wheel flanges against the rails. One truck only of each set is connected to the superstructure by a centre pin; the remaining trucks support the superstructure upon rollers which allow of a free lateral movement. Five claims are made.—No. 7529. May 6th, 1889. 8*d.*

LOOM DOBBIES.—*A. Sowden, Baildon, Yorkshire.*—This invention consists of improved apparatus for operating card barrel whereby the barrel may be caused to rotate or work in its ordinary course, or to be reversed and worked in the opposite direction without reversing any other part of the loom. The reverse motion is of instant application and effect, and the lagging back is effected two picks for each card. According to this invention, on a stud A is a vertical and preferably broken-backed lever B, at the foot of which are two catches C D (push and pull catches) which engage as required with two catch wheels E F on the axis G of the card cylinder H. The upper end of the vertical lever B is connected by an adjustable rod I with the rocking lever J of the dobby. The rocking lever imparts the requisite



motion to the vertical lever B, and thereby operates the catches C D. The catches C and D are connected by string or wire K K with a cross lever L on a stud M carried by the broken-backed lever B. The lever L is so arranged that when pulled down by cord or string O the pulling catch D will engage with its catch wheel E, and so turn the barrel H in one direction; but when the cross lever L is raised by the spiral spring N, the other or pushing catch C will engage with its wheel F, and the barrel H will be turned in the opposite direction. The reversing of the barrel is effected by simply pulling down the cross lever L, which will lift the pushing catch C out of gear with its wheel F, and bring the pulling catch D instantly into operation without any other part of the dobby or loom requiring to be reversed or interfered with. Claim: (1) Reverse acting catches mounted upon an operating lever, such as B, the catches being controlled by means of cords or wires K operated through a lever such as L.—No. 18868. December 27th, 1888. 8*d.*

OBTAINING MOTIVE POWER.—*F. W. Cleveland & L. Dove, London.*—Power is obtained by the application of tapered tubes for increasing the effective pressure and decreasing the resisting pressure of the water used in driving the motor. The apparatus is based upon the principle of injectors used in hydraulic machinery, in which water passed into a tapered tube at the larger end is ejected through the small end into a high pressure by a low pressure. The apparatus is constructed with a cylinder, piston, crank shaft, fly wheel, &c., similar to ordinary steam engines. To the end of the cylinder are attached the parts by which the motive power is obtained. A is a water and air holder answering to a boiler of a steam engine, and fitted with safety valve B and pressure gauge C. The holder A is in communication with the rear end of the cylinder F by tapered tubes D and



N. The passage of liquid through the tubes is regulated by the valves G and L, which are operated by the motion of the engine. In working the apparatus the holder is partially filled with water, and air at a pressure of 100lb. introduced into the remaining space. The water is now admitted to the cylinder by the tube D and by the principle involved the water as it is delivered from the small end of the tube to the cylinder should be of a higher pressure than that in the holder. The water thus admitted to the cylinder acts upon the piston and makes the outstroke of the engine. Upon the instroke of the engine the valve G is closed and the valve L opened to exhaust the water through the tube N. The exhaust taking place through a tapered tube as shown a less pressure in the cylinder should be sufficient to return it to the holder A. Thus, according to the principle of the apparatus, water is introduced to the cylinder at a high pressure and exhausted at a lower pressure, whilst the pressure in the holder A remains constant. Claims: (1) The combination with a water holder A and water and an air pressure in A acting on the water and a suitable hydraulic engine for the utilisation of the water of the tapered tubes D and N; (2) the arrangement of apparatus and water with air pressure substantially as described and illustrated in the accompanying drawings for the obtainment of motive

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power; (3) the improved form of hydraulic engine consisting of two or more single acting cylinders with pistons and other usual parts having an inlet and exhaust slide valve working at end of each cylinder independent of each other.—No. 7106. April 29th, 1889. 8*d.*

GENERATION OF STEAM WITH GASES.—*O. W. Ketchum, Toronto, Canada.*—A boiler is here described in which gaseous fuel is consumed under pressure, and the products of combustion are mixed with the steam produced from the water in the boiler, thereby doing away with the necessity for having a chimney. The illustrations show Fig. 1, a section upon a side elevation of the boiler, and Fig. 2, a section upon an end elevation. The boiler A is constructed with a dome B connected up by the pipes C. Within the boiler is the combustion chamber D, lined with refractory material E. F is the discharge pipe for the products of combustion, leading to a box F^1 which receives the feed water, and from there bending down into the water of the boiler, and terminating in a perforated tube G. The products of combustion

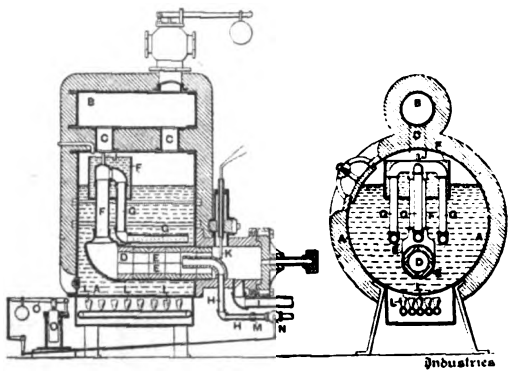


FIG. 1.

FIG. 2.

thus pass into the water, and ultimately mix with the steam. H is a pipe for supplying the gases, I the pipe for supplying air. K is a wire of platinum inserted in the combustion chamber, and electrically heated to cause ignition of the gases. The ignition of the gases, after the apparatus has been at work a short time, may be caused by the heated state of the lining of the combustion chamber, but if the electric current is used continually an automatic device for controlling the gas supply may be applied. A plunger O subjected to the pressure in the boiler is also used to control the supply of gas by acting upon the valve N, and gradually closing it when the pressure exceeds a certain amount. The gas jets L are for heating the boiler at starting to bring the pumps into use for supplying the gas and air to the combustion chamber at a pressure higher than the pressure in the boiler. Claims: (1) The combination of the closed chamber D having the air and gas supply pipes, the pipe F, and the feed water box F^1, through which pipe F passes; (2) the combination of the closed chamber having the air and gas supply pipes and the electrically charged wire K, the pipe F, and the feed water box F^1, through which the pipe F passes; (3) the combination of the closed chamber D, the air pipe entering said chamber, the gas supply pipe having cock M, and electrically charged wire extending into said chamber and having an armature connected with the cock M; (4) the combination of the closed chamber D having the air and gas supply pipes, the pipe F having the extension J, and the feed water pipe F^1; (5) the combination of the closed chamber D having the air and gas supply pipes, the pipe F, and the downward extension G.—No. 1977. February 4th, 1889. 8*d.*

LEATHER ROLLING MACHINES.—*E. E. Sheldon, A. Mills, & J. Masters, Walsall.*—These improvements refer chiefly to the adjustment of the table carrying the leather to be rolled. Fig. 1 is a side elevation of a leather rolling machine to which the improvements have been applied, Fig. 2 is an end elevation, and Fig. 3 is a plan showing the lower table-adjusting mechanism with the upper screw and table removed, while Fig. 4 is a plan of the upper adjusting mechanism with the table removed. The machine resembles other leather rolling machines in that the wheel A is driven by belt or separate engine, and its revolution causes the roller B carried on suitable framing and guides to travel to and fro over the table C by means of the connecting rod D. The

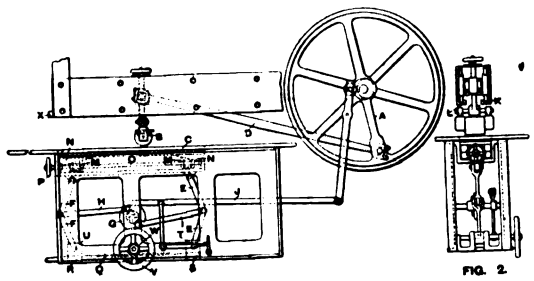


FIG. 1.

FIG. 2.

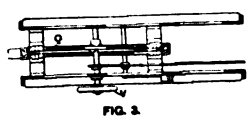


FIG. 3.

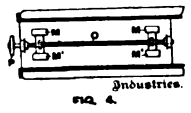


FIG. 4.

periodic raising and lowering of the table by means of the toggle levers E E, F F, and the wrist plate G and rods H I, together with the long rod J, lever, cam, and roller, is also well known and commonly applied. The invention consists in the application of novel contrivances for changing the level of the table which are shown in elevation at Fig. 1. Two wedges M M inclined in opposite directions act upon wedge surfaces N N fixed under the upper table. The wedge pieces M M are connected to the long right and left hand screw O, with a hand wheel P. By turning the wheel P the wedges M M are made to approach to or recede from one another, and thereby raise or lower the table to any desired proximity to the roller B independently of the lower adjusting arrangement. The lower adjusting arrangement consists of a rack Q having wedges R S at its extremities of the angle and direction as shown. These wedges carry the guide blocks T U, to which are pivoted the toggle-links E E, F F. The under surface of these blocks are inclined to suit the wedges, and as the blocks are only free to move vertically, when the hand wheel V is rotated in one direction the pinion wheel W moves the rack Q and the wedges simultaneously raise the blocks, and thus the table, the table always remaining in the same plane. The upper means of adjustment are provided to change the level of the table when a considerable movement is required. The lower adjusting arrangement is intended to alter the level of the table slightly to take the different thicknesses of leather, &c., in working. An arrangement for preventing oil dropping from the sliding piece carrying the roller B is shown in Fig. 2, and consists of two troughs K L inclined towards a third X, Fig. 1. Claims: (1) In a leather rolling machine the use of adjusting wedges such as M M, with a screw such as O for varying the level of the table; (2) in a leather rolling machine the use of a rack such as Q and wedges such as R S for the purpose of raising or lowering the table; (3) in a leather rolling machine the use of adjusting wedges such as M M, with a screw such as O in combination with a rack such as Q and wedges such as R S; (4) the contrivance described for preventing oil from dropping upon the leather from the sliding piece carrying the roller.—No. 1695. January 31st, 1889. 8*d.*

EVAPORATING APPARATUS.—*J. Frost, Huddersfield.*—The evaporating apparatus consists of a series of tubes A B. arranged one above the other, as shown in Figs. 1 and 2, The tubes A B are connected by elbows C and D, and they are heated by steam or hot water circulating through them. The solution to be evaporated is contained in the vessel O, from which it flows down to and over the tubes to a second vessel G. Plates H are provided as shown to collect and guide the solution to the centre of each succeeding pipe. Fig. 3 shows a plan of the plates and pipes; Figs. 4 and 5 differently shaped pipes. Claims: (1) The use and employment of a coil such as A, heated by steam, hot water, or air, for evaporating or concentrating solutions for the production of dyes or other like bodies, in combination with

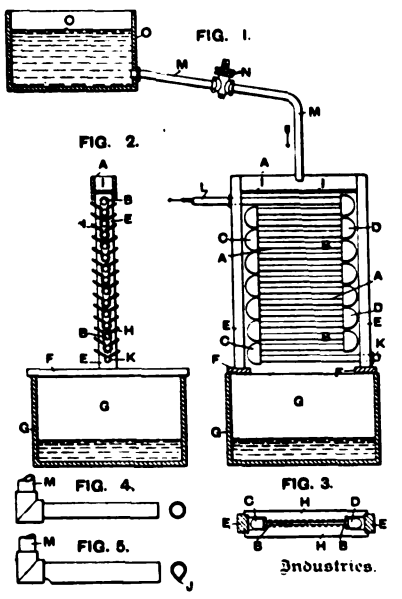


FIG. 1. FIG. 2. FIG. 4. FIG. 5. FIG. 3.

a tank or cistern containing the solution to be concentrated, and a tank or cistern for receiving the concentrated solution as it falls from the coil; (2) the coil A heated by steam, hot water, or air, when inclosed in a vessel or chamber, for evaporating or concentrating and distilling solutions; (3) in combination with the coil A and closed vessel of a bent pipe and conical pipe or "still head," for the purposes described; (4) the arranging of two or more coils A to act in conjunction with each other, and either exposed to the atmosphere as shown in Fig. 1, or inclosed in a vessel or chamber; (5) the combination with a coil or coils A of the inclined plates H, together with the trough I or its equivalent.—No. 1803. February 1st, 1889. 8*d.*

ELECTRICITY.

ELECTRIC REGULATING APPARATUS.—*A. L. Shepherd, London.*—The invention relates to electric regulating apparatus for use in connection with steam engines and other motors and dynamo-electric machines, and its main object is to provide simple and efficient means whereby the speed of the engine or motor will be varied automatically in accordance with the electromotive force of the current. To the spindle of a double beat throttle valve situated in the main supply pipe of the engine is attached a piston which works in a cylinder fixed over the valve chamber. By admitting steam to the cylinder the piston moves the throttle valve and regulates the supply of steam to the engine. The admittance of steam to the cylinder is controlled by an ordinary D slide valve, which is operated by electric mechanism. The electric mechanism may be the same as in the specification No. 10,209 of 1888; it comprises an electromotor consisting of a Pacinotti ring mounted between the poles of an inducing electro-magnet. The direction and duration of movement of the said electromotor is controlled by means of an electromagnet, solenoid, or other electrical device. The shaft of the electromotor is geared to the rod of the cylinder slide valve, the rod of the valve terminating in a rack. The operation of the apparatus is as follows:—The electric mechanism of appliance is coupled as a shunt circuit to the parts where a constant potential is desired. Any rise or fall of the potential at this point causes the electric mechanism to move the slide valve and admit steam to the cylinder, and so cause the piston to open or close the throttle valve. Claims: (1) A regulating apparatus comprising an electromotor arranged to operate a valve for controlling the distribution of fluid under pressure to a cylinder the piston of which is connected with a throttle valve or other regulating device for the purposes above specified; (2) the improved apparatus constructed as described.—No. 2003. February 4th, 1889. 8*d.*

TELEPHONES.—*E. Gwosdeff, St. Petersburg.*—The transmitter and receiver of the telephone described in this invention each have an iron diaphragm arranged between two horseshoe magnets, whose bobbins are wound with double wires, one being in communication with the line, and other short-circuited on itself, so that the resulting current is equal to the sum of the currents induced in each pair. The iron diaphragm is connected by a non-magnetic rod, or rods, to a non-magnetic diaphragm of larger diameter than the iron one. Figs. 1 and 2 represent in diagram the principle of construction of the proposed telephone—Fig. 1 being the transmitter and Fig. 2 the receiver. Figs. 3, 4, and 5 represent the construction of a complete apparatus, Fig. 3 being a plan view (the upper half being removed), Fig. 4 a section on the line X, Fig. 3, and Fig. 5 a section on Z, Fig. 3. D is a diaphragm of iron arranged between the poles of two horseshoe magnets M H; B and G are induction bobbins fixed on the polar extensions of the magnets M H, and are connected together in such a manner that the currents induced in the bobbins by the movements of the diaphragm D shall be added the one to the other, that is to say, that the resulting current shall be the sum of all the currents. The diaphragm D is placed at such a distance from the two magnets, that each exercises an equal attraction on the diaphragm. The screw ring A, in which the

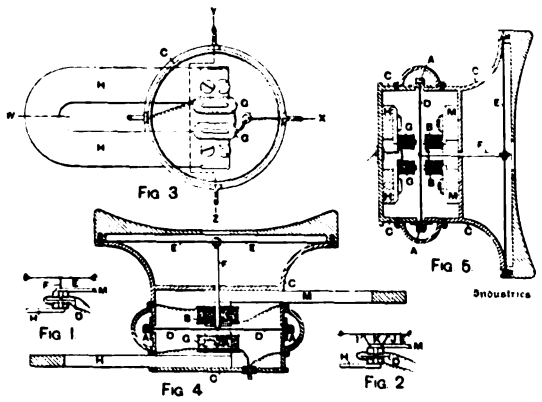


FIG. 3. FIG. 5. FIG. 1. FIG. 4. FIG. 2.

diaphragm D is fixed by its edge, provides for the exact regulation of the position of the diaphragm. In front of the magnets M H^1, a second diaphragm E is fixed, by its edge, to the box C of the apparatus. This diaphragm E is of a diameter greater than the diaphragm D, and is made of a non-magnetic material, such as wood, ebonite, aluminium, or aluminium bronze. The diaphragm E is connected, by means of an aluminium rod F, to the centre of the diaphragm D, the rod F passing between the bobbins B B of the upper magnet M. In the transmitter, the point of attachment of the rod is at the centre of the diaphragm E, as in Fig. 1, but in the receiver the diaphragms are connected by two or more rods as in Fig. 2. The method of connecting the diaphragms permits of the reproduction of sounds in a loud tone without the necessity of raising the voice. Claim: The improvements in magnetic telephony above described, and characterised by the employment of two diaphragms, one of which is of iron, and arranged between the bobbins of two horseshoe magnets—the other of non-magnetic material, and of a diameter greater than the first, and connected to the centre of the iron diaphragm by one or more rods made of non-magnetic material, the point of attachment of these rods being at the centre of the non-magnetic diaphragm when the apparatus is to serve as a transmitter, but at a distance from the centre when the apparatus is used as a receiver, the bobbins of the magnets being in all cases connected together in such a manner that the current resulting is equal to the sum of the currents induced in each pair.—No. 2137. February 6th, 1889. 8*d.*

MISCELLANEOUS.

SOFTENING AND CLARIFYING WATER.—*L. Archbutt & M. Deeley, Derby.*—In carrying out this process the chemical reagents are, in the first instance, mixed with or dissolved in water in a small tank. This prepared solution is passed into a well in a large settling tank containing the water to be softened. Near the bottom of the well opposite a pipe projecting into the settling tank is fixed a trajector, for the purpose of creating a current through the well into the tank to mix the solution and water. To effect the rapid subsidence of the precipitate, perforated pipes are provided at the bottom of the settling tank, through which air is passed to stir up the old precipitate, as it is found that the two settle afterwards together more rapidly than a single slight precipitate. Claims: (1) In purifying water by precipitation mixing it with the precipitate of former operations; (2) the process of purifying water, consisting of introducing it into a vessel containing the precipitate of former operations, mixing it with any suitable precipitant, stirring up the old precipitate and mixing it with water, allowing the old and new precipitate to settle together, and drawing off the clear water; (3) the combination of a settling tank apparatus for mixing a precipitant with the water and apparatus for stirring up the old precipitate; (4) the combination of the settling tank, the trajector and perforated pipes, with or without the tank for the solution of reagents as described; (5) apparatus for softening and clarifying water substantially as described.—No. 1791. February 1st, 1889. 8*d.*

Copies of the British specifications may be obtained on application to H. READER LACK, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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MESSRS. ARBEY'S TOOLS AT THE LATE PARIS EXHIBITION.

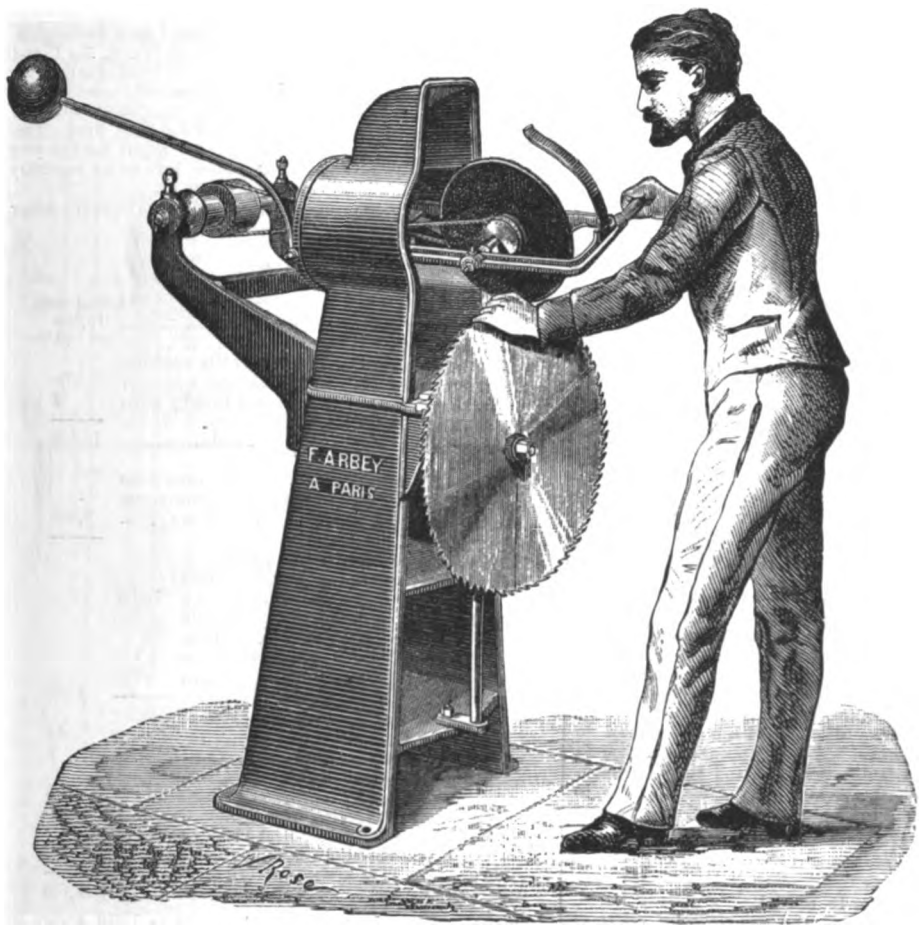


FIG. 1.—MACHINE FOR SHARPENING CIRCULAR SAWS.

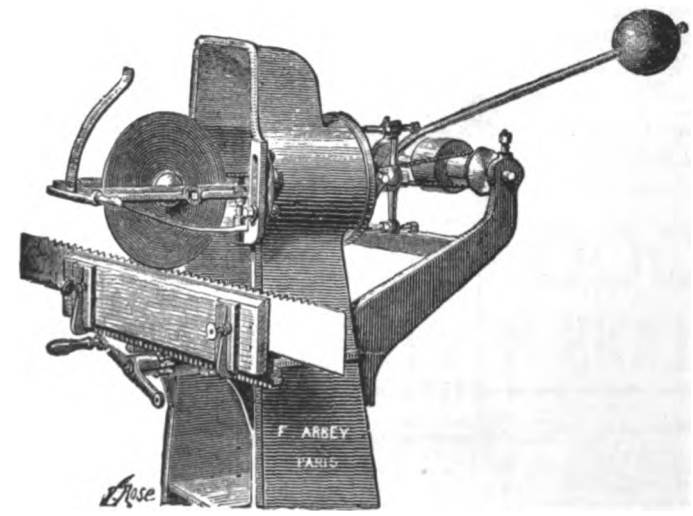


FIG. 2.—MACHINE FOR SHARPENING STRAIGHT SAWS.

MESSRS. ARBEY'S TOOLS AT THE LATE PARIS EXHIBITION.

WE illustrate above and on page 108 a number of special wood working and allied tools which were shown at the late Paris Exhibition by Messrs. Arbey & Son, of Paris. The most important machine shown in the agricultural department was a vertical saw with one blade at the side, which was intended chiefly for sawing thin boards and heavy planks out of logs. The saw is of great depth, and can be kept in high tension and made to work with accuracy. The log is supported by a carriage, which runs on broad rails and is very steady. Hence extremely thin boards can be cut of uniform thickness. The carriage is driven by a rack and pinion through a worm and worm wheel, and this feeds the timber at the rate of 1m. 50cm. per minute. The saw has four teeth set in each direction alternately. There is a continuous feed, and the sharpening is very simple. To change the saw only two bolts have to be loosed, and another frame with the saw adjusted can be bolted on, so that the old saw is being sharpened while the new one is working, without loss of time. The machine shown is for logs 1 metre in diameter, and it can cut stripe of less than 1mm. thick. A similar machine shown in Figs. 5 and 6 on page 108 is intended to take in logs of 50cm. diameter.

Figs. 1 and 2 represent a saw-sharpening machine shown in the same section. Fig. 1 shows it as arranged for sharpening circular saws, and Fig. 2 shows the arrangement for sharpening straight saws. An emery wheel is mounted in a frame and driven by a band from behind. The frame is capable of motion about an axis so as to bring the wheel down to its work, and its movement in this direction is regulated by adjustable stops. The wheel is balanced by a weight so as to be more easily worked, and also to be kept up clear from the saw when not pressed down. The wheel is also capable of motion about an axis perpendicular to the driving shaft, which enables it to be set at different angles for the teeth of different saws.

Figs. 3 and 4 on page 108 show a portable circular saw for sawing logs up to 60cm. diameter. In the figures the machine is fixed ready for working. The machine can easily be mounted on wheels and packed, so as to be carried to some other place where it is required. An engine of 8 h.p. is required to drive this machine.

A NEW FORGE AT WEST HARTLEPOOL.

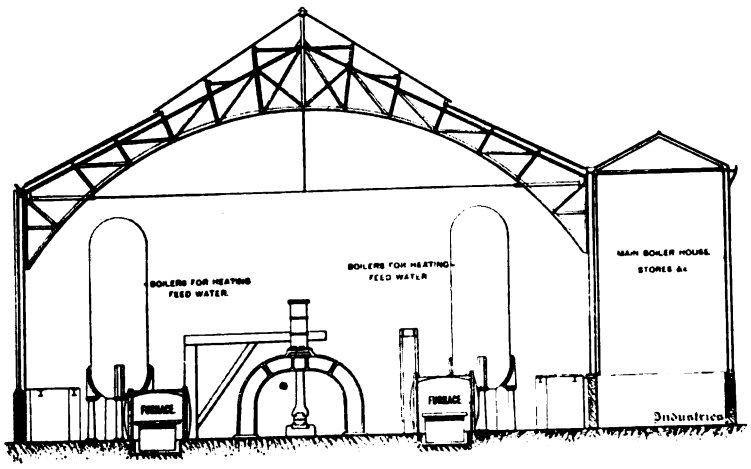
AN important addition has recently been made to the Central Marine Engineering Works, West Hartlepool, in the shape of a new forge department. As it is exceptionally well arranged for carrying on the work, we paid a visit to the works, and by the courtesy of Messrs. W. Gray & Co. we are enabled to illustrate and describe the arrangements and plant. The whole of the arrangements have been carried out according to the designs of the manager, Mr. Thomas Mudd. The new forge in reality is a combination of forges, smiths' shop, and fitting and finishing shops, and is provided with all the requisite plant and machinery required in manufacturing any kind of forgings up to twenty tons in weight.

On page 99 is shown a ground plan of the new forge. As the building is long as compared with its breadth we have divided the plan into two parts and placed one underneath the other. It will be seen that A B are related to A^1 B^1. The new shop is 500ft. in length and 85ft. broad, and has a continuation shed of 32ft. span extending nearly the full width. The shed is open at the end, and beyond it there are five large water tanks for storing rain water, which is used for feeding the boilers. The shed has a 10-ton overhead travelling crane for lifting finished forgings from the bogies and placing them on the railway waggons. The lines of rails are both the ordinary gauge and 30in. gauge. In the yard, beyond the water tanks, are scrap shearing machines. A powerful one, recently constructed by Messrs. Rusworth & Co., of Sowerby Bridge, which can cut at one stroke 16in. by 1½in., with 34in. blades, is driven by an independent 12in. engine fitted with heavy double gearing. A large scrap cleaner of the churn type is also actuated by this engine. On page 98 is a cross section, from which it will be seen the roof is lofty. It is 60ft. high at the pitch, 36ft. at the eaves, and is supported by lattice girders, which are carried on columns formed of two cast iron girders united by straps. One end of the large building is built up, and it will be seen the main driving engine is placed here. The engine is of the ordinary horizontal non-condensing type, with a single cylinder, 16in. diameter, 36in. stroke. One of the fans is a 5ft. Schiele, and the other a 4ft. 6in. Powis, James, & Co.'s fan. Down one side there are twelve smiths' fires and three 1cwt. steam hammers. Then comes the stamping plant and a 12cwt. square-legged steam hammer with circular fire furnace and cranes for rudder frame and similar work, also a 20cwt. steam hammer flanked on each side with a furnace for ordinary forging purposes. This duplication feature is important and worthy of special notice. Adjacent to the 20cwt. hammer is the plant for completing forgings of unwieldy dimensions—*e.g.*, stern and rudder frames—and consists of a Davis & Primrose steam hammer, 16in. cylinder, 5ft. 6in. stroke; the main framing of this plant is placed on a girder of 37ft. span, and elevated about 9ft. above the ground. There are also two 15-ton steam and two 2-ton hand cranes, and two fires for this special work. Four furnaces are placed at suitable positions in connection with each of the two largest steam hammers, which are a 5-ton Rigby's patent, 30in. cylinder, 6ft. stroke, by Messrs. Glen & Ross, Glasgow, and a 7-ton Morrison's patent, 32in. cylinder, 7ft. stroke. Two furnaces are similarly placed to serve each of 40cwt. hammers, which are by Messrs. Glen & Ross and Messrs. Davis & Primrose, Leith. All the steam hammers have specially good efficiency owing to the high pressure of steam used in working them—viz., 100lb. per square inch. The two larger hammers are provided each with four 15-ton jib cranes, six of which are steam and two of hydraulic power, working at 1,250lb. pressure per square inch. Each of the 40cwt. hammers has two cranes—viz., two 2-ton hand, one 3-ton and one 5-ton, both hydraulic. The arrangement of the furnaces obviates the necessity of Sunday work or the stoppage of ordinary operations for their overhauling or repairing. Another important feature is the utilisation of the waste gases from the principal furnaces. From the illustrations it will be seen that in close contiguity to twelve furnaces there is a separate boiler or feed-water heater, in which the water is heated by the waste gases to a high temperature. Eight of these feed-heaters are 27ft. by 8ft. 6in., and four 21ft. by 7ft. 6in. The heated water is pumped into the main boilers by a Worthington pump, situated near the hydraulic pumps and accumulator. As already indicated, there are a large number of fitting and finishing tools for completing forgings. These are situated opposite the smiths' shop, and for carrying the work to the various tools there are two overhead travelling cranes—viz., one 10-ton driven by cotton rope, and a 7-ton driven by a square shaft from the main engine. Amongst the tools are two heavy slotting machines, respectively by Messrs. Sharp, Stewart, & Co., and Messrs. Scriven & Holdsworth; two shaping machines for preparing scarfs; two lathes, each capable of taking in work 22ft. long, the larger one, having 26in. centres, being by Messrs. Butterfield & Co., Keighley, and the 16in. lathe by Messrs. Dron & Lawson, of Dundee. Amongst the drilling machines are a multiple with twenty-eight drills, and another with four tools on two saddles, by Messrs. Joshua Buckton & Co., Leeds. A boring machine by Messrs. Noble & Lund has a 28ft. 6in. table and 24ft. stroke. The foundations are being prepared for a large planing machine 20ft. in length, 7ft. 6in. wide, 6ft. high, having a table divided lengthwise, so that the machine can be worked either as one or two. It has been constructed by Messrs. Spencer & Son, Hollinwood, near Manchester, to Mr. Mudd's designs. Amongst other tools are Ryder's forge for small work, a circular cold saw, boring machine, &c. It can readily be seen how advantageous are the general arrangements of this forge department for dealing with repairing and other work requiring great expedition.

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A NEW FORGE AT WEST HARTLEPOOL.

(For description see previous page.)



TRANSVERSE SECTION.

THE MANCHESTER ASSOCIATION OF ENGINEERS.

AT a meeting of this society, held on the 25th inst., Mr. Michael Longridge read a paper on the "Evaporation in Lancashire Boilers," which we give in full as follows:—

The Lancashire boiler is such a common object in this part of the world that it is difficult to avoid the feeling that some sort of apology is required for venturing to ask a Society of Manchester Engineers to spend an evening in considering it, for it would almost seem as if everything that could be said about it must have been said already. In one sense this is true. As a structure the boiler has been so minutely studied and described that if the diameter and working pressure were given, none of us would find much difficulty in drawing a specification from which a perfectly safe boiler could be made, and if the factor of safety were also given I venture to say that, with the exception, perhaps, of some little disagreement about internal flues, the specifications would be practically identical. But if besides fulfilling conditions as to strength, the boiler were required to evaporate a given quantity of water in a given time and from a given quantity of coal, I fear that unanimity would vanish, that speculation rather than calculation would guide our pens, and that the result would be *quot homines tot sententiæ*. I at least have no hesitation in confessing that the problem would be very difficult to solve, and my object in bringing this paper before you is to explain how I have tried to solve it, and to learn what you have done in similar cases.

In 1882 a lecture was given at the Institution of Civil Engineers in London, by Mr. William Anderson, "On the Generation of Steam and the Thermodynamic Problems Involved." It is a lecture well worth reading, and it contains an illustration which I am sure Mr. Anderson will not object to my quoting, with one or two verbal alterations, as an introduction to my argument. He drew a picture (Fig. 4, page 101) representing the section of a hill-side. "Some distance up there is a lake L fed by streams running down from a still higher level. Lower down on the slope is a millpond P, the tail race from which falls into the sea. At the millpond is established a turbine, driven by water descending from the lake through a pipe. Datum or zero is the sea level. The level of the lake is T_o, and of the millpond T. W is the volume of water falling through the turbine per minute, σ the weight of one cubic foot. The sea level is the lowest level to which the water can possibly fall, hence its greatest potential energy, that of its position in the lake, is $W\sigma T_o$. The water is working between the absolute levels T_o and T, hence the maximum effect to be expected is $W\sigma T_o (T_o - T)/T_o = W\sigma (T_o - T)$." If for "hillside" we substitute "boiler flue," for "lake" "furnace," for $W\sigma$ the weight multiplied by the specific heat, or the heat capacity of the gases in the furnace, for T_o and T the absolute temperatures of the gases in the furnace and at the end of the flue, and for the sea level, the zero of absolute temperature, then $W\sigma T_o$ will represent the absolute energy of the heat generated in the furnace, and $W\sigma T_o (T_o - T)/T_o = W\sigma (T_o - T)$ the maximum proportion of $W\sigma T_o$, which we can by any possibility utilise so long as the initial and final temperatures of the gases are T_o and T. The proportion $(T_o - T)/T_o$ will no doubt be recognised as the Carnot's coefficient of efficiency of a perfect heat engine, and the illustration shows that we can no more utilise all the energy of the heat supplied to a steam boiler than we can all the energy of the heat supplied to any other heat engine; for we can neither make the temperature in the furnace infinitely great, nor that at the end of the flue absolutely zero. Thus, as the water in the lake possesses energy in virtue of its height, so does the fuel in the furnace possess energy in virtue of its temperature. As on the hill-side the energy of the water in the lake cannot become active without a fall of level, so in the boiler the energy of the heat in the furnace cannot be utilised without a fall in temperature. And as in the waterfall the work done by the turbine is proportional to the change of level, so in the heat engine is the work done by the heating surface proportional to the change of temperature.

Therefore if W be the weight of gases per lb. of coal, σ their mean specific heat at constant pressure, T_o and T the initial and final temperatures of the gases (whether measured from absolute zero or any other point is immaterial), the heat available for evaporating water cannot exceed $W\sigma (T_o - T)$ thermal units per lb. of coal.

So far we have dealt exclusively with quantity. We must now consider time, or settle the rate at which the heat $W\sigma (T_o - T)$ can be transferred from the gases to the water. This is really the question with which this paper is concerned, and it is a question of very considerable difficulty, and in my opinion well worth your consideration. The way in which I have tried to answer it is this: First, to obtain a general approximate formula connecting the different variables involved, and then to determine by experiment the constants and corrections required to make the formula available for numerical calculation under practical conditions.

If S = the number of square feet of heating surface per lb. of coal burnt per hour.
W = the weight of gases per lb. of coal.
σ = the mean specific heat of the gases under constant pressure.
T_o = the temperature of the gases in the furnace.
T = the temperature after passing over surface S.
t = the temperature of the water in the boiler.
m = the number of units of heat transmitted through the plates per square foot of surface per hour, and per degree difference of temperature.

Then considering m as constant and the rate of transmission proportional to the difference of temperature, the heat transmitted by an element of surface δS is $m (T - t) \delta S$: and the heat lost by the gases in passing over the surface δS is $-W\sigma\delta T$. Equating these two quantities we have $m (T - t) \delta S = -W\sigma\delta T$, or $-m\delta S/W\sigma = \delta T/(T - t)$ and integrating $-mS/W\sigma = \log_e (T - t) +$ constant, when $T = T_o$, $S = 0$. $\therefore 0 = \log_e (T_o - t) \times$ constant and constant $= -\log_e (T_o - t)$ whence $-mS/W\sigma = \log_e (T - t) - \log_e (T_o - t)$ or taking common logarithms and transposing $m = 2{\cdot}3 + W\sigma \{\log. (T_o - t) - \log. (T - t)\}/S$ (1) By means of this equation and a sufficient number of experimental observations of the values of the symbols in the right hand member, I hoped to determine the general value of the constant m, and this once done to use the formula

$\log. (T - t) = \log. (T_o - t) - mS/2{\cdot}3\, W\sigma$ (2) to calculate the final temperature T of the gases for any proposed case where the working conditions defining $W\sigma$, T_o and t were given, and then to calculate the probable evaporation in the following way:—

Having found T the heat lost by the gases is $W\sigma (T_o - T)$. Part of this heat is expended by transmission through the rickwork and by radiation, and partly in heating air drawn into the flues between the brickwork and the boiler. Call this heat R. The remainder is transmitted to the water in the boiler. If t_o be the temperature of the feed, w the number of lbs. of water evaporated per lb. of coal, then the heat transmitted to the water is $w (1114 + {\cdot}305t - t_o)$ thermal units per lb. of coal. Equating this to $W\sigma (T_o - T) - R$, the number of lbs. of water evaporated per lb. of coal will be $w = \{W\sigma (T_o - T) - R\}/(1114 + {\cdot}305t - t_o)$. (3)

It will be noticed that in constructing the general equation of transmission (2) I have treated m and t as constant, and have assumed that all the gas passes over the whole of the heating surface.

Now as regards m this treatment is certainly incorrect. Instead of being constant m is a function of T_o, T, t, of the condition of the plates in respect of soot and scale, and of the rapidity of circulation of the water and gas currents, for both water and gas are such bad conductors that unless the layers of heated water and cooled gas next the plates are rapidly displaced, the transmission is materially reduced. The mathematical expression of this function and its introduction into the differential equation, however, seemed so utterly impracticable, that there was no alternative but to adopt Newton's hypothesis, and treat m as constant in the integration, afterwards providing for such variations of this constant as experiment might suggest by a table of values or an empirical formula.

As regards t, the difference in the temperature of the water in contact with the different parts of the heating surface of Lancashire boilers is so small, that no material error can occur in treating it as constant and equal to that due to the steam pressure.

The error involved in the third assumption is also small, and the variation of the error smaller still, and it is this variation only which affects the coefficient m so long as this coefficient is applied to one type of boiler. Strictly speaking, the evaporation from the furnace plates should be calculated separately, and the formula (2) applied only to the part of the boiler beyond the bridge. But with any ordinary extent of heating surface, the results of the two methods differ by so little, that it is not worth while complicating the subject by the addition of another calculation.

Having made these necessary observations, I must now explain the way in which I have found the values of $W\sigma$, S, T_o, T, and t, which are required in order to determine m from equation (2), and I think I can do this best by taking a concrete case; for this purpose I have selected one of my own experiments with two Lancashire boilers, 7ft. diameter by 30ft. long, hand fired. This experiment is fully described in my annual report for the year 1888, and I will only give such particulars here as are necessary to the comprehension of the question before us.

The results of the experiment expressed in the form of a debtor and creditor account were as follows:—

BOILERS.

Dr.		Thermal units.
To calorific value of 1lb. dry coal		13,363
To heat contained in 1lb. coal		22
To heat contained in air, 14·79lb. entering furnace at 54°		179
To heat contained in moisture held by air		2
Total		13,566
Cr.		
By heat required to raise 9 819lb. water from 206° to 326°, and to evaporate it into steam containing 8 per cent. of moisture		9,626
Heat carried off in waste gases:		
9·146lb. products of combustion at 648°	1,606	
5·618lb. unburnt air, 0·135lb. vapour and 0·16lb. steam, arising from evaporation of water	914	
		2,520
Heat absorbed in evaporating ·016lb. water mixed with coal		18
Heat lost by imperfect combustion		0
Calorific value of ·0395lb. of unburnt carbon in ashes		575
Heat lost in clearing fires		45
Remainder, including heat lost by radiation and unaccounted for		782
Total		13,665

The heating surface of the boilers was 1,810 square feet, excluding the lower halves of the furnaces below the bars as is usually done, though why they should be excluded I do not quite understand, as they certainly receive heat radiated from the grates, though no doubt the quantity is very small.

The weight of dry coal burnt per hour was 1,073lb.

The weights, specific heats, and heat capacities of the waste gases are given below:—

		W lbs.	σ specific heat.	$W\sigma$ = Heat capacity.
Products of combustion	Carbonic acid	2·721	× 0·216	= 0·588
	Nitrogen	6·870	× 0·244	= 1·676
	Steam from combustion of hydrogen	0·445	× 0·481	= 0·214
				2·478
Air in excess and water	Air	5·618	× 0·238	= 1·337
	Vapour in air	0·135	× 0·481	= 0·065
	Steam from water mixed with coal	0·016	× 0·481	= 0·008
				1·410
				3·888

The value of S is found by dividing the heating surface by the weight of dry coal burnt per hour, and is in this case 1·69.

The value of $W\sigma$ is given above, namely 3·888.

The value of T_o must be obtained by calculation, since we have no reliable method of observing it directly. The calorific value of the coal was 13,363 thermal units, but this value was reduced by various losses in the furnace, as shown in the balance sheet, namely:—

18 units obsorbed in evaporating the water mixed with the coal.
575 units, the equivalent of ·0395lb. of unburnt carbon mixed with the ashes.
45 units lost in the hot ashes and clinkers, altogether 638 units, which being deducted from the calorific value of the coal leaves 12,725 units available for raising the temperature of the gases.

The heat capacity of the gases being 3·888, these 12,725 units will heat the gases $12{,}725 \div 3{\cdot}888 = 3273°$, and as the temperature of the air entering the furnaces was 54°, the temperature of the fire was 3327°, and this I take as the value of T_o.

The values of T and t were obtained directly by observation; they were 648° and 326° respectively.

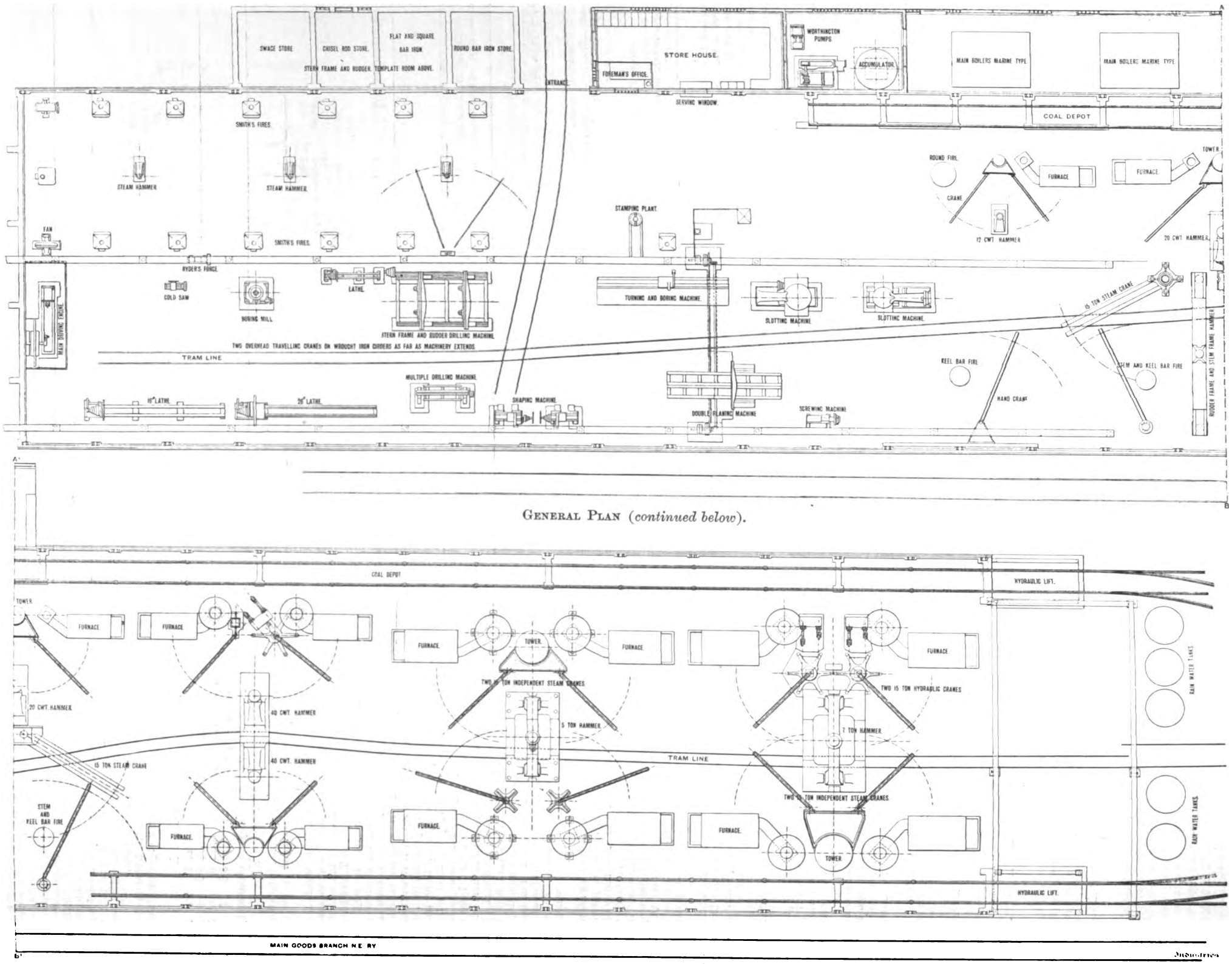
Substituting these numbers in the right hand member of equation (2), we have $m = 2{\cdot}3 \times (3{\cdot}888/1{\cdot}69) \{\log. (3273 - 326) - \log. (648 - 326)\} = 5{\cdot}13$ thermal units.

From this slight sketch, you will see that the determination of m depends upon a knowledge of a number of other quantities, the accurate evaluation of some of which is very difficult. To begin with, it is by no means easy to learn the calorific value of the coal itself. First, there is the exceeding difficulty of selecting an average sample for analysis and testing, and, secondly, the calorific values calculated from analyses, hardly ever agrees with those found from calorimetric tests. In my work I have been forced to content myself with one analysis of each coal I have used, but when using the same coal for several days I have made generally three calorimetric tests for each day: unfortunately, I have found that the three tests of one day, though agreeing among themselves, have not in general agreed with those of other days, although the coal was

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A NEW FORGE AT WEST HARTLEPOOL.

(*For description see page* 97.)



GENERAL PLAN (*continued below*).

GENERAL PLAN (*continued from above*).

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EVAPORATION IN LANCASHIRE BOILERS.

TABLE I.

		A	B	C	D	E	F	G	H	I	J
1	S	3·98	1·64	1·62	1·59	1·69	1·41	1·42	1·44	1·45	1·43
2	W σ	5·979	8·734	3·987	5·302	8·888	6·61	6·55	5·66	5·36	6·20
3	Value of coal net ...	14311	12450	11424	12871	12725	11239	11586	12026	12361	11282
4	T_o	2466	1518	2983	2482	3327	1756	1826	2170	2352	1866
5	T	399	691	750	700	648	743	782	700	730	703
6	t	298	304	322	327	326	308	308	326	326	316
7	m	4·60	5·97	4·41	5·84	5·13	5·61	5·36	6·28	5·97	6·39

TABLE II.

		L	M	N	O	P	Q	R	S	T	U
1	S	1·9	2·03	2·48	2·98	2·98	2·70	3·36	3·05	3·45	
2	W σ	4·788	4·479	4·799	4·527	4·268	3·924	4·833	4·529	4·804	
3	Value of coal net ...	12547	12610	13159	12705	12697	12482	12623	13289	13200	
4	T_o	2670	2858	2785	2843	3014	3191	2618	2967	2790	
5	T	405	428	440	381	394	430	410	419	394	
6	t	307	307	307	307	307	307	305	307	307	
7	m	8·0	6·72	5·65	5·36	4·92	4·60	4·50	4·71	4·70	

TABLE IV.

S	1	1·25	1·5	2	3	4
m	6	5·7	5·4	5·1	4·6	4·3
Steam Pressure, 40lb. t = 287°						
T.....deg. Fahr.	978	831	729	570	418	351
W σ (T_o – T) – 700 th. units	7721	8414	8893	9640	10355	10670
Steam Pressure, 100lb. t = 338°						
T.....deg. Fahr.	1015	871	771	615	466	400
W σ (T_o – T) – 700 th. units.....	7549	8226	8696	9429	10129	10437
Steam Pressure, 160lb. t = 371°						
T.....deg. Fahr.	1039	897	808	644	498	432
W σ (T_o – T) – 700 th. units.....	7436	8103	8521	9292	9978	10289

said to be supplied from the same seam and pit. I have found as much as 1,000 thermal units difference in different loads of what was supposed to be the same coal. In general I have taken the analysis (as was necessary) as the basis for calculating the volumes and weights of the chimney gases, but have relied upon the calorimetric tests for fixing the calorific value of the fuel. (Perhaps I may here suggest that in making tests with Thompson's calorimeter, the value obtained must be reduced by the heat liberated by the condensation of the steam arising from the combustion of the hydrogen in the coal, for when the coal is burnt in a boiler furnace this steam is not condensed, and does not give up its latent heat as it does to the water in the calorimeter. This correction is frequently overlooked; with Lancashire coals it generally lies between 400 and 500 units.) Secondly, there is the difficulty of determining the amount of the losses in the furnace, which have to be deducted from the calorific value of the coal, before the quantity of heat available for the calculation of T_o can be fixed. The most important of these are—the heat equivalents of the unburnt carbon, which is lost among the ashes, and of combustible gases, passing off unburnt. Without making an analysis of the ashes, which I have been unable to undertake, the only means of estimating the quantity of unburnt carbon is to deduct the percentage of ash given by the coal analysis from the percentage actually thrown away; a method which can only give correct results if the percentage given by the analysis of the single sample analysed be the same as the percentage in the bulk of the coal burnt. The amount of the loss due to imperfect combustion is also difficult to ascertain outside a laboratory. It is frequently asserted that combustible gases cannot exist in company with a large excess of air. This I think is a mistake. It is true it is often difficult to find carbonic oxide, while carbon vapour and free hydrogen entirely elude the snares of the apparatus ordinarily used for outdoor work. My experience, however, is, that with care and patience carbonic oxide can very frequently be found in small proportions, while as regards free hydrogen the experiments of Scheurer Kestner* seem to show that, in general, about 20 per cent. of the hydrogen in coal escapes unburnt whether the supply of air be great or small.

If these experiments be relied on, the losses in the furnace will exceed those found in the balance sheets of trials, while the remainders usually ascribed to radiation and heat unaccounted for will be diminished. Hence the probability is that the losses in the furnace have been under-valued, and the temperature T_o over-stated somewhat in my experiments.

Lastly, there is great uncertainty about the temperature of the waste gases if they exceed 600°, the maximum temperature for which a mercury thermometer can be used. I have tried Casartelli's, Schaeffer's, and Murrie's pyrometers, and found them altogether unreliable; hence in all the experiments in Table I., except those lettered A to E, I have had to correct the observed final temperature of the gases. This I have done by assuming a loss of 700 units from radiation and communication of heat to air drawn into the flues between the boiler and the brick-work, adding this to the heat absorbed by the water, and dividing the sum by the heat capacity of the gases, and then checking the results by the work done in the economisers, and the heat carried up the chimney where the temperatures were measurable by a mercury thermometer, and though I cannot hope to have arrived at accurate results, I think the figures are not far from the truth.

In experiments D and E, the pyrometer was found to agree with a mercury thermometer up to 550°, and therefore the observed temperatures of the waste gases are probably not far wrong, and are given as they were observed. Experiment B was made in Vienna, and I have no information about the pyrometer used. In experiment A the final temperature was low enough to be measured by a thermometer. The temperatures in Table II. were all taken with a thermometer and are correct, except perhaps those in L and M.

With such difficulties to overcome, it is not surprising that the determinations of m which I have hitherto made should be somewhat variable. They are given in Tables I. and II., and cannot be considered as more than near approximations.

The figures in Table I. refer to Lancashire boilers, those in Table II. to a combination of a Cornish boiler with a pipular boiler; but inasmuch as the furnace was internal, and the greater part of the evaporation done in the Cornish part, I think the values of m obtained from it are worth producing in addition to those shown in Table I.

Referring to these tables you will see that in experiment A the value of m is very low; the reason, I think, is that the temperature of the gases was reduced so much as to deposit a great quantity of soot upon the latter end of the large heating surface, and thus the effective heating surface per lb. of coal burnt was really less than the value ascribed to S. If this ineffective surface were not counted, the value of S would be reduced and that of m increased.

In C also m has a low value, but this is fully accounted for by the fact that the boilers were old ones, fed with very dirty water, and coated internally with thick scale. The figures in column D were obtained from the same two boilers as those in column E, and it is likely that the different values of m in the two experiments is due to the different conditions under which the boilers worked. The difference between T_o and the observed value of T being produced in part by the absorption of heat by air entering the flues between the boiler and the brickwork, it is natural that T should be lower with the strong draught, like that indicated by the value of W σ in D, than with the weak draught shown in E. But the formula for calculating m is based on the supposition that the difference T_o – T is produced by absorption of heat by the water alone, hence the value of m determined by it will always be higher with a strong draught or leaky flue than with a weak one and air-tight flues, and the actual coefficient of transmission rather less than the calculated. The high coefficients in F, G, H, I, J are due partly to strong draught, and partly to the boilers being very clean. The high values in L and M are inexplicable, except on the supposition that the thermometer was affected by a current of cold air, which entered at the damper-hole and at a crack in the brick-work, or that the loss by imperfect combustion was greater than that calculated from my analysis of the gases, or that the net heating value of the coal and the temperature T_o were over-estimated. The last seems the most likely, for the coal had been lying out of doors some time, and the outside of the heap was used for trial L, and the part near the outside for trial M. The low values in P – U are no doubt due, as in A, to the effective surface of the boiler being less than the actual surface, owing to deposition of soot upon the hinder parts.

On the whole I am disposed to think that the following values of m may be adopted till further experience throws more light upon the subject:—

TABLE III.

	S = 1	1·5	2	3	4
For very clean boilers.....	m = 6·5	5·9	5·5	4·9	4·6
For fairly clean boilers	m = 6	5·4	5·1	4·6	4·3
For rather dirty boilers	m = 5·5	4·9	4·6	4·2	4·1

Intermediate values of m may be obtained by the formula

$$m_n = m_1 / \sqrt[4]{S}.$$

Of course this formula has no rational foundation; it is only a convenient expression for substitution in the general formula when S is the unknown quantity.

I now return to the problem with which I started, namely, that of designing a Lancashire boiler to evaporate a given quantity of water at a given rate. If the calorific value of the coal and the value of W σ be given, T_o can be calculated and T found, and this once done, the rest is easy. But as these quantities are generally unknown, the engineer will have to fix them arbitrarily, and therefore ought to know the limits within which they usually lie. As regards the calorific value of Lancashire coals, my experience is that it varies from 12,000 units to 14,000 units, and that ordinary good mill coal, whether slack or burgy, has generally a value of about 13,500 units, and contains according to analysis about 78 per cent. of carbon and between 4 and 5 per cent. of hydrogen. The losses in the furnace may usually be taken between 500 units and 1,000 units per lb. of coal, thus reducing the calorific value from which T_o must be calculated to about 12,750 units for good coal. These losses are generally rather greater with slack than with burgy, owing to mechanical difficulties; for the same reason they are likely to be greater with bad coal than with good. For instance, with coal worth only 12,000 units, the value in the furnace would probably not be more than 10,800 or 11,000 units. The value of W σ depends, of course, upon the weight of air which passes through the flues per lb. of coal.

It is generally assumed that 12½lb. of air are required to burn 1lb. of coal in theory, and about 18lb. in practice. But this is only true for carbon, not for coal. As a matter of fact, good Lancashire coals require about 10lb. of air in theory, and with careful stoking, about 15lb. to 16lb. of air in practice. In such cases the value of W σ will be about 4·5, but in designing a boiler it will be better to take W σ at 4·7 for good coal. Of course W σ can be increased to almost anything by having a roaring draught such as some firemen delight in. Several such instances are noticeable in Table I.

And lastly, as to R, the heat lost by radiation and air leakage into the flues. Very few direct experiments have been made to determine R. It is generally found by difference, and thus includes all errors of observation. As far as I can judge with single Lancashire boilers, R ought to be between 1,000 and 700 units, and with groups of boilers between 700 and 400 units, per lb. of coal.

We can now proceed to the solution of our problem. Suppose it be required to evaporate 5000lb. of water per hour under a pressure of 100lb. per square inch (115lb. absolute) from feed water at 100°, and at the rate of 9lb. of water per lb. of coal. The heat required to evaporate 1lb. of water under these conditions is 1114 + ·305 × 338—100 = 1117 thermal units; therefore the heat transmitted through the plates from each lb. of coal burnt must be 9 × 1117 = 10,053 thermal units, to which must be added, say, 700 units for radiation, &c., making in all 10,753 thermal units.

Assuming the coal to have a calorific value of 13,500 units, or 12,750 units after deducting losses in the furnaces, the air to be at 60° and the value of W σ to be 4·7, then the value of T_o will be 12750/4·7 + 60 = 2770, and that of T is given by (3), viz., 4·7 (2770—T) = 10053 + 700, whence T = 482°.

What heating surface is required to reduce the temperature of the gases to 482°? The answer is given by equation (2), viz.:—

$$S = 2{\cdot}3\ W\sigma \left\{ \log.(T_o - t) - \log.(T - t) \right\} / m$$

Taking the value of m from the second line of Table III., referring to fairly clean boilers—viz., 6 / $\sqrt[4]{S}$ and t = 338, the temperature of steam at 100lb. pressure, we have

$$S = 2{\cdot}3 \times \frac{4{\cdot}7}{6} \sqrt[4]{S} \left\{ \log. 2432 - \log. 144 \right\}$$

or $$S^{\frac{3}{4}} = 1{\cdot}8 \times (3{\cdot}38596 - 2{\cdot}15836) = 2{\cdot}2086$$

The fourth root of S^3 may be extracted with the aid of a table of squares and cubes, by taking the square root of 2·2086, then the square root of that square root, and finally the cube of the result, or more conveniently by a table of logarithms. Thus:—

$$\tfrac{3}{4} \log. S = \log. 2{\cdot}2086$$

or $$\log. S = \tfrac{4}{3} \times 0{\cdot}34312 = 0{\cdot}45748$$

whence S = 2·87 sq. ft. per lb. of coal.

Now the coal to be burnt per hour is 5,000 / 9 = 556lb., therefore the heating surface required is 2·87 × 556 = 1,596 sq. ft.

How many boilers shall we use?

This depends upon the area of fire grate required. Well, my experience upon the point is this, that it is difficult to burn less than about 16lb., or more than about 21lb. of coal per sq. ft. of grate in Lancashire boilers, without considerable excess of air. Having to burn 556lb. of coal per hour, therefore, the total grate area should not be less than 26·5 sq. ft., or more than 33·5 sq. ft. Moreover, the length of each grate must not exceed 6ft., and

* Recherches sur la combustion de la houille par A. M. Scheurer Kestner, Mulhouse 1868.

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EVAPORATION IN LANCASHIRE BOILERS.

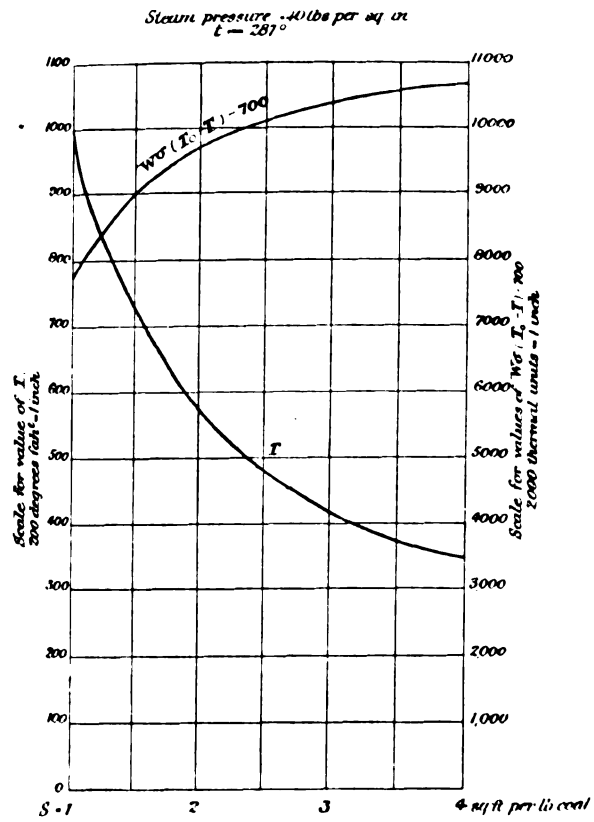


FIG. 1.

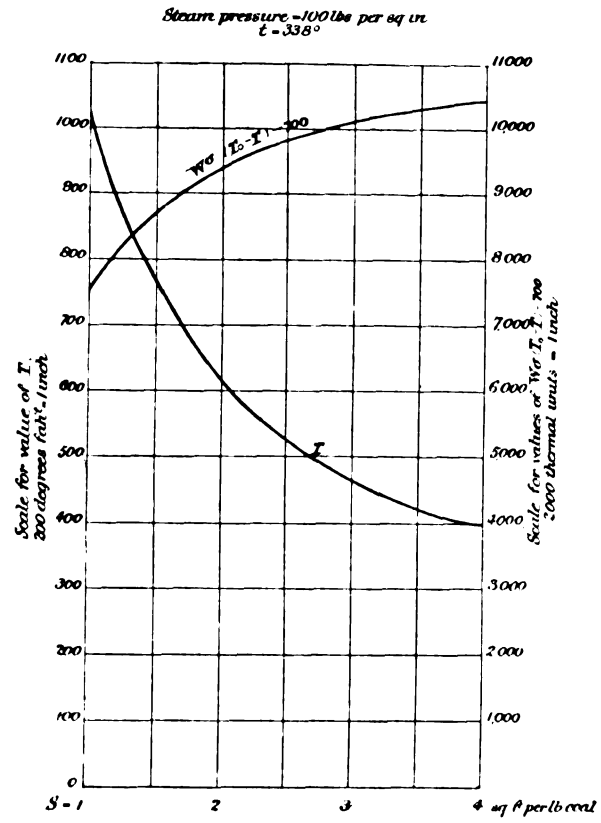


FIG. 2.

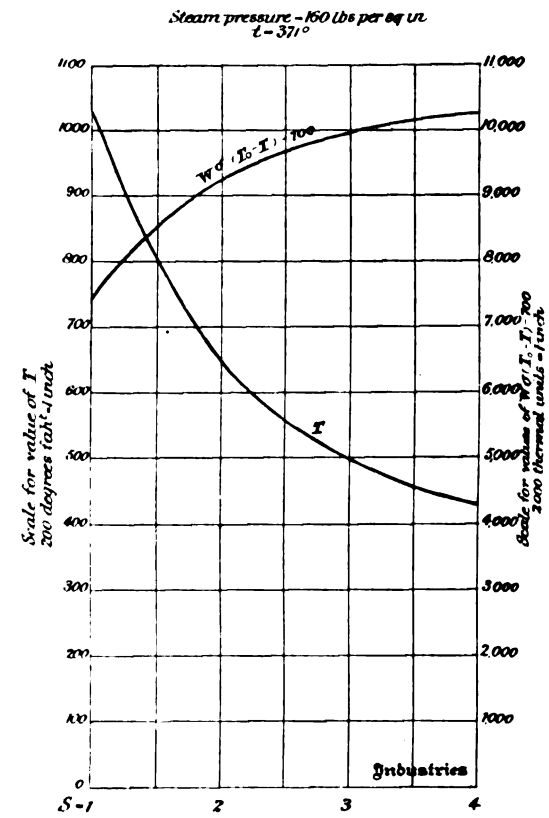


FIG. 3.

should not by preference be less than 3ft. 6in. The best way of fulfilling these conditions would probably be to have two Lancashire boilers, 7ft. diameter by 27ft. long, with internal flues 2ft. 8in. diameter, and grates 3ft. 6in. long, set low in the furnace, especially at the back ends, in order to reduce the mean width to about 2ft. 5in. In order to facilitate this kind of calculation I have drawn up Table IV. for pressures of 40lb., 100lb., and 160lb., giving the values of S, m, T, t, and $W\sigma(T_o - T) - 700$ (= the heat available for evaporation) on the assumption that—

The calorific value of the coal	=	13,500 thermal units.
The losses in the furnace	=	750 ,,
The heat available in the furnace	=	12,750 ,,
Loss by variation	=	700 ,,
The value of $W\sigma$	=	4·7
Temperature of air	=	60°

and from the figures I have plotted the three curves, Figs. 1, 2, and 3; the abscissæ being the values of S, and the ordinates the corresponding values of T, and of $W\sigma(T_o - T) - 700$.

I have now done my best for the engineer, and will conclude my paper with a few practical hints to boiler owners.

1st. Get your boilers designed for the work they have to do, and not made 7ft. 6in. × 30ft. or 8ft. × 28ft. as the case may be, because it is the fashion to have boilers of these particular dimensions.

2nd. Don't stick to 6ft. grates if a shorter length is required to burn the coal at the rate of from 16lb. to 21lb. per hour.

3rd. Reduce your draught as much as the nature of the coal and the smoke inspector will permit. Try and reduce it till the fire is hot enough to melt a piece of steel boiler plate.

4th. Buy your coal dry and keep it dry. Weigh the ashes which come out of the furnaces as well as the coal that goes into them.

5th. Be most careful to stop up air leaks in the brickwork and between the brickwork and the boiler.

6th. Establish a gasometer for collecting gases from the flues and analyse them for carbonic acid, and try to get 10 or 11 per cent. of that gas in the samples by cutting down the draught. The apparatus and its manipulation are of the simplest character, and the information gained will be of great practical utility, and will often lead to considerable economy.

In the discussion which followed the reading of the paper, Mr. Longridge explained that the table of coefficients did not pretend to be absolutely accurate, as the number of experiments were few. It was well known that the conductivity of metal was greater at a low than at a high temperature, and it might therefore be argued that it should be higher at the back than at the front of the boiler. But this reasoning left out the fact that the accuracy of the coefficient depended largely upon radiation, which was, of course, greatest at the furnace end. Again, the mobility of the water and gases was an important element, as both were bad conductors, and if they were in a state of rapid motion they aided the transmission of heat very materially. These conditions prevailed at the furnace ends, where not only was the water more agitated, but the volume and velocity of the gas were necessarily much greater than elsewhere.

Mr. Boswell agreed that engineers did not know as much about boilers as they thought they did. Fashion played an important part in the determination of the size of boilers ordered, and as a proof of this he might say that the boilers used in the Manchester Exhibition having been all 30ft. by 8ft., steam users for a long time afterwards would buy no other size. With reference to the formulæ used, he presumed they referred to the average quality of fuel, but it was known that cheaper coals were being used, and in some cases, with systems of forced draught, "duff" and such like fuel material was employed. The formulæ, therefore, would require amending. He was of opinion that what was wanted was to educate the stokers, and under present conditions the formulæ used would need to have a good margin where careless men were employed. Having given some instances of stupidity on the part of steam users, he said that, as in erecting a building an architect was called in, so in putting in a boiler a skilled maker should in every case be consulted.

Mr. Rea asked if Mr. Longridge meant to imply that a smaller boiler with a small grate was better than a larger one with a large grate. He would like some information as to the size of flues under and at the side of the boiler. In one system the former were made 6ft. high, the idea being to get a slow motion of the gases. What, he asked, was the best speed of gases through the different flues so as to get the greatest effect from radiation? He then referred to the cold zone theory of Mr. Thos. Fletcher, and asked what was the actual loss in transmission through the plates. Was there really much advantage in the corrugated flue or the Galloway tube from the point of view of economy? He thought there was a good deal of heat yet to be saved in boiler practice, and thought it was advisable to pay the stoker good wages in order to get a good man.

Some questions were then asked as to forced draught, and whether the efficiency of the boiler did not depend largely on the velocity of the gases, after which

Mr. Schofield asked for information as to the velocity of the draught. He questioned whether the bridge was of any value, and was inclined to the use of a furnace 8ft. long, in an ordinary sized boiler, but without bars for the last two feet, and without bridge, no air being admitted beyond that point. He did not agree with too great a reduction of the temperature of the gases on leaving the boilers. They should not be reduced below 500° F. To allow this heat to escape was, he thought, a mistake, and the use of an economiser appeared to him to be imperative for good working.

Mr. Longridge, in reply, said that his experiments were, of course, made with good coal, but the formulæ

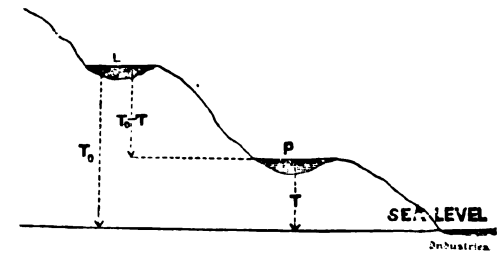


FIG. 4.

equally applied to all kinds of coal, as all that was necessary was to substitute the value of T_o, which could easily be calculated. He agreed with the French method of giving prizes to stokers at an annual competition, which would lead to improved stoking. The size of a boiler was, within certain limits, immaterial; the amount of heating surface determining the economy, and the size of the grate must largely depend on the class of coal used. For instance, Welsh coal being slow burning, and not easily moved about, was not so good to burn as Lancashire coal. It was difficult to fix the proper velocity of the gases, but he thought that an excess of air to the extent of 60 per cent. was the best condition to aim at. The quantity and speed of radiation was necessarily different under different conditions, and a Lancashire boiler being a slow-working machine could not fairly be compared with a locomotive boiler. He thought the Lancashire boiler was nearly perfect, and did not see how it could be much improved. The expression $W\sigma(T_o - T)$ represented the maximum transmission of heat, and was nearly reached. It was not possible to raise the value of T_o very much, as, if it was, dissociation took place. He had known this to occur at 1050° F., and 3 per cent. of carbon vapour to exist in boiler gases. Forced draught might be advantageous with thick fires and hard firing, and with the consequent resistance to the air. He did not think there was much gain in increasing the size of flues, as gas always follows the shortest course, and if the draught was not impeded the smaller the flues the better. The thickness of plates did not much matter, as the resistances occur when the heat was entering and leaving the plate, so that a variation in thickness would make an immaterial difference. Of course, with the extra thick plates about to be used for high pressure, there would be constructional difficulties which would require consideration. The best temperature of a furnace was the highest obtainable, one sufficient to melt a piece of steel being very effective. This could be obtained by a regulation of the draught.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

(FOR LATEST TELEGRAPHIC DESPATCHES SEE, PAGE 105.)

PARIS, 28TH JANUARY, 1890.

COAL.—The total imports of coal delivered for consumption in France in 1889 amounted to 7,800,249 tons, against 8,217,511 tons in 1888, a decline of 5 per cent. Of this loss of some 417,000 tons, 145,000 may be placed to English, 152,000 to Belgian, and 114,000 to German account. The coke imports also show a falling off, the total for 1889 amounting to 1,157,440 tons, against 1,186,913 tons in 1888. The falling off is in the trade with Germany, and it is much greater than the difference between these totals, the Belgian imports having increased considerably. The exports of French coal and coke in the year last past amounted to 1,682,527 tons, against 1,464,904 tons in 1888.

IRON.—The situation of the iron trade, now that we have fairly entered on the new year, is found to be satisfactory in an exceptional degree. In all districts manufacturers have their order books well filled, and fresh contracts, often of considerable importance, are being entered into daily. Engineering firms are very busy. Makers of railway rolling stock are overwhelmed with work. Besides the 3,000 goods waggons already contracted for for the Northern Railway, orders for 500 more are about to be placed, while still larger orders are in sight. Among locomotive builders, the Société de Construction de Batignolles and the Société Cail have each secured a contract for 30 powerful engines. In the shipbuilding yards the greatest activity prevails. Founders, too, are everywhere well supplied with work for the next six months. Here in Paris the market is calm, but firmer than it was a week ago. Old rails are quoted 88s. In the Haute Marne plates are in strong demand at 184s. common, and 208s. steel. The price of most articles of ironmongery has been advanced 10 per cent. In the Ardennes bars sell at 156s. and 160s. Tool steel is quoted 52s. per cwt. The declared value of the imports of iron of all sorts in 1889 is £254,360, against £358,120 in 1888, while the value of the exports has increased from £370,240 in 1888 to £907,320 in 1889.

LABOUR.—Paris is likely to be profoundly disturbed ere long by the labour movements. The Great Exhibition attracted large numbers of workmen of all classes to the capital, not only for the construction of the buildings in the Champs de Mars, but for the erection of numerous other structures which were pushed forward for completion last year. A large proportion of these have now no occupation, and there is much discontent and ferment in consequence. The Socialists are turning the opportunity to account to bring about a general strike in the spring. The prospect is contemplated with much anxiety in industrial circles.

SUBURBAN TELEPHONES IN PARIS.—The system of management of suburban telephone centres has hitherto been very vexatious. The details of the old system are, of course, only of local interest, but it may be said briefly that the chief objection lay in the high rate charged for the use of the trunk connecting line, in addition to the necessary subscriptions that had to be paid for the use of the two central offices at each end. These exorbitant charges have now been modified, and the suburban centres are formed into groups which can communicate with each other with less difficulty.

THE EIFFEL TOWER AS A LIGHTNING CONDUCTOR.—Some experiments have been made by electricians for the purpose of ascertaining what amount of protection will be afforded to the city of Paris by the Eiffel Tower. The conductivity of the tower is very great, of course, and the resistance of the "earths" are comparatively small, so that, if lightning conductors are any good at all, the Eiffel Tower ought to be of considerable value.

ELECTRICITY IN PARIS.—The commission of the Paris Municipal Council which has had the granting of licences for public electric installations has inserted a clause in the charters of agreement to the effect that all the machinery and plant used in the installations shall be made by French firms. It appears that all the electric pioneers are making use of the home-made article with the exception of the Popp Company, who are employing some English and American machines. This company, however, established its plant before the decree of the Council went forth.

BERLIN, 27TH JANUARY, 1890.

THE RAILWAYS IN 1889.—The report of the Minister of Public Works for the fiscal year 1888-89 shows a considerable extension of the Prussian railway system, and a notable development of the traffic in that period. The total length of the lines open at the end of the year was, exclusive of narrow gauge "feeders," 23,020 kilometres against 22,466 kilometres in the previous year. The total length of the private lines was 2,647 kilometres. The rolling stock is returned as consisting of 8,797 locomotives, of an estimated value of 393 million marks; 13,953 passenger carriages, valued at 118 millions; 3,791 goods vans, valued at 24 millions; and 174,428 goods waggons, valued at 500 millions. The increase in the passenger traffic was 8·4 per cent. relatively to the preceding year. Of this increase 53 per cent. occurred in the third-class traffic, 33 per cent. in the fourth-class, 10 per cent. in the second-class, and about 0·5 per cent. in the first-class. The increase in the receipts was 5·5 per cent. The goods traffic amounted to 108·4 million tons against 98·9 millions in the previous year, an increase of 9·6 per cent. To fully appreciate the significance of these figures, it is necessary to bear in mind that the goods traffic of 1887-88 showed a large increase over that of 1886-87.

SILESIAN COAL AT LÜBECK.—At a meeting of manufacturers held last week at Lübeck a resolution was passed to the effect that it is desirable, in the interests of the industries of the locality, to open up a trade in coal with Silesia in competition with English and Westphalian coal. By a reduction of the railway tariff from 185s. to 111s. a truck-load of 10 tons, Silesian coal could be sold at Lübeck, at present prices, for from 170s. to 180s., against 225s. for English and 210s. for Westphalian coal. As the Silesian coal is of a quality superior to that of either the English or Westphalian, a good trade could be established if such a reduction of the cost of carriage could be obtained as was recently conceded to the Westphalian importers.

ELECTRIC LIGHTING.—The use of the electric light has become general in the industrial districts of Upper Silesia. Nearly all the mines have their surface works lighted by arc lamps, to enable those engaged in the work of sorting, screening, and washing to carry on operations after dark. At Ruda the greater part of the village is included in the area lighted by the mine owners. Besides mining, the light is used largely in factories, workshops, and railway stations, and about buildings in course of construction. It cannot be doubted that the productive capacity of works is considerably augmented by electric lighting. The town of Hanover has just decided to adopt the electric light, and the council has voted a sum of £75,000 for the commencement of the scheme. The first order for an installation of 15,000 lamps has been given to Messrs. Schuckert.

TELEPHONIC COMMUNICATION WITH VIENNA.—The project for connecting Berlin with Vienna by a telephone line is receiving much attention. The preliminary experiments and tests have been made, and with such success that negotiations have been commenced between the two Governments with a view to an agreement for the immediate construction of the line. There can be no doubt that telephonic communication between these two capitals would tend greatly to promote the trade of both countries. A new form of receiver has recently been tried which makes, it is said, the voice of the speaker heard in any part of a large room.

THE BALTIC AND NORTH SEA CANAL.—At the end of last week the telegraphic communication between all the engineers' offices afong the line of the Baltic and North Sea Canal and the head office at Kiel was completed. The workmen's "barracks" are connected by telephone with the office of the engineer of the section in which they are situate, and also with the residences of the canal inspectors. The work of excavation proceeds apace. The contractor for the section situate between the town of Rendsburg and the Audorf lake had, at the end of 1889, removed 275,000 cubic metres, a quantity greater by 25,000 cubic metres than that to which he was bound by his contract.

MESSRS. IVAN LEVINSTEIN & CO., LD.—The German technical papers are much interested in the news about the formation of Mr. Levinstein's firm at Manchester into a limited company, for it appears that the proprietors of the Actiengesellschaft für Anilinfabrikation and the Farbenfabriken v. F. Bayer & Co., are among the shareholders in the new company. Mr. Levinstein has for a long time been the Germans' strongest rival, and the new departure is, therefore, not without interest.

THE WALCKER ACCUMULATOR COMPANY.—Some time ago mention was made in these columns of a new accumulator which was being placed on the market by M. Walcker. In this battery the plates were arranged as concentric cylinders, and many advantages were claimed for its use. The company which was started to exploit the invention has not met with success so far; it is even said, and it is not at all improbable, that the bank which had a mortgage on their works has taken possession.

THE POPP COMPRESSED AIR SYSTEM.—The savants and engineers at Berlin and Vienna have been merciless on the Popp system for the transmission of power by compressed air. A number of them have sent in reports to the *Allgemeine Electricitäts Gesellschaft* as to the comparative merits of electric and compressed air distribution of power, and it need hardly be said that they are all very much in favour of electricity. One professor stated that as much as 60 per cent. of the power was lost in the Popp distributing mains, which, although a very high figure, is probably not far from being correct.

CYCLE EXHIBITION.—On the 22nd prox. an Exhibition of cycles, &c., is to be held at Leipsic. Most of the leading makers in England, Holland, and Austria have applied for space, and the display of foreign articles will be far more extensive than in any previous exhibition of the sort.

THE NORDDEUTSCHE LLOYD.—During the past year the distance travelled by steamers belonging to this company were as given in the following official table:—

Bremen to New York	726,000	miles.
„ „ Baltimore	300,000	„
„ „ South America	550,000	„
„ „ East Asia	300,000	„
„ „ Australia	340,000	„
Hong Kong to Japan	44,000	„
Sydney to Samoa	65,000	„
Brindisi to Port Said	48,000	„

VIENNA, 27TH JANUARY, 1890.

COALS.—Everything is favourable for the improvement in the coal traffic. The advance in the rates for iron is causing a brisk activity in coal for rolling mill purposes, and the reopening of the Elbe shipping has been followed by an increase of the export. In the Ostrau territory there is such a strong demand that work is being carried on in shafts which for many years have been disused. The Northern Railway is reopening the Georg Colliery, where no work has been done for more than fifteen years. Gutmann Brothers and Archduke Albrecht, both proprietors of large coal works of that district, in a short time will open new shafts. Last year the animated export of Bohemian brown coals caused a shortness in the export of the Zwickau Works, Germany.

IRON.—No change of importance is to be noted as regards the situation of the iron market. There is a steady progress in activity, such as has not been observed for a long time. Prices in several branches tend to increase. Tinned plates have advanced 15fl. per ton. Large orders have been given this week: for instance, an order of the Northern Railway for the iron materials necessary for all the year; the Sud-Nord-Deutsche-Verbindungs Bahn (branch of the North-Western) ordered from a home manufactory ten goods locomotives, with tenders; and the city of Vienna gave an order for iron water mains amounting to 12,000fl.

ELECTRICAL ENGINEERING.—Ganz & Co., of Budapest, have resolved to erect, within their own waggon manufactory, a trial line of the Zipernowsky railway, and the work connected with it has already been begun. Although the demand for glow-lamps is very active, lamp makers are decreasing prices to meet the foreign competition. Last week the price was decreased from 1·85fl. to 1·35fl. Three years ago the price of a 16 c.p. glow-lamp was 3·50fl. The Vienna Agriculture Exhibition, 1890, will be lighted by electricity, and Siemens & Halske are to supply the installation. Besides the ordinary lighting by glow and arc lamps, the company will supply the electric light for the fairy fountains which are being brought from Paris.

EXHIBITIONS.—In September next an Exhibition will be held at Graz, the chief centre of the iron industry in Styria. The exhibits will be mostly the products of the district. The Emperor will be the patron.

BRUSSELS, 28TH JANUARY, 1890.

THE COAL MARKET.—The strikes have now come to an end, thanks to the masters having given way to the men, and work has been resumed at all the collieries. The market is therefore less strained, and business is settling down into its former briskness. During this time of discontent about 300,000 tons of foreign coal have been imported, and worse still, most of the large markets have contracted for the supply of German and English coal for three months longer. It is thus evident that both masters and men will have to pay dearly for their selfishness and folly. The feeling in the market at present is a little mixed, for there is no knowing what turn the prices may take, and until things have gained their legs again some amount of uncertainty will prevail.

THE IRON MARKET.—The iron trade is becoming more settled now in consequence of the termination of the coal strike. The current prices of iron would have been ruinous, and it was impossible to see how an advance could be obtained. It is, therefore, best that the industrial markets should be conducted with method and calmness. Pig iron is scarce, and firm in price. Work is plentiful in the rolling mills and in the workshops, although the prices continue high. Girders, joists, and plates are in the best position, and the tendency is in the most favourable direction. The prices of old iron show a great confidence in the future of the market. The producers have learnt something by the recent scarcity of fuel. For instance, they all confess that they have found the English coals superior to the native qualities.

GLASS WORKS.—During the past week the market has been without movement on account of the possibilities of the makers having to advance their rates. Now that the coal strike has been settled things will go on more in their normal condition. The absence of business from the United States is causing a good deal of surmising, but of course it is to be accounted for by the lower price of glassware at New York.

ELECTRIC LIGHTING IN BRUSSELS.—The disputes as to the granting of the concessions for the electric lighting of Brussels are still raging violently in the Municipal Council, and the two parties are arguing and exposing each other. M. van Rysselberghe explained his system publicly, and he seemed very confident that he could satisfy the council if they would only trust him. The discussion, however, has so far ended where it begun, and altogether electricity has lost some of its vogue.

DÜSSELDORF, 28TH JANUARY, 1890.

COAL.—The situation is again greatly strained, and the uncertainty of the future of the coal market weighs heavily upon trade. The colliery owners having refused to entertain the demand of the miners for a 50 per cent. advance in the rate of wages, the leaders are organising their forces for another struggle. The general opinion is that they will modify their claim to the extent of 25 per cent. and risk another conflict. As the Belgian markets are now practically closed to us for several months to come, the

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prospect is disquieting. The estimated requirements of the Prussian State railways in the fiscal year of 1890-91 is, for coal and coke, 2,608,818 tons.

IRON.—It can hardly be said that the iron market has improved within the last week, though prices have in some directions advanced a little. The upward tendency which has again become distinctly marked is due, not to a prospect of brisker trade, but to fears of another interruption of the production excited by the threat of the colliers, in both the Westphalian and the Saarbrück districts, to bring all industry to a standstill by another general strike. Consumers, apprehensive of yet higher prices for iron, are seeking te place fresh orders for distant delivery, but sellers are reluctant to entangle themselves in fresh contracts. Hence, though the demand is stronger, business has shrunk rather than expanded. Some disappointment is felt over the railway estimates for the fiscal year 1890-91, which are less than they were expected to be. The requirements are 84,962 tons of rails, 27,838 tons of small iron, and 39,415 tons of metal sleepers, a total of 152,215 tons of iron and steel for the permanent way, the estimated value of which is 22,622,900 marks.

PETROLEUM TANK TRANSPORT.—The firm of J. W. Hannesen, of Ruhrort, importers of American petroleum, have just set in operation a tank transport system between Bremen and Ruhrort. The tank-waggons are of 10 tons (seventy barrels) capacity. The petroleum is run into them at Geestemünde, through pipes laid from the vessel, and discharged into casks at the railway station at Ruhrort, whence it is despatched to consumers in all parts of this division of the country.

LILLE, 28TH JANUARY, 1890.

TEXTILE MANUFACTURES.—The sluggish tendency of business in the market for linen goods appears to be passing away. This week much greater activity prevails, and the turnover will compare very favourably with that of last week. Within the last few days the agents of several important houses, both native and foreign, have arrived at Armentières, and buying has been brisk. As a consequence the tone of affairs has improved, and manufacturers have begun to regard the future hopefully. The latest reports of the woollen trade at Roubaix are also encouraging. The declared value of the linen and hempen fabrics exported in 1889 amounted to £375,920 against £331,680 in the previous year, while the imports increased from £209,920 in 1888 to £237,040. The declared value of the woollen fabrics exported amounted to £13,427,440 last year against £12,935,000 in 1888. In the same time the value of the foreign woollen goods imported declined from £2,607,040 to £2,543,440.

FLAX AND YARNS.—There is now an abundant supply of Walloon, Douai, and Bergues flax in the market, and the demand is active. Prices remain unchanged. Notwithstanding the higher prices of Russian goods, a somewhat increased volume of business has been transacted within the last day or two. The market is quiet for tows. Spinners are trying to obtain higher rates for yarns to compensate the increased cost of the raw material. So far the only result has been a restriction of business. This remark applies also to jute yarns. The influenza epidemic has reduced the production of yarns fully 20 per cent. in the last two weeks.

COLLIERY VALUES.—The state of the market for shares in colliery companies is a good indication not only of the condition of the coal mining industry but of trade generally. The following differences are therefore instructive. The values are in francs per share, and represent the market prices on January 1st and December 31st, 1889:—Aniche, 9,225, 12,040; Anzin, 2,725, 4,250; Bruey, 11,500, 12,100; Bully Grenay, 1,250, 1,750; Courrières, 28,500, 36,000; Douchy, 2,305, 4,500; Dourges, 5,795, 8,710; Lens, 20,355, 23,200; Liévin, 4,255, 8,000; Marles, 14,250, 19,100; Meurchin, 2,400, 3,600; Ostricourt, 215, 350; and Vicoigne-Nœux, 16,550, 20,000.

AMSTERDAM, 27TH JANUARY, 1890.

ACCIDENTS IN FACTORIES.—The King has manifested the greatest interest in the proposed Exhibition of appliances tending to minimise dangers to life and limbs of workmen in factories and workshops, and also in the projected association of factory owners with the same object, to both of which I referred in my last letter. His Majesty has consented to become the patron of this association. Meanwhile, the committee of the Exhibition, to be held in the grounds of the Amsterdam Crystal Palace, has issued a programme, from which it appears that the collection will have an international character, and will form the nucleus of a permanent museum of factory hygienics. An international congress on the same subject will meet in the period during which the Exhibition is held. The Exhibition will be opened on the 16th June, and probably close on the 31st August following. Exhibits have to be forwarded to the Secretary of the Executive Committee, Mr. Van Deinse, at the Amsterdam Crystal Palace, not later than the 26th May next. Space is not to be charged for, but all expenses have to be borne by the exhibitors, and the committee will endeavour to arrange for them special railway and steamboat rates. Medals and the usual other marks of distinction will be awarded by a jury. In connection with this interesting subject, it is to be noted that the Common Council of Amsterdam has passed the local Bill, enacting liability of contractors towards their workmen for all accidents while carrying out works for the town. Various speakers opposed the measure, arguing that the town could not look after the insurance of artisans generally, even those not in the employ of the town authorities, without also stipulating their hours of labour and their rate of wages. Others objected because the town itself does not insure any of its own employés against accidents or death, although a project, also providing for old age and invalidation through sickness, is in course of preparation. But the Bill was carried by a substantial majority.

POSTAL MATTERS.—The Government is preparing a Bill for the better regulation of the Dutch postal service. It is proposed to increase the rates for printed matter, which certainly appear low. A newspaper, for instance, and a visiting card, may be sent for half a cent. As five Dutch cents have the same value as an English penny, the above rate is less than half a farthing.

AGRICULTURE.—The Royal Commission of Inquiry into the economic condition of the agricultural classes in Holland has completed its protracted labours. The Commission will meet in May to consider and draw up its report.

A NEW TIN ISLAND IN EAST INDIA.—The latest reports from Singkep, an island belonging to the Lingga group on the east coast of Sumatra, state that the prospects of finding permanent tin deposits there, similar to those in Banca and Blitong, are highly favourable. The concession for working these mines is in the hands of a private company.

GRINNELL'S SPRINKLERS.—Some Dutch factories have adopted these sprinklers, and others will probably follow after the highly successful experiments that have taken place last week in Amsterdam, large fires being easily put out by them. It was stated by the representative of the patentee that at least 5,000 buildings are now protected by these sprinklers all over the world, although the system was only introduced in 1882, and that insurance companies readily grant a substantial reduction in their premiums where they find them installed.

COCOA IN SURINAM.—The cocoa factories of Holland will be able to produce the manufactured article very cheaply this year, the crop being reported enormous in Surinam.

THE DUTCH SOUTH AFRICAN RAILWAY.—Latest advices show that the works between the Portuguese frontier and Pretoria are now in full work upon the first section to Nelspruit. Many engineers are wanted, so many, in fact, that a sufficient number of Dutchmen cannot be procured, and the directors of the above-named company are consequently thinking of engaging a few foreign gentlemen.

SAVING OF LIFE AT SEA.—Some time ago a committee was appointed to inquire into the present state of the means of saving life at sea in Holland. It has just issued a most exhaustive and instructive report, from which we gather that the service, although entirely voluntary, is very effective. In the main, it is performed by three societies, and the committee does not propose to interfere with their useful work. It proposes that the Government shall not as yet undertake that work itself, but shall continue to pay the small annual subsidy of £240, which commenced in 1881, and shall also assist the societies in every way, by placing at their disposal the best rockets manufactured at the State factory in Delft, and combining the coastguard service with the lifeboat service of the societies. The committee expresses the desirability of making one national society for the saving of life at sea, combined with a fund for encouraging and rewarding the efforts of those who risk their lives in promoting the objects of the fund.

COPENHAGEN, 25TH JANUARY, 1890.

SWEDISH STEAMERS FOR THE ARGENTINE REPUBLIC.—Within the last week or two three Swedish steamers have left Gothenburg *en route* for Buenos Ayres. They are not new steamers but second-hand boats, which used to belong to the Göta Canal Company, and when they have reached their destination they will be used on the La Plata River. Both crews and captains are Swedish.

WOOD PULP IN SWEDEN.—Another wood pulp and paper manufactory is about to be erected in Sweden—viz., at Atrafors, Elfsborg. The concern is a limited company, with a capital of 500,000kr.

STONE INDUSTRY IN SWEDEN.—I have several times drawn attention to the increase in the Scandinavian stone industry. As an instance of this, I may mention that the export of hewn stone during last year from the Bohuslön district amounted to a value of 427,725kr.

RAILWAYS IN SWEDEN.—It appears to be the intention of the Swedish Government to push ahead with the Northern Main Railway Line (Norra Stambauen). This important railway will prove a great boon to a large portion of North Sweden, where means of communication are sadly needed. The last Swedish Parliament raised the vote for the year from 2,500,000kr. to 4,000,000kr., and in the present session endeavours will he made to obtain another handsome vote. A plan has been drawn up by a number of prominent railway officials.

SILVER IN NORWAY.—The Kongsberg Silver Works, which are the only ones of any importance in Norway, have not done particularly well last year. The production of fine silver was only about 5,800 kilog., and, in addition to the smaller output, prices ruled very low; the quotation has ranged between 110¼kr. and 116¾kr. per kilogram. The surplus for the last financial year of the Kongsberg Silver Works only amounted to about 170,000kr., whereas it has averaged about 450,000kr. annually for the three previous years. The present prospects are considered satisfactory. The Armen Mine, which yielded well all last year, continues to give plenty of good ore; the Kongen's Mine, which has now been worked to a depth of 620 metres, is also tolerably good in certain portions; and the third of the Kongsberg old principal mines, the "Gottes Hülfe in der Noth" Mine, has also yielded well, and continues to promise well. Several of the other less important mines have also been worked with more or less satisfactory results.

COPPER IN NORWAY.—The Röros Copper Works, which is the most important establishment of this kind in the country, has lately been considerably extended, and new machinery, &c., has been provided. Last year appears to have been satisfactory, all things considered, and there are very fair prospects of remunerative working for the future. This satisfactory result has only been achieved by adopting the most approved processes, whereby the cost of production has been reduced simultaneously with an increase in the output. Special railways have been built and everything has been done to facilitate the business. Along with the copper production goes a very important export of sulphur ore. There are a number of other copper works in Norway, none of which, however, can compare with Röros, neither as to size nor rational working. Should the price of copper, however, leave a reasonable margin, there are signs of an increase in the Norwegian copper industry, as a good deal of experimental working has taken place of late.

EXPORT FROM THE FÄRÖ ISLANDS.—During the year 1888 (statistics are somewhat behindhand in these parts) the exports from the Färö Islands comprised 30,310cwt. dried fish, 4,389cwt. salt fish, 1,615cwt. turbot, 1,105 barrels of train oil, 137cwt. glue, 1,000cwt. guano, 137cwt. feathers, 5,714 lamb skins, and about 30,000 woollen vests.

A PAPER HOUSE.—A portable house of paper has recently been constructed in Hamburg. The walls consist of double layers of paper, of which the interior one is impregnated against fire, and the exterior one against moisture. The paper is fixed in frames, which can easily be attached to each other. The house is intended to serve as a restaurant, and contains a dining room 90ft. long.

THE STATE RAILWAYS IN FINLAND.—These railways are doing remarkably well. The increase on last year's takings will, no doubt, be about 1,000,000 marks in excess of the previous year's, which were, again, 1,000,000 marks above those for 1887. The net profits had been estimated at 2,400,000 marks annually for the three yearly financial periods 1889 to 1891, but will, no doubt, reach 3,000,000 marks for last year.

TRAMWAYS IN DENMARK.—Few capitals have a better system of tramways than Copenhagen. The oldest of the various companies was an English one, which has now been doing very well for some 27 years; but the later ones are Danish concerns, although one of the newest has been built by an English contractor. The Nörrebro Tramway Company, Copenhagen, has just published its balance-sheet for its 22nd year, which is eminently satisfactory, showing a net profit of between 25 and 30 per cent. on the share capital.

MADRID, 27TH JANUARY, 1890.

DYNAMITE IN SPAIN.—Although there is a large dynamite works at Bilbao, there is a good opening for another such establishment in the centre of Spain to supply the markets of Linares, the coal basin of Belmez, and the large and increasing mining districts in the provinces of Ciudad Real and Estremadura. The greatest inconvenience and delay are experienced in getting regular supplies in consequence of the difficulties of carriage. The dynamite from Bilbao must either pass through two systems of railways, which are not on the best understanding with each other, or must go by sea to Seville, and thence a long distance overland. If making dynamite pays anywhere, it would do so in the centre of Spain. The Bilbao works are reported as having done a good business for many years.

IRON ORES.—The price of iron ores at Bilbao is still looking up, and the last reports are to the effect that sales have taken place at 9s. 3d. for good Rubios, but the worst part of it is that the demand is much above the means of supply. Some of the Mediterranean mines are now making sales at improving prices, but the means of shipping are very far from being equal to the requirements.

THE AURRERA FOUNDRY COMPANY.—This company has been lately organised with a capital of £60,000, and has the best chance of being a very well paying business. The capital was obtained with the greatest ease at Bilbao as soon as the business was offered.

CHEAP RAILWAY RATES.—A most remarkable contract for the carriage of coals is reported to have been made between the Northern Railway Company and the Marquis of Comillas, the owner of some important coal mines in Asturias. The distance to be run from Santullano, the principal Catalonia market, is about 1,200 kilometres, or, in round numbers, 750 miles. The carriage is to be made at the cheap rate of 0.32d. per mile. Other conditions are that the quantity is to be not less than 120,000 tons per annum, to be carried in complete trains, and to pay for that quantity as if it was carried even in case that for any reason it was not offered to the company for carrying. Anyhow, it is the lowest rate that has ever been made in any country in Europe. It is just to say as an explanation that the Marquis of Comillas and his group of financiers are very large shareholders in the Northern Railway Company.

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THE WEBB AND THOMPSON STAFF APPARATUS.

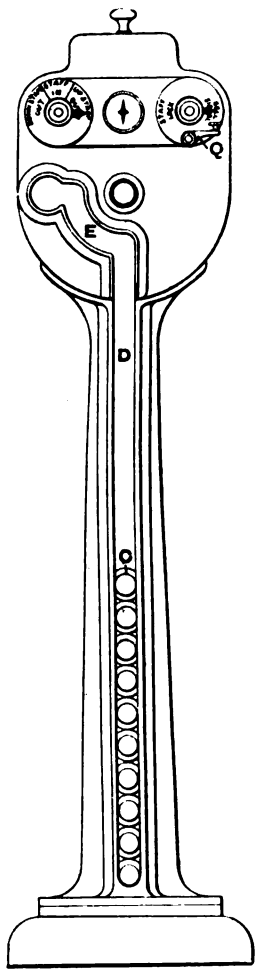


FIG. 1.

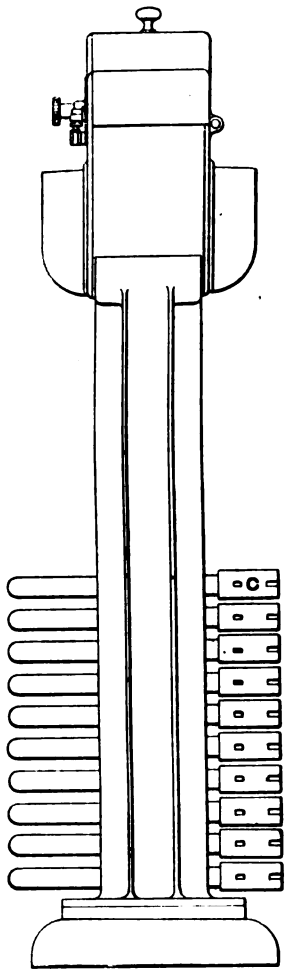


FIG. 2.

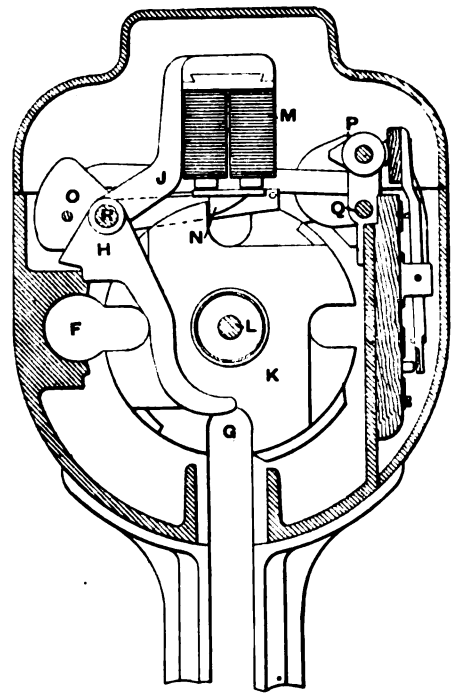
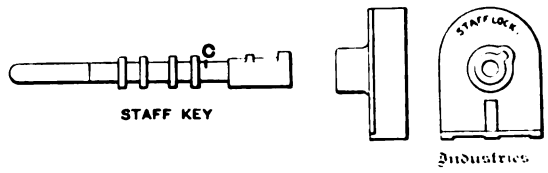


FIG. 3.



THE WEBB AND THOMPSON STAFF APPARATUS.

In view of the recent intimation by the Board of Trade of their intention to enforce their powers as to the completion of interlocking, &c., it will be interesting to railway managers to have a description of a new apparatus which has recently been perfected for the control of trains and the locking of siding points on single lines of railway. The "staff and ticket" system of working single lines is too well known, as also are the delays and inconveniences resulting from its use, to require any explanation; suffice it to say that, after an existence of over thirty years, it may be looked upon—certainly on busy sections of lines—as obsolete, and it has already in many cases given way to the well-known "tablet system." Further experience has resulted in the production of an apparatus similar in principle but much simplified and improved and possessing several special features. From our illustration it will be seen that ordinary train staffs are employed, the railway officers of the Board of Trade preferring the retention of the old-fasioned staff to any equivalent, and these staffs are each provided with a key by means of which sidings connecting with the main line can be securely locked.

It would take too much space, and demand too elaborate diagrams, to explain the action of the apparatus in all its minutiæ, but a general description may be of service. In the case of a single line between two points A and B, there can be no collision if there is one staff which has to be carried by any train passing between them. But if two trains want to go from A to B, and the first carries the staff to B, and leaves it there, the second train is delayed till another comes from B to A and brings the staff back. This apparatus supplies a number of staffs, but is so arranged that there can only be one staff out at a time. Figs. 1 and 2 show a pillar with 10 staffs. To remove a staff it is raised along the slot D, round the curved channel E to the enlargement, where it can be pulled out. In removing it it turns a set of discs, shown in Fig. 3, through a quarter of a circle; as it passes up the curved channel E it moves the notch G to the position opposite F. The discs are notched, as shown in Fig. 3. The discs are locked whenever a staff is removed. For instance, if all the staffs are in, and one is to be taken out, on raising it it is held by the discs which are mechanically and electrically locked. The rings C on the staffs release the mechanical catches, but an electrical catch, J, M, N, has to be released. This is done by a circuit through the other station, a single line wire being employed for both the apparatus and bells. In returning a staff the discs are rotated back a quarter turn. As each set of discs has four notches it can be in four positions. Calling the position of the bottom notches (1) when no staff is out, the notches on the right side (2), the top notches (3), and the notches on the left side (4). Now taking out a staff from A and putting it in at B, moves the A discs to (2) and moves the B discs to (4), another journey moves them back to (1) if from B to A, or to (3) if from A to B. Thus, whenever a staff is out, the two sets of discs are one at an odd number and the other at an even number, but when the staff is put back they are both at an odd or at an even number. The electrical catch can only be liberated when the sets of discs are both at odd or at even numbers, so that more than one staff at a time can never be out. Then again the apparatus is so arranged that a staff may be withdrawn for shunting purposes, which admits of shunting being performed on the single line with absolute safety and the cost of providing covering signals avoided, the staff being replaced when the work is complete. Combined with these special advantages the apparatus admits of a single line being utilised to its fullest capacity, as a staff is always at hand when wanted; and the traffic is not disarranged by specials or trains running out of course, as they can be passed forward without a moment's delay so soon as a preceding train has cleared the section, and as each train carries a staff, and each staff is provided with a key, all siding points can be secured at a trifling cost, and the cost of providing signals avoided; and finally the ordinary block instruments may be dispensed with, the apparatus itself being the most perfect block instrument known. In all apparatus of this kind it is most essential that the parts should be strong and simple in design, and capable of withstanding rough usage, and proof that this has been satisfactorily accomplished is found in the fact that a busy section of line has been worked for two years without any failure, and a set of apparatus put to work in the Paris Exhibition was removed at the close in perfect adjustment and order, although it was in constant use and received no attention. We may add that the apparatus is the joint patent of Mr. F. W. Webb, M.Inst.C.E., and Mr. A. M. Thompson, M.Inst.C.E. It has been approved by the Board of Trade, and has been adopted by the London and North-Western Railway Company.

THE STANLEY CYCLE SHOW.

The thirteenth annual exhibition of cycles and accessories, known as the Stanley Show, was opened at the Crystal Palace on the 24th inst., and closes on the 1st prox. The show was first held last year at the Crystal Palace, and was very successful, and this year the number of exhibitors has grown from 185 to 200. Two-thirds consist of the "safety," or geared-up bicycle type, and the remainder are tandems, bicycles and tricycles for two riders, twin bicycles, tricycles, and ordinary bicycles. The last-named type is coming back into partial favour again, as it is now made with a larger back wheel, and with the saddle placed farther back from the handles, thus giving greater security to the rider. Diamond-shaped frames and half-diamond frames appear to be coming into general favour. Attention is being given to the middle-aged rider by the introduction of a joint in the frame and springs to diminish vibration, and several makers exhibit specimens of this variety of machine.

Mr. J. Marston, of Wolverhampton and Holborn Viaduct, exhibits some neat safeties, in which the frames are made of double tubes ½in. diameter instead of the usual large size tube. With a 30in. front wheel and 28in. back wheel, both with ¾in. tyres, the weight is reduced to 36lb. for a full roadster, whilst a racer of the same pattern is 30lb. This maker shows the lightest machine we noticed, viz., a racer bicycle with 26in. equal wheels, the weight being only 15½lb. In some of the cycles shown by this maker the driving chain can be tightened by means of Marston's patent eccentric chain adjustment. This is accomplished by the bearing of the crank axle being carried in an eccentric which can be turned round as the chain stretches until the tightening length is equal to the throw of the eccentric.

One of the most striking objects in the Exhibition is a Hansom cab on five wheels, the front small wheel being a steerer and the four wheels behind the cab being driven by four riders. This machine is exhibited by the Coventry Machinist Company, and has been manufactured for the Sultan of Morocco. The interior of the cab is well upholstered, and it contains a sliding seat on which the Sultan can sit cross-legged. The machine can be steered from inside the cab or from the rear by the riders. The machine is highly finished, the bright parts being all nickelled, and is a good specimen of what can be done in the cycle trade.

A novelty is shown at the Pneumatic Tyre Company's stand. The usual solid rubber tyres are replaced by hollow rubber tyres 2in. in diameter. These are inflated by a special force pump, and it is claimed by the makers that they deaden vibration. The tyre is not of uniform thickness around its circumference, but is thicker on the wearing surface than elsewhere. A safety bicycle fitted with the special tyre is exhibited by this firm, and though it has been ridden for 1,000 miles the tyre appears to be none the worse for wear. Three or four other firms also exhibit this particular form of tyre.

Among the novelties is a "water cycle," shown at Stand 230. This boat is worked by two riders in the ordinary cyclist manner, who drive a crank shaft which is geared to the paddle shaft. The boat is balanced by a pair of small outrigger floats, one on each side, and they can be raised or lowered by a lever within reach of the drivers. The boat will carry four persons.

A counterpart to the water cycle is to be found in Rudge's "road sculler," fitted with hand-propelling gear and a sliding seat. This machine has been designed for the use of oarsmen. The machine exhibited by the Rudge Cycle Company, Limited, has 40in. side wheels and a 22in. front wheel. This firm has a good show, and in addition to ordinary machines they exhibit their "invalid" tricycle and their "parcel carrier." Their novelties for the season consist of a spring frame and a spring handle.

Mr. George Cousins, Birchington-on-Sea, Kent, exhibits a very light safety bicycle. The frame itself is its own spring, and it is formed of ½in. square steel. The back wheel is large and the front one small. The seat is placed back about 45 deg. from the driving axle, and, instead of the usual small saddle, the machine is fitted with a broad seat and a back rest. The weight of the machine is 48lb.

The Goulden Syndicate, Limited, Clapton, London, show a variety of their "Golden Era" cycles, including

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a military safety, in which the rifle is simply laid in sockets and not fixed. The frames are rigid, but the vibration is taken up by a spiral spring insulator on the hind wheel.

Mr. John Pollitt, Lower Mosley Street, Manchester, shows several machines fitted with the "Collier" instantaneous change gear. This is a contrivance by which the cycle can be reduced in speed for hill climbing. It contains one pinion only, which drives the chain wheel at the lower speed, which reduces the speed of the machine one-fifth. At the higher speed the pinion remains in gear with the chain wheel but does not work, and the whole is revolved as an ordinary chain wheel. The speed can be changed from the handle bar by a spring catch and levers withdrawing a bolt, which locks the pinion and chain wheel together. The gear is covered by a dust cap in actual work, and can be fitted to any ordinary machine.

Notices of Meetings.

NEXT WEEK.

SOCIETY OF CHEMICAL INDUSTRY.—Monday, February 3rd. Mr. A. H. Allen, "Metallic Compounds of the Phenols;" Mr. Watson Smith, "New Method of Hardening Steel for Projectiles;" Mr. Losawitch, "On Bromanil."

SOCIETY OF ENGINEERS.—Monday, February 3rd, 7.30 p.m. Presidential Address.

INSTITUTION OF CIVIL ENGINEERS.—Ordinary Meeting, Tuesday, February 4th, 8 p.m. Paper to be read with a view to discussion: "Bars at the Mouths of Tidal Estuaries," by W. H. Wheeler, M.Inst.C.E. Students' Meeting, Friday, February 7th, 7.30 p.m. Paper to be read: "Reclamation of Land on the River Tees," by Colin P. Fowler, Stud.Inst.C.E.

CHEMICAL SOCIETY.—Thursday, February 6th, 8 p.m. Papers to be read: "The Oxides of Nitrogen," by Prof. Ramsay, F.R.S.; "Studies on the Constitution of Tri-derivatives of Naphthalene," by Dr. Armstrong and W. P. Wynne; "On the Action of Chromium Oxychloride on Nitrobenzole," by G. G. Henderson, B.Sc., and J. Morrow Campbell, B.Sc.

PRICES CURRENT, 29TH JANUARY, 1890.

Quotations at per ton, unless otherwise specified.

METALS.

Spelter:	Ordinary	£25	2	6	to	£25	5	0
Copper:	British Cakes and Ingots	57	0	0	,,	58	0	0
,,	Chili Bars, G.O.B.'s	48	17	6	,,	49	0	0
,,	Other sorts, G.M.B.'s (equal to Chili Bars)	49	0	0	,,	.....		
,,	Manufactured (strong)	66	0	0	,,	.....		
Lead:	Common Pig	14	15	0	,,	15	5	0
,,	English Sheet	15	15	0	,,	16	5	0
Tin:	Straits	94	0	0	,,	94	2	6
,,	Australian	94	5	0	,,	94	7	6
,,	English Ingots	99	10	0	,,	.....		

Messrs. Carrick & Brockbank, Manchester, report as follows:—

COPPER is quiet, without any change in manufactured; ingots and raw copper are slightly lower, for the same reason as mentioned last week, viz., the high Bank rate. The fall in Scotch warrants seems to have affected metals generally, as they are all dull.

TIN: A fair business has been done in Straits, and a considerable quantity has been sold for February. English tin is, however, quiet.

LEAD is lower, and not much doing.

SPELTER keeps fairly steady, though price is about 2s. 6d. per ton lower than last week. There is a fair demand.

PIG IRON.

Messrs. Raby, Fell, & Co., Manchester, quote as follows:—

Middlesbro' Warrants, No. 3		55/6	Cash
Scotch Warrants, m/n		56/2	,,
Hematite Warrants, m/n		69/6	,,
Stocks in Stores	Scotch 911,704.—Dec. for week,	6,901	Tons.
	Middlesbro' 184,016.—Inc. ,,	508	,,
	Hematite 185,480.—Dec. ,,	506	,,

Exclusive of stocks in makers' yards.

	No. 1.		No. 3.		
Coltness	78/6	.....	70/-	f.o.b.	Glasgow.
Gartsherrie	76/9	.....	70/-	,,	,,
Dalmellington	69/-	.....	68/6	,,	Ardrossan.
Eglinton	63/-	.....	62/-	,,	,,
Glengarnock	76/6	.....	68/6	,,	,,
*Derbyshire	—	.....	72/6	f.o.t.	Works.
*Lincolnshire	—	.....	70/-	,,	,,
*Lancashire	—	.....	73/-	,,	,,

*Forge quality, about 1s. per ton less.

Market depressed, owing to the fall in speculative iron.

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	81/-	..... 74/-

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £	s.	d.		Best. £	s.	d.	
Middlesbro' Bars	8	0	0	.....	8	10	0	f.o.t. wks.
,, Angles	7	15	0	.....	8	5	0	,,
,, Plates	8	0	0	.....	8	10	0	,,
Staffordshire Bars (cheaper makes)	9	0	0	.....	9	10	0	London.
,, Angles	9	0	0	.....	9	10	0	,,
Crown Sheets	9	2	6	.....	9	12	6	,,
,, Hoops	8	5	0	.....	8	15	0	,,
"Siemens-Martin" Steel Boiler Plates				.....	10	5	0	,,
,, Ship and Girder				.....	9	5	0	,,

Market steady; demand quiet.

CHEMICALS.

		£	s.	d.		£	s.	d.
Acid: Carbolic Crystals	lb.	0	0	11	—	.....		
,, ,, Liquid	gal.	0	1	2	—	.....		
,, Citric	lb.	0	1	7	—	.....		
,, Oxalic	,,	0	0	3¼	—	.....		
,, Sulphuric	ton	1	10	0	—	.....		
,, Tartaric	lb.	0	1	4	—	.....		
Alum: Lump (powder 10/- ex.)	ton	4	17	6	—	.....		
Ammonia: Carbonate	lb.	0	0	3½	—	.....		
,, Muriate (Grey)	ton	22	5	0	—	.....		
,, ,, (White)	,,	26	0	0	—	.....		
,, Sulphate	,,	11	17	6	to	12	0	0
,, Liquor	lb.	0	0	3½	—	.....		
Antimony	ton	.....			—	.....		
Bleaching Powder	,,	5	2	6	—	5	5	0
Bisulphide of Carbon	,,	13	10	0	—	.....		
Borax	,,	30	0	0	—	.....		
Benzole (90 %)	gal.	0	4	1	—	.....		
,, (50/90 %)	,,	0	3	4	—	.....		
Copper Sulphate	ton	24	10	0	—	.....		
Copperas	,,	2	0	0	—	.....		
Kieserit	,,	1	13	0	—	.....		
Lead: Nitrate	,,	22	10	0	—	.....		
,, White Sugar	,,	24	0	0	—	.....		
,, Brown ,,	,,	19	0	0	—	.....		
Potash: Bichromate	lb.	0	0	4	—	.....		
,, Caustic	ton	22	0	0	—	.....		
,, Carbonate	,,	19	10	0	—	.....		
,, Chlorate	lb.	0	0	4½	—	.....		
,, Prussiate (Yellow)	,,	0	0	10½	—	.....		
,, Sulphate (Basis 90 %)	ton	9	10	0	—	.....		
Precipitate: Red	lb.	0	3	1	—	.....		
,, White	,,	0	3	2	—	.....		
Salts: Epsom { Bags	ton	3	0	0	—	.....		
Salts: Epsom { Casks	,,	3	15	0	—	.....		
,, Glauber	,,	1	10	0	—	.....		
Sulphur: Sublimed Flowers	,,	9	0	0	—	.....		
,, Recovered	,,	4	10	0	—	.....		
Soda: Ash	deg.	0	0	1½	—	.....		
,, Caustic (White 70%)	ton	7	17	6	—	.....		
,, ,, (,, 60%)	,,	6	17	6	—	.....		
,, ,, (Cream 60%)	,,	6	7	6	—	6	10	0
,, Crystals	,,	2	12	6	—	.....		
,, Bicarbonate	,,	5	5	0	—	.....		
,, Hyposulphite	,,	6	5	0	—	.....		
Solvent Naphtha	gal.	0	3	6	—	.....		
Tartar, Cream of	cwt.	5	12	6	—	.....		
Zinc Sulphate	ton	7	10	0	—	.....		

Messrs. S. W. Royse & Co., Manchester, report as follows:—

CHEMICALS.—We have to report rather less activity in the demand for general chemicals. Bleaching powder is quiet, but prices are steady, and makers are particularly strong in their ideas for forward business. Caustic soda remains firm, makers having plenty of orders on hand, but not much new business is being done. Soda ash still scarce. Soda crystals dearer. Sulphate of ammonia has fallen and is very depressed. Sal ammoniac has advanced £1 per ton. Benzoles have advanced about 6d. per gallon. Carbolic acids are unchanged. Makers of oxalic acid have had a push of orders, and are, consequently, expecting higher prices. Acetates of lime are quieter.

OILS.

		£	s.	d.
Cocoanut: Cochin	per tun	26	0	0
,, Ceylon	,,	23	15	0
Cottonseed	,,	22	0	0
Cod	,,	19	0	0
Lard	,,	37	10	0
Linseed	,,	20	10	0
Palm, Lagos	,,	25	10	0
Rapeseed: English	,,	32	10	0
Seal: Pale	,,	26	10	0
,, Brown	,,	19	0	0
Sperm	,,	45	0	0
Whale	,,	24	0	0
Turpentine	per cwt.	1	15	9
Coal	per gal.			
Petroleum (Refined)	,,	0	0	5½
,, Spirit	,,			

FOREIGN TELEGRAPHIC ADVICES.

(From our own Correspondents.)

PARIS, Jan. 30.—*Iron.*—The market has been startled by the announcement that the forge masters of the Nord have advanced their rates for bars and joists to 164s. This makes a minimum of 176s. here necessary. There is but little business doing. It is otherwise, however, in the provinces. In the Haute-Marne wire manufacturers are overwhelmed with orders. In the Nord the market is animated, the demand for bars, joists, and plates, particularly the last, being exceptionally strong.

Metals.—The metal market generally is weak. Copper has lost a few points. Chili bars, £54; English best selected, £60. Tin has given way more seriously. Banca, £105; Straits, £100. Lead has followed in the same direction, the current quotations being £14 8s. Havre and £14 16s. Paris. Spelter remains unchanged, at £26 Silesian. The amount of business done in spelter is small.

BERLIN, Jan. 30.—*Bourse.*—The prospect of another general strike of colliers in Western Germany caused a panic in the market for colliery shares, which were offered for sale in overwhelming quantities. Prices fell heavily, and in sympathy all other industrial securities drooped, particularly the shares of iron and steel companies. The downward movement has, however, been checked, and to-day some recovery has taken place.

Metals.—The demand for metals on the part of consumers continues strong and steady. The tendency of the market for good copper is still in favour of sellers. Mansfeld refined, £61 10s. to £62 15s. Tin remains dull at last week's prices. The demand for lead is a little slacker. Clausthol refined, £16 to £16 5s. For spelter the market is active and firm. Regulus of antimony has again advanced: English, £82 to £82 10s.

BRESLAU, Jan. 30—*Coal.*—The colliery proprietors having for the most part spontaneously advanced the rate of wages, the miners are settling down contentedly to work. The market is, therefore, less excited, and prices are steady. The coke ovens are being pushed to their utmost capacity of production. As the whole of their possible output in 1890 is already sold, the market is not sensitive to passing influences.

Iron.—The activity of the iron market tends rather to increase than abate. The demand is particularly strong for plates. A brisk business is being done in steel goods. In consequence of heavy buying of wire and wire nails, the prices of these articles have been again advanced. The current price for bars is 220s. a ton. Foreign orders for founders and machine makers are coming to hand plentifully. The former have advanced their rates 7½ and 10 per cent.

Zinc.—The labour difficulties which arose last week having been removed, the zinc market is steady again. There is no change to report in its general features. Throughout the industry the greatest activity prevails. W. H. spelter has been sold at 502s. a ton, but there is now a backward tendency.

DÜSSELDORF, Jan. 30.—*Coal.*—The situation in Westphalia has improved a little, the miners having decided, in view of the elections about to take place, to put off their proposed general strike till March 1. Prices for coal at the pits are practically the same as they were a week ago; but the merchants, who control a large proportion of the output, are asking higher rates.

Iron.—Business continues very active in all branches of the iron and steel trades. Prices are still advancing, though the movement is now relatively slow. Quotations for pig have not materially changed within the last few days. Foundry pig is more sought after. The total make of pig in Germany in December amounted to 391,523 tons. Total for the year 1889. 4,387,504 tons. Rolled wire and wire nails are in better demand. Rivets for boilers, bridge work, and ship plates are quoted 290s.

BRUSSELS, Jan. 30.—*Bourse.*—The improved aspect of affairs in the coal mining industry is reflected in the business of the Bourse. The market for industrial securities is slowly recovering from the effects of the late scare. Colliery shares are not now pressed for sale, and shares in iron and steel companies, which had dropped several points, are rising again. Shares in the best glass concerns are hardly procurable at the latest published quotations.

CHARLEROI, Jan. 30.—*Iron.*—The iron market is gradually resuming its normal aspect. Confidence in the future has in no degree been weakened by recent events, though much trade has been lost. That the pig iron manufacturers have no misgiving concerning the maintenance of prices is significantly shown by the fact that they are contracting for a year's supply of coking coal at 18s. 5d. per ton, equivalent to 28s. for coke. Business is brisk in plates.

Glass.—The syndicate of glass makers having decided to advance their prices 10 per cent. for the Continental, and 15 per cent. for the English markets, the situation has become more clearly defined, a circumstance which the men are turning to account in the agitation they have set on foot for a rise of 30 per cent. in wages. Frequent meetings are being called to discuss with their leaders the plan of action proposed by the latter.

WE have received an interesting little book from Messrs. Galloways, Limited, Manchester, showing the constructive progress of a boiler at their works. The book is capitally illustrated, and the various processes are described very fully.

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HOME INDUSTRIES.

LONDON 30th January, 1890.

The Money Market.—There has been rather a slackening in the tension which has existed in the money market for some weeks. Considerable purchases of gold by the Bank of England have contributed to this result, though in point of fact such purchases do not affect the banking department, but must be held by the issue department against the notes paid out for the gold. The inability of lenders to maintain the high rates ruling a fortnight ago for loans to the Stock Exchange, in connection with the settlement this week, has helped to depress rates in the money market generally. The decrease in Stock Exchange business, due to the money stringency, has been so great that comparatively little money was required to arrange the account. Hence the falling away in continuation rates. The stock markets have improved a little this week after the general fall in the preceding week. Consols have risen as money has cheapened, and most home railway stocks have become a little brisker on account of the same influence, though operating in quite a different way. Foreign securities have fairly maintained their prices: American, Canadian, and Mexican railways have been rather more in favour, but mining, nitrate, and miscellaneous shares show a declining tendency. The fall in nitrate stocks has been especially marked.

Companies.—The following companies have been registered since our last report:—The Barberton Gold Mining Company, Ld., with a capital of £150,000; Aaron's Reef, Ld., with a capital of £200,000, to acquire lands, mines, &c.; Kent Ice Consumers' Manufacturing Supply Company, Ld., with a capital of £5,000; Roberts, Mart, & Co, Ld., with a capital of £40,000, to carry on the business of paper merchants, &c.; The Compressed Air Carpet Cleaning Company, Leeds, Ld., with a capital of £10,000; Oastler, Palmer, & Co., Ld., with a capital of £80,000, to carry on the business of tanners, curriers, &c.; Holroyds, Ld., with a capital of £60,000, to carry on the business of cloth finishers; The Mills Cycle Company, Ld., with a capital of £10,000; Robinson & Price, Ld., with a capital of £10,000, to carry on the business of cycle manufacturers; E. Lloyd, Ld., with a capital of £250,000, to carry on the business of newspaper proprietors, &c.; The Adventurers of Mexico, Ld., with a capital of £50,000, to prospect and explore for minerals, &c.; The Bangor Marble and Limestone Quarries, Ld., with a capital of £15,000; A. Attwood & Co., Ld., with a capital of £50,000, to carry on the business of engineers and contractors; The Bradley Room and Power Company, Ld., with a capital of £20,000, to erect a power loom weaving shed; The Standard Portland Cement Company, Ld., with a capital of £100,000; North Shields and Tynemouth District Tramways, with a capital of £6,000; The Glendinning Syndicate, Ld., with a capital of £10,000, to acquire a certain antimony mine, &c.; West Indian New Gold Mining Corporation, Ld., with a capital of £120,000.

Exhibition of Meteorological Instruments.—The Council of the Royal Meteorological Society have arranged to hold, at 25, Great George Street, Westminster (by permission of the Council of the Institution of Civil Engineers), on March 18th to 21st next, an Exhibition of Instruments and Photographs illustrating the application of Photography to Meteorology.

Junior Engineering Society.—The fifth annual dinner of this flourishing society was held on Friday evening last at the Holborn Restaurant, when Professor John Perry, F.R.S., the President, occupied the chair. Among those present were Sir James Douglas, F.R.S., Professor W. C. Unwin, F.R.S., and Professor T. Hudson Beare. After the usual toasts, Professor Perry, on behalf of the society, presented Mr. W. T. Dunn, the energetic honorary secretary and treasurer, with an illuminated address and a purse of gold, in recognition of his services during the past five and a half years. Mr. Dunn, in acknowledging the presents, briefly referred to the history of the society, and amongst other interesting facts mentioned that the society had quite recently increased in membership upwards of 40 per cent.

The Civil and Mechanical Engineers' Society.—On the 22nd inst. an ordinary meeting of the Civil and Mechanical Engineers' Society, the President, Mr. Henry Adams, in the chair, was held at the Westminster Palace Hotel, when a paper, entitled "The Present Aspect of Electric Lighting in London," was read by Mr. E. C. de Segundo. The author went over the questions of dispute, and described in detail the various installations at present being laid down and in operation.

The Sanitary Institute.—The following weekly lectures, commencing February 18th, have been arranged by the Sanitary Institute for the special instruction of those desirous of obtaining knowledge of the duties of sanitary officers. These lectures are a continuation of the courses previously held by the Parkes Museum, and it is proposed to repeat the course twice each year, to suit the requirements of persons preparing for the examinations of the Institute:—(1) Introductory lecture. Practical Considerations for Sanitary Officers, by Mr. E. C. Robins; (2) Water Supply, Drinking Water, Pollution of Water, by Dr. Louis Parkes; (3) Drainage and Construction, by Prof. H. Robinson; (4) Ventilation, Measurement of Cubic Space, &c., by Sir Douglas Galton, K.C.B.; (5) Sanitary Appliances, by Prof. W. H. Corfield, M.A., M.D.; (6) Scavenging, Disposal of Refuse and Sewage, by Mr. Charles Jones; (7) Food (including milk), Sale of Food and Drugs Act, by Mr. Charles E. Cassal; (8) Infectious Diseases and Methods of Disinfection, by Mr. Shirley F. Murphy; (9) General Powers and Duties of Inspectors of Nuisances—Method of Inspection, by Mr. J. F. J. Sykes; (10) Nature of Nuisances, including Nuisances the Abatement of which is Difficult, by Mr. J. F. J. Sykes; (11) Diseases of Animals in Relation to Meat Supply, by Mr. A. Wynter Blyth; (12) Sanitary Law, General Enactments, Public Health Act, 1875, Model Bye-Laws, by Mr. A. Wynter Blyth; (13) Sanitary Laws and Regulations Governing the Metropolis, by Mr. A. Wynter Blyth. A fee of six shillings for the course will be charged to cover expenses, and students attending the course will be granted free admission to the Museum and Library during February and March.

Electric Light at the British Museum.—For some years the reading room at the British Museum has been lit with arc lights, and the success of the experiment has been so great that the trustees determined to light the whole of the building by electricity. On Tuesday night last the new installation was first tried publicly. There is hardly a place which we could mention where the use of electric lighting is more appropriate, for the building is gloomy at any time, the use of gas is detrimental to the preservation of the many valuable contents, and the hours of admission will become more available to the ordinary mortal. The dynamos, lamps, &c., have been supplied by Messrs. Siemens Bros., and the steam engines by Messrs. Marshall, of Gainsborough. Altogether the new installation is a great success.

MANCHESTER, 30th January, 1890.

The "Hercules" Street Cleaner.—A trial of the machine bearing this name was made in and about the yard belonging to the Manchester Corporation on the 24th inst. The machine consists of a water tank, mounted on a frame sustained by two wheels, supplying a stream of water to a perforated pipe. At the back of the machine is a revolving roller consisting of a number of india-rubber flaps or arms placed helically in the centre boss. The action is that a copious stream of water falls upon the *debris*, and the liquid slush thus formed is thrust at one side by the rotation of the india-rubber roller, by successive stages, until it is placed in the side gullies where the water can drain away and the solid matter collected. The trial was witnessed by a number of members of the Highways Committee of Manchester and of other Corporations. While the roadway was fairly well cleansed, it was not more effectively done than by the brush machine at present in use. The roadways in Manchester being all paved with granite sets do not lend themselves so readily to the action of the india-rubber flaps as do wooden or asphalted pavements, and a considerable drag was put upon the horses by the adhesion of the rubber. The general opinion expressed was that, while for smooth roadways the machine would be serviceable, it was not well adapted to the rough ways of Manchester. The quantity of water used was also a matter requiring consideration, and, as the machine at present in use does not require any water, it was considered to be more suitable for this district.

Automatic Gas Supply.—Messrs. Fletcher & Murphy, of Manchester, are constructing an automatic supply meter, which is receiving a trial in Liverpool. By the use of apparatus similar in character to other machines of this class, a penny dropped into the machine will supply a proportionate amount of gas, the amount depending of course on the cost per 1,000ft.

Boring Machine for Shaft Couplings.—Messrs. Hetherington & Co. have just constructed a handy little machine for boring out the bolt holes in propeller shaft couplings, which, as is well known, are taper. It consists of a light bridge-shaped frame carrying a hollow drill spindle, up the centre of which a bar is passed, in which a slot is formed. The inner end of the boring tool fits the slot, and by giving the latter any desired angle the tool can be pushed outward as the bar is advanced. As the internal bar is prevented from having a longitudinal motion, the movement of the boring spindle inwards causes the tool to project from it in the manner described. The spindle is externally screwed so that a wheel correspondingly threaded acts as a nut, and when revolved feeds the spindle forward. In order to prevent breakage, the feed apparatus is arranged to slip if too great a "bite" is given. The machine is very handy, and can be easily moved about as desired, being kept as light as possible. In the event of a breakdown it is likely to be useful, as, by means of two binding screws, it can be fixed to the coupling in any position.

The Manchester Ship Canal.—The Consultative Committee appointed in 1886 to advise on the probable future of the above work paid a visit to the works near the Manchester end on the 27th inst. The works are now practically complete in some parts so far as the cuttings are concerned, and in the Salford Docks some of the walls are completed. In the case of the Manchester Docks, the concrete walls were put in before the excavations began, and these are far advanced. One of the straight cuts, which was to be filled in a week or two, being nearly finished, has been flooded prematurely, and it is likely that the necessary operations to complete will be dealt with specially by dredging or otherwise. At Barton the Committee found the section completed, and at Irlam the locks are far advanced. Owing to the floods it was not possible to proceed beyond Warburton, but the large lock at Mode Wheel and the construction of the gates for it were both inspected. The Committee will complete their trip on the 6th prox. Mr. Marshall Stevens, the traffic organiser of the company, is arranging for the visits of a number of parties of traders and others, in order to demonstrate the advantages of the canal.

The Linen and Jute Trades.—There is an improvement in the tone of business here, but, owing to the absence of American buyers, few orders are being given on the spot for the United States. In regard to the home trade, the demand for such goods as are produced in Kirkcaldy, Sinclairtown, and other centres, for the manufacture of coarse fabrics, is limited, but greater activity is looked forward to about February, when the wholesale houses will in many cases complete stocks, which up to the present have not been kept up to the full quantity. Damasks, diapers, and napkins have been in slightly better request in the made-up form. The sale of diaper cloths in the piece grows less every year, and the trade, like that of Macclesfield cut-ups, is now transacted through three channels, represented respectively by the manufacturer, maker-up, and wholesale distributor. Including the retailer, there are four intermediaries through whose hands the goods pass before reaching the consumer. The designs in Dundee fancy jute fabrics have proved popular, and the demand promises to develop even more largely than hitherto. There is no new feature of importance in linen threads, which are unchanged in price, notwithstanding the increased cost of production.

GLASGOW, 30th January, 1890.

Iron and Steel.—A lull seems to have supervened in the iron market, and the steel makers, though still busy, have experienced during the last week a falling off in new orders. The withdrawals of pig iron from Connal's stores have been exceptionally heavy within the last few days. On Monday alone there was a decrease of 1,575 tons. There is little new to report in the position of the iron market. Disappointed holders lose heart as they see prices drooping almost daily. The only business doing in shipping brands is of a very retail character, and the question is whether buyers will have to pay the prices asked to meet their requirements or makers will have to come down in price to meet the buyers' views. Prices are irregular; makers profess to be well sold, but holders of second-hand parcels are willing to sell some brands much below. Although good influential buying came into the market a few days ago, in the neighbourhood of 60s, the price continued to fall, quantities of warrants, Scotch, Cleveland, and hematite, being pressed for sale. On Tuesday the market rallied slightly.

Railways.—Rumours are rife about the Caledonian Underground Edinburgh Railway scheme. These suggested the abandonment of the idea, and, though they have been categorically denied by the directors, they are still current. The proprietors of property on the north side of Prince's Street are in arms against the line, and have even raised a voluntary assessment to oppose the Bill in Parliament.

Glasgow Tramways.—At the annual meeting of the Glasgow Tramway Company, the Chairman, referring to the dispute between the Tramway Company and the Corporation as to the terms of the new lease, stated that, if the lease were not renewed, the Company would compete with the Corporation or with any company that might lease the tramways by running services of omnibuses all over the city.

Cassel Gold Extracting Company.—An extraordinary meeting of this company was held on Monday last for the purpose of securing the sanction of the shareholders to the proposal of the directors to increase the capital of the company by £30,000. The chairman intimated that the whole of the amount had been underwritten by the directors and their friends, but that the stock would be offered to existing shareholders at par.

The Clyde Tunnel.—The ground on the south side of the river for the shaft of the Clyde Tunnel has been purchased at the price of £3 per square yard. Operations will be at once commenced.

Minerals.—The Scottish Mineral Oil Association have advanced the price of paraffin scale by ½d. per lb.—The Lanarkshire coalmasters have rejected the demand of the men for an advance.

Pollock's Gold Extracting Company.—A Press inspection of the full-sized machinery took place yesterday, the 29th inst., and a public demonstration takes place to-day and to-morrow. Mr. H. A. Hedley is the manager of the company.

Overhead Electric Wires.—Major Cardew, on behalf of the Board of Trade, visited Glasgow on Thursday last, and inspected the overhead system of wires for the supply of electric light from the central station of Muir, Mavor, & Coulson, Limited. The inspection was made at the instance of the Corporation.

(From our own Correspondents.)

LIVERPOOL, 29th January, 1890.

The Strikes at the Docks.—Considerable inconvenience has been caused by the dock labourers refusing to unload several steamers arriving from Belfast and other ports, where a strike is now going on. Handbills have been posted in different parts of the docks calling upon the men not to unload any of the Irish steamers until the men there have received what they call their "just rights." A large number of the regular men are very indignant at the present dictation of the Union, but as the number of members is so

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small there is very little fear of the present rising reaching a serious crisis; all the ships get eventually discharged, and the inconvenience is only temporary. The labourers in the Liverpool Grain Storage Company's warehouse at the North End, numbering over 100, came out on strike on Tuesday, on account of the manager refusing to grant an increase of wages.

THE TRAMWAY COMPANY AND ELECTRIC CARS.—At the meeting of the shareholders of the Liverpool Tram and Omnibus Company last Saturday, the chairman, Sir David Radcliffe, referred to the electric cars which were about to be tried in Liverpool, and said the delay in trial was on account of the steep gradients, which necessitated the designing of special cars and apparatus. A letter was read from Lord Bury explaining these points, and stating that the experience gained by his company on the North Metropolitan Tramway at Barking compelled them to design cars of greater power than they had at first anticipated; that the experimental car was nearly completed, and that all the difficulties, as far as they could see, had been overcome.

LEEDS, 29th JANUARY, 1890.

THE IRON AND STEEL TRADES.—Old contracts continue to keep the finished iron and steel trades brisk, though the market is somewhat quieter, the cause being the reaction northwards. There is a disinclination to transact forward business. At the same time the impression is strong that the check is only of a temporary character, and locally quotations have not materially changed. Evidence of the flourishing condition of the engineering trade may be seen on all sides. Some of the large shops are still running a deal of overtime. Messrs. Hudswell & Clarke are well supplied with orders, both on home and foreign account. One of the specialties of this firm is their patent wrought iron pulleys, for which there is always a big demand. Messrs. Kitson & Co., and other firms in Hunslet, have large orders in hand for locomotives, tank engines, &c. Stationary and portable engines for foreign customers, chiefly in Paris and Mexico, are being turned out as rapidly as possible by Messrs. J. M. McLaren, while Messrs. Tannett, Walker, & Co. are maintaining their reputation for hydraulic machinery, and are fully employed on contracts for all parts of the world. Several sets of ponderous hauling appliances are being made by the firm for docks and railway departments. At the present time the orders for traction engines are not very numerous. Colliery proprietors have of late been more ready to renew plant and machinery, owing probably to the circumstance that prices are more remunerative than a few months ago. One of the last branches to feel the effects of any revival is the tool department of the engineering trade, and therefore the activity now prevailing in the tool shops is somewhat significant. There is a less demand for agricultural machinery. In reference to the wages and hours in the Leeds engineering trade, the masters have met the men in a most conciliatory spirit, and matters have been settled without resort to any extreme measures on either side. The minimum rate of wages demanded by the executive of the Leeds Amalgamated Society of Engineers for fitters, turners, and millwrights has generally been conceded. The demand was that the minimum rate should be 28s. a week instead of 26s. Moulders and others are now agitating for an advance.

THE COAL TRADE.—For every class of coal worked in West Yorkshire the demand is such as to give full employment to the miners. In some collieries additional men could be engaged. Steam coal is not so plentiful as fuel for domestic purposes, and coke is still dear and comparatively scarce. With the exception of best household coal, the prices remain firm, and that firmness is likely to be maintained in the face of the demand of the colliers for another 10 per cent. A successful Yorkshire colliery is that worked by the Lofthouse Colliery Company, which on Saturday declared a dividend of 10 per cent., and an addition of £2,000 to the reserve fund, making it £10,000, and leaving a balance of £3,407.

SHEFFIELD, 29th JANUARY, 1890.

THE COAL TRADE.—The growing scarcity of coal and coke, and the consequent increase in value, is giving proprietors confidence to lay down extra plant and machinery. Several new pit shafts are being sunk in this district. A new company has been formed to work the Duke of Portland's top hard coal at Bolsover, entitled the Bolsover Colliery Company, Limited, with a capital of £150,000. The colliery deputies of South Yorks and Derbyshire are forming a union to protect their mutual interests. South Yorkshire surfacemen have demanded a reduction of working hours to 54 per week.

IRON AND STEEL.—The iron market is rather weaker than usual, but there is reason to believe that the depression is only temporary. Makers have large orders in hand. Local makers are working to their full capacity on the best brands, and there is little demand for inferior irons. Heavy sections of steel rails are quoted at £7 10s. per ton; boiler and ship plates, £8 to £9; angles, £7 15s. Shipments to the United States are rather quiet. Messrs. Charles Cammell & Co. are extending their Cyclops Works for the production of tyres, axles, and general steel forgings. The Hadfield Steel Foundry Company are also extending their works for the production of steel castings.

CARDIFF, JANUARY 29th, 1890.

COAL AND COKE.—The steam coal market is firmer, and considerable difficulty is experienced by buyers in getting the vessels they have chartered stemmed for loading. Prices for steam coal are steady at 15s. 6d. to 16s. first quality, 14s. 6d. to 15s. 3d. second quality, and from 13s. 6d. for inferior descriptions. Colliery owners complain that even with these high prices they are not doing so well as would be conjectured, on account of the restriction to the output caused by the men working short time. Coke continues in excellent demand at last week's figures.

IRON AND STEEL.—The general tone of the pig iron market is quiet; in fact, there is no business to be done. Makers are well sold forward, and, for what little they have to spare, are quite independent and firm in their quotations. In fact, owing to the advance in raw material and fuel the cost of production is further increased. On the other hand, buyers are shy, and prefer to wait for lower figures, so it will probably be a question of development of events as to the future of the market. Steel bars are in good demand. Rails are steady. Tinplates are dull, buyers being determined to "bear" the market.

IRON ORE.—Arrivals have been more numerous, and the immediate wants of ironmasters have been satisfied. Prices are high, and about 10,000 tons Rubio has been sold at 17s. c.i.f. Cardiff or Newport, second-class quality. Freights from the ore ports are firmer, Bilbao to Cardiff being 5s. 9d.

MIDDLESBROUGH, 29th JANUARY, 1890.

PIG IRON.—There was full market yesterday, but business was flat. Prices were depressed, and buyers were doubtful about taking even the low figures quoted. During the past few days No. 3 G.M.B. could be got from second hands at 57s. 6d., but it is questionable if that can be done now. For delivery next month 58s. and 58s. 6d. is offered and 59s. is quoted. Warrants are cheaper, rising and falling daily as speculators find themselves placed. The average is about 57s. 6d. Hematite iron also fluctuates in price. Makers hold for 80s., but warrants may be had from 72s. 6d. to 77s. mixed numbers. On Monday, January 27th, the stock in Connal's store amounted to 184,016 tons.

SHIPMENTS OF PIG IRON.—The shipments compare favourably with those of last month, but unfavourably with those of the similar month last year. The main falling off is in the shipments to Scotland, which this year, up to the 27th, amounted only to 8,485 tons, whereas last year, to a similar date, they amounted to 25,088 tons. The total shipments for the month up to the 27th inst. amounted to 37,856 tons, as against 59,654 tons to a similar date last January. The shipments abroad, however, are much about the same.

MANUFACTURED IRON AND STEEL.—These industries are easier, and prices are not so strong. Iron ship plates are at £7 15s., angles £7 10s., bars £7 15s.; steel ship plates £8 15s., angles £7 10s., rails £6 15s., per ton, all less 2½ per cent. discount on trucks at works. The report of the accountant to the Board of Arbitration and Conciliation certifies the average net selling price per ton of manufactured iron, for the two months ending December 31st, to have been £6 1s. 4d., as against £5 15s. 5d. for the previous two months. In accordance with the sliding scale arrangement there will be an advance in the men's wages of 3d. per ton on puddling, and 2½ per cent. on all other forge and mill wages, after the 25th of January. The average net selling prices per ton during the two months were £6 2s. 8d. for rails, £6 1s. 4d. for plates, £6 4s. 5d. for bars, and £5 14s. 1d. for angles, against £5 11s. 7d., £5 15s. 5d., £6, and £5 7s. respectively for the previous two months.

SUNDERLAND, 29th JANUARY, 1890.

SHIPBUILDING AND MARINE ENGINEERING.—The members of the Amalgamated Society of Engineers on the Tyne and Wear have decided to accept the offer of their employers of 1s. per week increase, provided negotiations are at once opened for the remaining shilling demanded and the reduction of the working time on Saturdays by an hour. The other day three of Mr. John Dickinson's workmen were fined £5 each, and costs, for intimidating a fellow workman. No settlement of the drillers' dispute at these works has yet been made. The increased cost of coals may be expected to stimulate the adoption by shipowners of the latest economical development of marine engineering, and at least three of the local engine builders are prepared to take orders for quadruple expansion engines, and in two instances, it is stated, the designs are of the four-crank type.

SHIPPING.—The outward freight market is more active, coal cargoes being more readily obtainable, but there is not much improvement on the rates paid, despite the enormous increased cost of bunker coals, which presses heavily on short voyage steamers. There is a lull in the Black Sea and Mediterranean homeward market, but in a month or so a great improvement may be anticipated. The immense amount of tonnage absorbed by the American market, and the future prospects from the United States and Canada are good, and leave relatively little tonnage available for the Black Sea. The local coal shipments continue to increase, and to approach the normal condition. 70,357 tons were shipped last week, an increase for the week of 3,306 tons, 46,235 tons going coastwise and 24,122 tons abroad Other shipments included 800 tons of patent fuel, 100 loads of teak, 16,000 dozen glass bottles. The imports, timber, pig iron, flour, &c., were below the average.

NEWCASTLE, 29th JANUARY, 1890.

SHIPBUILDING.—Since November inquiries for new steamers have been steadily falling off, until, at the present moment, they are almost as rare as in the days preceding the advent of the existing briskness. The lack of new orders has not, as yet, affected the state of work in the building establishments, and can scarcely do so for some months to come, as the orders in hand at the close of the year were very numerous; but as these get worked out slackness in the yards must, if the present dearth of new business continues, necessarily supervene, as shipbuilders are not likely to fill empty berths by speculative building on their own account. If the opinions of gentlemen who have been all their lives connected with shipping and shipbuilding, and who have the best sources of information at their command, may be trusted, the main cause of the falling off of inquiries and orders is the increased cost of tonnage brought about by the considerable advances of wages that have taken place, combined with the rise in the value of material. The present price of new tonnage, indeed, may be looked upon as prohibitory, and until a fall in the cost of labour or material, or both, enables shipbuilders to offer lower quotations, shipowners are not likely to go in for additions to their fleets beyond what, in certain cases, may be rendered necessary by special circumstances. If the workmen insist on any further advances—and the tendency seems unfortunately to be in that direction—they will only all the sooner bring about that condition of things which will deprive large numbers of employment, and thus precipitate a return to the reduced wages rates which prevailed a couple of years ago.

THE COAL TRADE.—The Northumberland miners have made a demand for a further advance of 20 per cent. on the wages rates, and negotiations are now in progress to arrange a meeting between the representatives of the coal owners and the miners' association to discuss the matter. With respect to this question, it is very generally felt that the miners, having already received, since the commencement of the improvement in trade, several substantial advances, are now trying to exact too much, and unless they very largely modify their demand the resort to a temporary laying in of the pits may be forced upon the coal owners. Such an occurrence would, of course, be disastrous to all concerned, and it is to be hoped that the miners' representatives, who are mostly credited with a fair share of common sense, will use their influence to prevent it. The demand for all descriptions of coal remains strong, and prices still show an upward tendency. The shipment of coal and coke from Tyne Dock for the week ending January 25th amounted to 102,345 tons, being a decrease of 13,309 tons as compared with the shipments for the corresponding week last year.

CHEMICALS.—The chemical manufacturers on the river have not been, since the year began, by any means forcing their productions. The month of January, when compared with former years, will show that there has been a great falling off in extent of alkali, caustic soda, and crystal soda made. The work of demolition at the Tyne Dock works of the Jarrow Chemical Company has already begun, and the whole of the acid and caustic soda plant and machinery is being gradually removed. The stocks of crystal soda held on the Tyne amount to about 2,800 tons, showing, when compared with the same period last year, a decline of 800 tons.

DUNDEE, 29th JANUARY, 1890.

JUTE AND FLAX TRADES.—There has been little change in the condition of the staple industries of this district during the past fortnight. Advices from Calcutta state that the market for baled and loose jute is easier. There has been a considerable business done here on continental account. In yarns there is not much doing, but spinners are not willing to grant concessions, and quotations show little or no change. Only a moderate business is passing in jute goods, and the production tends to outstrip the demand It is reported from New York that prices are rather easier there this week, the price of 40 in 10¼oz. being about ⅛c. less per yard. Transactions in flax, both on the spot and on contract, have been of limited extent, and prices are rather easier notwithstanding an advance on the Exchange. Stocks of yarns are pretty large, and the sale is rather dull. Quotations, however, are unchanged. There has been a better demand for linens, both on home and foreign account, and the outlook is, on the whole, hopeful. The Admiralty contracts placed in this district are of smaller extent than usual. Messrs. Baxter Bros. & Co. have secured the largest share of the canvas and hammocking. The Boase Spinning Company, which carries on business in Fifeshire, has received a share of both also. Messrs. Richards & Co., Aberdeen, and Messrs. Hayward & Sons, Bridport, have got shares of the canvas. Messrs. Jameson & Co., Hull, have received the coal sacking contract. It is not yet known how the contracts for tent, duck, and linen sheetings have been allocated. The quantities of goods contracted for are as follows:—Sailcloth, 700,000 yards, against 825,000 yards last year; hammocking, 160,000 yards, against 150,000 yards last year; and coal sacking, 105,000 yards, against 60,000 yards last year.

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MESSRS. ARBEY'S TOOLS AT THE LATE PARIS EXHIBITION.

(*For description see page* 97.)

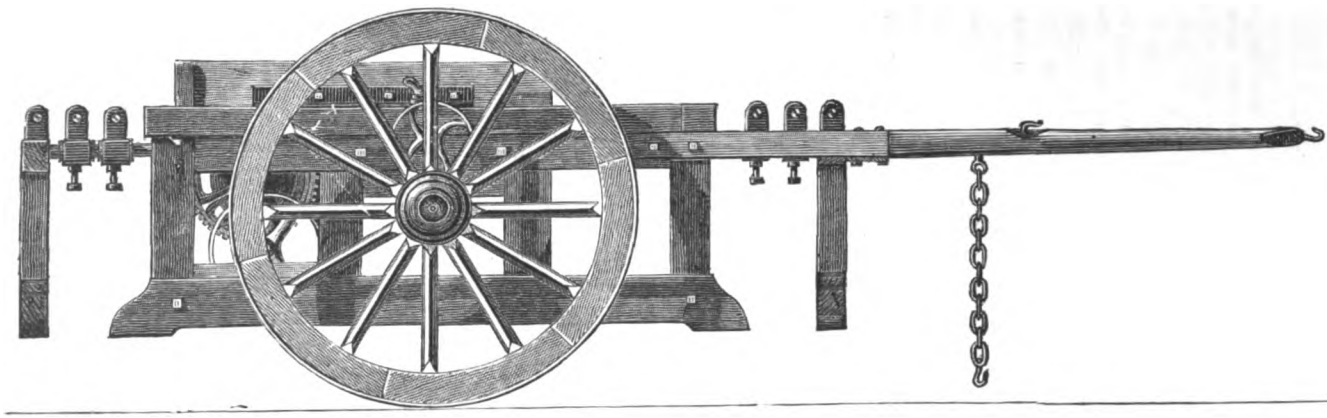


FIG. 3.—PORTABLE CIRCULAR SAW—SIDE VIEW.

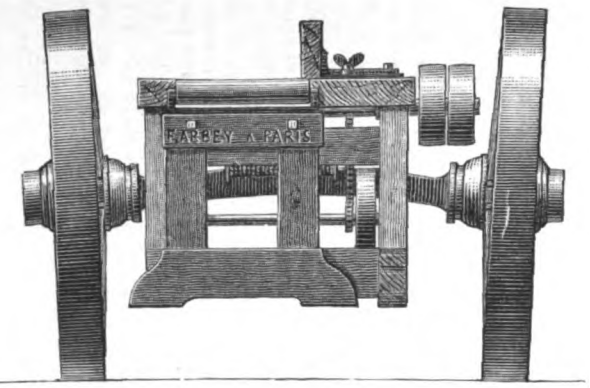


FIG. 4.—END VIEW.

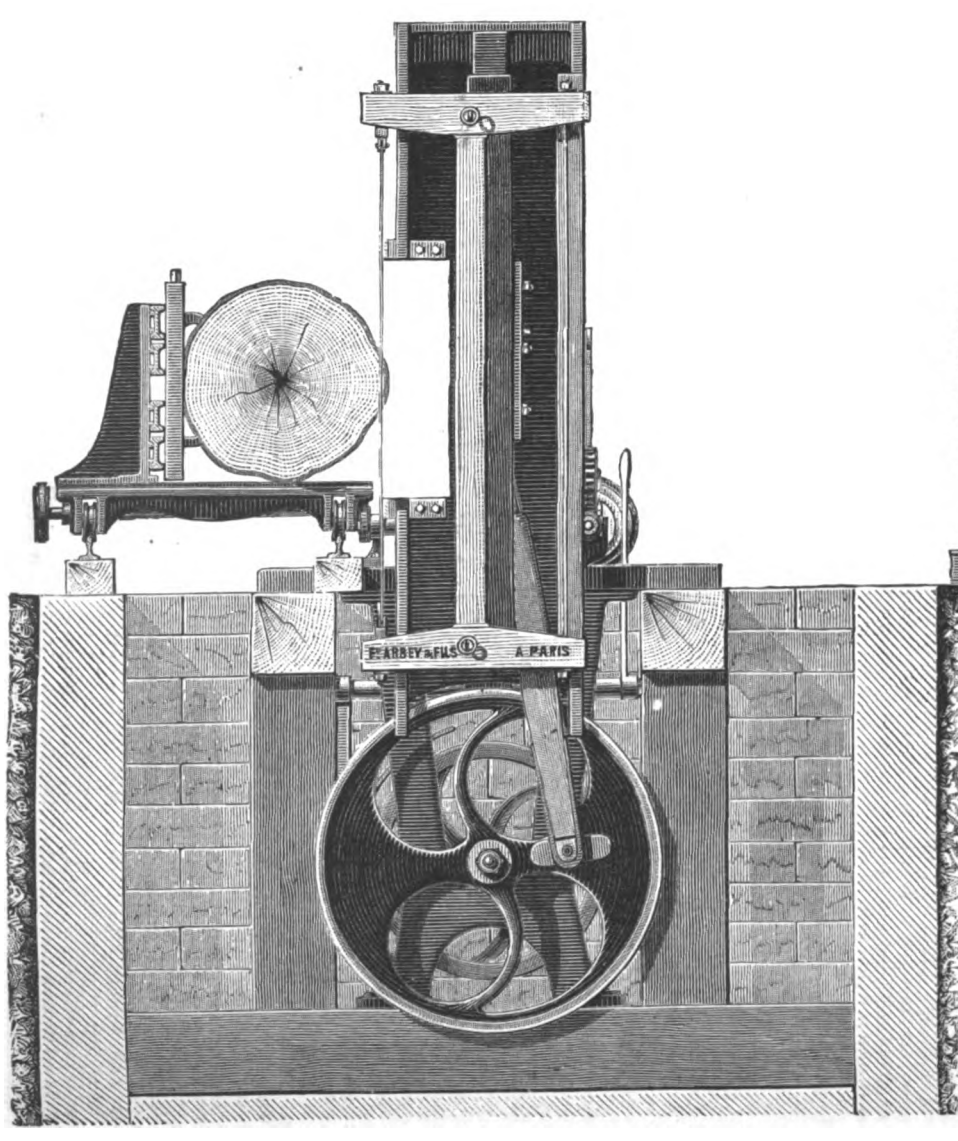


FIG. 5.—FRAME SAW FOR CROSS CUTTING LOGS—TRANSVERSE SECTION.

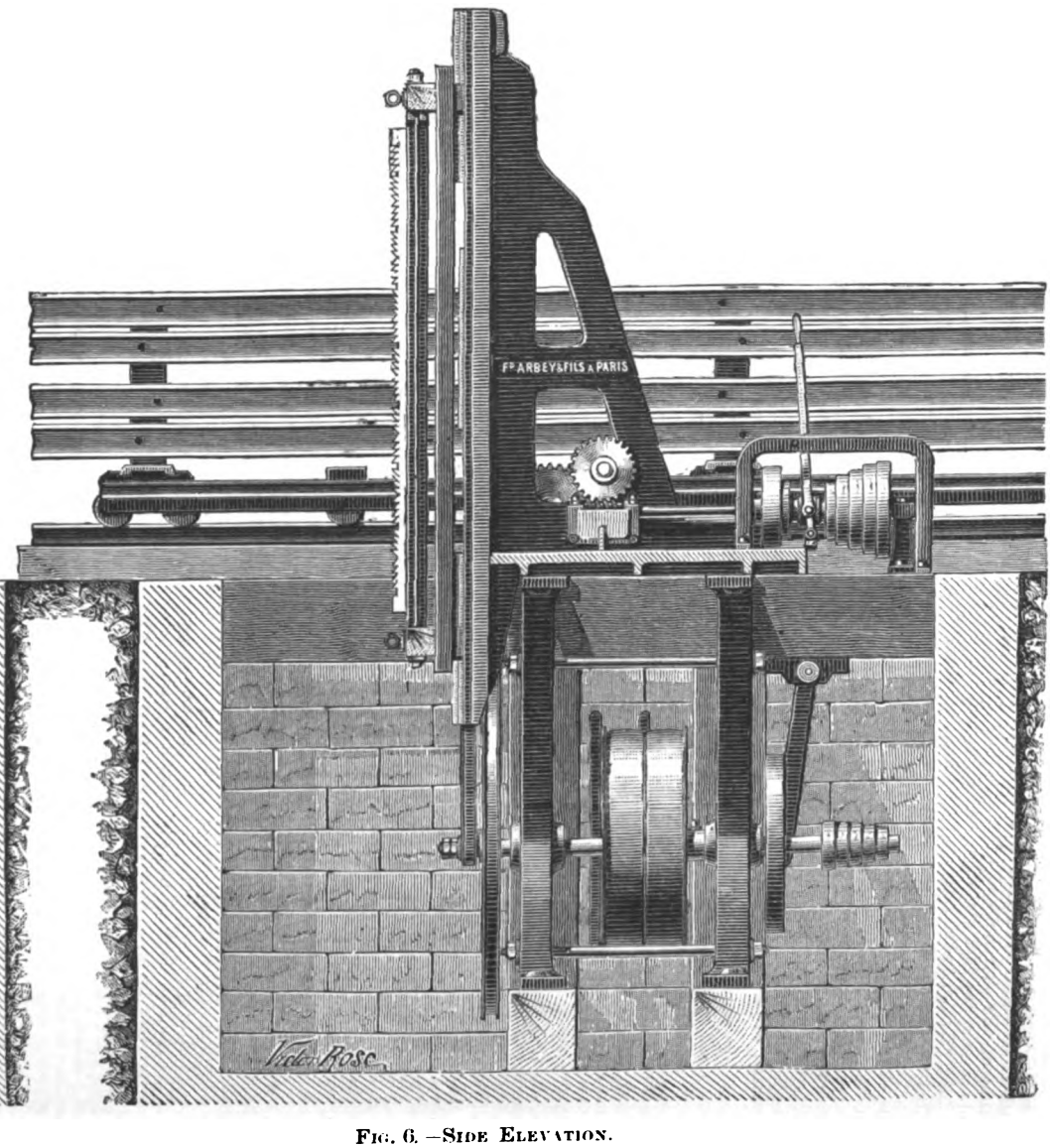


FIG. 6.—SIDE ELEVATION.

Industries, 31st January, 1890.

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As we go to press early with certain of our advertisement pages, all Alterations to Standing Advertisements should reach the Publisher not later than 2 o'clock on Wednesday afternoon in each week.

All accounts are payable to GEO. CAWLEY, 358, *Strand, London, W.C. Cheques should be crossed Manchester and Liverpool District Banking Co., Limited, 75, Cornhill, London, E.C. Post Office Orders should be made payable at the Post Office, Bedford Street, Strand, London, W.C.*

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93, Hope-street, Glasgow.

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

Contents.

	PAGE
Messrs. Arbey's Tools at the late Paris Exhibition (*Illus.*)	97
A New Forge at West Hartlepool (*Illus.*)	97
The Manchester Association of Engineers (*Illus.*)	98
Foreign Industries (Corres.)	102-103
The Webb and Thompson Staff Apparatus (*Illus.*)	104
The Stanley Cycle Show	104
Machine for Making Wood Wool (*Illus.*)	104
Shipbuilding Notes	104
Notices of Meetings	105
Prices Current	105
Foreign Telegraphic Advices (Corres.)	105
Home Industries (Corres.)	106-107
Chinese Railways	109
The Scientific Work of Joule	110
The Forth Bridge	110
The Late Mr. James Stewart	110
The Late Horatio Allen	111
The Institution of Mechanical Engineers	111
Letters to the Editor:—	
William Murdoch	111
Steam Boiler Legislation	111
Communication between England and France	111
The Bailey-Friedrich Steam Motor (*Illus.*)	112
Institution of Electrical Engineers	112
Graphic Constructions for Dynamos and Motors—III. (*Illus.*)	114
Double-Pole Two-Way Switch (*Illus.*)	115
Notes on Alloys—I.	115
The Examination of Commercial Glycerine	115
The Estimation of Oxygen Dissolved in Water	115
Notes	116
"Industries" Patent Record:—	
Applications and Acceptances	117-118
Illustrated Abridgments	118-120

To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

We cannot undertake to return manuscripts or drawings, and must request correspondents to keep copies.

BOUND VOLUMES OF Industries,

In half calf, gilt lettered, may be obtained at our London, Manchester, and Glasgow Offices, Price 20s. each.

Industries:

FRIDAY, 31ST JANUARY, 1890.

CHINESE RAILWAYS.

IN our issue of the 18th October last we gave a sketch of proposals for the construction of a trunk railway in China, 700 miles length, intended to be the beginning of a network of railways which had been sanctioned by the Chinese Government. These proposals raised quite a flutter of expectation among financiers, engineers, and manufacturers, as they seemed to open up large expectations, not only of immediate profit, but also of immense future developments. At the time, and also on previous occasions, we tried to moderate these expectations, not only because we knew something of the cautious nature of the Chinese, but also of the involved diplomacy and varied motives which influence the action of Chinese statesmen. Our warnings proved to be justified, for not long after we were informed that the railway scheme, at least in its main features, had been postponed, and in a note in our issue of the 13th December we gave the reasons which seemed to have influenced those who were responsible for the change of policy. We further pointed out that the facts which we gave showed the extreme uncertainty of a continued rate of progress in China for some years to come, and we expressed the opinion that, while there would be a general tendency towards development, it would be slow, shifty, and uncertain, until the mass of the Chinese people are more thoroughly awakened, and we warned those of our readers who are interested in China not to be oversanguine in their calculations. Since the last-mentioned date we have given other instances of the changing policy of the Chinese, and notably in the case of Mr. Little in his endeavour to improve the navigation of the Upper Yangtse. Our opinions have been strongly confirmed by a well-informed correspondent of the *Times*, writing from Pekin, who, like all who have resided in an Eastern country, seems to have been very much amused at the brilliant flashes of utter nonsense which are emitted from time to time by the London daily papers when they write on Chinese matters, as it is generally observed that they allow their imaginations to run off with them, and found calculations based on suppositions which are altogether unwarranted. On the other hand, while this is true, we very often find that correspondents residing in foreign countries are one-sided. Sometimes they are too sympathetic with the native Government, and too much in love with the people, to allow them fairly to see all the difficulties in the way of any industrial or other enterprise. Oftener, however, they have been soured by disappointment, or disgusted with official routine and what to them seemed senseless inertia, and their prognostications are usually unnecessarily gloomy. The fact of the matter is few foreigners are able to judge fairly of Chinese official action. We admit that some of it may seem to be, or may be, due to craft or duplicity but, on the other hand, a considerable experience with Chinese officials of the higher class has shown us that they have thought deeply on the problems connected with Western civilisation. They clearly recognise the advantages of it, but at the same time they are not blind to the disadvantages, and they hesitate before they commit their country to the problems with which we are now confronted. This we believe to be the real reason at the bottom of the inertia which irritates foreigners, whatever the apparent reason may seem. In a recent article in the *Nouvelle Revue* the eminent economist, M. Leroy-Beaulieu, has a most interesting article on the Paris Exhibition, in which he gives the opinions of imaginary people of different nationalities on the lessons to be learned from the Exhibition. Although M. Leroy-Beaulieu wrote the supposed journals or letters himself, they are no doubt founded on a careful study of the opinions of people of the different nationalities. The Chinese Commissioner is supposed to tell his master that the Westerns are far behind the Chinese in all the useful arts, especially in the arts of government, but in machines the Westerns excel, and he says that what the Chinese must do is to adopt the machines, but to take very good care to prevent the importation of the Spirit of the West, for he thinks that steam and electricity have a habit of getting into the heads of men who use them; and hence the mania for movement and for agitation which has destroyed the stability of the French State.

It is well known, and it has been mentioned by the *Times* correspondent, that for some years past there have been in China crowds of people, of all nations and classes, who have been presenting schemes for railway projects with one hand, and offering unlimited cash on the most alluring terms with the other. Indeed, he remarks, the way great capitalists, through more or less authorised agents, have been forcing money on the Chinese without success has afforded proof of a degree of public virtue in China which would hardly have been credited by those who knew the corruptness of the individuals who compose the Government, and that these contractors, promoters, and financial adventurers have little realised the actual state of affairs; that the railway question has been merely used as a football between various competitors for power and wealth, and has not yet been once seriously taken on its merits. We would not care to hold up the Chinese officials as examples of purity and incorruptibility, but we are strongly of opinion that those who speak most on such matters have little occasion to be accusers, and we have no hesitation in stating that the foreign financial adventurers should not make accusations, as in many cases they have done their best to bribe officials to come to their terms. We are glad to say that in our opinion British merchants have seldom condescended to such ways of doing business, and in this we agree with the *Times* correspondent, who states that so far the Chinese oyster has proved a disappointment to the adventurers. Germans, French, Americans have made strenuous but vain efforts to open it. The English have held aloof, either from apathy or latent wisdom, and in the end they will perhaps be as near the goal as their competitors.

As to the rivalry for power between Chinese statesmen, we are not sure that it is any greater or any worse than with the average statesman in any country. Naturally, a policy of railway extension, which would alter the whole social, industrial, and economic conditions of the country, is likely to be made the plea for discussions and opinions on all sorts of subjects. The *Times* correspondent admits that the Imperial family, Li Hung Chang, with the Governor of Formosa, and possibly one or two other officials throughout the Empire, are thoroughly imbued with the railway spirit, and do all they can to give practical effect to it, but he thinks that the mass of the officials are indifferent on the subject. On the other hand, he says, there is an active remnant of influential men who have no creed, no principles, and no policy, except greed of money for themselves and bitter envy of all

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possible rivals, and that this huge faction, actuated by purely personal motives of the most sordid kind, constitutes a real barrier to any sort of progress in the country. We think he has greatly exaggerated the two latter classes. The great mass of the officials may be indifferent on the subject, but not more so than in any other country, and they only require a start and direction to convert them into willing workers. The opponents of the railway schemes are likely to include many men who have thought over the matter very carefully, and are neither sordid, corrupt, nor envious, and would be quite willing to agree to Western methods if they could prevent the importation of the Spirit of the West, and keep steam, electricity, and money from getting into the hands of men who might misuse them. We believe that the crowds of adventurers who have found their way to China have done more to stop real progress than the Chinese obstructionists, as their methods and manners have disgusted all thinking Chinese. The *Times* correspondent states that the scheme to which we alluded in the articles we have named has been stopped in the meantime by two causes—jealousy of Li Hung Chang, and opposition on the part of the common people. No doubt there is a certain amount of jealousy, but it will gradually be overcome, and the scheme will be carried out as the opposition melts away. The superstitious reverence which the common people have for the graves of their ancestors, or "Fung Shin," as it is called, is no doubt a very powerful obstructive, and has a firm hold on the people in all places and of all classes, as they imagine that cuttings in hills and through graveyards would awaken the whole invisible fraternity and produce the most disastrous consequences. This feeling is, however, gradually disappearing, and they are beginning to see that railways are no worse, from this point of view, than roads and canals, with which the country abounds in all parts. Of course in China we find the same objections from the carters and the boatmen, and others engaged in the carrying trade, as we had in this country when railways were first proposed. But these will also soon disappear. The real cause of the stoppage in the meantime of the great railway scheme is, in our opinion, the financial one. The Chinese people have not sufficient confidence in the Government to supply the money, and the Government, on the other hand, wishes as far as possible to avoid foreign loans. If money had not been pressed on them to the extent that it has been, they would have had more faith in the good intentions of the lenders, and no doubt would have availed themselves to a considerable extent of foreign capital. In the meantime, the seventy-mile line between Tientsin and Tungchow is being proceeded with, and this will afford a most useful object lesson, and will do more to overcome opposition than any other arguments which could be used. We have a great respect for the intellectual powers of the Chinese, and we feel convinced that if they could get over the preliminary stage, they would enter on a steady, although slow, progress, which would make their country one of the great nations of the world, its immense resources and population giving it great possibilities for the future.

THE SCIENTIFIC WORK OF JOULE.

The first of the weekly evening meetings for the present year of the members of the Royal Institution took place on the 24th inst., when Professor Dewar, F.R.S., delivered an address on "The Scientific Work of Joule." Professor Dewar began his address by stating that, as the Royal Institution had always been associated with the great workers of physical science, it was thought that the death of Joule should not be allowed to pass without its recognition. The period between 1838 and 1843 was that within which Joule educated himself in experimental methods, and at this time he was principally engaged in the study of electricity and electromagnetic engines. His researches led, in 1840, to the discovery of the true law representing the relation between electric energy and thermal evolution. His great success was achieved by an elaborate examination into the relations of supply of electricity and its distribution, not only in the conductors exterior to it, but also in the battery cell itself. This law, which seemed so simple, was of the greatest importance. It was that the amount of heat produced by a given amount of electric current varied as the square of the intensity of the current, and directly as the resistance, always provided that a given unit of time were used. Joule saw that this was easily proved in a relative degree, but to account for the whole of the distribution of the current was more difficult. This led him to the study of electrolysis; and it was marvellous that, with the great difficulties which the method presented, he was able to discover all the impediments to an electric current, and to prove conclusively that the whole distribution of energy could be accounted for. In 1841 he had practically completely analysed the distribution of energy in the electric circuit; and he had discovered the law regulating the distribution of heat in all parts of it. In 1842 he had really his great discovery in hand, as was shown by a foot-note to a paper written on the 25th of January, 1842. It seemed extraordinary that always the most difficult and complex methods of dealing with a subject were at first taken; and to any one who read Joule's paper on the determination of the mechanical value of heat by means of an electric current it seemed astounding that he should ever have overcome his difficulties. To produce a thermal effect was easy enough; but the difficulty was to prove the permanent and persistent relation between the energy expended and the heat produced through the electric current. There were the fluctuations of the current, the effects of radiation, the movements of the air, and other circumstances to be allowed for; and Joule had to depend on very small variations of temperature, using, therefore, very delicate thermometers. By the end of July, 1843, Joule was able to state the quantity of heat capable of increasing the temperature of a pound of water by 1° Fahrenheit, and that was equal to, and might be converted into, a mechanical force, capable of raising 770lb. through a vertical height of one foot. After his first determination of the mechanical equivalent of heat, he stated that he had arrived at a nearly similar determination by a more direct method—namely, by the friction of water passing through small tubes. In all great scientific discoveries it was difficult to distribute merit exactly. There were those who, while admiring the broad and rapid generaliser, could not understand the patient and plodding experimentalist. Joule never pretended to be anything else but an experimentalist. He would go step by step through intricate masses of work and research and never generalise until he was perfectly sure. It was difficult to know how it was that Joule's great discovery had not been anticipated. Rumford, who first clearly defined the relation between the constant production of heat and the loss of motion from friction, went near to doing so. Sir Humphrey Davy continued Rumford's experiments in a different manner, and entirely dissipated the idea of the separate existence of caloric; and Young did much in analysing the position. After 1843 Joule several times, up to a late date, made fresh determinations of the mechanical value of heat, on each occasion varying his methods and ever reaching nearer to exactness. Thus in 1878 he stated that he found that 1lb. of water would be raised in temperature 1° Fahr. by 772·55 foot pounds of work. Besides the work on his mechanical equivalent, Joule was conducting in the forties elaborate investigations on the maximum density of water, specific gravity, and atomic volume. Joule's last research was long and laborious, extending over a period of nearly ten years, and was conducted with Sir William Thomson. The one subject of their research was the study of gases passing through narrow apertures, and the other the study of the velocity of bodies through air, and the temperature the bodies would ultimately attain by moving through air.

THE FORTH BRIDGE.

On Friday last, the 24th inst., the first passenger train passed over the Forth Bridge. The train left Edinburgh shortly before ten o'clock in the forenoon, and proceeded by the New Corstorphine and Dalmeny line to the Forth Bridge Station at South Queensferry. The following travelled by the train: Lord Colville of Culross, Chairman of the Great Northern Railway Company; the Marquis of Tweeddale, Chairman of the North British Railway Company, and the Marchioness of Tweeddale; Mr. Matthew P. Thompson, Chairman of the Midland Railway Company and of the Forth Bridge Railway Company; Mr. Wieland, Secretary of the North British Railway Company; Mr. Holmes, Locomotive Superintendent, and Mr. William Arrol. On the arrival of the train at the Forth Bridge Station, it was joined by Sir John Fowler, Mr. B. Baker, Mr. F. E. Cooper, Mrs. Cooper, Miss Cargill, Mr. Joseph Phillips, &c. The train passed on to the south approach viaduct at 10.20, and at 10.25 reached the south end of the South Queensferry cantilever. At 10.29 the train passed on to the north approach viaduct, thus occupying four minutes in crossing the bridge proper. The engine used was a recently built one, and was driven by Mr. Robert Ramsay, of the Locomotive Department, Cowlairs. During the passage of the bridge the Marchioness of Tweeddale, Lord Colville, Mr. Thompson, Mr. Arrol, and Mr. Holmes were on the locomotive, the Marchioness moving the regulator lever to start the engine. The train afterwards returned to Edinburgh with the party. The details of the arrangements for the official opening of the bridge by the Prince of Wales on 4th March next are not yet definitely settled, but it is understood that they will be somewhat as follows:—The Prince of Wales, the Duke of Edinburgh, and Prince George of Wales will arrive at Waverley Station, Edinburgh, on Monday, the 3rd March. The royal party will stay at the New Club, and on the evening of the 3rd the directors of the Forth Bridge Railway Company and the engineers of the bridge will dine with the Princes at the Club. The royal train will leave Edinburgh in time to reach the bridge about eleven o'clock in the forenoon of the 4th. After the train has crossed the bridge it will go on over the new approach railway to Inverkeithing, from which it will return to the bridge. At the connecting girder on the north side, the ceremony of driving the last rivet of the bridge will be performed by the Prince of Wales. At Inch Garvie the party will alight, and, should the weather be favourable, embark on board a steamer for the purpose of viewing the bridge from the Firth. The party will again join the train at Inch Garvie, and on regaining the approach viaduct at South Queensferry the Prince will declare the bridge open. After the ceremonial a banquet will take place at the works.

THE LATE MR. JAMES STEWART.

The death of Mr. James Stewart, of the well-known firm of iron tube manufacturers, of Coatbridge and Glasgow, will be regretted by a wide circle of friends. He died on the 12th inst., at his residence in Glasgow, in the 51st year of his age. For some months previous the deceased gentleman had suffered from anæmia, and to this he succumbed whilst yet in the prime of life. The firm of Messrs. Andrew & James Stewart is one of the oldest and most important of the tube manufacturing firms in the kingdom. The business was started in a very humble manner in 1861 by Mr. Andrew Stewart, who opened a modest workshop in St. Enoch's Wynd, Glasgow, where he limited himself entirely to the manufacture of gas tubes. He soon found ample employment there for the workpeople with whom he started, and encouraged by this success naturally sought to develop his business by taking up another department. But his premises in St. Enoch's Wynd did not admit of any increase of the work carried on there; and the production of boiler tubes, to which he was now anxious to direct his attention, had to be provided for elsewhere. Before the decade of 1861–71 was half run Mr. Stewart, having in the meantime taken in as partner his brother James (whose death we now record), looked about for a suitable site on which to make a fresh departure, and found it at Coatbridge. On the ground selected a workshop was erected which was the nucleus of the present extensive premises of the firm. The four acres which were then secured have since expanded into three times that extent, and the little workshop into a vast pile of buildings fitted with the most perfect appliances for carrying on the manufactures for which the firm is now well known. In close proximity to the works model dwellings for the workmen have been erected by the firm, and every acre of available ground around the original buildings has been acquired in order to meet the increasing demand for room which the expansion of the firm's operations has created.

Until 1882 the firm continued its business under the old designation, but in that year the concern was converted into a limited liability company, with a very extensive capital, held exclusively by the two gentlemen already named, and by seven of their managers and principal employés, who had been associated with the firm for many years past. The company thus remained practically a private one, and, apart from the loss occasioned by the death of Mr. James Stewart, remains to-day the same as when formed.

Mr. Stewart, who was the first Dean of Guild of the burgh of Coatbridge, and who at the time of his death was a Justice of the Peace for the county of Lanarkshire, a member of the School Board, and also held other public offices, was a man whose untiring zeal and industry made him superior to all ordinary obstacles.

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THE LATE HORATIO ALLEN.

On New Year's Day the death took place of the oldest of American engineers, Mr. Horatio Allen, the most noteworthy feature of whose life was his participation in the introduction of the locomotive into America. He was born in 1802, and, after receiving a college education, he took up the study of civil engineering, and entered the service of the Delaware and Hudson Canal Company. During his connection with this firm both he and the chief engineer, Mr. John B. Jervis, were attracted by Stephenson's experiments, which were then taking place in England, and they recognised the fact that the locomotive steam engine had a great future before it. Therefore, in the year 1828, Mr. Allen sailed to the Old World, and purchased two engines, and on their arrival at Honesdale, Pennsylvania, in the following year, Mr. Allen conducted a trial himself. It was, however, found that the roads were not heavy and strong enough, and the efforts of Mr. Allen were turned to reducing the load per wheel, and he invented a type which has since been modified into the "Fairlie" engine. In conjunction with Mr. Jervis and Mr. Winans he introduced many improvements, and the three of them together were the promoters of most of the early American lines. In later years Mr. Allen devoted much of his time to hydraulic engineering, and he was also the leading member of the well-known firm of Stillman, Allen, & Co., of the Novelty Ironworks, New York, who supplied the heavy engines to the American steamers before the time of Cunard. For the portrait which we give above we are indebted to the *Engineering News* of New York.



THE INSTITUTION OF MECHANICAL ENGINEERS.

The forty-third annual meeting was commenced on Wednesday, Mr. William Anderson in the chair, when the report of the Council was read. The number of members gave a total of 1,856, being 50 in excess of last year. The reports of the Research Committee dealt with the subjects of a standard system of marine engine trials, the value of the steam jacket, the friction of pivot bearings, and the application of the periodic law to the mechanical properties of materials. The Council have had under their attention the question of the taxation of machinery, which of late has acquired very great importance through the efforts of professional valuers to increase the rateable value of factory property by including the machinery. The voting for the election of officers was then taken, and Mr. Joseph Tomlinson was announced as President. The summer meeting of the Institution will be held in Sheffield. The first paper read at this meeting was by Mr. Thomas Urquhart, superintendent of the Grazi and Tsaritsin Railway, South East Russia, on

The Compounding of Locomotives Burning Petroleum Refuse in Russia.

The author of this paper, with a view to satisfy himself on the question of the utility of compounding in locomotives, obtained the sanction of the Russian Government to alter one of the petroleum-burning locomotives running on the Grazi and Tsaritsin Railway in South East Russia according to his own plans. This altered goods engine was put to work on the 1st September, 1887, and subsequently tested, under similar conditions, against a non-compound of the same type, with the result that the compounded engine burned 22 per cent. less fuel than the other. On this practical basis the compounding of other locomotives was at once proceeded with. At the end of 1889 there were in daily use in the regular train service of this line twelve compound goods engines with six wheels coupled, and three compound passenger engines with four wheels coupled, while four other goods engines and two passenger engines were in the shops undergoing reconstruction.

The saving of fuel effected by the compounding was found to be, for the twelve goods engines, 18½ per cent. as a mean. This question has not yet been determined for the three passenger engines, but the author believes it cannot be less than 20 per cent. in the second or third notch of the reversing lever.

In the drawings of one of these compounded 36-ton goods engines illustrating the paper, the diameter of the high-pressure cylinder is 18½in., and that of the low-pressure 25⅝in., the piston areas being thus about 1 to 2. The original stroke of 24in. has been retained, and the boiler pressure kept at 135lb. to the square inch above the atmosphere. With the original eccentrics giving the valves a maximum travel of 4½in., and having an angle of advance of 30°, the indicator diagrams showed excessive compression in the high-pressure cylinder and too early a cut-off in both. These defects were remedied by extending the travel to 4¾in., and making the angle 20°. Indicator diagrams were given to show the useful effect of the changes made. In all these diagrams the author has added 10 per cent. to the mean pressure in each cylinder to allow for the effect of the pipe connection from the cylinder to the indicator.

To ascertain the correctness of the common opinion that the compounding of existing locomotives, while retaining the original boiler pressure, and also retaining one of the original cylinders to serve as the high-pressure cylinder in the compound, necessarily results in a considerable loss of tractive power, and at the same time to determine what are the relative tractive powers of compound and non-compound locomotives, a series of comparative trials were made by the author in the summer of 1889 with both passenger and goods engines. The results were shown in tabulated form, from which it appears that in the compound passenger engine the tractive power undergoes the following diminution relatively to the non-compound in the five successive notches of the reversing lever:—Loss in the first notch, 42 per cent.; in the second, 28 per cent.; in the third, 17 per cent.; in the fourth, 7 per cent.; and in the fifth (full gear), 5 per cent. For the compound goods engine the losses were 27, 17, 10, and 5 per cent. in the first, second, third, and fourth (full gear) notches respectively.

Besides the economy of fuel, the author believes that the compounding of the locomotives will result in a saving of not less than 25 per cent. in the cost of repairs, because the initial stresses are not so great on the bearings and other mechanism in the compounds, and because the force exerted by the pistons is continued upon the crank pins for a greater distance during each stroke. Moreover, the friction of the slide valves is much less in the compounds, the back pressure of about 60lb. per square inch under the high-pressure slide valve tending to ease it off the face, while the low-pressure slide valve is loaded to less than half the boiler pressure.

The author observed that a very small difference in lap of a slide-valve, outside or inside, has a great effect on the fuel consumption. In the drawings a longitudinal section is given of the two valves in that one of the twelve goods engines which showed the best results. In this case we have: High-pressure valve, outside lap 0·79in., inside clearance 0·06in.; low-pressure valve, outside lap 0·61in., inside lap 0·08in. The drawings show two different devices for relieving the pressure of the slide-valves on their faces.

The first four engines compounded had their high-pressure crank leading and the low-pressure following in forward running. But it having been observed that one of these seemed to work better and to develop greater tractive force when running backward, the order was reversed in those subsequently altered, with very satisfactory results. The author believes that the sequence of cranks has never before been taken into consideration. The only objection he sees to the low-pressure crank leading is that it gives too much power to the large cylinder and too little to the small, thus putting the engine out of equilibrium. This defect may, however, be in large measure remedied by increasing the capacity of the receiver.

To prevent a vacuum in the receiver being formed by the low-pressure piston when running down hill with the regulator closed, an air inlet-valve was placed in the receiver, and arrangements were made to mix with the cold air entering through this valve some of the hot gases from the smoke-box to avoid the cooling effect which would result from the admission of cold air. There is a starting valve of very simple construction on the receiver, worked by hand, for admitting boiler-steam direct to the low-pressure cylinder.

The first passenger engine compounded had a receiver capacity equal to the volume of one stroke made by the high-pressure piston; but in those subsequently altered the capacity was increased to 1·3 of that volume with good results, the indicator diagrams for the low-pressure cylinder coming out fuller. More recently, in the case of one of the goods engines compounded, the receiver capacity was further increased with still better results.

The author's experience leaves no doubt in his mind that compound locomotives are the engines of the future in all countries.

At the invitation of the President, a discussion on this paper was commenced, but the evening being far advanced it was, after a few remarks, adjourned till the following day.

Mr. Schönheyder doubted the accuracy of the results in so far as the 10 per cent. addition to the pressures allowed for the connecting pipes was concerned. He had known a loss of 30 per cent. in such cases. It would be desirable in future trials to eliminate that source of error. He was also of opinion that the slide-valve relief arrangements were not to be relied upon.

Mr. Beaumont said it was not clear how the 10 per cent. referred to was taken account of in the indicator diagrams. He would like to know why the author of the paper had increased the receiver capacity, for he, the speaker, failed to follow his argument in that particular. It would appear from what had been said that a progressive increase of the receiver capacity was accompanied by a corresponding increase in the power of the locomotive, a result which, to him, was not easily to be accounted for.

Mr. Tomkins thought that the saving in fuel seemed to be compensated by the loss in tractive power due to compounding. As for the economy in the matter of repairs, that was a question to be decided by experience. The author of the paper had adduced no practical results to support his opinion that there would be, as he states, a saving of fully 25 per cent.

Letters to the Editor.

WILLIAM MURDOCH.

To the Editor of "Industries."

Sir,—I thank you for your insertion of my letter of last week on "The Sun and Planet Motion of William Murdoch." To aid me in a sketch I am preparing of this distinguished man of science I shall be glad if you will kindly extend your courtesy still further by permitting me through your columns to ask your readers to favour me with any items of fact or anecdote bearing on his life and inventions. Besides being the inventor of the sun and planet motion, the D slide valve, which displaced the older cumbrous and complicated arrangement of levers and valves, and other equally radical and important improvements on the stationary engine, he was the first to discover and apply coal gas as an illuminant and as an economic substitute for oil and tallow.

Yours, &c.,
Alex. Murdoch.

2, Berlin Place, Pollokshields, Glasgow,
28th January, 1890.

STEAM BOILER LEGISLATION.

To the Editor of "Industries."

Sir,—Certain facts in connection with the "Halesowen" explosion have come to light, and from them I find I was in error in one of the statements contained in my letter of the 13th inst. The company who insured the boiler which exploded in the s.s. "Perseverance" is not defunct, as stated by me, but probably soon will be if there is a repetition of such disastrous events as have recently occurred. Trusting you may find room for this correction, so that the saddle may be placed on the right horse,

Yours, &c.,
Manchester, January 28th, 1890. S. Boswell.

COMMUNICATION BETWEEN ENGLAND AND FRANCE.

To the Editor of "Industries."

Sir,—I notice in your issue of the 10th inst. a letter signed "T. C.," in which the writer refers to a project for crossing the Channel, which, if I am not mistaken, tallies with a proposal made about sixteen years ago by my late brother, Mr. Theobald Obach, and his associate, Mr. B. Lebret, civil engineers, of Vienna. Since your correspondent, as he himself admits, writes solely from memory, it happens that his description is not quite accurate, and he makes the proposal appear more venturesome than it really is. The idea was to erect a floating bridge, some 40ft. below low water, so that the largest vessels could pass over it, and to provide it with rails, acting as guides to a kind of floating ferry. The latter has a covered platform sufficiently high above water, so as to be beyond reach of the highest waves. On this platform the railway carriages are placed and thus carried from shore to shore. The ferry is propelled by means of a towing chain resting on the middle of the guide bridge and passing round a drum driven by steam on board the ferry. The passengers are not to be shut up in water-tight compartments and supplied with compressed air, as your worthy correspondent seems to imagine, but, on the contrary, would be able to enjoy not only the fresh sea air but daylight also.

I can quite believe that submerged guide bridges, similar to that proposed by my late brother and his friend, may one day prove to be a valuable addition to the existing modes of crossing the waters, and it would perhaps be worth a trial at some suitable

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place. *A priori*, one would expect a submerged bridge, out of harm's reach, to be more durable than a pontoon bridge, of which there are many in existence.

In conclusion, I may mention that I do not intend entering into any lengthy discussion about the merits or demerits of my brother's proposal, but content myself with having drawn the attention to it, which it certainly deserves, even if only for its originality. Those readers of your valuable journal who have more than a passing interest in the matter I refer to an illustrated pamphlet, published by the inventors in 1874, under the title "The Channel Railroad Ferry," and printed by Messrs. Vacher & Sons, of 29, Parliament Street, London, where it may probably still be obtained.

Yours, &c.,
EUG. OBACH.

Woolwich, January 25th, 1890.

THE BAILEY-FRIEDRICH STEAM MOTOR.

WE give two views in Figs. 1 and 2, on the opposite page, a new steam motor which is being extensively made by Messrs. W. H. Bailey & Co., Limited, of Salford. The machine is complete with boiler, which forms a base for the engine. The boiler consists of a number of Field tubes fixed into a steel plate, which is suspended, by means of steel bolts, from an upper plate of the same material. The coal is fed by the hopper shown, and moves slowly upon the fire-bars, which are angularly placed. It is found that the emission of black smoke is prevented, owing to the gases passing over the coked fuel at the back of the fire. A heavy charge can be put into the hopper, and this slowly falls on to the bars. An interval of an hour may occur between the charges. Owing to the peculiar construction of the boiler—no rivets being employed—it is easily repaired, and if the pressure rises much higher than the fixed amount—viz., 70lb.—the expansion of the steel tube plates causes leakage, and thus renders the boiler inexplosible. Also, by an ingenious arrangement, a flap over the air door, placed at the top of the hopper, is opened or closed if the steam falls below or rises above the normal pressure, thus automatically regulating the combustion. The engine is, as shown, of an ordinary vertical kind, and is controlled by a sensitive governor of the high-speed type. The governor sleeve has a cam groove formed in it by means of which an automatic rotary cut-off valve is regulated. By means of a screw valve the supply of steam can be accurately regulated, and the cut-off arranged as desired.

The chief feature of this motor is, however, to be found in the treatment of the exhaust steam. There is a surface condenser fixed in a vertical position, round the tubes of which a continuous current of water is passed. The water supply is obtained from a tank or cistern similar to those used with gas engines for supplying the water jacket, so that the water can be used over again, with occasional replenishments to compensate for the slight loss by evaporation, which, however, is not great. After the engine has been working for some short time, the water becomes of a temperature of 100° to 150° Fahr., and it is found that a considerable mineral deposition takes place where salts exist in the water. The steam being condensed, the water so obtained is pumped back into the boiler, and it is found possible to maintain an unvarying water line in the boiler. The same water is used repeatedly, and if it were not for the slight loss resulting from escapes of steam through the stuffing boxes, &c., there would practically be no fresh water needed. It has been established by experience that about two quarts of water per horse-power per day is all that is necessary to supply all loss in the engine or boiler. This quantity is obtained from the condenser by means of a sight drop feed, the rate of the dropping being regulated by a valve. In this way the feed water is kept pure, and incrustation of the tubes prevented. The small consumption of water is remarkable, but is verified by a large number of users in various parts of the world. If necessary the boiler can be arranged to burn petroleum, the consumption being about one quart per horse-power per hour. The makers have not hitherto made many of these motors for this country, but have sent a large number abroad. They have made several in combination with dynamos, including one for the Thomson-Houston Company. A motor has also been sent to the Williamson Electric Company, of Sydney, of which Mr. Williamson, late superintending engineer for the Edison Swan Electric Light Company, of Manchester, is the founder. The motor has also been applied to pumping, and, generally, there have been a number of combinations made. Messrs. Bailey have given some results of a number of daily tests made at their works with a motor supplying power for 40 16 c.p. incandescent lamps, the fuel used being gas coke. The fire was lighted at 3 p.m. each day, and the current finally switched off at 9 p.m., during which time the fuel used was 135lb., the cost being 6d. per cwt., or equal to 1d. per hour. This is a remarkable result, and one probably the makers would not guarantee, but if it is even approached should be of sufficient importance to justify the adoption of the motor for small powers. The motor is made in three sizes, developing respectively 4, 8, and 12 brake horse-power.

INSTITUTION OF ELECTRICAL ENGINEERS.

ON the 23rd inst. the discussion on the President's address on "Magnetism" was continued by

Mr. Shelford Bidwell, who referred to the portion of the paper relating to the influence of stress on magnetisation. If a long thin iron wire be suspended vertically and subjected to longitudinal magnetising forces, its curve of magnetisation, resembling Fig. 1, is easily obtained. If now the wire is stretched by a weight, the curve of magnetisation rises more rapidly at first, but subsequently bends over and cuts the ordinary curve, and remains below it as the magnetising force increases. The point of intersection is known as the "Villari critical point," and the change in the relative permeability is called the "Villari reversal." Converse effects were obtained by Joule in 1840, who showed that a bar is lengthened by magnetisation until the magnetising force reaches about 120 c.g.s. units when no further elongation was observed. Some time ago he had misunderstood Prof. J. J. Thomson's argument, for quite recently the latter had predicted a "Villari reversal" when cobalt was compressed, and this was verified by experiment, whereas he had published a contrary prediction.

Prof. Roberts-Austen said that even pure electro-deposited wrought iron on cooling does not evolve heat as carbonised irons do at 858° C. Osmond has, however, shown that there are at least two perfectly distinct phenomena which may be observed in cooling masses of iron. First, there was the transformation of hard β iron into soft, or α iron; and secondly, the "recalescence" of Barrett. Heat is evolved at both points, but the first is variable in position according to the chemical composition of the mass, and is that at which the magnetism reappears. The second point, the true recalescence, occurs at a fairly constant temperature of about 640° C., and it has, Prof. Austen considered, no appreciable effect on the magnetic properties of the mass, but is essentially due to a change in the relations between the carbon and the iron.

Professor S. P. Thompson said the behaviour of the nickel-iron alloy reminded him of a specimen of natural alloy of the same two metals shown to him some years ago by M. Becquerel. This differed in its magnetic properties from Dr. Hopkinson's samples, for although it was non-magnetic when first obtained, it became magnetic on being heated and allowed to cool. Dr. Thompson said that, in a paper on the Mechanism of Magnetisation, Chivolson had endeavoured to distinguish between temporary and subpermanent magnetism, and his curves show that the former increases regularly at first, and afterwards more slowly, whilst the latter makes a sudden rise when the magnetising force reaches a certain value, and afterwards remains nearly constant as the force increases. The sum of the two effects gives the usual magnetisation curve. The speaker also described a simple apparatus for measuring permeability by measuring the attraction due to the induction over the cross-section of the sample.

Professor Ayrton asked Dr. Thompson whether the character of the surfaces in contact affected the results obtained by his new apparatus. He also inquired whether the President had tried if the magnetic properties of iron were regained at a white heat, for Dr. Wormwell said that such was the case. On roughly trying the experiment by heating a piece of iron in a blowpipe flame and bringing a magnet near it, he had only found one out of three pieces to give any signs of magnetisation, and of this he was not quite certain.

Mr. J. Swinburne, alluding to Weber's theory of magnetisation, inquired if any experiments had been made with the object of setting the axes of all the magnetic molecules parallel by first magnetising the sample at right angles, and thus reducing the angle of the cone within which, for a given magnetising force, they must all be. As a method of doing this, he suggested that a wire be subjected to circular and longitudinal magnetisation successively. Referring to the terminology of the subject, he said the term "magnetisation" generally conveyed very vague ideas to the average mind, and thought its use should be avoided.

Mr. W. H. Preece described the methods of testing magnet steel used by the Post Office authorities, and promised to add a table of tests to his remarks as printed in the Journal. The tests are made by two methods—1st, by determining the force required to detach an armature; and, 2nd, by the magnetometer method. A great improvement, he said, was made in the magnetic quality of steel by the addition of about 3 per cent. of tungsten, the influence of which was brought into prominent notice by the Alvarre steel exhibited at the Paris Exhibition in 1881. The subject, he thought, required the careful attention of manufacturers, and he hoped that immediate steps would be taken to improve the quality of magnet steel. On examining the numbers obtained by Continental observers, he found that the maximum value had been obtained by Kohlrausch, and was 3,900.

Mr. S. Evershed said he was one of those who thought there was no need to use the word magnetisation in its present ambiguous sense, and that the ideas of polarity, magnetic moment, free magnetism, &c., were not required, except, perhaps, for permanent magnets; even with them, now that the President had given a definite meaning to "coercive force," this value of H, together with the permeability, seemed to him to give all the necessary information. He also thought the word "induction" should be defined to mean what is generally called "total induction," and a new name should be given to density of induction, or induction per unit area.

Mr. A. P. Trotter asked the President whether the sample of nickel iron alloy, whose properties were represented in Fig. 11, was unique, or whether other alloys have been found to give similar results. The remarkable peculiarities of this specimen suggest the possibility of copper, lead, &c., being cooled low enough to become more magnetic than Mr. Preece's magnet steel.

The President, in replying to Sir W. Thomson's remarks on recalescence, said that in heating the metal a considerable absorption of heat occurs at about 30° C. above the temperature at which recalescence takes place on cooling, but his experiments proved that the changes in the magnetic properties follow precisely the absorption and liberation of heat both in ascending and descending. Referring to Professor Ewing's remarks on what he called the "hysteresis of nickel steel," shown in Fig. 11, Dr. Hopkinson said he thought the word hysteresis not very appropriate when applied to this phenomenon, for he considered the peculiarity more analogous to change of state from liquid to gas, or *vice versa*, as in the case of water, for example, these changes can be considerably retarded by adopting suitable precautions. Professor Roberts-Austen had, he said, alluded to the liberation of heat when iron changed from the non-magnetic to the magnetic state. The phenomena accompanying this change seemed to him (the President) to be analogous to "boiling with bubbling," where the temperature of the liquid is first raised considerably above the boiling point, and a sudden liberation of vapour brings down the temperature. As regards Professor Ayrton's question relating to the return of the magnetic property at high temperature, he could only say that he had not observed it, but the greatest temperature attained in his experiments was about 950° C. Referring to the revision of terminology by several speakers, Dr. Hopkinson thought there was no necessity for this, for the terms "pole," "magnetic moment," &c., were most convenient when talking of permanent magnets; whilst "induction" and "permeability" were preferable when the magnetisation of iron was under discussion. In reply to Mr. Trotter, he said that many other alloys had been tried, and one specimen of nickel-steel, containing 5 per cent. of nickel, gave very similar results to that shown in Fig. 11, but the range between the critical temperatures was considerably shorter, these temperatures being 650° C. and 800° C. respectively. The same sample tested for recalescence was found to absorb heat about 800° C., and on cooling heat was liberated about 650°, thus showing the close connection between these phenomena and magnetisability. Since last meeting he had tested the variation of specific resistance of nickel-steel with temperature, and found that a considerable reduction was produced by cooling it in solid carbonic acid. On heating its resistance increased slowly and uniformly at first, and afterwards with increasing velocity, until a temperature of 600° was reached. At this temperature a sudden change occurred, and the resistance increased more slowly and uniformly as the temperature rose. On cooling the specimen its resistance fell uniformly until at the ordinary temperature it returned to its initial value. The whole cycle could be repeated by again cooling in carbonic acid and proceeding as before. Fig. 6 shows diagrammatically the character of the changes. Other samples were tested for tensile strength, and when in the ordinary state gave an average breaking stress of 50 tons per square inch with an extension of 30 per cent. Specimens which had been chilled broke at 85 tons with an extension of only 8 per cent. This fact, he said, was of vast importance from an engineering point of view, for if such changes in the nature of a mild steel were brought about by its being subjected to a hard frost, the consequences would be very serious if such a metal were used in structures.

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THE BAILEY-FRIEDRICH STEAM MOTOR.

CONSTRUCTED BY MESSRS. W. H. BAILEY & CO., LIMITED, ENGINEERS, ALBION WORKS, SALFORD.

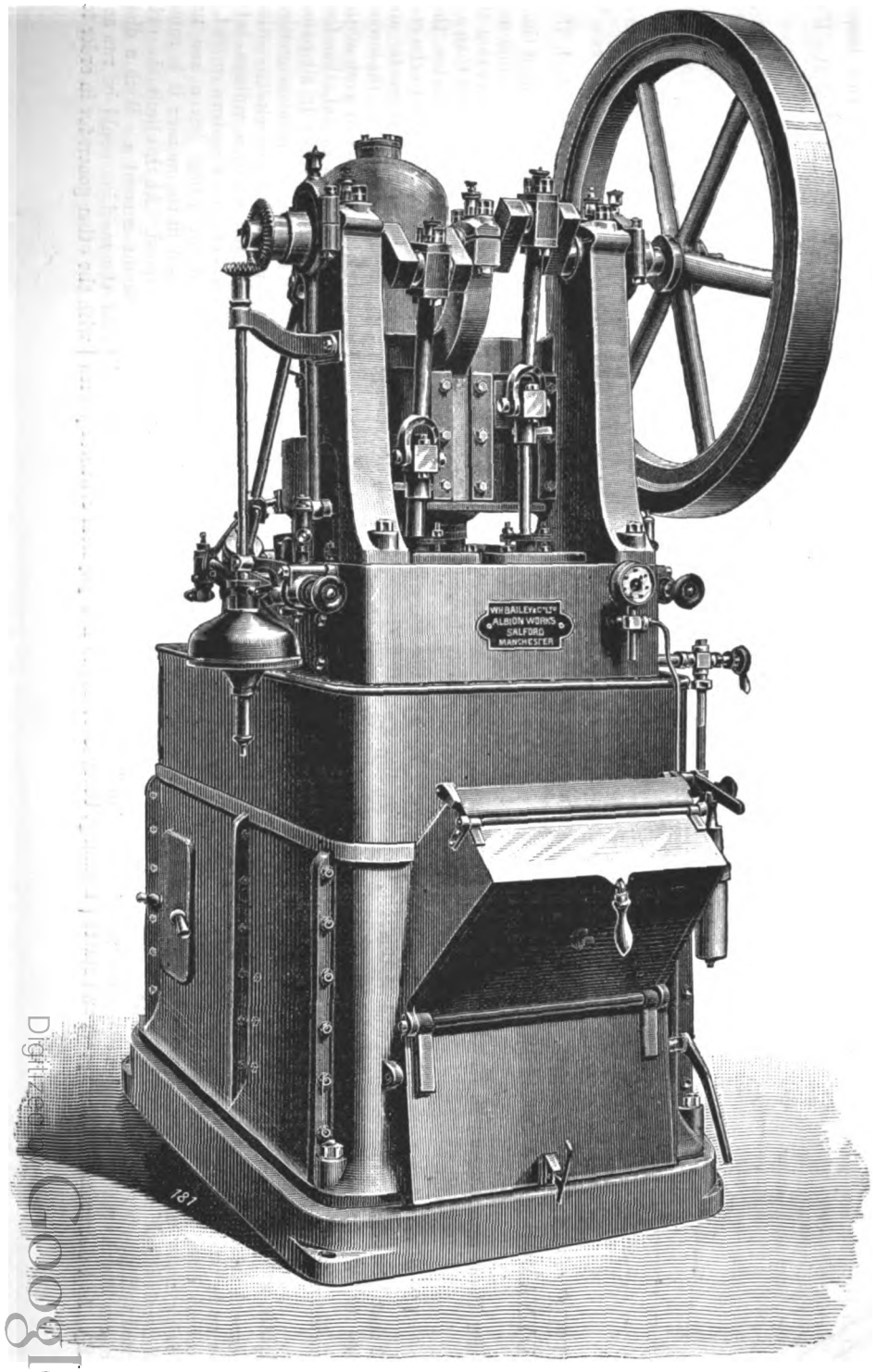


FIG. 1.—END VIEW.

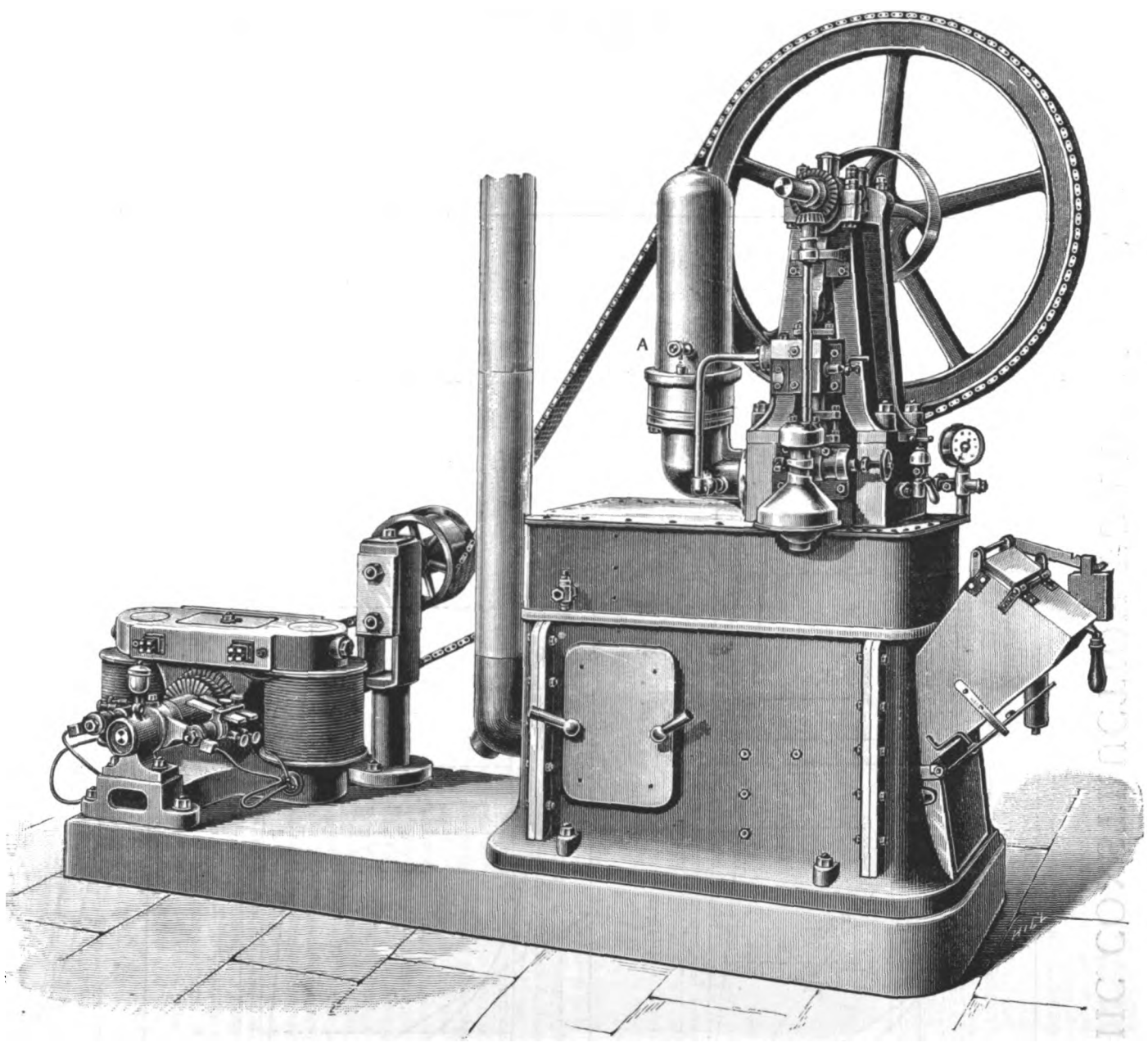


FIG. 2.—SIDE VIEW.

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GRAPHIC CONSTRUCTION FOR DYNAMOS.

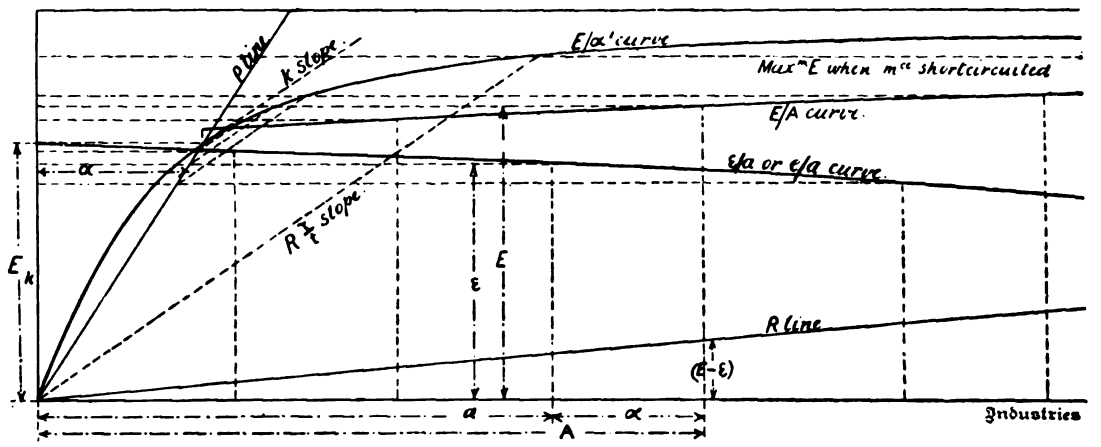


FIG. 8.

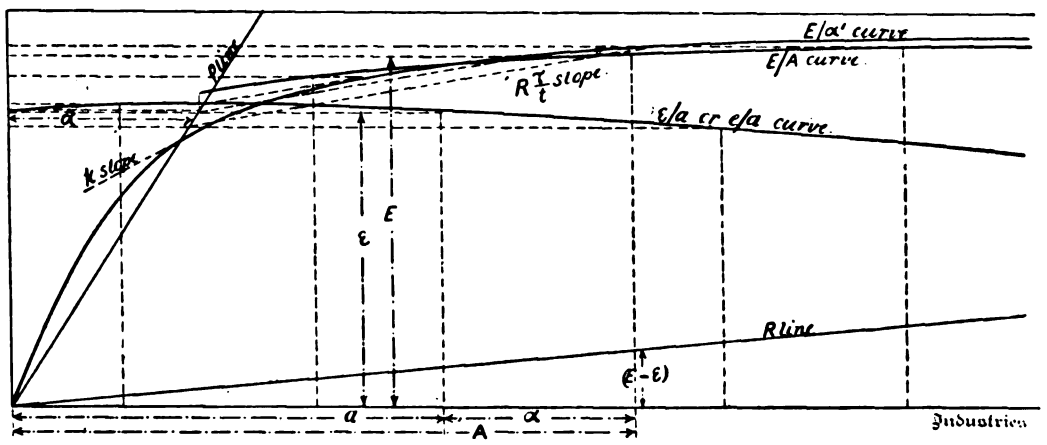


FIG. 9.

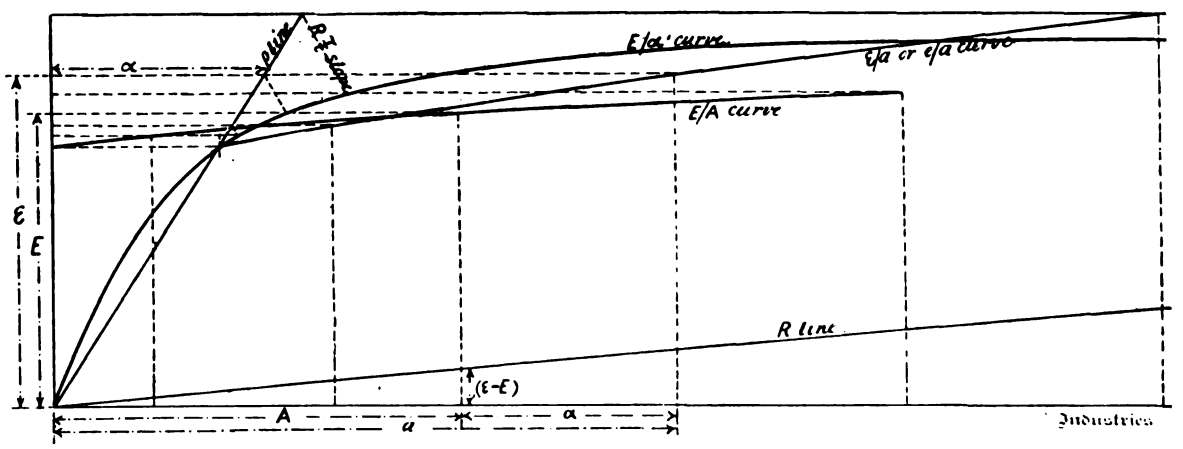


FIG. 10.

GRAPHIC CONSTRUCTIONS FOR DYNAMOS AND MOTORS.

BY PROFESSOR ROBERT H. SMITH.

III.

(*Continued from page* 91.)

Provided that k be not small as compared with R, then the external voltage ϵ changes very little with the external current a if the condition be fulfilled that $R\frac{\tau}{t}$ be only slightly greater than k. If $R\frac{\tau}{t}$ nearly equal k, then, of course, k must be much greater than R, because τ is always made much larger than t. Since this is a most important case, approximately constant voltage machines being more needed than any others, it is specially illustrated in Fig. 8. The approximately constant external voltage ϵ is only a little less than E_k. The variation of ϵ is less the flatter the $E\alpha/^1$ curve is beyond the point E_k. As k decreases with the speed, and starts from the value ρ at the first speed at which the machine begins to work, it is evident that, for every machine in which $\tau > t$ and $R\frac{\tau}{t} < \rho$, there is a theoretically possible velocity at which this result is obtained. In order to fulfil this condition, and at the same time obtain a high value for ϵ or E_k, it is necessary that $R\frac{\tau}{t}$ should not be large, which can be economically done only by making R, the internal resistance, very small.

In the other case, see Fig. 9, in which $R\frac{\tau}{t}$ is a little less than k, the same general variation of the quantities takes place so long as ϵ, the external voltage, lies below E_k. When $\epsilon = 0$, E is at its maximum, the machine being short-circuited between the terminals and there being no current in the shunt. As ϵ rises, E, A, and a all decrease as in the previous case. When $\epsilon = E_k$, the line $R\frac{\tau}{t}$ cuts the curve $E\alpha/^1$ at two places; the higher intersection, however, being the one that has a physical meaning, because it alone has physical continuity with the intersections obtained when ϵ was less than E_k. Still continuing the rise of ϵ, the higher of the two intersections, giving the corresponding E, still sinks and proceeds towards the left-hand. This continues until the line $R\frac{\tau}{t}$ becomes tangent to the curve E/α^1. At this position its lower end (or intersection with line ρ) gives the maximum possible value of ϵ. Continuing the left-hand movement of the intersection of the $R\frac{\tau}{t}$ line with the E/α^1 curve, the value of E still decreases, but ϵ now begins to decrease. At the same time $(E - \epsilon)$ continues to decrease as before, and therefore so also does A and a. Note that during this fall of ϵ, the intersection on the curve further to the right-hand has no physical meaning. It is thus evident that there is no ambiguity between these two intersections. The two belong to quite different values of A and a, and of, therefore, τ, the external resistance; these different values, however, corresponding to the same value of ϵ.

It is evidently by this arrangement that the nearest approach can be made to constant external voltage. Roughly speaking, this result is reached by making $R\frac{\tau}{t} = k$. As already mentioned, k can be made equal to a given value of $R\frac{\tau}{t}$ (within certain limits), by regulating the speed to make it so. But this is not the proper procedure. The speed should be settled among the first elements of the design in accordance with the energetic requirements to be fulfilled by the design. So also are settled the elements which fix the form of the curve E/α^1, and also R and ρ and τ (τ depending chiefly on the "efficiency" demanded). There remains, however, t undetermined by these more fundamental considerations. Therefore, the nearly constant external voltage is obtained by making $t = \frac{R}{k}\tau$.

Or, rather, t is to be made a little greater than this value. How much greater can be determined exactly with great ease by half of the diagram. The ends of the stretch of the E/α^1 curve to be used in ordinary working are first determined by considering the values of E required for the machine to work as may be desired in the two extreme cases of minimum and maximum resistance ever used. The slope of the chord joining these two points of the E/α^1 curve is to be used in the equation instead of k, and the number of turns thus determined for the series coils will give the greatest possible constancy to ϵ consistent with the other elements of the design already determined.

In motors compound wound, and with the series coils inside the shunt terminals, the value of α^1 for the E/α^1 curve remains the same as for generators—viz., $\alpha^1 = \alpha + A\frac{t}{\tau}$. But ϵ is now greater than E and $A = \frac{\epsilon - E}{R}$. A line from the point at the height ϵ on the ρ line (and therefore with horizontal ordinate α) to the point on the $E\alpha/^1$ curve at height E, slopes downwards to the right hand; that is, it has a negative tangent of inclination to the horizontal axis, this tangent being as before $\frac{\epsilon - E}{A\frac{t}{\tau}} = R\frac{\tau}{t}$. Fig. 10 illustrates the construction of the characteristics, internal and external. The parts of the curve E/α^1 and the line ρ below their intersection have evidently no application here, because throughout this part of the diagram no line can cross from a *higher* point on the ρ line with a *negative* slope to a *lower* point on the curve. All values of $R\frac{\tau}{t}$ used as a negative slope give possible results, the limiting case being again the pure shunt wound machine in which the line $R\frac{\tau}{t}$ is vertical.

It must be noted as one of the most remarkable distinctions between generator and motor working that in the motor it is not necessary that the initial slope of the E/α^1 curve should be greater than ρ, as was seen to be the case in generators. If it be less, the construction of Fig. 10 may be followed down to the origin where both ϵ and E become zero. If it be greater and the curve cross the ρ line at height E_k, this is the lowest value of ϵ and E_k at which the machine will work at that speed as a motor. At this limit $\epsilon = E$, and, therefore, no current passes through the armature; it all passes through the shunt coils. The shunt current magnetises the field so that at this speed the counter-electromotive force just balances the external positive voltage between the terminals. Since there is no armature current, there is no mechanical moment being driven and no horse-power being developed in the motor; it is running "empty" at the given speed. At this limit the external current equals the shunt current α. With a diminished external current the machine could be run as a generator in series with the other generator in order to reinforce its action

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—of course, on the condition that mechanical power is *supplied* by the belt to drive it.

From Fig. 10 it will be noticed that after the armature current A has been found by placing $(\epsilon - E)$ under the R line, the external current a is found by *adding* a to A instead of subtracting, as in the case of the generator.

It should also be noted that the same machine run as a motor has an E/a^1 curve a little higher than it would be when the machine is run at the same speed as a generator, because for equal ampere-turns on the magnets the motor has the smaller armature current, and, therefore, also smaller armature self-induction and cross-magnetisation.

(To be continued.)

DOUBLE-POLE TWO-WAY SWITCH.

Our illustration shows a new form of switch, made by Messrs. Woodhouse & Rawson, which is likely to find favour with those who advocate the double-pole arrangement of switches. Its construction contains one or two interesting novelties. It will be seen that the brushes are built up in a somewhat different way from the well-known multiple brush hitherto employed in switches of Messrs. Woodhouse & Rawson. They are given a still greater individuality of movement by separating each part from the adjacent one with a washer in the centre, and for simplicity of construction they are made with square corners in place of round. The crossbars which connect the two brushes are of vulcanite, which possess sufficient strength and the necessary elasticity and insulating properties. The method of attachment for the cables is the very convenient movable socket form into which the cable is sweated. The switch appears to be well designed for a class of work which is in common demand.

NOTES ON ALLOYS.

I.

We propose reviewing from time to time the progress made in the manufacture of alloys or in their industrial application, but in this our first notice we do not intend to do more than briefly note the direction in which improvements are now being made, reserving for future descriptions details of the more important patents and developments as they are brought before the public.

By far the most interesting alloys from an industrial point of view are the special steels which have been introduced within the last year or two, and which have originated from the careful analyses of many chemists, who have shown that minute percentages of foreign elements have an important influence on the quality of the iron and steel containing them. Considerable attention has been devoted to these new steels in France, and several French manufacturers are now making these steels of definite composition and possessing definite physical qualities. They are known commercially under the names of manganese-steel, silicon-steel, chrome-steel, copper-steel, tungsten-steel, titanium-steel, and nickel-steel. We have in a recent article (see *Industries*, Vol. VII., page 526) drawn special attention to the last of these, and have there pointed out that the increase in the visible supply of nickel will no doubt tend to induce manufacturers to turn their attention to this remarkable alloy. We do not propose to discuss the merits of these other steel alloys, but refer the reader to the summary of their properties and composition as at present known to the appendix of Howe's treatise on "The Metallurgy of Steel," which has recently been published by *The Engineering and Mining Journal*. Visitors to the Paris Exhibition must have been struck with the specimens of ferro-chrome and chrome steel that were then exhibited, and noticed that Holtzer and the manufactory at Firminy have used these alloys to a considerable extent for the manufacture of projectiles and thin plates for protection against musketry. Chrome steel is also used for the manufacture of files and other cutting instruments. Most of this chrome steel is at present made in crucibles, although some French makers have adopted the basic open-hearth furnace with success.

The establishment of the manufacture of aluminium on a sound commercial basis has also given an incentive to the study of the alloys of this metal, and has introduced into the market a series of copper-aluminium alloys which are competing with the older brasses and bronzes. These alloys, varying in content of aluminium from 12 to 2 per cent., differ widely in their physical properties, and seem to have a wide future before them. The alloy containing the smallest percentage of aluminium has been used by Christoffle in Paris for many years for casting models of works of art, while those containing a larger quantity of aluminium are in use for bells, musical instruments, and as a substitute for gold; and that with 10 per cent. of aluminium has a hardness, ductility, and elasticity equivalent to that of the best kinds of steel. An admirable *résumé* of our present knowledge of these aluminium bronzes has been contributed to a recent number of Dr. O. Witt's new journal *Prometheus* by D. E. Heim.

In the manufacture of alloys, as is well known, great care is required to prevent the oxidation of the more oxidisable metal present, and also to avoid the introduction of foreign elements which may deteriorate the quality of the metal produced. Many ingenious patents are continually being applied for to cover these difficulties, and we shall hope to discuss them as they come before us from time to time. Brin, in a patent last year for the manufacture of the triple alloy of copper, iron, and aluminium, has claimed the use of an atmosphere of aluminium chloride, or a mixture yielding the same to avoid the loss of metal by oxidation, and as an illustration of methods for the removal of foreign elements from alloys we may cite what appears to be a valuable patent of Professor Roberts-Austen and others, who claim to purify the alloys of iron from sulphur by treating the molten metal with an alkaline mixture containing a cyanide or cyanogen compound. With these rapid strides in the manufacture and application of new alloys little has been done towards contributing to our knowledge of the chemical composition of these important bodies, but we should think that with the increase of data now obtained further research will before long formulate a theory which will generalise our present empirical data in a way which will be the means of indicating the direction in which future fresh discoveries may be made. We drew attention some time past to a communication by Mr. A. P. Laurie on the constitution of the copper tin alloys, and he has recently communicated to the Chemical Society the results of a further investigation on the constitution of alloys. It appears from these experiments that the electrometer method confirms the conclusions arrived at by Matthiessen, that lead, tin, zinc, and cadmium do not combine with each other when mixed together. It will be remembered that in his earlier paper the author pointed out that from the behaviour of copper-zinc and copper-tin alloys in a voltaic cell it is evident that compounds of the formulæ Cu_2Sn and Zn_2Cu exist in these two alloys. The text-books usually give the formula Sn_3Pb for the lead-tin alloy, but the author finds that the composition of the alloy, as well as its electrical behaviour, does not warrant this statement, and Spring, in a recent paper, states that he does not believe that these metals form a compound. The usefulness of the lead-tin alloys for wiping a joint is owing to their behaviour on cooling, one alloy apparently crystallising out after another, so that they remain in a pasty state for a considerable range of temperature.

THE EXAMINATION OF COMMERCIAL GLYCERINE.

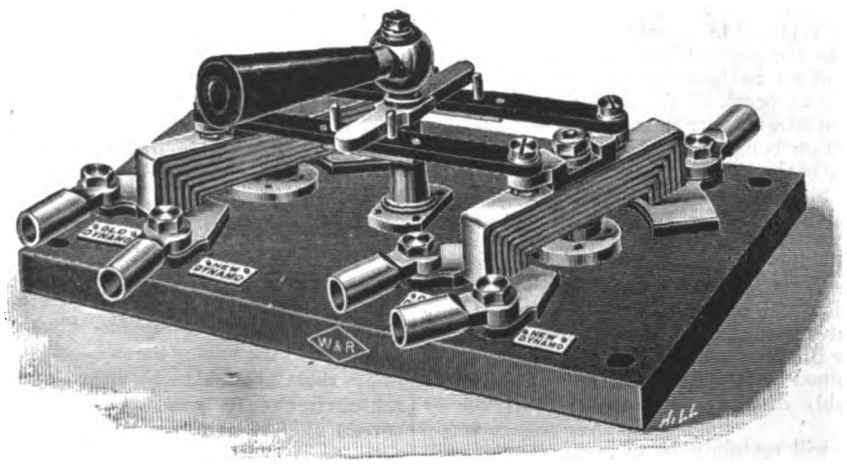
In the United States a different import duty is imposed on crude and refined glycerines, which renders it necessary for the United States Laboratory to analyse every import of crude glycerine, in order to prevent possible attempts to enter through the Custom House a partially refined glycerine as the crude article. Mr. Wainwright, in a recent article published in the journal of the American Chemical Society, after reviewing the methods at present adopted for deciding this point, advocates the use of the following tests as extremely reliable and admitting of very nice distinction between crude and refined (or distilled) glycerine, which may be valuable to buyers of glycerine in this country. A 10-grm. sample is heated in a tared platinum capsule until it inflames, when the source of heat is removed, and it is allowed to burn spontaneously. Distilled or refined glycerine will yield from 0 to 0·5 per cent. of carbonaceous residue, rarely more than 0·5, and never as much as 1 per cent., whereas crude glycerine frequently yields as high as 10 per cent. The ash may be determined by igniting this carbonaceous residue, but he points out that Sulman and Berry's conclusions on the value of the ash determination will not apply to a crude glycerine which has been made by the saponification of fats with steam. He also advocates the use of the silver nitrate and basic lead acetate tests, which he uses as follows:—5 c.c. of the sample is dissolved in 20 c.c. of distilled water, and 5 c.c. of a 2 per cent. solution of silver nitrate is added, and the mixture allowed to stand at rest for an hour. Crude glycerines give a flocculent precipitate, while refined glycerines give a darkening of the solution accompanied with a slight reduction of silver. The lead acetate test consists in adding to a basic solution (made by adding 10 grms. lead acetate, 8 grms. litharge, to 500 c.c. distilled water, then boiling and filtering) its own volume of a solution containing equal volumes of the sample and distilled water, and shaking and allowing to stand at rest for one hour, as in the silver test. Refined glycerine remains unchanged, whilst crude glycerine will always give more or less of a flocculent precipitate. Refined glycerine should also give no reaction with ammonia, ammonium oxalate, barium chloride, nitrogen peroxide (gas), or Fehling's solution, whilst crude glycerine often responds to these tests.

THE ESTIMATION OF OXYGEN DISSOLVED IN WATER.

Dr. Thresh, in a recent communication to the London Chemical Society, has described an entirely new process for estimating the oxygen dissolved in water, which is of great simplicity, and apparently gives as accurate results as the elaborate method used by Schützenberger, and subsequently modified by Dupré and Dibdin, Roscoe and others. The process is based on the observation that whereas, in absence of oxygen, nitrous acid and hydrogen iodide interact to form iodine, water, and nitric oxide; in presence of oxygen the nitric oxide becomes reoxidised, and, serving as a carrier of the oxygen, an amount of iodine equivalent to the oxygen present is liberated, in addition to that resulting from the initial action of the nitrous acid. The solutions employed are (1) a solution containing ·5 gram sodium nitrite and 20 grams potassium iodide in 100 c.c.; (2) a solution of 7·75 grams sodium thiosulphate (hyposulphite) in 1 litre, 1 c.c. of which corresponds to 0·25 milligram of oxygen; and (3) a solution of starch and (4) dilute sulphuric acid (1:3). The apparatus consists of a wide-mouthed glass bottle of about 500 c.c. capacity, fitted with a four-holed india-rubber cork. Through one of these holes is fitted a separator, containing the water to be

DOUBLE-POLE TWO-WAY SWITCH.

Constructed by Messrs. Woodhouse & Rawson, London.



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examined and 1 c.c. of the nitrite iodide and 1 c.c. of the acid solution, while through a second hole passes a glass tube fitted to a burette containing the standard th osulphate solution. The third and fourth holes contain inlet and exit tubes for coal gas, which is introduced into the bottle for some time before the experiment in order that all the air in the apparatus may be expelled. After fifteen minutes have elapsed the stopper of the separator is removed and is replaced by a cork fitted with an india-rubber tubing to the gas exit tube in the bottle, which prevents access of air to the water as it flows into the bottle when the stopcock of the separator is opened. The water is then titrated with the thiosulphate solution, the starch solution being added through the separator when the colour of the iodine is nearly destroyed. Concordant results are easily obtained by this process, and the author has found that the small quantity of oxygen present in coal gas does not interfere with the accuracy of the method. By previous blank experiments, and allowing for the effect of the oxygen in the thiosulphate on the assumption that as much oxygen is dissolved in it as distilled water would contain at the same temperature, the author has obtained results which closely agree with those obtained by Roscoe and Lunt for the oxygen content of freshly distilled water at different temperatures.

The method will certainly be of great value for determining the quantity of oxygen present in river waters and sewage by those chemists who have only occasionally to make this determination, and also in those cases in which it is desirable to make an examination of the quality of a water immediately the sample is taken, as the apparatus can easily be removed and fitted up at short notice.

Notes.

STANDARD SMALL SCREW THREAD,

The Electrical Section of the London Chamber of Commerce has appointed a small committee to push the adoption of the British Association threads.

EXCHANGE OF INFORMATION.

Mr. R. E. Crompton is anxious to arrange that the various electrical supply companies should exchange information as to costs of working. The Electrical Section of the Chamber of Commerce will, it is hoped, bring this useful exchange about, not only with reference to supply, but to other branches of electrical business and manufacture.

A NEW CANAL IN HUNGARY.

Her Majesty's Consul-General at Budapest has sent to the Foreign Office the conditions on which the Hungarian Minister of Commerce applies for tenders for the construction of a navigable canal near the Iron Gates of the Danube, and for the removal of obstructions in the river, and for other works connected with these undertakings. For the canal and some of the other works tenders are to be sent in by March 31st, while tenders for methods of, and apparatus for, blasting were to be sent in before to-day. Forms of tenders in German and Hungarian can be seen, and further information obtained, by personal application at the Commercial Department of the Foreign Office.

THE ESTIMATION OF PHOSPHORUS IN IRON AND STEEL.

Mr. Norris has modified the method recently proposed by Dr. Drown, in the journal of the American Institute of Mining Engineers, which renders it much superior to and more rapid than the Emmerton process usually adopted. The following is an outline of the process :—Five grams of pig iron or steel are treated in a large covered beaker with 90 c.c. of nitric acid (s.g. 1·135) for steels, or 120 c.c. for pig irons. After heating on an iron plate until all action ceases, and the solution begins to boil, 20 c.c. of a solution of potassium permanganate containing 8 grams to the litre are added. After boiling for a few minutes, a precipitate of manganese dioxide appears, indicating that excess of permanganate has been added A small crystal of tartaric acid is next added to dissolve the manganese dioxide which has been thrown down, and the solution transferred to a half-litre spherical flask, and 10 c.c. of nitric acid (s.g. 1·40) is added. The solution has then a volume of about 90 c.c., but in the case of pig iron the solution is first made up to 100 c.c. with water, the graphite filtered off, and 80 c.c. of the filtrate is treated with the 10 c.c. of nitric acid. The solution is then heated to 90° C., and 80 c.c. of ammonium molybdate solution added, the flask stoppered, wrapped in a cloth, and agitated for five minutes. The precipitate is then reduced with zinc, and titrated with permanganate, as in Emmerton's process. The molybdate solution is prepared from 100 grams of molybdic acid dissolved in 400 c.c. of strong ammonia, and then mixed with 1,200 c.c. of nitric acid (s.g. 1·20).

APPLICATION OF ELECTRICITY TO TRAMWAYS.

It is said that Edison has prophesied that in twenty-five years electricity will in great part have displaced horses, and it looks as if that prophecy was likely to be fulfilled. In Scranton, Pennsylvania, electricity has almost banished animal power from the street railways. The People's Street Railroad Company, which now works all the lines in the city, has twenty-five miles of railway under its charge, and the whole arrangement is found to work in a very satisfactory manner, as the cars run very smoothly, and do not experience any difficulty in climbing the steepest gradient. In the United States there are said to be 600 miles of electric tram and railway track in daily use, and on the Continent there are several electric tram lines in operation. In this country, however, comparatively little progress has been made, although there are now signs that the purely experimental stages are past. The few instances which have been carried out are the short railways at Brighton, Blackpool, and Portrush, and the recently inaugurated electric tramcars at Northfleet, and those on the Barking line of the North Metropolitan Tramway Company.

ARTIFICIAL MANURES.

According to *Kuhlow's*, the convention among the artificial manure manufactures has been very disadvantageous to the German agriculturists. This is especially marked in the ground Thomas slag trade, as the expiration of the contract with the German Agricultural Society was followed by a considerable rise in the price of that article. At the end of 1887, under the contract, the price per 1,000 kilos. had been fixed at 310 marks, while at the end of last year 510 marks was the price demanded. The manufacturers, by selling their slag meal to foreign countries at abnormally low prices, have been enabled to keep up the high prices in their home market. Phosphoric acid has also advanced in price, and last year in Germany it amounted to 80 per cent. increase on the former year. The artificial manure consumers have therefore been advised to buy from England and Belgium, where these products are far cheaper, and we understand that several contracts have been made for supplying Germany with Thomas slag meal from this country. Our competition in Germany will therefore be to the advantage of the German farmer, and probably result in the manufacturers restoring their prices to a fair level.

MACHINERY FOR CLEANING COAL.

This subject has been inquired into by a Committee of the Mining Institute of Scotland, and visits have been paid to numerous collieries in England and Scotland. The Committee has reported, and gives an account of the machinery in use at each of the places visited, but, with the proverbial caution of Scotchmen, do not commit themselves to a statement as to which of the systems is the best. They say what they saw, and leave the selection to the reader of the report. The following general deductions are made :—In the first place, the methods and appliances most suitable depend very largely upon local circumstances. The best results are obtained where attention is paid to the form of hutch and tumbler, the inclination of screens, and the drop into waggons. The best contrivance for screening where a large output has to be dealt with is the single or double jigger, or shaking machine, going at about 100 strokes per minute. For picking a shaking screen, or the travelling band, or both combined, is more economical. The dry process is universally employed for round coal—say above 1¼in. cube—and can be successfully applied to nuts from ¾in. upwards, where the refuse does not exceed 2, 3, or even 4 per cent. In the wet process, it is desirable to have the arrangement so that the small coal can be delivered direct from the screens into the washing tanks without the intervention of waggons. Where the coal and the refuse approach each other in specific gravity, the trough washer gives the best results. The felspar washer is the most effective for removing refuse from the smaller sizes—say under ¾in. The Robinson washer is cheap as regards first cost and up-keep, and requires little water, but a good deal of attention. Generally speaking, more elaborate machinery is effective in avoiding waste in preportion to its cost.

SULPHUR COMPOUNDS IN CRUDE PETROLEUM.

In the last number of the *Ber. d. deutsch Chem. Gesellschaft* Charles F. Mabery and Albert W. Smith have contributed a note on the results of their investigation on the sulphur compounds of the crude petroleum from the Ohio oil field. They find that on fractionating the crude oil, the sulphur compounds collect in the portion boiling between 200° and 300° C., and that they can be easily separated from this fraction by the addition of concentrated sulphuric acid. From this acid solution, after neutralising with lead carbonate or lime, the compounds separate on warming. They appear to be very unstable, but when the aqueous solution is distilled, a yellow oil collects in the distillate, which contains 14·97 per cent. of sulphur. When they attempted to distil the oil, it decomposed, evolving sulphuretted hydrogen. Under diminished pressure the oil was fractionated into portions, which, on being tested, contained no thiophene or mercaptan compounds, but consisted of various organic sulphides. The portions having the lowest boiling point yielded on distillation a hydrocarbon which formed a bromine addition compound of the formula $C_{17}H_{14}Br_2$. By the addition of alcoholic mercuric chloride they also succeeded in isolating the double compounds of methyl, ethyl, and propyl sulphides, and obtained indications of the presence of buryl sulphide.

SEMI-JUBILEE OF A GLASGOW LOCOMOTIVE FIRM.

The semi-jubilee of Messrs. Dubs & Co.'s Glasgow Locomotive Works took place recently, the works having been started in 1864. During the interval the firm had sent out 2,500 engines, and these are running in every part of the world, and by their working showed that Dubs & Co. turned out work which was second to none of its kind. Measured by the number of men employed, Messrs. Dubs & Co. now hold the second position in the kingdom among locomotive builders. In the month of September last the following were the number of employés in the leading establishments in Great Britain :—

Neilson & Co., Glasgow	2,166
Dubs & Co., Glasgow	1,744
Beyer, Peacock, & Co., Manchester	1,735
Sharp, Stewart, & Co., Glasgow	1,330
Kitson & Co., Leeds	1,260
Vulcan Foundry Co., Newton-le-Willows	538
Nasmyth, Wilson, & Co., Patricroft	518
Manning, Wardle, & Co., Leeds	389
R. Stephenson & Co., Newcastle	300
Hunslet Engine Co., Leeds	286

BUTTER SHOWS.

A very interesting series of butter shows has been organised at Copenhagen, by Professor Fjord, the well-known director of the Dairy Section of the Danish Agricultural Department, the first of which was opened on the 18th of November last. It appears that the shows hitherto held had not been of much practical benefit, and with a view to maintaining the position of that country as a producer of first-class butter, and effectually tracing to their source any faults in manufacture, an entirely new system of shows has been started, in which a large number of dairies, dairy experts, and leading butter merchants of Copenhagen and the provinces will co-operate in endeavouring to advance the general interests. It is expected that the evidence and practical information thus collected can hardly fail to be most instructive to all concerned. In the printed prospectus, setting forth the aim and general arrangement of these shows, Professor Fjord states that, while in many of the countries with which Denmark has to compete the most strenuous efforts are being made to improve and develop the yield of butter, the produce of his country has not gained in quality by the rapid increase in the number of associated dairies, whose members, he says, are often not competent to look after the important interests entrusted to them. Complaints, it seems, are not unfrequently heard of want of good keeping qualities and presence of water in butter; and now that the export of this article has become one of the principal sources of the country's income, it is held to be of the utmost importance that every means should be taken to maintain the acknowledged position which it has acquired in the markets of the world.

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Patent Record.

(Compiled from "The Illustrated Official Journal (Patents).")

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

13th January, 1890.

570. Roots, J. ..... Rotary engines.
580. Brown, A. G. ..... Compound engines.
583-4. Tosh, G. ..... Rolling mill.
585. Meredith, T. ..... Type-writing machines.
592. Honegger, J. ..... Carding engines.
603. Asbeck, W. ..... Friction coupling.
606. Brock & Minton ..... Filter presses.
609. Priestman, Priestman, & Morgan ..... Dredging or lifting machinery.
614. Hood, J. ..... Wheel gearing.
619. Haddan, R. ..... Axle boxes (*Dory*).

14th January, 1890.

624. Eccles, R. ..... Looms.
628. Sloan, R. A. ..... Switches for railways (*Norton*).
629. Moore, B. R. ..... Street car motors.
631. Hartley & Wilson ..... Shuttle boxes.
645. Thornycroft, J. I. ..... Steam generators.
647. Dodge, M. B. ..... Crushing mills.
649. Dodge, M. B. ..... Rock breakers.
650. Dow, G. E. ..... Multiplex pumps.
655. Hall, R. ..... Ordnance.
662. Southgate, T. ..... Breechloading small arms.
666. Bonnard, J. B. ..... Apparatus for cleaning grain.
668. Rigby & Wylde ..... Apparatus for separating solids and liquids.
671. Clark, A. M. ..... Cutting stone (*Foerster*).
672. Wilkinson & Hague ..... Machines for tunnelling.
673. Von Babo, A. ..... Transmitting power.
676. Apostoloff, L. ..... Elevator for fluids and solids.
677. Rawsthorne, T. ..... Carding engines.
680. Maxim, H. S. ..... Armour-piercing projectiles and shells.
684. Crossley, F. W. ..... Gas engines.
685. Simon, Parkinson, & Parkinson ..... Apparatus for treating grain.
686. Mewburn, J. C. ..... Implements for imparting rotary motion (*Low*).
687. Mewburn, J. C. ..... Combination implements (*Low*).
697. Lake, H. H. ..... Looms (*Stafford*).
699. Lake, H. H. ..... Milling machines (*Woodruff*).
700. Lake, H. H. ..... Crushing machines (*Krom*).
704. Colvin, R. J. ..... Rail joints.
706. Scaife, W. L. ..... Lock gates and dams.
707. Lawson, G. ..... Machines for cutting rock.

15th January, 1890.

712. Greaves, W. McG. ..... Furnaces.
728. Bergmann, T. ..... Firearms.
729. Bergmann, T. ..... Locks for firearms.
731. Clifford, W. ..... Pressure gauges.
732. Brown, B. ..... Boiler flues.
739. Bartlett, C. H. ..... Weighing apparatus.
740. Clark, W. G. ..... Watertight ports and scuttles (*Clark*).
743. Feather & Greenwood ..... Hank dyeing machine.
745. Greaves, W. McG. ..... Furnaces.
749. Pritchard, J. ..... Cast iron mould.
752. Austin, H. K. ..... Dust shields for rolling stock and machinery.
753. Healey, Milne, & Healey Reeling machines.
754. Healey, Milne, & Healey Swifts for reeling machines.
757. Rogers, W. H. ..... Axles.
758. Wingen, A. ..... Combined hydrant and sluice valve.
766. Michaud, J. ..... Printing machine.
774. Jones, D. ..... Securing tubes in plates.
780. Emery & Brigham ..... Anti-friction devices for car axles.
785. Chance Brothers & Co., & E. F. Chance ..... Machinery for rolling glass.
787. Scott, A. E. ..... Rail for railways.

16th January, 1890.

799. MacLellan, J. A. ..... Moulds for casting.
801. Blance, R. P. ..... Propellers.
810. Schofield, H. ..... Glands of piston rods.
811. Truswell, W. ..... Furnaces.
813. Imray, H. ..... Rolling metal bars (*Moerchen*).
814. Allison, H. J. ..... Printing machines (*Morris, Gould, Fairchild, & Roberson*).
818. Fortune & Bentham ..... Drilling and punching machinery.
822. Tetlow, H. ..... Textile machinery.
823. Barlow, H. B. ..... Spinning machines (*Scott*).
824. Krause, G. M. ..... Gas engines.
825. Albert, W. ..... Machines for drying textile materials.
826. Muncaster, H. ..... Balanced slide valves.
832. Hope, G. F. W. ..... Sand separators.
835. Thomson, T. ..... Dams for retaining water.
837. Mannesmann & Mannesmann ..... Transmitting power.
838. Mannesmann, R. ..... Composite guns.
839. Mannesmann & Mannesmann ..... Driving shafts.
840. Mannesmann, R. ..... Metal furnaces.
841. Mannesmann, R. ..... Feeding and mixing metal in furnaces.
842. Mannesmann, M. ..... Fire bars.
843. Mudgemarchant, R. ..... Fluid-pressure engines.
856. Kluge, A. ..... Crank shafts.
861. Harfield, W. H. ..... Steering gear for ships.

17th January, 1890.

870. Garrett, G. W. ..... Vapour engines.
876. Darling & Darling ..... Brake.
877. Elliott, D. ..... Furnaces for heating iron.
883. Skett, M. ..... Breechloading small arms.
886. Ogden, J. E. L. ..... Metallic packing.
894. Mewburn, J. C. ..... Air-compressing machines (*Proell & Kummel*).
908. Thoms, W. A. ..... Drawn or rolled metal articles.
909. Morgan, W. M. ..... Elevated railways.
912. Horn, W. W. ..... Piston rod packing (*Grob*).
916. Ballard & Fisher ..... Railroad scales.
917. De Rechter, F. ..... Railway vehicles.

18th January, 1890.

922. Holden & Ashworth ..... Machinery for winding yarns.
927. Pilkington, W. W. ..... Glass annealing kilns.
928. Tweedale, S. ..... Carding engines.
930. Bradbury & Tonge ..... Looms.
931. Kendal, G. C. ..... Boiler furnaces.
935. Austin, H. K. ..... Axle boxes.
943. Wise, W. L. ..... Steam plows (*Brown*).
947. Urry, E. C. ..... Steam engines.
948. Howard, T. H. ..... Ordnance.
952. Grimston, G. S. ..... Oil burners for furnaces.
953. Hart & Baynes ..... Carding engines.
958. Ferrière, L. Le G. ..... Rotary engines.
959. Davy, C. ..... Pumping engines of presses.
960. Saunderson, H. P. ..... Machines for cleaning corn.

ELECTRICITY.

13th January, 1890.

600. Mewburn, J. C. ..... Dynamo-electric machines (*Carriere*).
607. Peacock & Langb ..... Electric motors.
615. Evered & Rudling ..... Electric lighting.

14th January, 1890.

665. Crampton, P. J. R. ..... Electric motors.
693. Currie, S. C. C. ..... Electric motors.
694. Clegg, J. ..... Electric lamps.

15th January, 1890.

718. Nichols, A. E. ..... Electric lamp holders.
761. Dahl, O. ..... Electric batteries. (17th June, 1889.)
771. Oesterreich & Genest ... Telephone system.

16th January, 1890.

804. Gardner, W. J. ..... Electric brake.
836. Gwosdepf & Bunge ..... Telephonic circuits.
847. Graham & Allen ..... Electrical communicators.

17th January, 1890.

872. Perry, J. ..... Alternating dynamo.
873. Perry, J. ..... Electric supply meters.
878. Swinburne, J. ..... Dynamo machines for producing electric energy, ventilation of culverts for distributing it, accumulators for storing it, and motors for utilising it.
882. Patterson, G. W. L. ..... Linesman's detectors.
911. Pitt, S. ..... Insulating conductors (*Atherton*).

18th January, 1890.

941. Lineff & Bayley ..... Electric tramways.
950. Thompson, W. ..... Dynamo machines.
962. Swinburne, J. ..... Cars worked by accumulators.

CHEMISTRY.

13th January, 1890.

575. Ginster, M. C. ..... Manufacturing manure.

14th January, 1890.

656. Templeman, J. ..... Soaps.
670. Domeier, A. ..... Purifying salt (*Mitting*).

15th January, 1890.

715. Wolseley & Punshon ... Explosive compounds.
724. Hummel, J. J. ..... Red dye.
735. Bang, A. ..... Dyestuffs (*Dahl & Co.*).
764. Barnes, W. H. ..... Paints.
779. Leigh, H. H. ..... Alumina and phosphoric acid (*Lorenzen, Stuhr, & Heinz*).
788. Horn, W. W. ..... Washing gas (*Jarrell*).
792. Guignard & Hédouin ... Alcohol.
794. Maxim & Sedgwick ..... Carburetting gas.

16th January, 1890.

858. Roth, C. ..... Ammonium and sodium salts.
859. White, W. ..... Aluminium.

17th January, 1890.

907. Thoms, W. A. ..... Electro-deposition of alloys.
910. Freund, E. ..... Manufacture of gas.

18th January, 1890.

933. Feld, W. ..... Caustic soda.
938. Lewis, G. H. ..... Distributing oil on waves (*Banzett*).

MISCELLANEOUS.

13th January, 1890.

574. Garniss, F. ..... Spindles.
598. Wynne & Morrison ..... Dry gas meters.
618. Smith, W. E. ..... Alarm signalling.

14th January, 1890.

643. Tullis, J. K. ..... Leather belting.
679. Lockwood, C. S. ..... Belt fasteners.
703. Haddan, R. ..... Dyeing textile materials (*Leplat*).

15th January, 1890.

711. Greaves, W. McG. ..... Ventilator.
768. Teuber, C. ..... Fire escape.
769. Dunn, M. ..... Fire escapes.

16th January, 1890.

800. Tarbath, H. ..... Fire escapes.
864. Lorrain, J. G. ..... Extinguishing fire.
865. Lorrain, J. G. ..... Saving life from fire.
866. Duncan & McLaren ..... Miners' safety lamps.
869. Ball, J. ..... Deep-sea trawling gear.

17th January, 1890.

880. Foster, R. ..... Marine signalling.
893. Ford, A. N. ..... Insulating and waterproofing composition.
903. Charles, E. ..... Vats for dyeing.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form, of such opposition.

Year 1888.

14901. Dougherty.
16486. King.
17220. Jones.
18211. Vaughan (*Weiller*).
18357. Herbert.

1889.

489. Myall (*Judd*).
598. Fisher.
813. Diehl.
935. Leeming & Wilkinson.
954. Capell.
1013. Craig.
1046. Willcox (*The Farbenfabriken vormals Friedrich Bayer & Co.*).
1166. Lowrie & Hall.
1195. Dann.
1200. Davis.
1261. Blackwood.
1339. Smith.
1569. Rivnac.
1577. Youlten.
1619. Ogle.
1750. Shepherd & Dee.
1873. Howard.
1902. De Farranti.
2112. Sidebottom.
2284. Leigh (*Li Hung Sing*).
2302. Robb.
2428. Newman.
2544. Douglas & Smith.
2567. Elwell & Starley.
2694. Goolden & Evershed.
2712. Gladding.
2798. Stansfield.
2962. Lake (*Durham*).
2867. March.
2878. Brindle, Reade, Taylor, & Moulson.
2931. Parnell.
2998. Flavel.
2932. Thompson (*Coté*).
3048. Levinstein.
3010. Jones.
3161. Sinclair.
3075. Nelson.
3318. Bagnall.
3296. Greig & Shaw.
3338. Taylor.
3347. Taunt.
3430. Burn & Macdonald.
3402. Scott & Laurence, Paris & Scott, Ld.
3441. Dreyfus, Bull, & Hall.
3498. Hutton.
3475. Kuhne (*Proell*).
3546. Anderson.
3533. Abel (*The Firm of Siemens & Halske*).
3720. Schindler.
3721. Lea.
3741. Marshall.
3764. Brearley & Brearley.
3787. Jones.
3790. Gray.
3814. Southam & Southam.
3844. Thompson (*The Westinghouse Electric Co.*).
3869. Harper.
3902. Rose.
3918. Thompson (*Blandy*).
3953. Amos.
3970. Matheson.
3980. Oliver.
3994. Tattersall.
4003. Lones, Davies, Davies, & Webb.
4047. Ferrero.
4088. Hunt.
4018. Lord.
4157. Cassels.
4179. Kenyon.
4183. White.
4195. Muhlenbruch.
4231. Sheard & Harrison.
4261. Dallmeyer & Beauchamp.
4264. Phœnix & Kirk.
4279. Seabury.
4354. Parnell.
4365. Hill.
4446. Briggs.
4458. Brewin, Parr, & Kirk.
4462. Johnston.
4469. Webb.
4471. Salendre.
4477. Maxim.
4489. Kellar.
4496. Ellmore.
4507. Bevan & Longworth.
4513. Hallam.
4516. Boyd.
4527. Smith.
4549. Barbet.
4558. Colley.
4570. Capeyron.
4578. Riley.
4590. Hookham.
4593. Boyd.
4613. Knowles.
4625. Chorlton & Scott.
4626. Holland.
4630. Keats (*Keats*).
4634. Shafto.
4643. Langbeck.
4644. Siemens.
4660. Lehman.
4678. Andrews.
4698. Woodham.
4704. Goodwin.
4707. Adams & Paul.
4708. Lock.
4710. Von Oechelhaeusbr.
4720. Rhodes.
4730. Townsend.
4753. Cleeve.
4777. Morton & Morton.
4795. Cudlipp.
4799. Lyndon.
4824. Simon.
4830. Dinz.
4834. Combe.
4869. Irving & Cockey.
4875. Immisch.
4883. Howard.
4928. Bywater & Beanland.
4939. Hughes (*Haum*).
4946. Clunis.
4947. Clunis.
5030. Birch.
5031. De Montravel (*Mavaut, partly*).
5068. Blyth.
5077. Brighton.
5195. Lones, Vernon, Holden, & Bennett.
5349. Freemont.
5352. Mees & Mees.

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5378. Levetus (*Haines*).
5754. Glover & Glover.
6063A. Lake (*Thomson*). (9th April, 1889).
7311. Heathfield.
8234. Burrows & Sarjeant.
9699. Milne.
11661. Hurlser (*Mestern*).
12635. Lancaster.
14450. Dickinson, Emsley, & Seed.
14999. Schuler.
15356. Willcox (*Belleville*).
16060. Ritchie & Eason.
16148. Studte.
16489. Morris&Van Vestraut.
16722. Pound.
17352. Parkin.
17407. Binns.
17630. Smith.
18035. Emery.
18198. Griscom. (16th May, 1889).
18749. Melvin.
18967. Miller.
19159. L'Hollier.
19259. Wheatley (*Leonard*).
19368. Horn & Effinger.
19438. Groth & Constantine.
19789. Rippke.
19805. Allison (*Rushforth*).
19892. Fowler.
19955. Boult (*Mabel*).
19996. Spilker, Bendel, Hahn, & Loewe.
20062. Wagener.
20110. Lane.
20135. Johnson-Johnson.
20137. Spencer.
20153. Godinet.
20166. Schubert & Frederking.
20171. Rochester & Dejean.
20225. Haddan (*Lefèvre*).
28257. Jacques.
20272. Lake (*Cramer, Lindemuth, & Dunstedter*).
20294. Imray (*Kensett*).
20299. Liebing.
20387. Andrews.
5489. Neve & Neve.
5766. Barbezat-Baillot. (8th January, 1889.)
6832. Hampson.
8223. Sloan.
8311. Lloyd & Priest.
9700. Milne.
11744. Thompson (*Heberle*).
14004. Nienhous & Gaetcke.
14886. Barker (*La Bruce*).
14934. Lorey, Getz, & Dickenshied.
15779. Horner.
16119. Dunlop.
16388. Bremner.
16615. Hale.
17016. Day.
17398. Robertson.
17576. Morris.
18021. Thompson (*Williams*).
18044. Douglass.
18235. Green.
18339. Gingell & Stafford.
18956. Williamson.
19052. Doddrell.
19207. Worden. (29th April, 1889.)
19427. Winchester.
19646. Coney & Hewitt.
19744. Marsden.
19801. Burges.
19871. Munton.
19893. Lake (*Van Wagenen*).
19962. Wright.
19999. Fox.
20040. Siegener.
20097. Douglas & Smith.
20129. Brock.
20136. Gerlach.
20152. Martignoni.
20154. Cooper.
20169. Malam.
20170. Mills.
20216. Resch & Grand.
20237. Rodiger.
20263. Jay.
20273. Lake (*Pain*).
20284. Van Duzer.
20295. Sayer.
20345. Giebel.
20389. Kenoyer.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

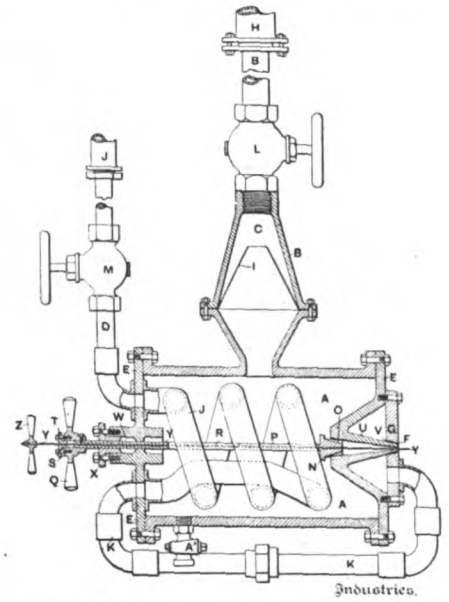
ENGINEERING.

Wire Ropes.—*E. E. Bird, London.*—This improvement consists in making wire ropes of an elliptical section. In such a rope greater flexibility is gained in comparison to its strength than if the rope was circular, and from the fact that the rope will bend in the direction of its greatest flexibility the tendency to revolve will be obviated. Claims: (1) The manufacture of a core for a wire rope, band, or cable, of an elliptical or oblong shape, having its major diameter in the same plane throughout its entire length; (2) the drawing of a core through a tube, or through a collar, and between a pair of rollers, to ensure its major diameter being in the same plane throughout its entire length; (3) the manufacture of wire rope, band, or cable, of an elliptical or oblong shape, or as nearly as possible elliptical or oblong as is consistent with the ropes laid or twisted round a core, and having its major diameter in one and the same plane throughout its entire length.—No. 2464. February 12th, 1889.

Bending Plates.—*D. R. Radcliff, London, & J. M. Garvey, Liverpool.*—The machine here described enables the plates to be bent to the required shape without removal from the bending table. A suitable cylinder or shaft of metal, turning on journals, is mounted upon bearings on the bending table. From this cylinder a fourth is removed, the part removed being such as would be contained by two planes passing through the axis of the cylinder at right angles to each other. Another part of the cylinder similar to that removed is detached from the rest, but held in position by being bolted to eccentric plates, which are mounted on the journals of the cylinder. The eccentric plates hold the detached portion, which constitutes the former, in its original position, and they are connected to the main portion of the cylinder by catches. The face of the detached part or former nearest the cylinder is reduced to permit the plates to be bent being passed between the two. The surface of the bending table is level with and projects to the centre of the cylinder. The operation of the machine is as follows:—The plate is passed along the bending table into the slit between the former and the cylinder until the point at which it is be bent is at the centre of the cylinder. The cylinder and former are now revolved together, and the plate being held between the two is bent on the edge of the table at the centre of the cylinder. When the plate has been bent the cylinder is released from the former by the catches, and the cylinder thus assumes its original position by revolving backwards upon its journals. As the cylinder revolves backwards the eccentric plates cause the former to be raised, and so enable the plate bent to be easily removed. Four claims are made.—No. 17,362. November 1st, 1889. 8*d.*

Lubricators.—*E. D. Bangs, Milwaukee, U.S.A.*—The lubricator here described is intended for those parts of engines which have reciprocating motion. The body, or container, for the lubricant is of cylindrical shape. In a thickened portion of the side of the container is made a small vertical channel which extends from within and at the top of the cylinder to and through its bottom, and a screwed projection on the bottom for attaching the ubricator to the part to be lubricated. On the top opening of the channel, within the cylinder, is an adjustable sliding piece, which is made to partially close the channel, and so regulate the flow of oil to the part lubricated. This sliding piece has a cup-like aperture, which collects and guides the oil to the channel. Upon the opposite side of the container to that in which is the channel is fixed a piece of bent plate similar in shape to a spoon. The action of the lubricator is due to the reciprocating motion of the part to which it is attached throwing the oil up by the aid of the spoon unto the mouth of the channel. From the channel it trickles down into the part to be lubricated. An advantage of such a lubricator is that it only feeds whilst the part is in motion. Five claims are made.—No. 17624. November 5th, 1889. 8*d.*

Feeding Liquid Fuel to Furnaces.—*G. R. Young, Charlton, Kent.*—An important feature in this invention is the employment of a jet of steam at the top and bottom of the discharge nozzle for drawing the liquid fuel out in a spray into the furnace. Another feature is the provision of appliances for separating from the liquid fuel any impurities and any ammonia or water contained in it. The illustration shows a central vertical section upon the



side elevation of the apparatus. A is a cylindrical or other suitably shaped chamber or receptacle for the tar, oil, or other liquid; B is a pipe communicating with any suitable supply of tar, oil, or other liquid fuel; C is a strainer or filtering chamber placed between the said pipe and the chamber or receptacle A; D is another pipe communicating with any convenient source of steam supply. The steam passes from the pipe D, round the coil J, along pipe K to the chamber U, from the chamber U it passes out through the opening F from between the nozzle and the plate G. The opening in the plate G is oval, whilst the nozzle is round, thus the openings F for the discharge of the steam are of a crescent shape. The discharge of the steam through F induces a flow of liquid fuel through the nozzle, the flow being regulated by the adjustment of the rod Y and valve N in a manner apparent from the drawing. Eleven claims are made.—No. 8118. May 15th, 1889. 8*d.*

Governors.—*A. W. Cooper, Dundee.*—The inventor describes a form of governor preferably adapted to control the action of trip valve motions. Upon the vertical shaft is a collar C, which slides upwards and downwards with the motion of the balls. The collar C slides upon a feather fixed in the shaft, and it is constructed with flanges D and a groove E. In the groove E

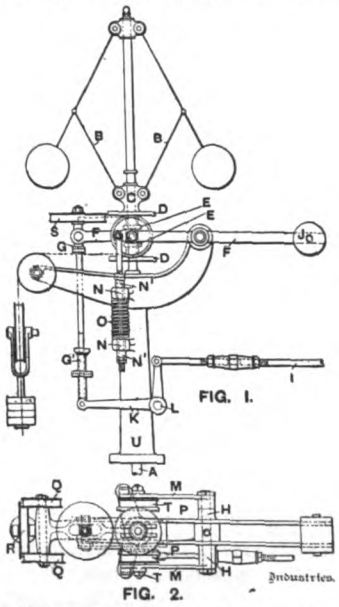
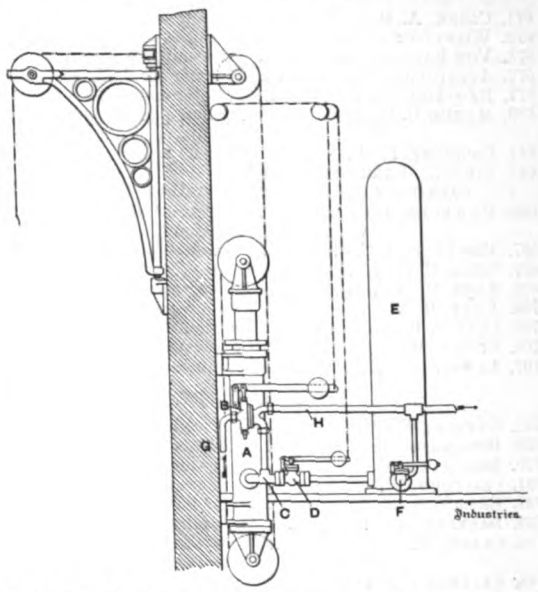


FIG. 2.

works part of a weighted lever F, and between the flanges D are rollers T. Upon one end of the lever F is a pulley S, whose revolution operates an adjustable joint G^1 which controls the valve motion through the lever K and rod I. Round the pulleys S T Q and tension pulley R passes an endless band. The action of the appliance is as follows:—As the rollers T only just clear the flanges D, any distinctive rise or fall of the latter causes the former to be revolved in one of two ways. The revolution of the rollers T gives motion to the endless band, and thus also to the pulley S. The pulley S revolving, operates the adjustable joint G^1, and so the trip valve motion is controlled. Claims: (1) The improvements for the automatic regulation of steam distribution within steam engines as prime movers; (2) the employment of floating stirrup spanners with discs for transmitting motion; (3) the employment of floating collar, with discs gearing with vertical rods; (4) method of adjustment for floating of disc by springs between brackets and adjusting nut; (5) tension arrangement for lever arrangement.—No. 1360. January 25th, 1889. 8*d.*

Spinning and Doubling Machines.—*J. Dickinson, Manchester.*—The object of this invention is to prevent what is known as "ballooning" on ring frames, especially when spinning or doubling upon bobbins of more than five inches in length. The method of carrying this into effect will be seen from the following claims. Claims: (1) So mounting the guide wire flaps or lappets of ring spinning or doubling frames that they can be brought down below the horizontal position to within a very short distance from the tops of the spools when commencing a fresh set of cops, and then raised up above the horizontal position, either by hand or automatically, as the winding proceeds; (2) refers to a form of guide wire flap, constructed by inserting the guiding wire into one end of a block of wood which is attached at the other end to a short piece of tube. The tube is supported by a rod passing through it, making a hinged like joint for the flap. A pin passes through a slot in the tube into the supporting rod, to keep the flap in place and at the same time permit it to be turned up for piercing up. The rod is attached to a hand lever by which it is turned and the wire guide raised or lowered; (3) refers to a modified form of the invention; and (4) to automatic arrangement for raising and lowering the guide wire.—No. 3321. February 25th, 1889. 8*d.*

Hydraulic Cranes.—*H. C. Walker & R. Carey, London.*—An improvement is here made in the method of bringing back the crane chain when the crane has been used for lowering goods. By the use of an air reservoir the water in the lifting cylinder is used to bring back the chain without any other pressure being expended on it but that caused by the lowering of the load. Referring to the illustration, A is the lifting cylinder and B its controlling valve, with inlet G and exhaust outlet H. The lifting cylinder is also in communication with an air vessel E through the pipe C and its controlling valve D. The valves are shown to be worked by chains. When lowering a load the water in the cylinder A is allowed to escape into the air vessel E by raising the valve D. The water passing into the air vessel E compresses the air contained in it, and stores up energy. When the chain is



to be brought in, the valve D is reopened and the water passes back from the air vessel into the lifting cylinder under the pressure of air previously formed. To bring the chain back to its greatest height, an automatic valve may be arranged to admit water under pressure to the lifting cylinder at the end of the stroke. Claim: In hydraulic cranes, hoists, and the like, the employment of an air vessel or vessels of suitable capacity, together with the necessary valves and pipes, in order that the lifting cylinder may exhaust into or be supplied from this said air vessel or vessels at will.—No. 2282. February 8th, 1889. 8d.

Reading and Punching Jacquard Cards.—*C. A. Town, Nottingham.*—This invention relates to apparatus used in reading and punching cards used in jacquards, lace making, weaving, &c. Improvements are made in the means for attaching and detaching the wale strings to the selector needles of the changing frame or punching machine. The ends of the selector needles are formed to receive detachable end pieces, which are fitted to the needles by a male and female joint and retained by a spring catch. These detachable end pieces are carried in holes formed in an additional box, the holes corresponding to the position of the selector needles. The box slides freely on and is held in position by two pins secured to the back of the needle box, and is provided at the back by a sley with holes of a reduced size for preventing the withdrawal of the detachable end pieces from the box by the wale strings. The wale strings are permanently attached to the detachable pieces of the selector needles, and the two are, together with the box in which the detachable ends are carried, removed to insert lathes by reading in the usual manner for punching a fresh pattern. By this arrangement the process of hooking on is entirely done away with. Six claims are made.—No. 3275. February 23rd, 1889. 8*d.*

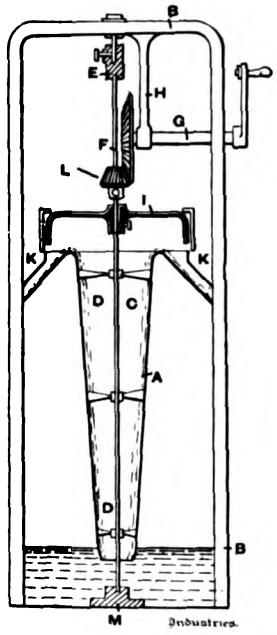
Pistons.—*W. G. Kent & H. S. Price, London.*—The piston is formed with a circular plate fitting the bore of the cylinder. On each side of the disc is a washer of leather, rubber, or other elastic material. These washers are shaped with one or more suitable corrugations around the outer part, so that the washers touch the disc at their centres and edges, but are bulged away from the disc between those parts. A metal plate of the same form in cross-section as the elastic washers is fitted over each of them. Holes are cut in the metal plates in the bulged part.

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The tendency of the steam in the cylinder when the engine is at work is to enter the holes in the bulged part of the plates and compress the bulged part of the elastic washers, thus causing their periphery to be pressed against the cylinder and make a steam-tight jacket. Five claims are made for the form of piston described.—No. 2772. February 16th, 1889. 8*d.*

GRINDING ROLLS IN TINPLATE MILLS.—*J. H. R. Ritson & W. Jenkins, Neath.*—Hitherto it has been difficult to polish the rolls of tinplate mills without stopping the mill and allowing the rolls to cool. The inventors propose to remedy this by attaching to the mill an appliance which will grind the rolls without allowing them to cool if so desired. Suitable brackets are attached to the framing of the mill upon each side, and support one or more rods and a screwed shaft, which reach across the mill parallel to the rolls. The rods act as guides for a bracket, which carries the block of emery or material for grinding the rolls. The bracket is screwed to receive the screwed shaft, by which it is fed gradually along the faces of the rolls from end to end. The block of emery is shaped to suit the contour of both rollers, and can be adjusted in its supporting bracket to press against them in any position required. In place of the emery block as above described, a pair of emery polishing wheels may be used, and rotated by a strap driven from a drum pulley fixed in the mill-framing above the rolls. The screwed shaft might be substituted by a rack, and the supporting bracket for the polishing block provided with a wheel gearing into the rack. Claims: (1) In machinery or apparatus for polishing or grinding rolls used in tinplate and other machines, the polishing surfaces or blocks mounted and carried by travelling mechanism as and for the purpose described; (2) in machinery and apparatus for polishing grinding rolls used in tinplate and other machines, the arrangement of mechanism described and shown for regulating and operating the polishing surfaces as described.—No. 3551. February 28th, 1889.

CENTRIFUGAL PUMP.—*J. Martinez-Ancira, Paris.*—The pump is constructed of a vertical rotating tube open at both ends, and its diameter increasing from the bottom upwards. The illustration gives a vertical section of the apparatus. D is the tube mounted upon a vertical shaft which is rotated in any suitable manner as shown. By rotating the tube it may be seen that the water will ascend close to the side of the tube. Over the tube is a deflector I, for deflecting the water, as it is delivered from the tube, down into the delivery pipes K. Claims: (1) The improved centrifugal pump as described; (2) in a centrifugal pump



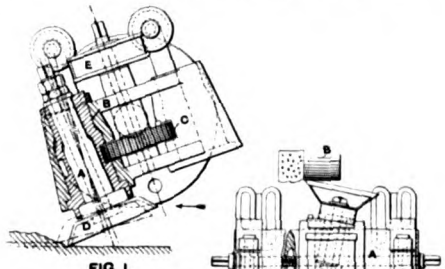
the use of a vertical conical tube which dips into the liquid to be raised, and is carried by a central vertical spindle, to which rotary motion is communicated in any convenient manner; (3) in a centrifugal pump the use of a rotating vertical conical tube, to which is attached internally a spiral; (4) in a centrifugal pump the combination of a vertical conical tube, to which rotary motion is communicated in any convenient manner, with a collector surrounding the upper end of said tube; (5) in a centrifugal pump, in which a rotating vertical conical tube carried by a central spindle is employed, the use of a deflector I, mounted adjustably on the same spindle.—No. 17505. November 4th, 1889. 6*d.*

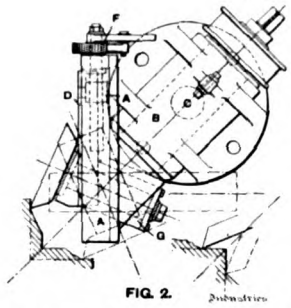
PADDLE-WHEEL BOATS.—*J. S. Baker, New York.*—The novelty of this invention lies in the arrangement of the paddle wheels horizontally—that is to say, with their axes of rotation vertical. The wheels are fixed in recesses in the hull of the vessel below the water line. The blades of the wheels are arranged in planes inclined to the wheels' axes to tend to lift the vessel forward and get more effective pressure from the water. Claims: (1) The combination with a boat of a horizontal paddle-wheel projecting from a recess in each exterior opposite side of the hull below the water line, and located forward of the middle and where the shape of the hull has a parting action on the water, and the wheels have buoyant effect upon the bow; (2) in a boat having horizontal paddle wheels located in and projecting from recesses in the side of the hull below the water line, and located forward of the middle, said wheels constructed with a spiral pitch of the paddles directed so that the reactionary effect of the water has a lifting action on the wheels; and (3), (4), (5), and (6) referring particularly to the method of fastening the blades to the disc or discs of the paddle wheels, and for the construction and arrangement of paddle wheels as described.—No. 11106. July 10th, 1889. 6*d.*

GAS ENGINES.—*M. J. Adams, York.*—The improvement consists of an arrangement by which the pressure obtained by the explosion of gas, petroleum, or other vapour is utilised to drive a motor. The gases are exploded in a chamber and then allowed to pass into and accumulate in a reservoir. From the reservoir they are drawn off as desired to the cylinder of the motor.

Claims: (1) The combination of a reservoir of suitable size with a chamber in which ignition or explosion of gas or vapour shall take place, such reservoir supplying to the working cylinder of an engine the pressure necessary to impart motion thereto; (2) the arrangement and design of parts as shown and figured in the specification of the patent.—No. 3331. February 26th, 1889. 6*d.*

MACHINERY FOR WORKING STONE.—*F. Trier, London.*—Improvements are here described in the tool holders for circular rolling cutters. The objects effected are—1st, the skewing of the cutter to the plane of the stone; 2nd, the cutting in steps by means of one cutter; 3rd, the production of internal and external angles by one cutter. The first of these objects is attained by fitting the spindle A which carries the cutter D within the bush B, such that the axis of the one crosses the axis of the other. The bush B may be turned on its axis by the gear wheel C, and thus give the cutter any desired screw. The second object is effected by turning the bush B halfway round at the end of each stroke, and so shifting the cutter D from the position shown in full lines to that shown by the dotted Fig. 1. An advantage of this arrangement is that a roughing cut is taken as the stone or the cutter travels in one direction, and the finishing cut as the stone or cutter makes the return movement. The semi-rotation of the bush B may be made automatically by the method known as the "Jim Crow" movement. A rope is passed round the pulley E, and connected to the movement. To effect the third object, a slide A, Fig. 2, is mounted upon the trunnion B at an angle of about 45° to the directions in which the trunnion





slides. The trunnion is made to swivel upon its centre C. On the slide A is a second slide D carrying the circular tool-holder G. The slide D is worked backwards and forwards upon A by a screw and ratchet wheel arrangement F, which is itself actuated automatically. When one side of the angle has been cut, the slides and cutter holder are turned into the position shown by the dotted lines by swivelling the trunnion, and the second side is then cut. Fig. 2 also shows the application of the cutter to the work in cutting outer angles. Fig. 3 shows an improved grindstone dresser, the chief improvement being the employment of a tubular slide A. The apparatus is shown at work upon a grindstone B. Claims: (1) The manner of giving skew to a cutter substantially as described; (2) step-cutting with one cutter; (3) the construction of the tool-holder substantially as described and illustrated by Fig. 1; (4) cutting internal and external angles with one cutter substantially as described with reference to Fig. 2; (5) the construction of a grindstone dresser using rolling cutters with a tubular slide and movable feet substantially as illustrated and described with reference to Fig. 3.—No. 355. January 8th, 1889. 8*d.*

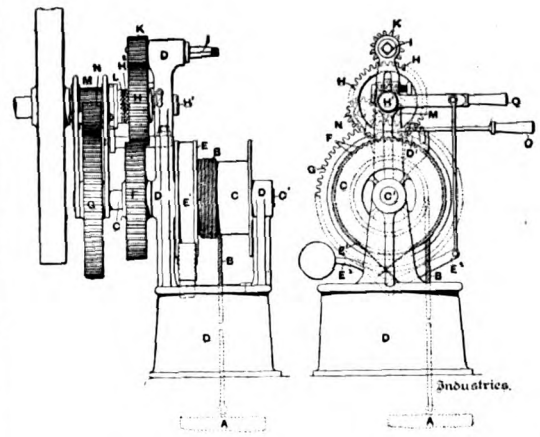
ROLLING MILLS.—*H. H. Lake, London.* (*The Proprietors of the Copenhagen Horse-Shoe Manufactory.*)—In this invention a device is described for feeding the blanks of horse-shoes to rollers. A disc of metal is fixed before the rolls with its axis vertical, and in the edge of its upper surface are inserted perpendicularly pins or studs of metal. The blank in a heated state is placed upon the disc, and the disc revolved until the blank has assumed the proper position for passing between the rolls; the blank is then pushed forward by the attendant, and is taken in by the rolls. The vertical pins are for the purpose of keeping the blanks from falling off the disc. Claim: A feeding device for rolling mills for rolling small articles, consisting of a disc, a fixed or rotary standard for the same to revolve upon, and a stand for supporting the whole as described.—No. 1185. January 22nd, 1889. 6*d.*

JOURNAL BOXES.—*J. F. Morell, Camden, New Jersey, U.S.A.*—The journal is constituted by a number of anti-friction rolls and rings, having concave and convex surfaces to keep them in proper position, and permit, in the case of car wheels, the car to oscillate without injury to the bearings. The main shaft is turned with its surface raised and convex. The convex surface of the shaft works in the exterior and concave surfaces of two annular rings. The inner surface of each annular ring is flat and works against a number of small rollers kept in position by a second annular ring concentric to the first. The rollers are also in contact with a supporting stud or axle upon which the whole are supported. The axles of the small rollers work in slots in the second annular ring, thus being kept at their proper distances from each other. When the shaft is in motion, the first annular rings rotate in contact with the shaft and the small rollers, and the rollers are caused to revolve upon the surface of the supporting stud. Claims: (1) A journal of the form of a frustum, of a circular spindle, and a roller or bearing for the same, having a concave periphery to receive said journal combined and operating as described; (2) a hollow friction roller for a journal or axle, containing a circle of friction rollers and having a concave periphery in combination with a journal of the form of a frustum, of a circular spindle occupying said concave periphery, as described; (3) the combination of the journal with the hollow rollers, the axles within said hollow rollers, and anti-friction rollers within the said hollow rollers and bearing on the inner face of said rollers and on the axles, as set forth; (4) a hollow friction roller for a journal or axle, containing friction rollers and slotted rings for supporting the said rollers as described.—No. 18504. November 19th, 1889. 6*d.*

LOOMS.—*L. H. Marsden & J. H. Frost, Manchester.*—The improvements refer to the slackening motion for slackening the dupe thread in weaving leno work. Upon the top rail of the loom are fixed brackets to support a shaft parallel with the top rail. To this shaft are attached two or more levers, the ends of the levers being flattened surfaces, which are arcs of a circle described from the centre of the shaft or thereabouts. These levers are made in two parts, so that their radii are adjustable. To the curved surface of these levers are attached cords, which support a horizontal rod whose ends slide in guides. This rod carries the dupe or leno thread as it comes from the yarn or warp beam. The rod is lowered for the purpose of slackening the thread by dropping the curved ends of the levers. To drop or raise the levers another lever or finger is attached to the shaft and projects from it in a contrary direction to the curved levers. To the end of this finger is attached a spring for depressing it and a cord for raising it. The cord for raising it is attached to the tappit, dobbie, or jacquard, which causes the lever to be raised or lowered at the proper time, and so the thread to be slackened, &c. Claim: The arrangement of parts as described—either with adjustable or non-adjustable curved ended levers—for lowering the rod over which the leno thread passes from the yarn or warp beam, to give the slackening required for the twist of the thread.—No. 18733. November 22nd, 1889. 6*d.*

STARTING ENGINES.—*B. Smith, Bath.*—An appliance is here described for attaching to engines operated by gas or oil for giving them the impetus necessary to set them working. The appliance is constructed to accumulate energy when the engine is stopped, and expend it in revolving the crank shaft when the engine is required to be started. Fig. 1 is a side elevation of the apparatus attached to the crank shaft, and Fig. 2 a front elevation. Upon a shaft C^1 are keyed a double drum and two spur wheels F G. The smaller part of the drum C received a rope B by which a weight A is suspended, whilst the larger part of the drum E constitutes with the band E^1 a friction brake. The spur wheel F is in train with two other wheels H and K. The wheel is fixed to a spindle which revolves in a bearing in the frame and

FIG. 1. FIG. 2.



terminates in square shank I. The wheel H is free to revolve upon a shaft H^1, and has upon one side a serrated boss H^2 which constitutes with a similar face L a clutch. The spur wheel G is in train with the wheels N M. By the lever O the wheel M^1 may be put in and out of gear with the wheel N, and by the lever Q the friction brake and clutch are operated. When the appliance is being wound up the wheel M is put in gear, and the weight is raised, as may be seen from the drawings. To start the engine the wheel M is taken out of gear, the clutch put into contact, and the brake released, permitting the weight to descend and revolve the engine shaft. When the engine has reached its working speed or the weight has fallen to the bottom the clutch is disconnected and the brake applied. The square shank I permits the appliance to be wound up by a hand crank. Seven claims are made.—No. 2762. February 16th, 1889. 8*d.*

REVERSIBLE ROPE DRIVING GEAR.—*R. Hornsteiner, Prague.*—The inventor describes a method of driving and reversing the motion of shafts, by gut, rope, or such like bands. A V-shaped grooved pulley is fixed upon the shaft to be driven, between two other loose pulleys, which are grooved by a circular-shaped groove. An endless band passes round one of the loose pulleys, and round two guide pulleys, back again to the fixed pulley upon the shaft. The endless band always runs in the same direction, and its motion upon the fixed pulley is contrary in direction to that upon the loose pulley. From this it may be seen that if the turn upon the fixed pulley is shifted to the other and unengaged loose pulley at the same time the turn upon the loose pulley is shifted to the fixed, the motion of the fixed pulley is reversed. One of the guide pulleys may be the driving pulley. The bands are shifted by two forks fixed to slides in the usual manner, but operated simultaneously by pins upon each slide working in grooves in a third sliding plate. The fixed pulley may be made with two V-shaped grooves, one with less diameter than the other, to make the motion more rapid in one direction. The loose pulleys then would have to be of corresponding diameter to the diameters of the grooves. In the case of a single grooved fixed pulley, the loose pulleys may be double grooved, to permit the fixed pulley to be thrown altogether out of gear. In this case the turns of the band would be upon alternate grooves. Claims: (1) The driving and reversing gear described in combination with the transmission or guipe pulleys described; (2) in the construction of driving gear as aforesaid, the combination of two pairs of

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pulleys of different diameters as described, the two fixed ones being attached to each other or separate; (3) in the construction of driving gear as aforesaid, the combination of three pulleys of equal diameter, the inner and fixed pulley single grooved, the outer and loose pulleys single or double grooved, for the purpose and in the manner described; (4) in the construction of driving gear as aforesaid, the combination and arrangement of two loose pulleys, so fitted as to be alternately coupled to the shaft; (5) the general constructions, combinations, and arrangements of parts together constituting the improved reversible driving gear. —No. 18116. November 13th, 1889. 6*d*.

GAS PRODUCERS FOR MARINE STEAM BOILERS.—*G. Scott, Glasgow.*—The gas producers are placed before each furnace of the marine boiler to supply it with combustible gas. The usual fittings of the furnace are removed, and, in place, a number of narrow channels are built with refractory material one above the other in the bottom of each furnace. These channels communicate at the back of the boiler with the atmosphere, air being permitted to enter and pass up in a zigzag manner to the upper half of the furnace just under the entrances for the gas. The channels for the admittance of air become heated by the combustion of the gases in the upper half of the furnace, and so the air becomes heated by passing through them. The furnace is entirely closed, except for the entrances mentioned, and adjustable openings in the front to regulate the supply of cold air to the furnace. The action is as follows:—Gas is produced in the gas producer and admitted as desired to the furnace, in which it meets with a supply of hot and cold air and is consumed, the products of combustion being conducted through the boiler in the usual manner. Claims: (1) In the generation of steam in marine steam boilers, the employment of gas producers for the purpose of supplying the boiler furnace or furnaces with gas for combustion; (2) in the generation of steam in marine steam boilers, the general arrangement and construction of the various parts constituting the improvements as described.—No. 18714. November 22nd, 1889. 6*d*.

MACHINE FOR DRAINING LAND.—*J. H. Rimell, Chipping Campden, & F. Clements, Weston-sub-Edge, Gloucestershire.*—The machine is designed for making channels below the surface of the land to convey away the water to the various dykes, &c. The tools proper are mounted upon a frame similar to that of a plough, and are worked either by horse or steam power. In the illustrations Fig. 1 is an elevation, and Fig. 2 a plan of the machine. The first tool B upon the frame A is for the purpose of cutting and turning aside the turf. The second tool C is a sharp cutting blade, which penetrates sufficiently deep into the ground to make

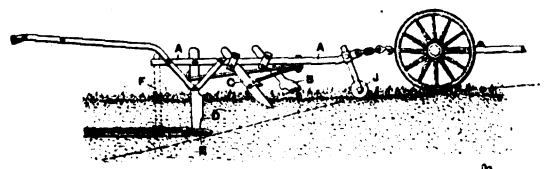


FIG. 1.

FIG. 2.

a vertical slit to ease the work upon the last tool D. The tool D terminates in a bullet-shaped head E which forms the channel. Behind the tool D may be placed a fourth for sleeking the channel and removing any obstacles that remain in the channel. The depth of the channel is determined by adjusting the wheels F and J, and the wheel F is placed in the position shown by the dotted lines for removing the appliance on roads, &c. Claim: An improved machine for draining land by horse or steam power substantially as and for the purpose herein set forth and shown upon the drawings.—No. 18144. December 12th, 1888. 8*d*.

APPARATUS FOR COOLING CLOTH.—*A. Armitage & T. Carter, Huddersfield.*—The cloth which has become heated by the process of tentering is cooled by passing cold air through it by an apparatus of the following description: The cloth as it leaves the tentering machine is passed over a roller through a flat rectangular box. In opposite sides of this box are pierced holes in a direction perpendicular to the surface of the cloth. These holes are in communication with an air fan, which blows air into the rectangular box through the holes, and out by slits in the ends of the box where the cloth enters and leaves the box. Claims: (1) For the purpose of cooling cloth which has become heated during the tentering process, the employment of a rotary fan blowing cold air into a cooling box through which the cloth passes, the cooling box being provided with air passages and slits opening upon the cloth being cooled, all the various parts being constructed and operated in the manner described; (2) an apparatus for cooling cloth after it has passed the tentering machine, the general arrangement and combination of the rotary fan with the air passages and slits in the cooling box, and a regulating tongue, for distributing the air over the cloth.—No. 3194. February 22nd, 1889. 6*d*.

IRON AND STEEL FURNACES.—*L. Roberts & J. Jones, Stockton-on-Tees.*—The inventors here describe an apparatus for introducing pig and scrap iron into a steel or iron furnace, the object being to obtain a more uniform and methodical feeding than is possible by hand. A charging peel is slung from a travelling frame which runs on overhead pulleys and which is supported on a rail. The rail is of such a length and is arranged in such a manner that the peel can easily pass through the feeding hole and be withdrawn to a sufficient distance for receiving its charge. The peel is in the form of a shaft which has a shovel at one end and a two-pronged handle at the other. On insertion in the furnace the handle is turned and the charge of pig or scrap iron is overturned. In order that the charging peel may be supported inside the furnace within a short distance of the shovel the travelling frame is constructed to follow it into the furnace. The frame is made of two horizontal bars which extend from a common vertical bar. The upper arm of this frame is secured to the overhead pulleys which run upon the rail, and the charging peel is slung upon the end of the lower arm. Claims: (1) In combination with open-hearth furnaces the construction and use of apparatus or combinatfon of mechanical appliances in which a charging peel is slung from the arm of a travelling frame by which means it is inserted into and withdrawn from and otherwise manipulated for charging the furnaces; (2) the use of bogies constructed with troughs or channels formed between ridges upon which the pig iron or scrap metal is lodged to enable the peel to be inserted underneath.—No. 2369. February 11th, 1889. 8*d*.

ELECTRICITY.

ELECTRIC SWITCHES.—*S. Z. de Ferranti, London.*—The switch is designed of small dimensions, yet capable of passing currents of very high tension to or from either one or other of two pairs of conductors from or to a third pair. Fig. 1 is a side elevation of the switch, Fig. 2 an end elevation, Fig. 3 a plan, and Fig. 4 a diagram showing clearly the working of the switch. A B are two short lengths of conductor carried at a distance apart from one another by a slide C, which can be slidden to and fro along two fixed parallel rods D. E F^1 F^2 E^3 are metallic brushes with which the upper ends of the conductors A B can be brought into contact. The brushes E E^1 are coupled with one another by a conductor I, and the brushes E^2 E^3 by another conductor J. The conductors I J have coupled to them two conductors Z Y of an electrical circuit, say from a dynamo electrical machine. F F^1, G G^1 are four metallic brushes with which the lower ends of the

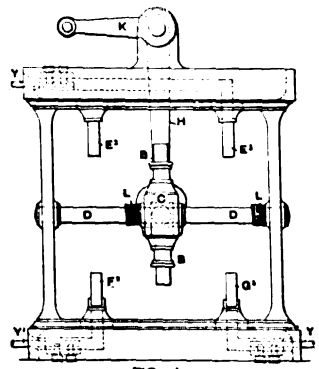


FIG. 1.

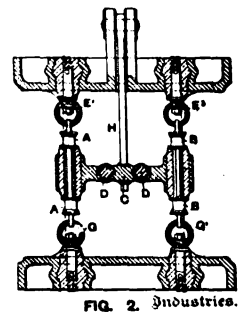


FIG. 2. Industries.

conductors A B can be brought into contact. The brushes F F^1 have conductors X^1 Y^1 leading from them, and the brushes G G^1 have leading from them other conductors X^2 Y^2. When the conductors A B are brought into contact at the top with the brushes E E^2, and at the bottom with the brushes F F^1, the conductors X^1 Y^1 will form continuations of the conductors Z Y, but when the conductors A B are at the top in contact with the brushes F^1 E^2, and at the bottom in contact with the brushes G G^1, the conductors X^2 Y^2 will form continuations of the conductors Z Y. In this way whenever the slide C is moved so as to carry the conductors A B away from the brushes E E^2, F F^1 or E^1 E^3, G G^1, the circuit will be broken at four points. The slide C is shown as being moved along the guide rods D by a lever arm H turning on a pin. The lever can be

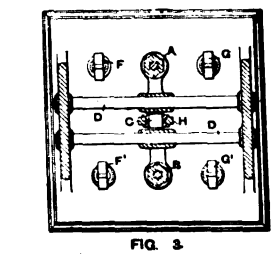


FIG. 3.

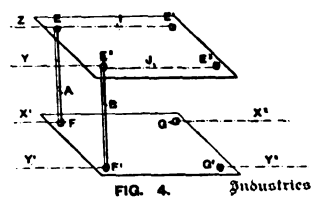


FIG. 4. Industries

rocked by a second arm K upon it, to which movement may be given in any suitable way. L L are spring stops or buffers for the slide C to strike against at one or other end of its movement. Claims: (1) A switch for putting one pair of conductors into connection with either one or other of two other pairs of conductors in which whenever one or other of the circuits is broken it is broken simultaneously at four different points; (2) the arrangement of the coupled contact brushes E E^1 and F^2 E^3, the brushes F F^1, G G^1, and the conductors A B, which can be shifted either into a position to put the brushes E E^2 into connection with the brushes F F^1 or with the brushes G G^1; (3) the construction of electrical switches as described.—No. 915. January 17th, 1889. 8*d*.

PRINTING TELEGRAPHS.—*J. E. Wright & J. Moore, London.*—In the ordinary forms of column printing telegraphs the type wheel shafts are such that a good deal of friction is caused as the type wheel slides along it. The inventors, therefore, make the shaft with two or more knife edges, so that not only is the friction reduced, but the shaft is made lighter. A knife-edge bar is also used for the propelling mechanism of the type wheel to slide upon. It is also stated that these knife edges also prevent the usual shake of the type wheel. Claims; (1) The construction of the type wheel shafts of column printing telegraphs with two or more longitudinal V or knife edge projections or grooves for corresponding grooves or projections on the type wheel to bear upon to reduce friction and peripheral shake during the operation of printing; (2) the combination of the type wheel shaft having longitudinal V or knife edge projections or grooves, the type wheel with corresponding grooves or projections, the carriage sliding upon a bar similarly formed with projections or grooves, and the arm from the carriage entering a groove cut around the circumference of the type wheel.—No. 2413. February 11th, 1889. 6*d*.

INCANDESCENT ELECTRIC LIGHTING.—*J. Hartness, East Boldon, Durham.*—The inventor's object is to localise the electric light by attaching it to some convenient part of the body of man or beast, thereby securing portability, and bringing the light as near the work in hand as may be desired. The lamp may be secured to the cap or headgear of the operative requiring its light, a peak intervening of sufficient length to shade the eyes. The lamp is attached by a swivel or knuckle joint, and connecting to the main leads of an electric generator by branch wires, which are slack to allow the operator to have free movement. The lamp is designed for the use of operatives having such work to perform as the examination of chains, anchors, and fine work. Claim: The combination with the dress head-gear or person of the user of an electric lamp or lamps supplied with current from an electric generator.—No. 3330. February 25th, 1889. 6*d*.

CABLES FOR ELECTRIC CONDUCTORS.—*S. Pitt, Sutton, Surrey (A. Dey, New Brunswick, New Jersey, U.S.A.).*—The improvements in this invention are described in the following claims: (1) An electric cable, comprising a conductor or multiple conductors, each covered with a spiral wrapping of paper ribbon, and the whole being enclosed in an impervious sheath, such for instance as lead; (2) an electric cable, comprising multiple conductors, each wrapped spirally with insulating ribbons of manilla paper, the conductors being twisted in pairs, and all the twisted pairs then twisted together, and an impervious sheath, such for instance as lead, closely enveloping all the conductors. —No, 18,748. November 22nd, 1889. 6*d*.

CHEMISTRY.

MANUFACTURE OF CHLORINE.—*T. Parker & A. E. Robinson, Wolverhampton.*—The inventors here describe a new process for the manufacture of chlorine by electrolysis. The electrolysing vessel is divided by means of a porous diaphragm, and the two adjacent spaces are filled with solutions of common salt and a metallic sulphate respectively. The most convenient sulphate for ordinary use is that of iron, though copper or zinc sulphates may be used if there is any particular advantage in so doing. On a current of electricity being sent through the bath the sulphate and chloride are decomposed, the iron and chlorine are liberated in the separate compartments, and the sulphuric acid combines with the sodium to form sulphate of soda. The chlorine and the sulphate of soda are abstracted in any suitable manner. The inventors claim (1) the production of chlorine by the simultaneous electrolysis of common salt and a metallic surface in the vessel described; and (2) the vessel composed of two compartments separated by a porous diaphragm for the purpose described.—No. 2310. February 9th, 1889. 4*d*.

CYANOGEN COMPOUNDS.—*T. Parker & A. E. Robinson. Wolverhampton.*—The inventors here describe an electrolytic method of producing cyanides from sulphocyanides. The sulphocyanide is first treated so as to give up free sulphocyanic acid, and the liberated acid is split up into sulphuric and hydrocyanic acids by the action of a current of electricity. The hydrocyanic acid is condensed either in water to form the acid of commerce, or in an alkali to form a cyanide. The inventors also describe a commercial method of producing these chemicals from gas liquor. Two claims are made.—No. 2383. February 11th, 1889. 4*d*.

ARTIFICIAL SILK.—*J. H. du Virier, Paris.*—The inventor describes a method of making artificial silk filaments from pyroxyline. After the cotton has been trinitrated it is dissolved in glacial acetic acid, and is mixed with a solution of gutta percha in bisulphide of carbon and with a solution of isinglass in glacial acetic acid. After this mixture has been kneaded together with a small proportion of castor oil and glycerine, it is ejected under pressure through small orifices into a reservoir of water. The filaments thus formed are led through a series of baths, for the purpose of cleansing and strengthening them, and they are afterwards reeled in the usual way pursued with silk fibres. There are five claims.—No. 2,570. February 13th, 1889. 8*d*.

MISCELLANEOUS.

SPINDLE BEARINGS.—*B. R. Bond, London.*—This invention relates to apparatus described in Patents No. 5605 of 1888 and No. 14868 of 1888, for measuring and otherwise manipulating cloth; and the present invention relates to improved methods of mounting the spindles upon which the cloth is intended to be wound. The axle consists of a bar of metal, or other suitable material. The ends of the axle are supported by revolving plates, which work in bearings formed in stationary plates fixed to the framing of the apparatus. The revolving plates may be made in two parts and bolted together, so as to revolve in a circular opening in the stationary plate, or the revolving plate may be a single plate, revolving in a groove formed in the stationary plate. There are four claims.—No. 19001. December 29th, 1888. 8*d*.

Copies of the British specifications may be obtained on application to H. READER LACK, ESQ., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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WIRE COVERING MACHINE.

THE machine which we illustrate in Fig. 1, and in front elevation and part section in Fig. 2, and partial transverse sectional view in Fig. 3, is expressly designed to effect the covering of wire for electrical purposes.

A machine of this class is usually constructed with several heads or sections, each of which is independent to a large extent of the rest. One of these will be described. On the driving shaft J, which extends along the machine, a number of discs M are keyed, there being one to each head. Adjoining each disc, and to a certain extent covering it, is a grooved disc or pulley N. One side of this disc is hollowed and has a circular leather plate fixed in it, which acts as a frictional surface by which N is driven when pressed up to M. Over the pulley an endless band K is passed, the course of which is shown by the dotted lines in Fig. 3, and which drives the two rotating spinning heads B and C in opposite directions. The grooved disc can be slid upon the shaft by means of the lever F, by moving which to the left contact of the frictional surfaces is established or *vice versa*. The wire is drawn from the reels A—shown in place at the upper part of the machine in Fig. 1—and is passed through the hollow spindles of the spinning head, after which it follows the course shown until it reaches the draw roller E, on which it is taken a complete turn. The rate of rotation of the draw roller regulates the speed of covering, and the reels G, upon which the covered wire is wrapped, are driven by a band from the shaft on which the draw roller is fixed, so that the speeds of the two are relatively proportionate. The covering material is carried in spools fixed upon pins fastened in the face of the spinning discs L. Instead of driving the shaft O and draw roller by bevel gearing, they are driven by a worm and worm wheel, the former being fixed on the driving shaft. In this way a regular speed of traverse is obtained, entirely free from the irregularities arising from back lash when ordinary gear wheels are used. This is important for the reasons previously given. The stop motion consists of a small finger U, attached to the spinning disc in such a way that as the latter is rotated the finger tends to assume a perpendicular position. It carries an eye, through which the yarn is passed, the tension upon the latter being sufficient to prevent the finger from taking the position named. As soon as the end falls the finger assumes the perpendicular, and in its rotation strikes one end of the small lever V, which is oscillated through an arc of 90 deg. The movement communicated to V causes the part X to descend and press a small weight D, which is suspended by a cord in a slot of the lever B. On the latter is a projection, in front of which the weight is forced, and is thus brought into the path of a cam on the driving shaft. In this way the lever is pressed back, and by means of the connecting rod S^1 it raises and releases the lever F^1, so that it can be drawn over by a spring, and the section is thus stopped in the manner previously described. To restart the machine it is necessary to piece up the thread and restore the small lever V X to its original position. This is done by a small lifting rod Z, specially provided and arranged to act for both discs.

The machine we have described has been found to possess many advantages, and an important works in the neighbourhood of Manchester has been fitted with it. It is capable of a larger turn-out than other machines, owing to the regularity of its working and the rapid stoppage of the heads, which obviates winding back and facilitates piecing. The covering can be guaranteed to be satisfactory, and the cost of labour is reduced by each head being worked automatically. The makers are Messrs. Thomas Barraclough & Co., Limited, of Manchester.

WIRE COVERING MACHINE.

CONSTRUCTED BY MESSRS. T. BARRACLOUGH & CO., MANCHESTER.

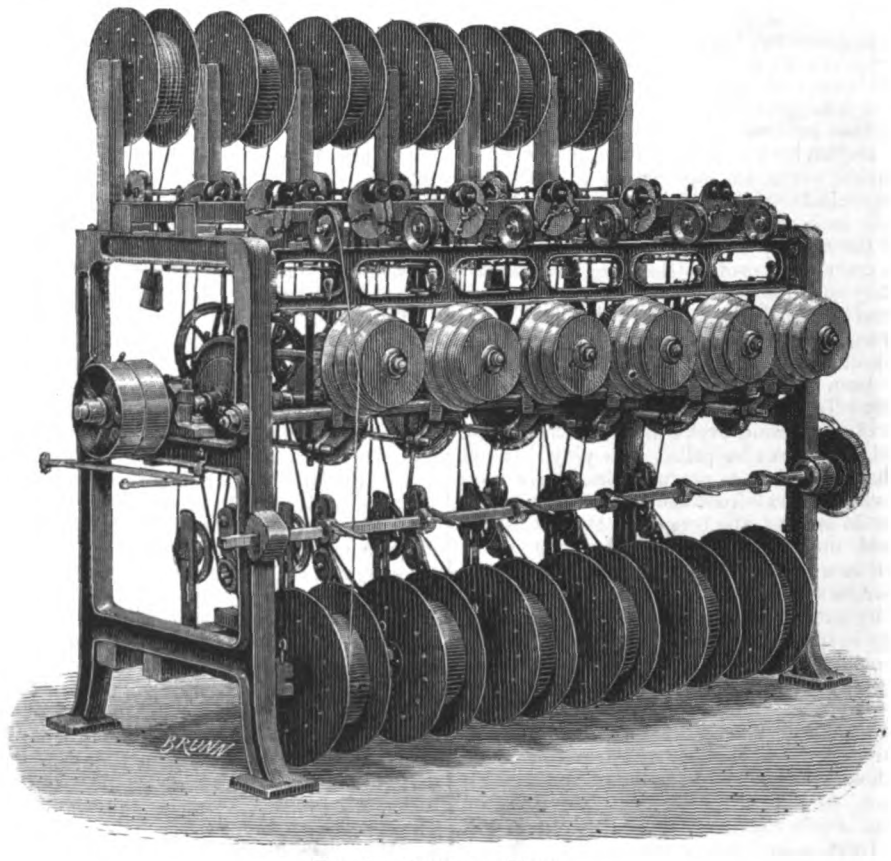


FIG. 1.—GENERAL VIEW.

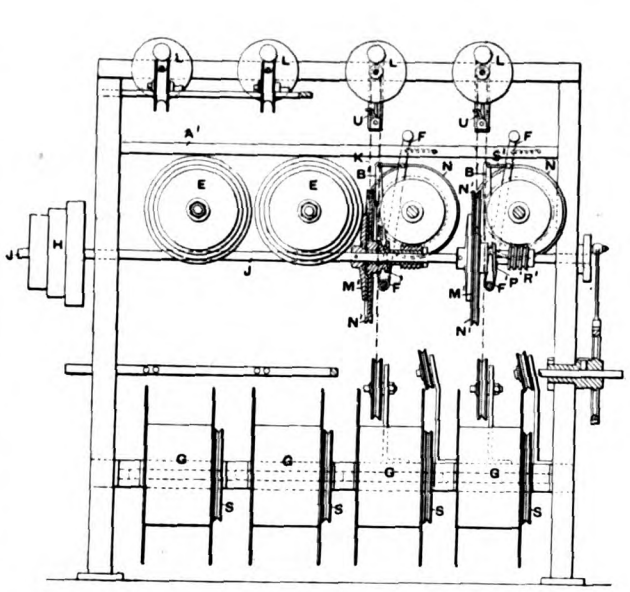


FIG. 2.—FRONT ELEVATION.

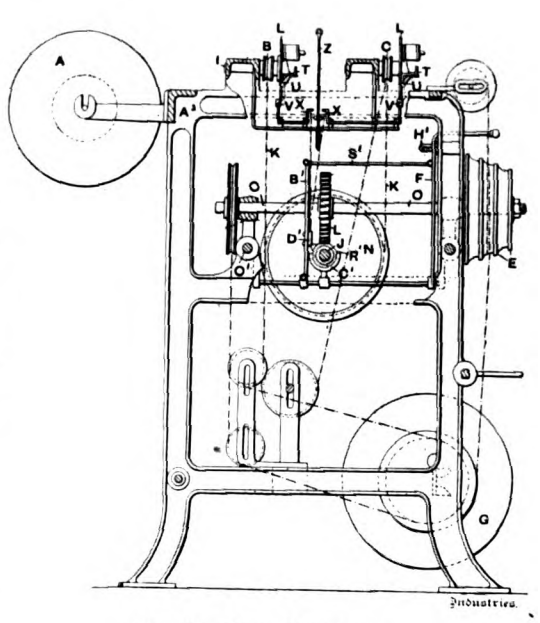


FIG. 3.—END ELEVATION.

NOTES ON PATENTS.

II.

COMPULSORY LICENCES.

IF a patentee refuses to grant licences on reasonable terms, the Board of Trade may compel him to do so in either of the following events:—(*a*) That the patent is not being worked in the United Kingdom; or (*b*) that the reasonable requirements of the public with respect to the invention cannot be supplied; or (*c*) that any person is prevented from working or using, to the best advantage, an invention of which he is possessed. The above is the effect of the 22nd Section of the Patents Act, 1883. The object of this section seems threefold:—To foster English labour and industry; to compel owners of patents to supply public demand; and to enable a person who is the owner of an improvement patent to utilise his invention.

There are, in many European countries, provisions as to the working of patents in the particular country; and in some countries the importation of the articles manufactured abroad according to the patent destroys the validity of the domestic patent. The effect of this has, however, been considerably restricted by the International Convention, which the following (amongst other) countries have joined—viz., France, Spain, Portugal, Italy, Belgium, and Great Britain. Article V. provides as follows:—"The introduction by the patentee into the country where the patent has been granted of objects manufactured in any of the States of the Union shall not entail forfeiture. Nevertheless, the patentee shall remain bound to work (*exploiter*) his patent in conformity with the laws of the country into which he introduces the patented objects (*où il introduit les objets brevetés*)."

It has been said that the provision which practically forces a manufacture in England is a return to Protection. The slightest consideration shows this to be incorrect. Protection means favouring manufactures at the expense of consumers. A compulsory licence would benefit consumers, and certainly not injure them. It is the duty of a State, in granting an inventor a monopoly, to see that the monopoly is not abused, and to grant it subject to such reasonable restrictions that the community at large are not unduly injured. If a patentee does not manufacture in Great Britain he should be compelled to grant licences to manufacture here on reasonable terms. There can be no doubt that the absence of such a provision works great injury to an industry. Take, for instance, the aniline colour trade, the foundation of which was laid by our countryman, Mr. Perkins. At the early stages of the manufacture the industry, for the great part, was in England. Subsequent discoveries in Germany, founded on Perkins' inventions, took away to a great extent the industry from England. The German manufacturers, by patenting in England, completely prevented competition. This is the direct result; but the evil does not rest there. The effect is felt in the next generation, as the manufacture, being in German hands, prevents English chemists from learning their business. The absence of a law to compel working of the patents in England may be said to be one of the main reasons why the greater

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part of the colour industry of the world is in Germany instead of in England. There are important colour manufactories near Manchester and Huddersfield; but they are small when compared with the combined forces of the Badische Anilin und Soda Fabrik of Ludwigshafen, the chemical industry of Basle, Actien Gesellschaft für Anilin Fabrikation of Berlin, and Farbenfabriken vorm. F. Bayer & Co. of Elberfeld, Messrs. Casella & Co., and Meister, Lucius & Brüning.

Up to the present time there have been no compulsory licences by the Board of Trade. This does not prove that the section is without value, as it acts as a lever to patentees to grant licences on reasonable terms, or to start works in England. The works in England must of course be genuine works, and not merely a depôt into which goods manufactured abroad are received. Reference was made in a recent issue to the important decision under the Merchandise Marks Act, 1887, which would seem to completely protect the English manufacturer against any such fraud. It was held that a manufacturer incurred the penalties of the Merchandise Marks Act by selling as his own manufacture goods purchased from abroad, and that the label "made in Germany" ought to have been placed on the cylinders into which they were eventually placed. The following may be cited as an instance of the second event in which the powers of the Board of Trade can be called into play. It not infrequently happens that a manufacturer buys up a patent to prevent a rival from working it. In such a case the public do not get the benefit of the invention, which is locked up and useless for fourteen years. The third event in which the Board of Trade can grant compulsory licences seems a very just one. An inventor may make an important improvement on, say, the telephone, and may be unable to put his invention into use so long as the master patent exists. The Board of Trade would probably only exercise its jurisdiction in case of an important improvement, and then only on such terms as are just. A provision such as this seems desirable as it promotes invention. Previously the inventor of an improvement, however important, had only one market for his invention, namely, the owner of the patent on which his was an improvement. The two patentees will now be able to treat on more equal terms.

A consideration of these remarks will show that the compulsory licence clauses of the Patent Act are likely to benefit, not merely the manufacturer and the labour market, but also the public and subsequent inventors. The rights of patentees are abridged, but we think patentees may rest assured that their interests will be fully protected by the Board of Trade, whenever their jurisdiction is invoked; and that fair and equitable terms and conditions will be inserted in any licences that may be granted.

THE INSTITUTION OF MECHANICAL ENGINEERS.

On Thursday evening, the 30th ult., the discussion on Mr. Urquhart's paper, "On the Compounding of Locomotives Burning Petroleum Refuse in Russia," was resumed.

Mr. J. Head, who spoke on the previous evening, said that he tried, many years ago, the piston arrangement for the relief of the valve shown in the drawings illustrating the paper read. It worked well for a time, but it soon failed by giving way at the connecting link.

Mr. J. A. F. Aspinall said that Mr. Urquhart was working under favourable conditions in compounding his engines, because where liquid fuel was burned we could have a large blast-pipe, and get rid of the back pressure in the low-pressure cylinder. Another advantage lay in the fact that his engines had outside cylinders. In the narrow space allowed by inside cylinders it was difficult to properly dispose the parts of a compound, so that one could not, so readily as he had done, take old locomotives from the lines in this country and compound them. He, the speaker, had made some trials with liquid fuel, using gas-works tar for the purpose. The results were very satisfactory in all respects except cost. In this country, where relatively coal was cheap and liquid fuel dear, he did not think that the latter could be advantageously adopted.

Mr. Le Page thought that Mr. Urquhart had done wisely in giving greater capacity to the receiver. A further increase would probably be attended with good results. As for compounding with inside cylinders, the difficulty mentioned by Mr. Aspinall was not great. He himself was then engaged on a design in which one set of valve gear was adapted to the two cylinders. He did not see why high pressures should be considered necessary for the efficient working of a compound engine.

Mr. Walker could not understand why there should be so much difference of opinion among engineers as to the advantages of compounding. It seemed to him that the question was to be settled by reference to the coal bills. If Mr. Urquhart found that compounding saved him from 18 to 20 per cent. of fuel, he wanted no further evidence of the merits of the system. As for his own opinion, he had long ago convinced himself of the advantages of compounding, and he recommended that engineers should not allow themselves to be cramped by existing forms and modes of construction, such as inside and outside cylinders, for example; but that they should boldly launch out into something new and more favourable to the conditions involved in expanding in two cylinders.

Capt. Fairholm informed the meeting concerning trials of compounded locomotives made in Germany since 1885, the results of which were similar to those arrived at by Mr. Urquhart, the saving in fuel being from 18 to 20 per cent. In response to a suggestion from the President, he promised to endeavour to obtain, for publication in the Transactions of the Institution, drawings of a new form of valve gear of extraordinary simplicity, designed by Herr Klein, of Chemnitz.

Mr. Young said that the receiver should have a capacity not less than three times that of the high-pressure cylinder. Mr. Urquhart might, therefore, continue with advantage for some time longer on the lines on which he was now moving. He thought, however, that the proper way to equalise the power of the cylinders was to regulate the cut-off with the low-pressure valve.

The President, in closing the discussion, said that, in considering the relative merits of the single cylinder and the compound systems, the conditions under which the engines worked must be taken account of. For marine engines, and for all engines the work of which was regular, the compound was beyond doubt the better system. But for locomotives the advantages were not so clearly apparent. The work of a locomotive was of the most irregular character. In the run from Paddington to Swindon, for example, fully 50 per cent. of the way was downhill. As for the saving in fuel, it was difficult to see how it could be greater than about 15 per cent. at the best. The wear and tear in the compound must certainly be greater than in the non-compound. Possibly not much greater; but it was vain to look for less. There was a source of error in estimating the saving of fuel that more or less vitiated the conclusions drawn from observed facts. He would explain what he meant by quoting instances. Two men were set to drive in turn the same engine over the same line, and in the same circumstances. One always burned 32lb. of coal per mile, the other never exceeded 26lb. In 1847 he, with others, selected eight drivers, and to each of these in turn the locomotive was entrusted for three days, twice repeated. The difference between one man and another in fuel consumption was as great as 22 per cent. Now, in Mr. Urquhart's trials, if the compound was not run by the same man who drove the non-compound engine, we did not know to what the saving was attributable.

The next paper was read by Mr. Michael Stephens, on

The Burning of Colonial Coal in the Locomotives of the Cape Government Railways.

The discovery of the South African coal fields dates back only about sixteen years, when the line known as the Eastern system of the Cape Government was in course of construction. To ascertain the possibility of working this line with Colonial coal known to exist in an outcrop in the Stormberg Mountains, at the spot where the village of Molteno now stands, a mining engineer was engaged to survey the country. His survey was interrupted by the outbreak of the Kaffir war in 1877; but fresh discoveries made within the last few years have added much to the information which he gave in a report issued in 1878. From this it appears that the quantity of coal which can be made accessible by a branch railway from the Eastern system will suffice for the requirements of the existing Colonial railways at the present rate of consumption for about three hundred years. Moreover, outcrops occur in various places, indicating an extension of the coal field far beyond the limits of the recent surveys. Mr. W. Galloway, of Cardiff, in a report to the Cape Government in 1889, says:—"The coal field of South Africa covers a fairly symmetrical area, embracing parts of the Cape Colony, the Orange Free State, Transvaal, Natal, and the whole of Basutoland. . . . . The greatest length and breadth of the coal field within this boundary line are 500 and 200 miles respectively, and its area is about 56,000 square miles. . . . . Up to the present, its fringe has just been touched in a few isolated and far-distant points. It is certain that further systematic researches will be rewarded by the discovery of great stores of mineral fuel, capable of supplying the wants of South Africa for many generations."

The Eastern Railway system, some 300 miles in length, is at present supplied with coal from the two Stormberg mines known respectively as the "Molteno" and the "Cyphergate." The latter, being in direct communication with the railway, furnishes the greater quantity. The cost is 14s. a ton at the mine. The Cyphergate coal is bituminous and gaseous, gives out great heat, and generates steam rapidly as long as the grate is fairly clean; but it contains about 29 per cent. of incombustible matter, which becomes partially fused and forms a pasty mass underneath the incandescent coal, and thus checks the generation of steam by preventing the admission of air between the fire-bars. Attempts were made to overcome the difficulty by means of tipping grates, rocking bars, and other contrivances; but these were not successful, and hand labour was resorted to. The firemen were selected for strength and powers of endurance; the fire-bars were spaced 3in. apart—that is, with 3in. clear open space between them, and the spaces were kept clear by pushing the semi-fused dross through them with the pricker. Owing to the gauge of the railway being 3ft. 6in., the narrowness of the fire-box rendered the grate area sufficiently accessible for the purpose through a fire-hole of the ordinary size. The dross fell between the rails through openings in the ashpan. Occasional halts had to be made for removing through the fire-hole masses of dross which had become set; but apart from such delays the traffic was efficiently worked on a line abounding in gradients of 1 in 40 and five-chain curves. The work of the firemen, however, was exceptionally severe, being closely akin in that respect to puddling; and even the prospect of speedy promotion could hardly induce them to stop at it.

The difficulty has been overcome by the introduction of the movable-bar grate, which is the invention of Mr. J. D. Tilney, locomotive superintendent of the Eastern system of the Cape Government Railways. The fire-bars, which are of cast iron, and spaced 1½in. apart, rest on racks placed near their ends, and have serrated tops. The alternate bars are 1½in. shorter than the others, and have each a lug projecting downwards. A long pin goes through the lugs, and through the ends of two rods which pass from the pin through slots in the damper to the front axle, on which is fixed a drum. The rods are connected to crank-pins in another drum, which the engine-driver can bring into contact with the drum on the axle by means of a hand lever, as in the chain-brake arrangement. A longitudinal motion of 1½in. is thereby imparted through the rods to half the fire-bars; and the dross which has settled on the serrations, being cooled by the air from below, is broken up when the bars are put in motion, and falls through doors in the ashpan, which can be opened and closed from the foot-plate. The dross when set is friable, and not hard like ordinary clinker; and the grate is kept clean by putting the bars in motion occasionally for about ten seconds at a time. Fire cleaning during a journey is thus dispensed with, and the firing of the engines by men of ordinary powers of endurance is rendered practicable. The mechanism is simple and durable; and its introduction has rendered practicable the efficient working of the traffic on an exceptionally heavy line, with the inferior coal, containing 29 per cent. of dross, which crops out on the western boundary of the Cape coalfield.

In the discussion which followed, Mr. Galloway pointed out on the map of South Africa the ascertained boundary of the coal field described in part in Mr. Stephens' paper, and indicated the point down to which the Colonial coal could successfully compete with imported Welsh coal. He stated that no attempts had yet been made to wash the coal, large coal being at present used exclusively. He believed that hitherto no trials of the coking quality of the Colonial coal had ever been made. He had tested the coal practically for locomotive use, and found it to be excellent for the purpose. He could testify from actual experience to the efficiency of the movable-bar grate described in the paper just read.

Mr. White doubted the durability of the fire-bars. As shown in the drawings exhibited, the serrations appeared to him to be too fine. A hard clinker would be likely to throw the mechanism out of gear. In reply to a question, he said that the Colonial coal was used under marine boilers, many coasting vessels and tugs being supplied with the produce of the Indwe mines.

Mr. Woodall said that Natal coal did not contain more than 12 per cent. of ash. It was good for gas making.

The last paper which was read was by Mr. Kenneth S. Murray, on

The Mechanical Appliances Employed in the Manufacture and Storage of Oxygen.

About thirty years ago Boussingault discovered that at a temperature of 1000° F. barium oxide took up another atom of oxygen to form a peroxide, and that when this peroxide was raised to a temperature of 1700° F., this oxygen was given off again free. He recognised the fact that here was a method of obtaining pure oxygen from the atmosphere, but unfortunately the practical success of the operation was rendered impossible by the fact that after a short time the barium oxide lost the power of absorbing the oxygen. This difficulty was never sur-

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mounted until the brothers Brin, a few years ago, succeeded in manufacturing a form of baryta which never oses its power of recovery. This baryta is prepared from the sulphate or carbonate by first converting it into the nitrate, and then driving off the nitric constituents by the application of heat. The plant which was first erected by Brin's Company was described and illustrated in our issue of the 21st October, 1887, and a full account of the most recent and improved form of the plant will be found in our issue of the 13th of December, 1889. After the works were erected it was soon found that a great loss of efficiency was occasioned by the retorts and furnace being subjected to two different temperatures alternately, and in seeking for a remedy they discovered that the same results could be obtained by maintaining a constant temperature of 1300° F., by forcing the air in at a pressure of 10lb. per square inch, and by subjecting the peroxide to a partial vacuum. Further improvements in the process were made by mounting the retorts vertically in the furnace and by conducting all the operations automatically. A full account of the automatic reversing gear will be found in our issue of the 13th of December, 1889. According to the most recent methods the air is purified of its carbonic acid and moisture by being passed through lime and caustic soda *after* it has been through the pump, so that the work required of the pump is decreased, and no traces of lubricants can now find their way into the baryta. During 1887 Brin's Oxygen Company sold about 140,000 cubic feet; but in 1889 this amount actually rose to 1,000,000 cubic feet. The author also gave a short description of the manufacture of the steel storing cylinders and of the method of charging them.

In the discussion which followed,

Mr. Joseph Adamson, who was engaged in the construction of the works of the Brin Company, said that at first the process was carried on in a laboratory fashion, and the designs were by no means calculated to obtain a practical success. However, after a year or two of experience, the managers became more of engineers than chemists, and now the plant was one of the simplest and most practical that he could well imagine.

Mr. R. A. Hadfield wished to know how much of the moisture of the air was removed by the lime and soda purifiers.

Professor A. B. W. Kennedy considered that it was the preservation of the same temperature in the peroxidation and deoxidation of the baryta that was the key of the success of the present process.

Mr. E. B. Marten, of Stourbridge, said that it would be instructive to hear a list of the various industrial processes in which the use of the oxygen had been found to be valuable. He also described an excellent model of the plant which was on view at a recent meeting of the Midland Institute at Birmingham. He had a great admiration for the skill with which the storing vessels were made, and considered that except for them the industrial application of the oxygen would be comparatively small.

Mr. C. E. Cowper, in referring to the storing of hydrogen by the Brin Company, said that the same steel vessels were formerly used for both gases, and that an explosion had been caused by oxygen being stored in a hydrogen cylinder. The greatest precautions should be taken to avoid such a mishap, and he hoped that the manufacturers were not unmindful of the matter. He also wished to know how long the storing vessels would last, and how long a charge would remain in without leaking away.

Mr. Schönheyder, while congragulating the engineers and chemists on the general efficiency of their plant, pointed out that there was still room for improvement as far as economy was concerned. For instance, a great amount of heat was wasted with the escaping gases from the furnace, and the very great heat which was acquired by the air as it passed through the retorts was also entirely lost. The fact that some time had to elapse before the oxygen came off pure in the deoxidising process was, in his opinion, far from satisfactory from an economic point of view, and was worthy of the consideration of the Brin Company.

Mr. Bernard Dawson corroborated Mr. J. Adamson's statement that the plant had been wonderfully improved since it was first laid down; in fact, it was gradually changed, until it was quite unrecognisable now to him who had helped to lay it down at the commencement. One question he would like to ask was whether the oxygen thus prepared had ever been tried in the manufacture of glazing pottery by the high temperature process.

Dr. Thorne, the chemist at the works, then proceeded to give considerable additional information. The opinion of Mr. Marten as to the dependence of the process for its extensive application upon the successful manufacture of the steel storing cylinders was incorrect, for the cylinders were only used in storing small quantities for such purposes as limelights, &c., and wherever the use of the oxygen was at all extensive, the gas works or steel works at which it was employed would have plant erected on purpose for its manufacture, and then no compressive storing would be required. With regard to Mr. Cowper's question as to the danger of using the same cylinders for storing hydrogen and oxygen, he confessed that accidents had been caused by carelessness on the part of the company. They had so far recognised the necessity of preventing such occurrences as to adopt a left-handed screw-thread for the charging plugs of the hydrogen cylinders, and a right-handed thread for those of the oxygen cylinders, so that in future there would be no possibility of a mishap. The introduction of oxygen into metallurgical processes had a great future before it, and at the present time a number of very important experiments were being carried on with regard more especially to the reduction of the refractory ores. Mr. Hadfield desired to know what percentage of the atmospheric moisture was removed by the lime and soda. Usually there was about from 1 to 1½ per cent. of moisture in the air, and after it had passed through the lime and soda there only remained about ·02 per cent. This incompleteness of the removal of the moisture was, however, no drawback; indeed, it was apparently the cause of the difference in the practical results of Boussingault's and Brin's experiments. Boussingault, in his laboratory process, with a few feet of air, extracted every trace of moisture, and therefore the surface of the baryta became incapacitated for taking up oxygen after a few cycles of operations. With regard to Professor Kennedy's remark about the difference of pressure being the key to the success of the process, Dr. Thorne reminded the members that there was nothing extraordinary in the fact that at different pressures different chemical operations took place. When the plant was first erected, the peroxidation was conducted at a dull red heat and the deoxidation at a bright red heat, both at the same atmospheric pressure. It was afterwards found that the same effects could be obtained, but far more economically, if the temperature at which the two operations were conducted was kept constant at a little below the mean of the two, and if the pressure was increased for the first operation and decreased for the second. Theoretically, 1lb. of baryta would absorb and give off again 1¼ cubic feet of oxygen. With the old process, only about ·6 or ·7 cubic feet could be obtained practically, and even that took 3 hours. With the new process only ·1 to ·12 cubic feet could be obtained, but on the other hand the cycle of operations only took 15 minutes, so that the new process was in the end much more economical. In reply to Mr. Dawson, Dr. Thorne said that, as far as he knew, no experiments had yet been made with the high temperature glazes; but the glass blowers used the oxygen extensively in their blowpipes, and found, among other things, that they could work on lead glass with it without any fear of any reduction of the lead, and that the harder glasses could be melted as easily as the lead glass. He then described the Ramsgate gas purifying plant which we illustrated in Vol. VII., page 574, and afterwards proceeded to explain the action of oxygen in bleaching processes. The oxygen of the atmosphere was used for bleaching in those districts where fabrics are spread out in the open fields, but the process was very slow. Bleaching was, of course, identical with oxidation, but the free oxygen was not sufficiently alive to start its own work. Nascent oxygen is the most powerful bleacher, and it was this which was supplied by bleaching powder. When Brin's oxygen is used in conjunction with bleaching powder the nascent oxygen of the powder sets the other oxygen to work, and thus the efficiency of the mixture was very great. The saving of bleaching powder was sufficient to cause a very substantial reduction in the cost of the operation of bleaching. A large number of paper manufacturers and jute spinners had adopted this combined process, and there was every probability of its use becoming general. Another application mentioned by Dr. Thorne was in the purifying and boiling of oils for varnishes and for the thickening of them in the manufacture of linoleum. By the use of the oxygen the time occupied and the temperature were both reduced, and the great advantages entailed thereby would be appreciated at once by anyone who had worked with oils. Other applications were in the manufacture of vinegar and of sulphuric anhydride. Altogether he considered that the use of oxygen was only in its infancy, and that its future development would be marvellous.

Sir James Douglass gave some interesting reminiscences of the attempts of Goldsworthy Gurney and Faraday to use a jet of oxygen in conjunction with vegetable oils for the purposes of lighthouse illumination. Though the light was increased 2½ times, yet the price of oxygen in those days prevented its adoption. He had the greatest admiration for the mechanical skill exhibited by the engineers and managers of the works of the Brin Company, and he said that there were few places where things were carried on on such excellent principles. With regard to the oxygen compresser used in charging the cylinders, he was somewhat sceptical as to the possibility of obtaining the high efficiency given, as he himself had never in all his experience managed to obtain such satisfactory results.

Mr. Alfred Paget thought that Mr. Schönheyder was too severe in his criticisms on economy and waste, and he inquired whether it was a fact that the oxygen was found to be serviceable in removing fusel oil from spirits.

Mr. Murray, in replying to Sir J. Douglass, said that the company had four compressers continually at work, and that their efficiency was as stated in the paper. The first cylinder was double-acting, which might account for the good results. The compressing operation added 50 per cent. to the cost of the gas. Mr. Paget was right in supposing that the oxygen had a good effect in ageing spirits and wines. In reply to Mr. Cowper he stated that loss and leakage from the storing cylinders had given them a great deal of trouble, and that it arose entirely from the valves, which were always more or less porous. However, after a lengthened series of experiments they had adopted bronze three times run for their valves, and the oxygen could now be retained for six months without any sign of escape.

TRIPLE EXPANSION MILL ENGINE.

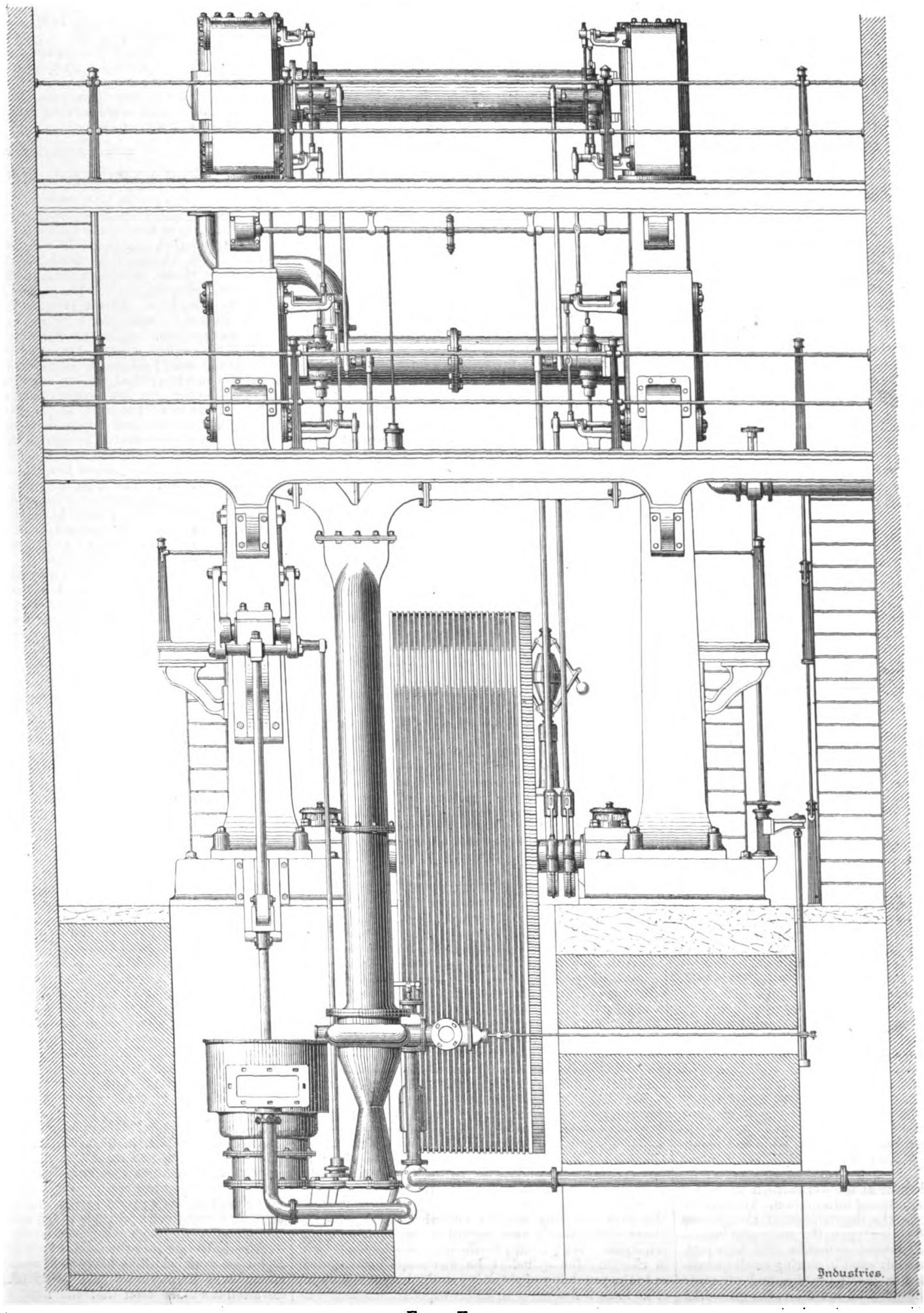
The engines of which we give illustrations on pages 124 and 125 have been made by Messrs. John Musgrave & Sons, Limited, engineers, Bolton, to the order of the Sun Mills Company of Bombay, who entrusted the work to Messrs. Musgrave through their agents Messrs. Sorabji, Shapurji, & Co. The makers have not been tied in working to a contract price, and therefore care has been taken to make the work as completely successful as was possible. A glance at the illustrations will show that the engines, instead of being constructed with three cylinders side by side, are arranged with four, so as to form two complete vertical tandem engines. The two lower cylinders form the low pressure, and are bolted to the top of the standards, while above them respectively are the high pressure and intermediate cylinders. The engines are thus connected to cranks placed at right angles to each other at each end of a straight shaft, which permits the rope-driving drum being placed in the centre of the engines. The high pressure cylinder is 16in. diameter, the intermediate 25in., and each of the low pressures 28in., all the pistons having a stroke of 3ft. 6in. The valves are of the Corliss type, worked by the well-known gear of the maker's, and those on the high and intermediate cylinders are directly controlled by the governor. The latter is an improved high speed one, and is also provided with Higginson's patent mercurial regulator (see description of this in *Industries*, Vol. VI. p. 340). The results obtained by the use of governors of this type, and the regulator, as shown by Moscrop's recorder, are highly satisfactory. It is claimed that with cylinders arranged in the manner described practically the same load is exerted on each crank, the engine is well balanced, and uniformity of speed is thoroughly attained. The standards are strong and substantial, and are constructed with large spreading bases, which are secured to a strong cast iron bed plate. The standards are made exceptionally long, and the result is that the engines are practically independent of any support in connection with the walls of the engine-house, while maintaining perfect steadiness and freedom from vibration. The high pressure and intermediate cylinders are carried by strong cast iron chairs bolted to the top of the low pressure cylinders. Stages on platforms are fitted to enable easy access being obtained to the various parts. The crank shaft is made of Siemens-Martins steel of high quality, the journals being 11in. diameter and 22in. long; the cranks are of best hammered scrap iron, and the crank pins are of mild steel, and are 6in. in diameter and 7½in. long. The crossheads are hammered scrap iron, and carry cast iron slippers of ample size. The piston rods are of mild steel, the high pressure being 3¾in. in diameter and the low pressure 4½in. in diameter, the pistons being fitted with Buckley's packing rings. Attached to the crosshead is a wrought iron lever, pivoted to the standard which drives the air pump rod. The air pump is vertical and single-acting, being 28in. diameter and 15in. stroke, and the barrel, bucket, and valve grids are of brass with india-rubber valves. The condenser is of the type usually adopted by the firm, which, while occupying a small space, gives good results in practice. As has been intimated, the power is transmitted by means of a grooved pulley 18ft. in diameter, and furnished with grooves for twenty-two ropes 1¾in. diameter, being built up with separate arms and boss, the rim being in segments. Arranged to work in connection with the wheel is one of Musgrave's patent barring engines, constructed upon their well-known principle to fall automatically out of gear after the engine is properly started. It only remains to be said that the makers have a reputation for high-class work which is likely to be maintained by the execution of the work we have described. In the side elevation it will be seen that the front cylinders have been removed for the purpose of showing the valve gear.

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TRIPLE EXPANSION MILL ENGINES.

CONSTRUCTED BY MESSRS. JOHN MUSGRAVE & SONS, ENGINEERS, GLOBE IRONWORKS, BOLTON.

(*For description see page* 123.)



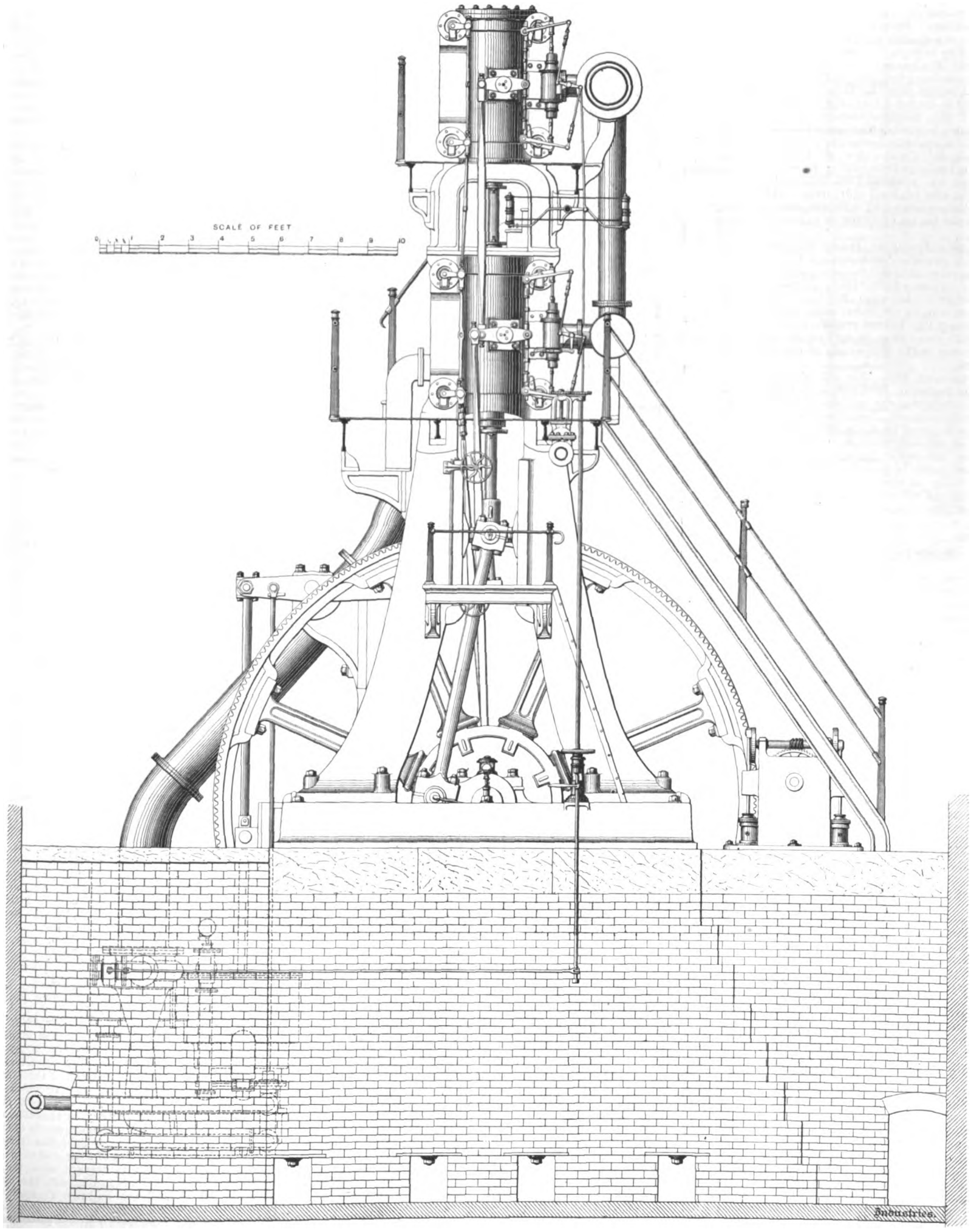
FRONT ELEVATION.

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TRIPLE EXPANSION MILL ENGINES.

CONSTRUCTED BY MESSRS. JOHN MUSGRAVE & SONS, ENGINEERS, GLOBE IRONWORKS, BOLTON.

(*For description see page* 123.)



SIDE ELEVATION.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

(FOR LATEST TELEGRAPHIC DESPATCHES SEE PAGE 129.)

PARIS, 4TH FEBRUARY, 1890.

IRON.—Business in iron continues on a very restricted scale here in Paris, and there is no prospect of much greater activity for some time to come. That prices are firmly maintained is due to the better state of things in the provincial markets. From all the chief centres of industry come reports of a steadily growing trade, and the prospect is brightened by important orders ahead, which cannot be long delayed. The success of the Fives-Lille Engineering Company in obtaining the contract for the construction of the proposed bridge over the Danube by the Roumanian Government has given a fillip to the markets of the Nord, and enabled the manufacturers more easily to obtain another advance in prices. The competing parties were the Fives-Lille Company, who tendered 7,657,617fr.; the Société Internationale de Construction at Braine-le-Comte, in Belgium, who tendered 7,958,949fr.; the Société du Creusot & M. Gaertner, who tendered 8,625,527fr.; the Société des Ateliers Eiffel, who tendered 9,017,082fr.; the Société des Anciens Etablissements Cail, who tendered 11,765,073fr.; and the Danube Bridge Company, in London, who tendered 17,630,084fr.

THE FOREIGN TRADE IN IRON.—The import trade in iron shows a considerable shrinkage for the year 1889, while the export trade exhibits an equally notable expansion. In the following figures the quantities in parentheses are those for 1888. Imports: Pig iron, 119,932 (136,613) tons; finished iron, 28,948 (33,843) tons; steel, 9,307 (8,473) tons. Exports: Pig, 120,000 (24,540) tons; finished iron, 67,556 (33,387) tons; steel, 36,323 (14,562) tons. The exports of pig iron in the last month of the year amounted to 40,000 tons.

THE VINTAGE OF 1889.—The official statistics of wine production in France in 1889, just issued by the Minister of Finances, show, for the vintage of that year, a yield of 23,223,600 hectolitres, a quantity that is less than that of the preceding year by 6,878,500 hectolitres, and below the average of the last ten years by 6,700,000 hectolitres. The Minister attributes the diminution partly to the phylloxera and partly to mildew and other maladies of the vine. The quality of the wine is described as excellent. The production of cider was some six million hectolitres below that of 1888, and ten millions below the average.

BERLIN, 3RD FEBRUARY, 1890.

RAILWAY ROLLING STOCK.—Makers of railway rolling stock were kept fully employed throughout 1889 by the large orders given out by the State Railways Department of the Government. The flow of orders from the same source continues, and in sufficient abundance to maintain the present activity at the works till the end of the current year. In the middle of last December contracts for the Breslau railway were entered into to the value of more than two million marks. On the 28th ult. further orders were given for the Frankfurt lines, and to-morrow, the 4th inst., the Cologne directorate will receive tenders for 2,810 goods waggons and trucks. As all makers are now fully provided for for many months to come, it is expected that in the course of the year large orders will be placed abroad.

THE GLASS TRADE.—The serious rioting which has taken place among the glassworkers on strike in Northern Bohemia has directed attention to the glass industry of that and its neighbouring locality. In consequence of changes in the export trade and keener competition brought about by the adoption of machinery, the wages of the glass cutters have fallen to only about one-fifth of what they were ten years ago. The evil is in large part due to the middlemen, who have the bead trade largely in their hands. The glass industry on Prussian territory is rapidly growing. At Weisswasser, as well as at Penzig and Rauscha, important works exist, and another large works is in course of construction, and still another is about to be commenced at Hoyerswerda. As an expression of discontent, and a protest against the high prices of glass brought about by the syndicating of the glass makers, a petition to the Minister of Commerce is being numerously signed, praying that the import duties may be removed or lightened for so long as the syndicate remains in existence. The imports of foreign glass in 1889 amounted to 241,018 cwt., the exports of German produce in the same period being 1,471,058 cwt. Of the latter quantity 237,212 cwt. were shipped to Great Britain. The syndicating of the glass bottle trade in England is regarded as favourable to the German export trade in those goods.

FLAX AND YARNS.—The yarn market at Trautenau has been better attended of late, and a fairly large amount of business has been done in linen and tow yarns. From Bielefeld we learn that the demand for flax and tow yarns has slackened. Prices, however, remain firm. The quantity of linen yarns imported into Germany in 1889 was 231,896 cwt. Of this quantity Great Britain furnished 22,214 cwt. The imports from Austria-Hungary amounted to 143,030 cwt. Sewing thread was imported to the amount of 8,864 cwt., nearly the half of which was derived from England.

GERMAN COMPETITION ABROAD.—The Germans are quick to profit by the faults and misfortunes of their rivals in trade. It seems that of late much of the mining machinery sent out from England to the gold fields of the Transvaal has failed to give satisfaction to the purchasers. The opportunity is being seized by the manufacturers of this country to send out properly qualified agents to South Africa, to endeavour to acquire a footing in the markets of those parts. In like manner, the ill feeling now existing against England in Portugal is being made use of to push forward German trade in the Peninsula.

EXHIBITION OF BEVERAGES.—An exhibition of German liqueurs, wines, beers, and mineral waters is to be held here from the 15th February to the 15th March, in the rooms of the new "Equitable Palast." The collection of exhibits will be a good one, and will probably attract a good many visitors from abroad.

THE ALKALI INDUSTRY.—The syndicate of the alkali works has issued its report of the sale during 1889. It appears that the deliveries of chloride of potash during the first half of 1889 amounted to 1,200,000 centners, and during the last half to 1,271,000 centners, as against 1,119,000 centners and 1,126,700 centners during the corresponding periods of 1888.

A SHIP CANAL FOR BERLIN.—The German Government have determined to construct a canal between Berlin and the Baltic. Herr Scheck has been asked to make surveys, &c., at the Stettin end of the canal. The canal is to accommodate the largest sea-going vessels.

THE POPP COMPRESSED AIR PATENTS.—The International Popp Compressed Air and Electricity Company was registered last week, with a capital of 1¼ million pounds. This company is constituted, among others, of the following:—Disconto Gesellschaft, Berlin; Dresdener Bank, Berlin; Oppenheim, of Cologne; Merck, of Munich; and Norddeutsche Bank, Hamburg.

TORPEDO BOATS.—The Portuguese Government have ordered five torpedo boats from Herr Schichau, of Elbing.

VIENNA, 3RD FEBRUARY, 1890.

THE IRON MARKET.—The iron market is very firm and the tendency in all branches is towards an increase. Last week the Styrian iron works increased their price of iron wire by 10fl. per ton. The Bohemian wire-nail syndicate announced an increase of 10fl., and the foundries one of 5fl. per ton in the prices of their products. Most of the railway companies in closing their accounts for the year found a considerable increase in their income during the last year as compared with 1888. They will pay higher dividends, and they will probably give out many orders for rolling stock. The Brünner Maschinenfabriks-Gesellschaft will hold their general meeting on the 25th February; at this meeting they will determine on an increase of the capital by at least 600,000fl.

THE COAL MARKET.—Great activity is displayed in the coal market. In the Western Bohemian district the brisk export continues, and last week the Saxon State Railways alone forwarded 80,606 tons of Bohemian brown coals, whilst a considerable quantity was shipped by the Elbe. The railways are taking advantage of the situation by increasing their tariffs. The Ministry recently granted the constitution of the new great Bohemian coal works company "Nordböhmische Kohlenwerks-Gesellschaft in Brüx," which has bought the largest collieries in the Brüx and Dux district.

BRUSSELS, 4TH FEBRUARY, 1890.

THE COAL MARKET.—The state of the coal market is undecided. On the one hand the producers are determined to sustain the prices, and on the other the buyers are holding back. The cessation of work at the Lens mines, a partial strike at some of the collieries, and the expectation of further strikes in Germany, all inspire the sellers with confidence in the maintenance of prices. The collieries have a large arrear of orders to complete, and they have not yet got into full working order after the strikes; for these reasons the price of coal is kept up. The effect of the strike may be seen from the returns of the amount of coal carried by the State Railways during January, which show a decrease of 10 per cent. as compared with the corresponding period of 1889.

THE IRON MARKET.—The iron market is in a much better position than one would have expected after the recent strikes in the coal trade. The prices are held firmly, and there is a great confidence in the future. Employment is assured for the whole of the year, and producers do not hesitate to arrange for long contracts. The buyers are holding off for a short time, as they expect that a possible lowering of the prices of coal may have a similar influence on those of iron. However, the chances of a fall in coal prices is very remote, and their anticipations are not likely to be realised. All the ironmasters are expecting a large demand from all quarters.

GLASS.—In window glass the dearness of raw materials and fuel maintains the tendency towards high prices. The American syndicate has decided not to buy from Belgian makers at rates above a certain maximum which they name, and the manufacturers, of course, are in serious difficulties on account of the great cost of production. They intend to hold a meeting shortly to determine on a line of action. Another glassworks has just been started at Brussels—viz., the Société Anonyme des Verreries de la Louvière. The capital is 125,000fr. in 250 shares of 500fr. each.

DÜSSELDORF, 4TH FEBRUARY, 1890.

COAL.—The question of the coal supply for the railways is engaging the earnest attention of the State railway authorities. One aspect of this question now under consideration has reference to the form of fuel to be used in future; whether the coal is to be burned in its natural state as heretofore, or in the form of artificially prepared blocks or briquettes. A number of specimen blocks prepared in different ways are undergoing the test of exposure to atmospheric influences. The agitation among the miners is again increasing, and it is feared that the Socialists will succeed in urging them to declare another general strike. The total production of coal in the Dortmund mining district in 1889 amounted to 33,851,190 tons, an increase of 2·1 per cent. relatively to the previous year. The number of hands employed at the end of the year was 121,200, against 111,198 tons at the end of 1888. The loss of the output in the second quarter of the year due to the colliers' strike in May last appears from the statistics of production to have been about 2,000,000.

IRON.—The business of the iron and steel markets remains without much alteration. The upward tendency of prices, occasioned by the prospect of dearer coal, continues distinctly marked. In most classes of iron the syndicate minimum is being oversold. The South-German rolled iron makers' syndicate has advanced its minimum to 192s. a ton at Neunkirchen. The total production of pig iron in Germany, including Luxemburg, in December amounted to 391,523 against 354,866 tons in the same month of 1888. The production of the year 1889 being 4,387,504 tons, the imports 339,246 tons, and the exports 156,434 tons, we have 4,570,316 tons as the quantity taken for the home consumption. The quantity of foreign iron imported is approximately equal to one month's production of the German furnaces.

AN IRON CHURCH.—A writer in the Leipsic *Tageb'att* describes an iron church which is approaching completion in the works of a Belgian engineering firm. The novelty of this structure, about which much interest is felt, lies in the fact of its being designed in the pure Gothic style to imitate stone. It is intended for erection in Manila, where earthquake shocks are frequent. It is 54 metres in length and 22 in breadth, the height to the roof of the nave being 20 metres. There are two towers to the structure, each 20 metres high. The total weight of iron is 1,600 tons.

LILLE, 4TH FEBRUARY, 1890.

IRON.—The recent considerable advance in the price of iron having been foreseen and discounted, has had no visible effect on trade. Consumers continue to give out their orders freely. Manufacturers are in some instances overwhelmed with work, having sufficient in hand for at least six months to come, and being pressed to deliver quickly. The scarcity of coal is everywhere felt. The prospect of another strike of colliers makes buyers desirous of getting their orders accepted as soon as possible. Bars and joists are quoted at the works 168s., and plates, for which the demand is strong, are hardly procurable at 192s. a ton.

TEXTILE MANUFACTURES.—The tone of affairs in the linen market has greatly changed in the last fortnight. The depressing languor in which the old year ended and the new year began has given place to at least relatively vigorous life, and manufacturers have come to take a cheerful view of the prospect. The turnover of last week was 16 per cent. greater than that of the week before, which was superior to that of the previous week by some 25 per cent. Buyers are continuing their operations, so that we may confidently look for a further expansion of business. The latest reports from Roubaix show a satisfactory state of things in the woollen trade of that district. The raw wool market is quiet, and the tendency seems to be towards slightly lower prices.

FLAX AND YARNS.—The situation has not greatly changed in the course of the last week. All the markets of Flanders are now well supplied with home-grown flax, and the demand is active. The better qualities are much sought after, and prices have advanced a little. The market for Russian flax is more active, but the amount of business done is small for the season. Dealings in yarns are mostly limited to the wants of the moment. Prices remain unchanged. The demand for jute yarns continues active. Cotton yarns are a little stiffer in price, and business is in consequence somewhat restricted.

AMSTERDAM, 3RD FEBRUARY, 1890.

RAILWAYS.—The Dutch Government has submitted to the States-General Bills for the approval of the agreements successfully made with the Dutch-Rhenish Railway Company, the Holland Railway Company, and the State Railways Company. The chief contract, to which I have already referred in these columns, is the one for the purchase of the Dutch-Rhenish Railway by the State, and the two other agreements are merely consequences of the first. Having bought the Dutch-Rhenish lines, the Government had to decide about the working of them, and as in Holland the State does not work the railways it owns, the choice lay between the Holland Railway Company, the oldest in the kingdom, and the State Railways Company, which works most of the State railways. The Government has decided to divide the purchased railways between the two companies for working in such a manner as to attain the chief object in view—viz., the doing away of excessive

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competition and the bringing into closer harmony of the different sections, particularly in relation to foreign railways, and the international train service. For this reason, too, considerable improvements will be carried out on the lines of the Dutch-Rhenish Railway, and a short loop line is to be constructed at Rotterdam to connect the Dutch-Rhenish with the Holland Railway, thus ensuring a through service of trains that has hitherto been wanting, *viâ* Rotterdam east and westward. The State is to pay 1,200,000 guilders—say, £100,000—for this connecting line, and 800,000 guilders—say, £75,000—for the improvements above mentioned. The purchase money payable to the Dutch-Rhenish Railway is 63,415,537 guilders—say, a little over £5,000,000. Some £2,000,000 of this total is for loans of the railway company, and the remainder for its share capital, to which must be added an amount of over £500,000 to be paid to the Dutch-Rhenish shareholders by way of premium for immediately selling a property to the State which could not be purchased compulsorily before 1898, that being the legal term of the concession. It has been argued that the Government could have made a better bargain by waiting until 1899, but, in the *exposé des motifs* which accompanies the Bills the Government explains that there were many reasons for acquiring the Dutch-Rhenish system now, and making suitable arrangements for working it—arrangements that, perhaps, could not have been perfected in 1899, or could only have been perfected then under less favourable conditions. Moreover, the ease of the money market and the present high prices of Dutch State securities will enable the Government to borrow the necessary purchase money at a low rate, whilst a totally different state of affairs might exist in 1899. The Dutch-Rhenish shareholders will virtually receive £123 for £100 stock, which does not appear excessive. In order to pay for this bargain, the State will have to contract a new loan of 47,523,000 guilders, close upon £4,000,000, in 3 per cent. bonds. The total amount payable is 65,415,537 guilders, but this sum is diminished by 20,267,847 guilders, being the estimated value of certain assets, mainly the rolling stock of the Dutch-Rhenish system, valued at about £750,000, and shares in the Leyden-Woerden and Utrecht-Kampen railways, which shares were in the possession of the Dutch-Rhenish Company, but will pass now into the possession of the State, together with the net receipts of the current book year above 5 per cent. The real amount payable is, therefore, 45,147,689 guilders, or 47,523,000 guilders in the shape of a 3 per cent. State loan at 95. This constitutes the most important railway combination in Holland ever since railways began there. The capital invested by the State in railways will now exceed £20,000,000.

ELECTRIC LIGHTING AT DORDT.—The town authorities at Dordrecht have signed a contract for the electric lighting of the public streets. The installation will be underground as far as the wires are concerned. The estimated cost is £13,000.

ELECTRIC TRAMWAY AT SCHEVENINGEN.—The first electric tramway of Holland will be opened in March next. It runs from the Hague to Scheveningen, the distance traversed being about four or five miles.

ACCIDENTS IN FACTORIES.—The public meeting at the Hague on Friday to promote the formation of an association of factory owners, with a view of minimising dangers to the lives and limbs of workmen in the factories of Holland, was a decided success. Some sixty factory owners were present. It was decided to constitute the association, a committee being appointed to draw up its articles, after which the King's sanction, necessary to constitute a legal body in Holland, will be asked.

THE GOLDFIELDS OF GUIANA.—I have already alluded to the boundary dispute which had arisen between the French and Dutch Governments in Guiana, a dispute that mainly relates to the possession of the Marowyne goldfields. After a brisk diplomatic correspondence, it had at last been decided to appeal to arbitration, but the first attempt to obtain a suitable arbitrator has signally failed, the Czar of Russia having refused to act in that capacity. It is stated in Government circles at the Hague that the refusal of the Russian Emperor is the consequence of certain conditions to which the Dutch Government had made the arbitration subject. France, on the other hand, had put forward no such conditions.

COPENHAGEN, 1st February, 1890.

SPIRITS IN SWEDEN.—The Carlsbaum Spirit Refining Company, at Carlshaum, Sweden, has, during the past year, refined and re-exported not less than 18,428,000 normal litres of spirit; in hand at the end of the year there was close upon 13,000 000 normal litres.

AN ICE BREAKING STEAMER.—The ice breaking steamer "Martaja," built at Finnbodazand, Sweden, for the Finnish Government, was launched recently. This is a very powerful ice breaker, being intended to force a thickness of 25in. ice. She will be stationed at the Hangö Harbour. Her principal dimensions are: Length, 160ft.; breadth, 37ft.; and depth, 20ft. The engine is on the compound system, and indicates 1,200 h.p. There are four independent boilers made of best Swedish Siemens-Martin boiler plate. The ice belt is of best Surahammer puddle plate, and the vessel altogether is built of the best possible material.

BEETROOT SUGAR MANUFACTORIES IN SWEDEN.—The manufacture of sugar from beetroot, which has become such an important industry in many countries, is rapidly increasing in Sweden, and, amongst others, a very large factory is approaching its completion at Helsingborg. The buildings are being roofed. The refinery will be ready about July, and the whole establishment will, barring accidents, be ready for the autumn's campaign. The new factory will have a capacity of about 5,000cwt. beetroot per day, or about 600,000cwt. during the four months of the "campaign." The pecuniary results seem exceedingly satisfactory to the growers. The same company is also building a sugar factory at Engelholm. During the last the four beetroot sugar manufactories at Arläf, Staffanstorp, Säbzholm, and Trelleborg, which are all in the same district, handled altogether 108,222 tons of beetroot.

SWEDISH STATE RAILWAYS.—During the year 1889 the section on the main line Langsele-Vännäs has been entirely finished between Langsele and Skorped, and leveling and other work done between the latter station and Anundsjö, so that the portion Langsele-Anundsjö, about 82 kilometres, is ready for traffic. Rails have since been laid for another 9 kilometres. The total length of the Swedish State railways was at the beginning of last year 2,531 kilometres, and on December 31st 2,613 kilometres. Takings amounted to about 21,800,000kr., of which 6,500,000kr. have been handed over to the Exchequer.

TIMBER TRAFFIC IN SWEDEN.—The opinion that the timber would be mostly floated down the rivers rather than forwarded by rail does not seem unlikely to alter. It was thought that the railways would only serve the timber traffic inasmuch as conveying it to the rivers was concerned, but the State railways think they can carry timber the whole length to the coast, and that this means of transport will in many cases be preferred to floating it down. It would, of course, be necessary to construct side lines from the trunk railway (the question is here more especially about Norrland) to the coast, where sufficient accommodation for further working the timber would have to be procured. The more important Swedish industries are altogether being more and more rationally dealt with, and are undoubtedly entering upon a more satisfactory stage. The question of timber is, of course, a very important one, and it has recently been argued with considerable weight that the present reckless and often aimless cutting down of Swedish forests should be put a stop to, and the matter dealt with and properly controlled and regulated through some Parliamentary measure. Along with a better handling of the raw materials in Sweden, such as timber and iron, runs an increased amount of manufacture within the country, both for home consumption and export, attended, as far as can be judged at present, by satisfactory results. As a new venture may be mentioned the manufactory at Ljungby, close to Sunnerbo, for wooden shoes and other articles of wood, such as lasts, &c. The works have secured the patent rights for Sweden for some perfected machinery, and the whole seems to be arranged in a thoroughly business-like manner.

MADRID, 3rd February, 1890.

THE NOXIOUS FUMES QUESTION—The Council of Estate has declared that it was within the powers of the Government to issue the decree prohibiting the open-air calcination of iron pyrites in the province of Huelva. This decision against the Rio Tinto Company greatly complicates the affair, and technical men cannot understand why this company is so reluctant to apply some other and more satisfactory process which would keep them in peace with the Government and with the country in general.

RAILWAY FROM LA ROBLA TO VALMASEDA.—An unsuccessful attempt has been made at Bilbao to raise the capital for the railway which it is proposed to make from La Robla to Valmaseda, near Bilbao. This line will pass through various coal districts.

PIG IRON AT BILBAO.—Bilbao pig iron, which has been selling at 80s. per ton, is to be raised to 84s. The buyers are not accustomed to frequent changes of prices, and they think that the prices ought to remain the same for years.

BLAST FURNACE OF QUIROS.—The blast furnace of Quiros, in Asturias, after having been improved, was put in blast last week. It is a very small one, and will hardly produce more than 200 tons per week. The Mieres Company, to which it belongs, have been limited in their make of rolled iron by want of pig. This furnace has one of the cheapest supplies of iron ore of about 38 per cent. of metallic iron.

NEW YORK, 24th January, 1890.

THE COAL TRADE.—The anthracite trade remains very dull for domestic sizes. There is no demand for these sizes, and it is not believed that any concession in price would improve the market. There is a good demand for manufacturing and steam sizes, which is likely to continue. What the trade needs is some cold weather or a restriction of tonnage. The output is considerably lighter than it was, but it is still enough to keep the trade in a bad state. Another depressing influence is the competition between the different companies for the large contracts usually given out af this time of year. The Reading Company is reported to have taken the contract to supply the Philadelphia Waterworks with 66,000 tons of pea coal at $2·03 per ton. As the tolls are $1·40 this contract means 63c. at the mines, and probably does not leave over 11c. to 13c. for the mining company. Prices are being cut in New York, and there are reports of sales of stove coal at something like $1 below circular rates.

GROWTH OF THE NORTH-WESTERN STATES.—Some of the evidences of the great growth in the new North-West are given in the record of the Northern Pacific Railroad Company, which gives a synopsis of the business done during the four years from 1886 to 1889. The gross receipts have increased from 11 to 19 million dollars. The number of passengers carried in 1889 exceeded those carried in 1886 by just about one million. The quantity of freight carried one mile increased from 500,000,000 to 900,000,000 tons. The growth of traffic has resulted in a good increase of net income. The expenses have not kept pace with the gross receipts because of the better-fitted trains, although the rates for both passengers and freight are less now than four years ago.

A LARGE ARTESIAN WELL.—A large Artesian well was put down in Woonsocket, Dakota, a short time since, and, after repeated attempts, the water has just been got under control. A lake, covering some forty acres, had been formed by the escaping water, and a dense fog is constantly rising from the warm water. Half the pressure is now turned on, and the water runs through a 6in. pipe and the force is sufficient to form an unbroken stream of 150ft.

NAVAL AFFAIRS.—The actual horse-power performance of the new cruiser "Baltimore" on her recent trial trip was made known on the 19th inst., by the promulgation of the report of the trial board. The aggregate indicated horse-power was 10,064. This gives the Cramps a power premium of $106,400—*i.e.*, $100 for each horse-power in excess of 9,000. The ship has already been placed in commission, and steamed to Norfolk to receive her armament. A special meeting of the Senate Committee on Naval Affairs was held on the 15th to hear the views of the Naval Board of Policy appointed last summer by the Secretary of the Navy to formulate and report a plan for the building of a navy to be commensurate with the dignity and power of the nation. They approved in general terms the Bill introduced by Mr. Hale, authorising the construction of eight battleships of from 7,500 to 10,000 tons each, two armoured coast defence vessels, three gunboats of from 800 to 1,200 tons each, and five torpedo boats. This Bill appropriates five million dollars for construction and two millions for armament. The Policy Board will recommend in their report to the Secretary the construction of one hundred and two vessels of all classes; these would be built, according to the plan of the Board, in fourteen years, and will cost together with their maintenance during the fourteen years $280,000,000, but it is not at all likely that Congress will authorise any such extensive plan.

IMPORTANT RAILWAY MEETING.—There is to be an important meeting of railroad men in New York this week. Representatives from roads in all parts of the country will be present, and the object of the meeting will be to devise plans to promote harmony and maintain rates. There has been a good deal of trouble among the Western roads lately, and it is generally recognised that the Inter-State Railway Association has outlived its usefulness. The object now is to form a railway clearing-house, and the idea will be not to make a railroad combination, but a clearing-house, or several of them, taking in certain prescribed terrtorial limits, with clerks to audit the accounts, under established tariffs, and make the necessary settlements with adjoining lines.

THE IRON AND STEEL TRADE.—The events of the past week have not been particularly encouraging to the iron trade. Prices have become very irregular, and the chances of a further advance are small. Sellers are inclined to wait developments, but it is probable that for good-sized lots concessions could be obtained. There is no material change in pig iron. The local furnaces are well sold up, and can afford to wait, but Southern irons are being offered in this market at less than local brands. This, if continued, can only lead to lower prices, and with the continually increasing output it will be difficult to maintain present rates. Prices are nominally $20, $19, and $18 for the three grades at tide; favourite brands bring a little more. The manufactured iron business is dull, and prices are somewhat easier, and concessions are not hard to obtain on good orders. Prices are 1·95c. to 2c. per lb. for bars, 2·35c. to 2·40c. for plates, 2·30c. to 2·35c. for angles, with about 25c. additional for steel. The steel rail market is firm, with an increase of from 50c. to $1 per ton. $36 at mill is now the usual quotation, and nothing is to be had at less than $35 50. The mills are all full of work, and therefore in good condition to maintain prices.

COMMERCE OF PHILADELPHIA.—The report of the value of exports and imports and duties collected at this port during the past year shows a slight increase over last year, the total imports amounting to $50,987,102, for 1889, and $45,020,132 for 1888. Exports during the same year amounted to $31,335,645, and $28,012,879 for the two years, while the duties collected amounted to $22,612,956·17 for 1889 as against $20,587,684·17 for 1888.

FLOUR FIRMS COMBINE.—At a meeting held in Milwaukee on the 9th inst., a combination was formed among the seven great flour mills of that city, involving $5,000,000 capital, and an annual output of nearly 1¼ million barrels of flour. The combination was made to meet the threatened competition of the Minneapolis mills. Milwaukee stands third in the country as a flour-producing city, having marketed 1,265,833 barrels of flour during the past year.

INTER-STATE LAW AMENDMENTS.—In their annual report, the Inter-State Commerce Commission make recommendations looking to the amendment of the law, so as to make both inter-State and international roads subject to the provisions of the Act; to better provide for through traffic and through rates over connecting lines; and allowing the free transportation of persons injured in railroad accidents, and of the families of railroad employés.

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IMPROVED BOILER FLUES.

CONSTRUCTED BY MR. DAVID MIDGLEY, WOOD NOOK IRONWORKS, LEEDS.

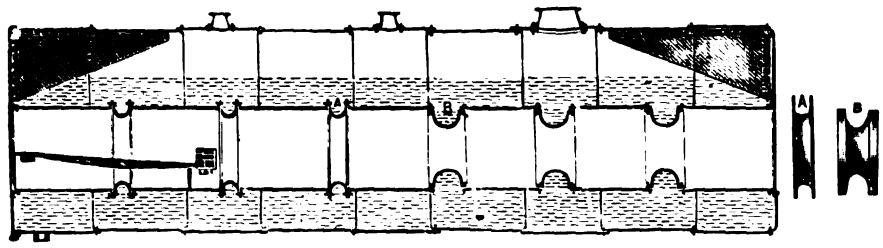


FIG. 1.

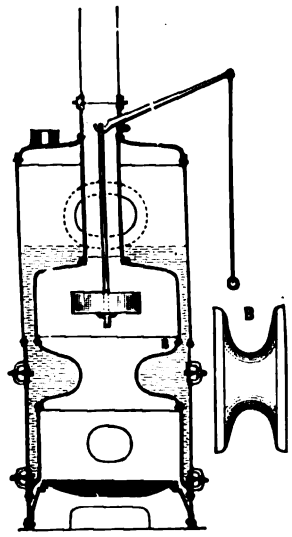


FIG. 2.

IMPROVED BOILER FLUES.

WE illustrate herewith a method of strengthening boiler flues, which has lately been adopted by Mr. David Midgley, Wood Nook Ironworks, Stanningley, near Leeds. Instead of using cross-tubes of the Galloway type, or external corrugations, or rings, now so general, Mr. Midgley inserts a few of what he calls "inverted expansion rings (A, B) into the length of the flue. The flue thus appears to have internal corrugations, and these extra surfaces thus gained are very effective as heating surface. The rings also will stand great strain, and therefore save the ends of the boiler to a large extent. They may be applied to vertical boilers, as in Figs. 2 and 3, or to Lancashire or Cornish boilers, as in Fig. 1. In practice Mr. Midgley finds that in boilers constructed on this plan, one ring is equal to three cross-tubes, as far as economy of steam and coal is concerned, and their general working is giving entire satisfaction.

THE BOILER EXPLOSION AT BENNERLEY FURNACES.

IN view of some probable legislation during the coming Session in connection with steam boilers, we give below an abstract of the result of the formal inquiry made on the 27th ult. at Ilkeston by the Board of Trade Commissioners—Mr. Howard Smith, barrister, and Mr. W. Lang, consulting engineer—into the cause of a boiler explosion at the Bennerley Furnaces on the 23rd November last. We do not care to trench upon the official report by giving the evidence of the various witnesses, and will simply give the substance of the Commissioners' opinion, as stated by Mr. Howard Smith when reviewing the evidence. From this it will be seen that, although the boiler exploded and caused the death of two children and injury to three women, the Commissioners held that no one was to blame—neither the boiler maker, the boiler owner, the boiler attendant, nor the insuring company. We therefore commend the following abstract to the consideration of those engaged in preparing additional legislation for steam boilers and steam users.

In reviewing the evidence, Mr. Smith said that he and Mr. Lang were of opinion that the iron of which the boiler was made was of good quality, and that the boiler was properly constructed. They considered the boiler would not have undergone a satisfactory examination unless it was tested by hydraulic pressure before it left the maker's works. Whether it was so tested or not in this case they were not able to say. They were

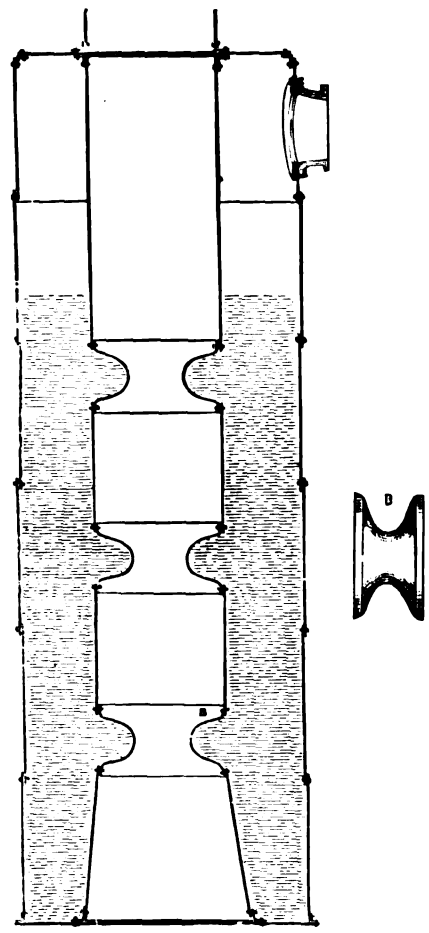


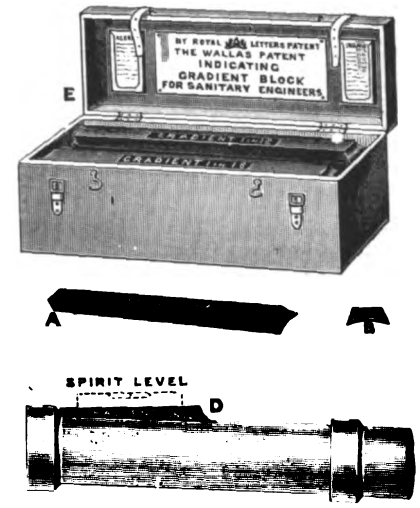
FIG. 3.

satisfied that Mr. Young, the inspector to the insurance company, made a thorough examination of the boiler on April 12th. They thought that at that time no repairs were necessary.

Mr. Smith remarked that they were further of opinion that the water which was put into the boiler was of proper temperature. They had come to the conclusion that the explosion was due to the flaw which was in the plates along the rivets of the circumferential seam which ripped right round the boiler. It was impossible for them to say how long the seam rip had existed. They did not agree with the evidence of one of the witnesses that probably it occurred on the day the boiler was filled. They thought that probably it had existed for two or three weeks, but they had no reason to suppose—in fact, the evidence was to the contrary—that it existed at the time when Mr. Young made his examination on April 12th. They had great pleasure in acquitting Mr. Young of any blame whatever. With regard to whether the owner was to blame, they were glad to say that the management of this particular boiler was very different from the management of other boilers which they had had to inquire about recently. It seemed to them that Mr. Davis, the owner, had done all that a man ought to have done, having taken great pains to see that a proper examination was from time to time made. It was probable that had a detailed examination been made when the boiler was laid up a day or two before the explosion the rip would have been discovered; but it was not the ordinary time for laying it up for that purpose, and in justice to the men it should be stated that they had no suspicion that the boiler was not in proper working order. To the question, which he understood would only be put formally, as to whether the owner was to blame, their answer was in the negative. They did not think that any blame attached either to him or Mr. Young. As to whether the company were justified in insuring the boiler without having first made an examination of it, they had already said that they hoped that in every case before a company took the risk they would make a proper inspection of the boiler In this particular case, however, there were, they thought, good reasons why the insurance was accepted. The boiler had been previously insured with the company, and all the facts in connection with it were known. In regard to the question whether the company were justified in taking the risk without making a further examination, their answer was that on the whole they were justified.

GRADIENT INDICATOR FOR DRAINS.

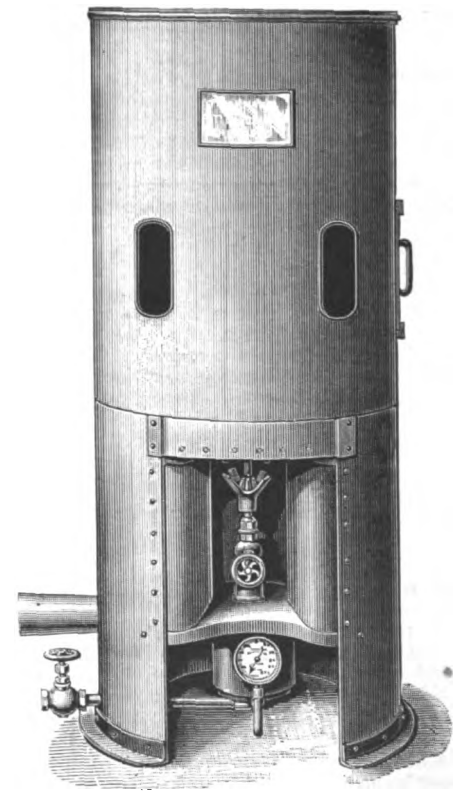
MR. I. C. WALLAS, Kilburn, London, has recently brought out a simple and inexpensive indicating block, illustrated herewith, for use in laying drain pipes to any desired gradient. A different block is made for each gradient, and it fits over the upper surface of the pipe.



A spirit level is placed upon the top of the block, and when this level is horizontal the pipe is at the gradient required. It will be seen that the whole length of a drain can be tested for gradient with the greatest ease, and by means of the blocks the pipes can be laid to give a definite outfall.

SAND BLAST FOR CLEANING CASTINGS.

WE illustrate below an apparatus which has been designed by Tilghman's Patent Sand Blast Company, Bellefield Works, Sheffield, for cleaning brass, iron, and steel castings, and other metallic surfaces by means of a sand blast. Decided advantages have been found in using the sand blast for cleaning ornamental and cored castings where there are a great many hidden surfaces, on account of the rebounding of the grains of sand in all directions. The slightly roughened surface which the



blast produces is well adapted for the adherence of zinc and plating metals. It has been found that the action of the blast does not interfere with the quality of the metal. In working with this apparatus the casting is introduced through a door at the back, and the workman places his hands through the two oblong openings in the front, and thus holds the article. A glass window is arranged above the oblong holes for him to look through to see the progress of the operation. With larger castings a chain is used for supporting them, and the workman simply guides them.

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SHIPBUILDING NOTES.

On the 18th ult. the s.s. "Sandfield," a new vessel, 275ft. by 30ft. 6in. by 20ft. 6in., built by Messrs. Withy & Co., of West Hartlepool, for Mr. Frederick Woods, of London, left West Hartlepool for her trial trip. Her engines are of the triple expansion type, and have been built by Messrs. Blair & Co., of Stockton-on-Tees.

On the 20th ult. Messrs. E. Withy & Co. launched from their shipyard at Hartlepool a screw steamer built to the order of Mr. G. Steel, of West Hartlepool. She is 300ft. long, and of large deadweight carrying capacity. She has a raised quarter-deck, long poop, topgallant forecastle, and cellular bottom for water ballast, and is fitted with steam winches, steering gear, and all the latest improvements. Messrs. Richardson & Son, of Hartlepool Ironworks, will provide the engines. She was named "Blenheim."

On the 21st ult. there was launched from the yard of the Tyne Iron Shipbuilding Company, Limited, of Willington Quay-on-Tyne, a steel screw steamer which has been built to the order of Messrs. Burrell & Sons, of Glasgow. She is of the following dimensions:—Length, 300ft.; breadth, 41ft.; depth, 22ft. This steamer has water ballast right fore and aft on the cellular system, and is fitted with all modern improvements for the rapid loading and discharging of cargo, including large donkey boiler and four double-cylindered steam winches, and has direct-acting steam windlass, steam steering gear by Messrs. Muir and Caldwell, and Hastie's screw gear aft. The engines, which are to be supplied by Messrs. Wigham Richardson & Co., are of the triple expansion type, having cylinders 23in., 37in., and 62in., by 42in. stroke, with two large boilers working at 160lb. pressure. On leaving the ways the vessel was named the "Strathdon."

Notices of Meetings.

THIS WEEK.

The Institution of Civil Engineers.—Students' Meeting, Friday, February 7th, 7.30 p.m. Paper to be read: "Reclamation of Land on the River Tees," by Colin P. Fowler, Stud.Inst.C.E. Ordinary Meeting, Tuesday, February 11th, 8 p.m. Paper to be further discussed: "Bars at the Mouths of Tidal Estuaries," by W. H. Wheeler, M.Inst.C.E.

NEXT WEEK.

Society of Arts.—Monday, February 10th, 8 p.m. Cantor Lectures: "The Electromagnet," by Silvanus P. Thompson, D.Sc., M.I.E.E. Tuesday, February 11th, 8 p.m. "Cast Iron and its Treatment for Artistic Purposes," by W. R. Lethaby. Wednesday, February 12th, 8 p.m. "Modern Improvements in Facilities for Railway Travelling," by George Findlay.

The Institution of Electrical Engineers.—Thursday, February 13th. "The Theory of Armature Reaction in Dynamos and Motors," by Jas. Swinburne.

The Junior Engineering Society.—Friday evening, February 14th. "Newspaper Printing Machinery," by Mr. P. Marshall; "Cylinder Ratios and Heating Surface in Marine Engine and Boiler Efficiences," by Mr. R. L. Newman.

PRICES CURRENT, 5th February, 1890.

Quotations at per ton, unless otherwise specified.

METALS.

		£	s.	d.		£	s.	d.
Spelter: Ordinary		£23	10	0	to £23	12	6	
Copper: British Cakes and Ingots		56	0	0	„	57	0	0
„ Chili Bars, G.O.B.'s		48	15	0	„	49	0	0
„ Other sorts, G.M.B.'s (equal to Chili Bars)		49	0	0	„	.....		
„ Manufactured (strong)		64	0	0	„	.....		
Lead: Common Pig		14	15	0	„	15	5	0
„ English Sheet		15	10	0	„	15	15	0
Tin: Straits		94	12	6	„	.....		
„ Australian		94	10	0	„	.....		
„ English Ingots		99	0	0	„	.....		

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £	s.	d.		Best. £	s.	d.	
Middlesbro' Bars	8	0	0	.....	8	10	0	f.o.t. wks.
„ Angles	7	15	0	.....	8	5	0	„
„ Plates	8	0	0	.....	8	10	0	„
Staffordshire Bars (cheaper makes)	9	0	0	.....	9	10	0	London.
„ Angles	9	0	0	.....	9	10	0	„
Crown Sheets	9	0	0	.....	9	10	0	„
„ Hoops	8	2	6	.....	8	12	6	„
"Siemens-Martin" Steel Boiler Plates				.....	10	5	0	„
„ Ship and Girder				.....	9	5	0	„

Market quiet.

PIG IRON.

Messrs. Raby, Fell, & Co., Manchester, quote as follows:—

Middlesbro' Warrants, No. 3		53/-	Cash
Scotch Warrants, m/n		52/11	„
Hematite Warrants, m/n		65/2	„
Stocks in Stores: Scotch	902,309.—Dec. for week,	8,395	Tons.
Middlesbro'	184,227.—Inc. „	201	„
Hematite	185,977.—Inc. „	497	„

Exclusive of stocks in makers' yards.

	No. 1.	No. 3.		
Coltness	77/6	69/-	f.o.b.	Glasgow.
Gartsherrie	75/6	69/-	„	„
Dalmellington	—	—	„	Ardrossan.
Eglinton	60/6	60/-	„	„
Glengarnock	76/-	67 6	„	„
*Derbyshire	—	72/-	f.o.t.	Works.
*Lincolnshire	—	69/6	„	„
*Lancashire	—	73/-	„	„

*Forge quality, about 1s. per ton less.

Market rallying somewhat.

CHEMICALS.

		£	s.	d.		£	s.	d.
Acid: Carbolic Crystals	lb.	0	0	11	—	.....		
„ „ Liquid	gal.	0	1	2	—	.....		
„ Citric	lb.	0	1	7	—	.....		
„ Oxalic	„	0	0	3½	—	.....		
„ Sulphuric	ton	1	10	0	—	.....		
„ Tartaric	lb.	0	1	4	—	.....		
Alum: Lump (powder 10/- ex.)	ton	4	17	6	—	.....		
Ammonia: Carbonate	lb.	0	0	3½	—	.....		
„ Muriate (Grey)	ton	22	5	0	—	.....		
„ „ (White)	„	26	0	0	—	.....		
„ Sulphate	„	11	15	0	to 11	17	6	
„ Liquor	lb.	0	0	3½	—	.....		
Antimony	ton	.....			—	.....		
Bleaching Powder	„	5	0	0	—	5	2	6
Bisulphide of Carbon	„	13	10	0	—	.....		
Borax	„	30	0	0	—	.....		
Benzole (90 %)	gal.	0	4	1	—	.....		
„ (50/90 %)	„	0	3	4	—	.....		
Copper Sulphate	ton	24	10	0	—	.....		
Copperas	„	2	0	0	—	.....		
Kieserit	„	1	13	0	—	.....		
Lead: Nitrate	„	22	10	0	—	.....		
„ White Sugar	„	24	0	0	—	.....		
„ Brown „	„	19	0	0	—	.....		
Potash: Bichromate	lb.	0	0	4	—	.....		
„ Caustic	ton	22	0	0	—	.....		
„ Carbonate	„	19	10	0	—	.....		
„ Chlorate	lb.	0	0	4½	—	.....		
„ Prussiate (Yellow)	„	0	0	10½	—	.....		
„ Sulphate (Basis 90 %)	ton	9	10	0	—	.....		
Precipitate: Red	lb.	0	3	1	—	.....		
„ White	„	0	3	2	—	.....		
Salts: Epsom: Bags	ton	3	0	0	—	.....		
Epsom: Casks	„	3	15	0	—	.....		
„ Glauber	„	1	10	0	—	.....		
Sulphur: Sublimed Flowers	„	9	0	0	—	.....		
„ Recovered	„	4	10	0	—	.....		
Soda: Ash	deg.	0	0	1¼	—	.....		
„ Caustic (White 70%)	ton	8	5	0	—	.....		
„ „ „ 60%)	„	7	10	0	—	.....		
„ „ (Cream 60%)	„	7	5	0	—	.....		
„ Crystals	„	2	12	6	—	.....		
„ Bicarbonate	„	5	5	0	—	.....		
„ Hyposulphite	„	6	5	0	—	.....		
Solvent Naphtha	gal.	0	3	6	—	.....		
Tartar, Cream of	cwt.	5	12	6	—	.....		
Zinc Sulphate	ton	7	10	0	—	.....		

Messrs. S. W. Royse & Co., Manchester, report as follows:—

Chemicals.—Caustic soda continues in short supply, and prices are advancing strongly under the influence of an improved inquiry. Bleaching powder is a turn easier for both present and forward delivery. All qualities of soda ash are tending upwards; ammonia alkali just advanced 7s. 6d. per ton. There is very little inquiry for carbolic acids, and prices of crude and crystals continue to droop, liquid, however, remaining steady. Benzoles are in good demand at the advanced rates, and solvent naphtha has a steady outlet. Sulphate of ammonia is again lower. Acetates of lead are steady. Acetate of soda, which has been persistently depressed, is receiving more attention.

OILS.

		£	s.	d.
Cocoanut: Cochin	per ton	26	0	0
„ Ceylon	„	23	10	0
Cottonseed	„	21	10	0
Cod	„	19	0	0
Lard	„	37	10	0
Linseed	„	20	17	6
Palm, Lagos	„	24	0	0
Rapeseed: English	„	32	10	0
Seal: Pale	„	26	10	0
„ Brown	„	19	0	0
Sperm	„	46	0	0
Whale	„	24	0	0
Turpentine	per cwt.	1	15	9
Coal	per gal.			
Petroleum (Refined)	„	0	0	5½
„ Spirit	„			

FOREIGN TELEGRAPHIC ADVICES.

(From our own Correspondents.)

Paris, Feb. 6.—*Iron.*—The market is steady, and prices are firmly maintained. Bars and joists, 170s.; old rails scarce at 78s. In the Haute-Marne very brisk demand for wire, wire-nails, and chains. Founders less busy. In the Nord recent advance well established. Demand active, but production hindered by want of coal. In Loire-et-Centre prices are higher. Base price of bars 168s. a ton.

Metals.—The "bull" operations in copper seem to have nearly played themselves out. Chili bars same as last week. Best selected a little lower. The market is heavy for tin, at three or four points below last week's prices. Lead is again lower. Spelter, too, has receded a point. Consumers are buying as little as possible.

Berlin, Feb. 6.—*Bourse.*—The decision of the Westphalian colliers to postpone the general strike till after the elections created a scare among the "bears" in industrial securities. The buying back which resulted from it not only checked the downward movement, but brought about some recovery in the market. The change is, however, due wholly to speculative dealings. Investors have lost confidence, and stand aloof. The market is weaker to-day on receipt of unsatisfactory news of the Scotch iron market.

Metals.—Speculative business in metals is just now confined within very narrow limits, and the buying on the part of consumers is limited to the requirements of the moment. The tone of the market is, however, unmistakably firm all round. Mansfeld refined copper, £61 to £62 10s.; Banca tin, £103 to £106; Clausthol refined lead, £16 to £16 10s.; ordinary Silesian spelter, £26 to £26 5s. Antimony regulus a little dearer.

Breslau, Feb. 6.—*Coal.*—The colliery owners have again advanced their prices. Large and round are quoted 8s. to 9s.; nuts, 7s. 3d. to 8s.; small, 4s. 7d. to 5s. The demand is very active. The output of the pits is said to be kept 25 per cent. below their possible production by the want of a sufficient number of railway waggons. The miners are now working contentedly.

Iron.—The iron market is strong and active. The brisk demand for pig and the absence of stocks keep prices very firm. Forge pig is scarce. The demand for scrap is constantly increasing. In the finished iron and steel market a large business is being done in plates and joists. Prices are unaltered. Founders report increasing activity in their branch of the industry. Export orders are more numerous.

Zinc.—The supply of spelter barely keeps pace with the demand. The state of the market is significantly indicated by the fact that it finds its way immediately into second hands. Best W. H. spelter is quoted as high as £25 2s. 6d.; other refined brands a little less. The new zinc rolling works at Myslowitz are approaching completion.

Düsseldorf, Feb 6.—*Coal.*—Though the miners have agreed to wait till March 1st before proceeding to extremities, it is becoming every day more certain that next month will bring another interruption of the output of coal. In view of this contingency manufacturers here are contracting largely with Belgian producers. The coal merchants seem disposed to advance their rates. The attitude of the colliers occasions great anxiety.

Iron.—The business of the iron market has perceptibly fallen off in volume. Buyers manifest less confidence in the stability of the situation, and hesitate to enter into fresh contracts. Nevertheless prices are firm all round, and for some classes of iron have advanced slightly since yesterday's opening hour. Spiegel pig is in better demand for export. It is announced that the makers are fully sold ten months forward. Forge pig, 93s. and 94s.; finished iron and steel unchanged; rolled wire less inquired for.

Prague, Feb. 6.—*Glass Workers' Strike.*—The glass workers out on strike threaten to burn down the works if foreign workmen are engaged to fill their places. The rioting continues. Public sympathy is in favour of the men, whose wages have been cut down to starvation point. Indignation is strong against the middlemen. Quiet can be restored only by a complete change of the basis on which the trade is now carried on. Market wholly disorganised.

Hamburg, Feb. 6.—*Nitrates.*—There is no improvement in the market for Chili saltpetre, and last week's prices are with difficulty maintained. Spot, £8 2s.; to arrive in March, £7 10s.

Charleroi, Feb. 6.—*Iron.*—Confidence is being gradually restored. Buyers are giving out their orders freely at the prices now current. Pig iron is being sold at the prices of the day for distant future delivery. Ordinary forge, 72s. The market is active for finished iron. No. 2 bars, 152s. at works and f.o.b. Antwerp; joists, 144s. and 148s. Plates No. 2 are quoted from 176s. to 180s.; steel plates, 208s.; steel rails f.o.b. Antwerp, 140s. a ton.

Ghent, Feb. 6.—*Flax and Yarns.*—An abundance of home-grown flax on offer, and a moderate volume of business transacted. Prices unchanged. Russian flax more inquired after. Demand slack for tow and linen yarns. Cotton spinners are asking higher prices for yarns; but the attempt to keep pace with the advance in the raw material has checked business.

We have received two catalogues from Messrs. John Birch & Co., engineers and merchants, Liverpool. One of them is called "Railroads and Rolling Stock," and it gives almost every information which could be desired as to the cost of plant and material for all kinds of lines. The other is called a "Representative Catalogue of Machinery, Machine Tools, and Engineering Material," and we think it well deserves its name.

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HOME INDUSTRIES.

LONDON 6th February, 1890.

The Money Market.—There is virtually no change in the position of the money market. Though the conditions which brought about the stringency have somewhat improved, the Bank of England maintains its precautionary attitude and still manages to control the policy of the market. The foreign exchanges have begun to move in favour of this country, with the effect of making money a little easier, but there is not yet any general disposition towards ease. In point of fact no one ventures to forecast the immediate future of the money market. That being so it is not remarkable that business remains dull on the Stock Exchange. The instances of activity are isolated and arise from special causes. The slight improvement in the monetary conditions has told favourably on Consols. Foreign bonds stand fairly well, renewed favour being shown towards Turkish and Egyptian issues. The publication of the programme to be followed by the Peruvian bondholders under the Grace Contract has led to an improvement in Peruvians. Eight per cent. dividends declared on North-Western and Great Western stocks have been insufficient to keep up the "heavy" market, and in general home railways have been depressed. American railways have been less in request than last week, although New York still takes a hopeful view. The Mexican Railway maintains and improves on its recent recovery. Nitrate and mining securities are in undisguised disfavour.

Companies.—The following companies have been registered since our last report:—John Corrigan & Co., Ld., with a capital of £10,000, to carry on the business of engineers and machinists; The Glass Bottle Industries, Ld., with a capital of £1,400,000; Grindley & Co., Ld., with a capital of £20,000, to carry on the business of distillers of naphtha, tar, resin, &c.; Multiple Automatic Co., Ld., with a capital of £50,000; The Lichfield Brewery Co., Ld., with a capital of £250,000; The Clitheroe Salford Bridge Mill Co., Ld., with a capital of £2,000; Norwich Electricity Co., Ld., with a capital of £50,000; The Automatic Amusement Co., Ld., with a capital of £3,100; The Universal Electric Light and Power Trust Corporation, Ld., with a capital of £5,000; The Costa Rica Syndicate, Ld., with a capital of £250,000, for the purpose of constructing and working railways, &c.; The Central Argentine Andine Extension Railway Co., Ld., with a capital of £500,000; Peter Stubbs, Ld., with a capital of £150,000, to carry on the business of engineers; The Morgan's Automatic Electric Signal System Syndicate, Ld., with a capital of £5,000; The Sheffield Smelting Co., Ld., with a capital of £150,000; The Paragon Smoke Preventer, Ld., with a capital of £30,000; The Goldenhill Ironstone, Coal, and Oil Syndicate, Ld., with a capital of £1,000; The South Staffordshire Coal and Iron Syndicate, Ld., with a capital of £5,000.

Copper.—In their monthly report, Messrs. Lewis & Son state that after advancing from £50 10s. to £52 per ton for cash good merchantable copper, and from £51 to £52 10s. for three months prompt during the first week of the year, the improvement was checked by the sale of about 4,000 tons of copper by one of the French bankers to London dealers. This had the effect of placing a large number of warrants on the market, and causing the demand to be freely met. A decline ensued, until £48 12s. 6d. was accepted for cash, and £49 5s. for three months prompt on the 24th ult. On the 30th, £49 was paid for cash, and £49 15s. for three months, but the market closed at £49 2s. 6d. for cash and £49 12s. 6d. for three months prompt sellers. The fall of 10s. per ton in pig iron warrants and the dearness of money have assisted to depress the value of copper.

Shipping.—During the last fortnight freights have been dull, and not much business has been done. Shipbuilders are still busy on old contracts, but very few new orders are obtained. Prices continue to be above the value of tonnage.

Electrical Engineering.—Messrs. Woodhouse & Rawson United, Limited, have declared an interim dividend of 15 per cent. per annum, which shows a prosperous state of affairs.

The Association of Sanitary Inspectors.—The Association of Public Sanitary Inspectors of Great Britain held its seventh annual dinner on Saturday; Dr. B. W. Richardson presided. In giving the toast of "The Association and its President, Sir Edwin Chadwick," Dr. Richardson gave a sketch of the history of the society. Referring to Sir Edwin Chadwick, who had been the president of the Association since its formation, Dr. Richardson said that the record of the work he had done was written in the history of the century. Though brought up for the Bar, with great abilities in that direction, he had lent himself to new and simpler work. For a period of over sixty years he had continued to spread sanitary light in England, and had made sanitation what it never could have been if he had not lived to be its guide, philosopher, and friend.

London Geological Field Class.—A course of four lectures will be delivered by Professor H. G. Seeley, F.R.S., on February 15th, and the three following Saturday afternoons, at 4 o'clock, by permission of the Gresham Committee, at the Gresham College, Basinghall Street. The subject will be "The Tertiary Rocks on which London Stands." The price of tickets for the course will be 5s. each, and they may be had of J. Herbert Hodd, Hon. Sec., 30, Hatton Garden, E.C.

MANCHESTER, 6th February, 1890.

The Iron Trade.—The continuous fall in the price of pig iron warrants in Glasgow has practically stopped buying in this market. Makers of all brands are adhering firmly to their nominal quotations, but there is not enough business to test prices. Most consumers are covered for their present requirements, and are unwilling to do anything more until they see how the market is likely to turn. On the other hand, makers have contracts booked at the higher prices sufficient to carry them on for some time to come, and are therefore indisposed to sell at much below late rates. The result, therefore, is a deadlock, which, however, must terminate in a short time. Bar iron is decidedly easier in tone, and there is a little underselling by merchants for prompt deliveries. Steel boiler plates remain firm, and do not seem to be much affected by the movements in pig iron. The price of fuel is now a serious factor in local ironworks, and it appears as if a further advance would be obtained by the colliers, who have agreed to send in notices to cease work on the 10th of this month unless 10 per cent. advance is granted.

The Engineering Trades.—The condition of trade amongst engineers is good, and in all departments there is no falling off in the activity prevailing. Prices have not yet been raised in accordance with the increases in raw materials, but they are higher than they were. Boiler makers possibly form an exception to the rule, as raw material is such an important item in their manufacture that it is absolutely necessary to obtain enhanced rates. Millwright work is being cheaply sold considering the present conditions of things. Machine tool and locomotive builders are fully occupied and have a lot of business booked. Machine makers are working at the highest pressure and orders are coming freely from India, America, and the Continent. There is also a steady flow of business from the home market, and generally prospects are very bright. Loom makers are fairly employed, but are not yet increasing their business. Messrs. Wm. Smith & Sons, of Heywood, are engaged in the erection of a carpet loom which is intended to weave carpets 12ft. wide, further details of which we will give at a later stage.

The Linen and Jute Trades.—Business amongst the large distributing houses here has been interfered with considerably owing to the fact that retailers are too busy with their annual sales to attend to travellers. This has made the results of recent journeys very poor, although samples of new styles had been prepared for the purpose of showing. These disappointments, however, are only temporary. Scotch coarse linens are in moderate request at unchanged prices, and Leeds continues to do a fair business in crashes and other specialties of the town. Leeds crashes are noted for their quality, and are much dearer than the general run of these goods. The carpet syndicate has not yet been definitely arranged, and those jute and linen manufacturers doing business with carpet producers are still without positive information. In the meantime, the carpet trade is greatly depressed in consequence of the general uncertainty prevalent. The fancy linen and fancy jute trades are brisk, and looms are well engaged. Handkerchiefs are in active demand, and stocks are low. Prospects of trade in these articles are as satisfactory as ever, and makers must be making considerable profits. Linen threads are without appreciable change.

Hydraulic Power.—The Manchester Town Council has determined to authorise the Waterworks Committee to oppose the Bill—of which we gave some particulars recently—promoting a scheme of high pressure hydraulic supply. It was stated that £6,000 per year was paid to the Corporation for water supplied at ordinary pressure for small motors, and that when the Thirlmere scheme was complete a pressure of from 220lb. to 240lb. would be obtained.

Board of Conciliation.—It is proposed to form a Board of Conciliation from the directors of the Manchester Chamber of Commerce, who shall adjudicate upon labour disputes in this district. The directors are willing to consider the proposal if the consent of the employers' associations and the trade unions in the district can be obtained, and a scheme formulated by which each would be bound.

Short-reeled Cotton Hanks.—At the last meeting of the Manchester Chamber of Commerce, Mr. Hahlo called attention to a practice which he alleged existed of short-reeling yarns sent from Bombay to Calcutta. He stated that English yarns sent to the latter place were bound to be full length and correct counts, while yarns sent from Bombay were short length and coarser counts than marked. It was pointed out that no supervision was exercised over yarns sent out of either this country or India, but only those imported, nor was it possible to exercise such a supervision over internally shipped goods, which could be refused by the buyer if not up to standard.

Weavers' Grievances.—In a report issued by the secretary of the Preston Power Loom Weavers' Association attention is called to an alleged system of driving by which the weavers are pressed beyond a reasonable limit. It is asserted that many accidents occur by reason of this practice, and that a deleterious effect is produced on the health of the workpeople. It is proposed to take active steps to stop the practice.

Chemical Trade Amalgamation.—The well-known works of Messrs. I. Levinstein & Co., one of the leading English aniline manufactories, has passed into the hands of the Actiengesell-chaft für Anilin Fabrikation of Berlin. At the same time the works of Friedrich Bayer & Co., of Elberfeld, have become the property of the new concern, which in England will be carried on as I. Levinstein & Co., Limited, Mr. Levinstein being managing director. A considerable enlargement of the Manchester works is to take place, and the amalgamated concern will be a very strong one.

GLASGOW, 6th February, 1890.

Pig Iron.—The selling in this pig iron market has been more and more pronounced every day this week. No amount of buying seemed to stop the fall, for the impression was spreading among holders that the lull in shipbuilding, and the falling off in the shipping demand, necessitated a return to a lower platform of prices all round. A few "bears" went as far as to indicate 55s. as a figure likely to be reached ere long; but few anticipated that we would be as low as 52s. so soon. As usual, selling brought on selling; no fresh set of buyers was found willing to take the place of those who wanted to get out. Quite possibly 52s. for Scotch, 63s. for hematite, may at last attract investors who have kept aloof all the time that we were at fancy prices.

Shipbuilding.—A decided calm has supervened in shipbuilding. Some four vessels only have been ordered on the Clyde during the past ten days. Yet this falling off has not yet diminished the briskness at the yards. Indeed the want of orders is to some extent due to the uncertainty of delivery, although no doubt the fall of freights, and the relatively high prices of labour and material, are mainly to blame for it. The vessels laid down at the beginning of the revival are now coming into the freight market, and the increased tonnage is beginning to tell.—Mr. Carmichael, yard manager for the Fairfield Shipbuilding Company, leaves that firm almost immediately for the yard of Messrs. Caird & Co., Greenock. He will be succeeded by Mr. Robert Middleton, who has been at the head of the drawing office for some years. The "Normannia" will be launched by the Fairfield Company on Saturday, the 1st prox.—At a dinner given by the directors of the Fairfield Shipbuilding and Engineering Company to the staff of the works, Mr. Barnwell, chief director, who occupied the chair, mentioned that the firm had commenced the year with work in hand to the extent of 41,000 tons of shipping and 65,000 horse-power in marine engines. He mentioned also that the amount to be paid in instalments on this work, as far as executed during the year, would exceed £1,250,000 sterling. Last year the total tonnage launched b the firm had been 40,115 tons, and the horse-power produced had been 56,995. These figures exceeded those of even the year of greatest briskness in shipbuilding, the year 1883, and were far above all other years in the history of the firm.—Mr. Biles, who has been for some years at Clydebank, as scientific adviser, &c., to Messrs. J. & G. Thomson, is about to take the general management of the new firm which has taken over the business of Messrs. Oswald, Mordaunt, & Co. The new firm, which will be styled the Southampton Naval Works Company, Limited, will begin work at once. Its range will include mercantile steamers as well as men-of-war.

Scotch Railways.—In the forthcoming session of Parliament there will be fought a great Scotch railway battle. The Caledonian Railway Company are much aggrieved at the proposed amalgamation of the North British and Glasgow and South-Western Railways, and are about to promote a Bill authorising them to share the spoil of the South-Western with the North British, or alternatively to take the South-Western over on its own account. Meetings have been held in several of the towns interested, and since the Caledonian almost everywhere competes with the South Western, and nowhere has interests identical with it, expressions of public opinion are altogether in favour of the North British scheme, since competition would thereby be maintained and monopoly prevented. If the scheme be carried out as originally intended, the North British will obtain access to the coast on both sides of the Clyde, and will thus be able to compete with the Caledonian on even more favourable terms than hitherto. The details of the arrangement by which the North British proposes to take over the South-Western have now been settled. The capitals of the two companies, inclusive of debentures and loans, are put down at about £44,000,000 and £15,000,000 respectively, while the City Union Railway, which is also involved in the proposed transfer, is put down at £800,000. The arrangement involves that the shareholders of the Glasgow and South Western Railway should, after the amalgamation, become shareholders in the North British Railway. Ordinary shareholders of the Glasgow and South Western Railway are to receive from the new company a 4 per cent. preferential dividend, with a lien upon the present property of their original company. The deferred stock of the South-Western is to be converted into North British ordinary on terms to be hereafter agreed upon. It is reported that the Midland Company are pledged to support the North British proposal.

(From our own Correspondents.)

LIVERPOOL, 5th February, 1890.

The Timber Trade.—The timber trade of the past year has been, as far as volume of business done is concerned, fairly successful; the imports in the aggregate show an increase of 37 per cent. on the previous year, the consumption an increase of 15 per cent., and the stock on hand is more than double that of the previous year. Although the trade has been large, the profits, unfortunately, have not been in the same proportion. This is due to a certain extent to the

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increased employment of steamers bringing forward the goods with greater rapidity than before, thus taxing to the utmost the local resources for discharging. Stocks require now to be less in consequence, and this, in conjunction with the increased freights, causes buyers to be exceedingly cautious in contracting for the coming season. This new development of the trade will ultimately require special provisions to be made to work it; and if it had not been for the action of the Timber Trade Association, obtaining the assistance of the Dock Board and the railway companies, serious strikes would undoubtedly have taken place among the men. In addition to the large deliveries on crowded quays, timber merchants complain that the shipowners claim to the last farthing whatever demurrages there may be legally due, and exact the fulfilment of the smallest conditions in their favour. The prospects of the present year are much brighter than the present state of things would appear to warrant: the volume of trade increases, and the improvement is likely to be permanent, as it is not the result of speculative operations, but emanates from a legitimate source.

THE LIVE STOCK AND DEAD MEAT TRADE.—Ten steamers arrived in Liverpool last week from the American and Canadian ports, with 2,442 cattle and 9,175 quarters of beef, showing a decrease of 440 cattle and 4,657 quarters of beef compared with the imports of the previous week.

SHEFFIELD, 5TH FEBRUARY, 1890.

THE COAL TRADE.—There is a less demand for coal than is usual at this time of the year, mainly owing to the warm weather. The official announcement of the demand from the miners of an additional 10 per cent. is causing an uneasy feeling in some branches of trade. After the last advance in January it was not expected that any further disturbance of prices would occur for at least six months. There is every intimation of a firm resistance to the proposal from South Yorkshire and East Derbyshire colliery owners. Coke of all kinds continues in brisk demand. For steel melting purposes local makers are now able to produce a very satisfactory quality. Messrs. Crookes, Roberts, & Co., of Sheffield, are introducing a new smoke-consuming apparatus, which has at present a very promising prospect.

THE IRON TRADE.—Although rather a quieter tone has prevailed for the past week or so, there is at present no diminution in the demand for iron of all classes. One of the best indications of this is to be noticed in the fact that Messrs. John Brown & Co., Atlas Works, have re-started another blast furnace. The demand for railway material still continues good. Tyres are quoted at £11 per ton; axles, best charcoal iron, £10 to £12 per ton; steel rails, £7 to £7 5s. per ton. On the West Coast some good lines are in hand by Messrs. Cammell for colonial and foreign railways. The Rolling Mills Association has again raised the prices, varying in amount from 5s. to 10s. per ton. Steel of all classes is in good demand. Castings of crucible and Siemens steel continue to be made in large quantities.

NORTH STAFFORDSHIRE, 5TH FEBRUARY, 1890.

THE IRON TRADE.—The depression in the Scotch and North of England iron trade, believed to be mainly due to speculative influences, is adversely affecting prices and demand in this district. Consumers and merchants are waiting to see the outcome of the struggle between the "bulls" and the "bears" in the North, and the feeling of confidence in the future of the trade is being lost. There is a general belief, however, amongst producers that as the year advances there will be a further improvement in prices. At the present time Middlesbrough iron is being imported into this district at prices below those ruling for local brands of pig iron.

THE COAL TRADE.—The extreme mildness of the season has effectually dispelled the hope entertained by some colliery proprietors of seeing coal selling at £1 per ton at the pit, which there is little doubt would have been the case had the weather been less propitious. Prices are lower, and the demand is not equal to the supply.

IRONWORKERS' WAGES.—In accordance with the terms of the sliding scale the prices taken out for the past two months gives the ironworkers an advance of 5 per cent. in wages.

LEICESTER, 5TH FEBRUARY, 1890.

WOOL SPINNING AND YARN TRADES.—The wool market shows but little variation since last report. Holders of stocks are not pressing sales, and consumers appear to have faith in the maintenance of current rates. There is a good consumption, and the tone of the market is very confident. This feeling has been largely stimulated by the results of the Colonial wool sales. Choice wools are not quite so plentiful, but skin wools are in good demand and find a ready sale.

HOSIERY TRADE.—Business is not very good or very bad in this industry. A fair amount of trade is being done, but the weather has considerably interfered with the selling of the kinds usual at this period. Most of the houses are busy with sampling for the spring trade, and a few orders have been placed. Though the output is not so large as is desirable, the prospects for the coming season are on all hands deemed satisfactory.

BOOT AND SHOE TRADE.—An excellent trade is being done. Most of the houses are working up to their full capacity, and some are working overtime. The amount of business is without parallel at this time of the year. A very cheerful feature of the present briskness is that orders for large amounts are still coming in freely, so that there is every prospect of a good trade for some time to come. The leather merchants are doing a good business both in present sales and contract orders. Prices are firm at late rates, with a slight tendency to harden in some lines.

SWANSEA, 5TH FEBRUARY, 1890.

TINPLATES.—The continued advances in the price of bars, without a corresponding rise in the selling price of plates, is becoming a matter of such serious import to the trade that it is compelling concerted action between the masters and the men. A meeting of makers and their employés was held last Thursday, when it was agreed that all tinplate works shall be closed in March for two weeks, and a like stoppage be repeated at intervals, if found necessary, so as to reduce the output. The total exports of tinplates in 1889 amounted to 437,800 tons, or an increase of 46,000 tons on the previous year, so there appears to be every justification for the hope that a bold and determined front on the part of the manufacturing interests may quickly change the "bearing" tactics of the merchants, and thus make the proposed stoppage unnecessary.

LOCAL RAILWAYS.—Subject to the approval of Parliament and that of the shareholders, an agreement for amalgamation has been decided upon between the Great Western Railway and the Whitland and Cardigan Line, by which the former company take over the latter railway. Mr. W. H. Mathias has secured the contract for the construction of the Cowbridge and Aberthaw Railway, the first sod of which is to be cut on the 7th inst. The directors of the Taff Vale Railway recommend a dividend of 10 per cent. on the ordinary stock for the half-year ending 31st December last, carrying forward a balance of £579. It is stated that this railway has carried 125,000 tons of coal more in that time than during any previous similar period. The Rhondda and Swansea Bay Railway are seeking powers to authorise the company to construct additional short lines as well as a wharf, and to raise £66,000 in shares and borrow £22,000 for the purpose. The falling off of 26 per cent. in the exports from Newport is mainly attributed to the various reductions which have been made in the carriage of Monmouthshire coal to Cardiff, the Great Western Railway having by successive steps lowered the former rate of 1s. 6d. to the present charge of 10½d. per ton. No corresponding reduction has been made in the rate for bringing coal from the Rhondda Valley to Newport.

THE LANDORE ALKALI WORKS.—Mr. Kirkman notifies to the local press that the increase recently demanded by the men was for piece work, and ranged from 22 to 28 per cent. for loading and discharging, although already paid at such high rates as to enable them to earn 6s. per turn of nine or ten hours for work that is considered to be well paid at 3s. per day in other places.

BARROW-IN-FURNESS, 5TH FEBRUARY, 1890.

IRON.—Hematite iron remains in brisk and steady consumption, but the actual business with makers is on a small scale. This is owing to the attitude they have assumed in reference to the speculative action on the part of holders of warrants. The latter have gone down in price to the extent of 5s. 6d. per ton on the week, and are now quoted at 63s. per ton, or something like 17s. below the actual cost of production. It is evident a position like this cannot long be maintained. Makers must have relief from one quarter or another, either in the shape of cheaper raw material and a lower rate of wages or in a higher price for the manufactured article. The belief is still generally entertained that prices must advance, as it is impossible to get raw material at a cheaper rate when the iron mines and the coke ovens cannot give adequate supplies at present for the furnaces.

STEEL.—There can be no question as to the permanence of the briskness of the steel market for many months to come. Makers are steadily employed in all departments, and orders are still offering on a large scale all round. Rails are in full demand alike on home and foreign account, the Continental inquiries being numerous and important.

CHEMICAL WOOD PULP.—The new chemical wood pulp works at Barrow have been started, and the output is being increased day by day as the machinery and the digesters are put in operation. A brisk trade is offering, and the new concern starts with every prospect of a very busy trade for a long and indefinite period to come.

MIDDLESBROUGH, 5TH FEBRUARY, 1890.

PIG IRON.—The pig iron market is quite in a state of collapse. This has been caused by the reckless buyers becoming as reckless sellers, who have thrown their iron upon the market either from timidity or weakness. Makers ask 60s. per ton for No. 3 G.M.B., prompt delivery, but no one will give that price, as warrants can be had for so much lower. Cleveland warrants are quoted at from 53s. 6d. to 54s. per ton. On Monday the stock in Connal's store amounted to 184,227 tons, as against 184,016 tons on the previous Monday.

SHIPMENT OF PIG IRON.—The shipments of pig iron from the port of Middlesbrough for the month of January are most discouraging, being 40,574 tons, as against 74,725 tons for January, 1889. The main falling off has been in the shipments to Scotland and English ports. The shipments coastwise only amount to 20,068 tons, as against 46,484 tons during the same month last year, and the shipments abroad to 20,506, as against 23,931 tons. With Cleveland as dear as Scotch, this can hardly be wondered at.

IRONMASTERS' RETURNS.—The make of all kinds of pig iron during the month of January amounted to 236,337 tons, against 241,806 tons in December, showing a decrease of 5,479 tons with the same number of furnaces blowing.

NEWCASTLE, 5TH FEBRUARY, 1890.

THE IRON TRADE.—The reaction in the pig iron trade, which has reduced prices since the early part of January to the extent of from 12s. to 14s. per ton, has caused a depreciation in the value of finished iron, and quotations for both bars and plates are now considerably lower than at the opening of the year. Manufacturers in this district, however, are generally well supplied with forward orders, and the slackening of demand has consequently had no appreciable effect on the state of business at the works.

ENGINEERING.—At the Gateshead Works of the North Eastern Railway Company business is just now exceptionally active, there being several locomotive engines of the compound type in progress, besides a great quantity of other work. Messrs. Hawthorn, Leslie, & Co. have also some important orders for locomotives in course of execution at their Forth Banks Works. At the St. Peter's establishment of the same firm, there are two large steamers receiving their machinery. Messrs. Tangye, of Birmingham, are supplying through their Newcastle agency, 45 duplex pumps of the new bulkhead pattern, for cruisers and line-of-battle ships now being built for the Admiralty. They have also on order for the Palmer's Shipbuilding Iron Company, Limited, six centrifugal circulating engines for use on the three cruisers that are being constructed by that firm.

ENGINEERS' WAGES, &C.—A conference of engineering employers of the Tyne and Wear, and representatives of the workmen on both rivers, was held in Newcastle on Tuesday, to discuss the claims for an advance of wages and a reduction of the working hours by one hour per week, lately put forward by the latter. The result was to be laid before mass meetings of the operatives to be held on a later date. It is understood that, though the employers are willing to concede a part of the wages claim, they are quite determined to resist any change in the working hours which involves a reduction of the same. They have indeed taken steps to ascertain the opinion of the Iron Trades Employers' Association on the question, and that opinion is decidedly averse to any reduction of the present working hours.

THE COAL TRADE.—It has been arranged to hold a conference of coalowners and miners' representatives at Newcastle, on Saturday, the 8th inst., to discuss the demand of the Northumberland miners for a 20 per cent. advance on the wages rates. The shipments of coal and coke at Tyne Dock for the week ending February 1st amounted to 94,130 tons, being a decrease of 11,282 tons as compared with the shipments for the corresponding week last year.

ELECTRICAL ENGINEERING.—Messrs. C. A. Parsons & Co. have now got their extensive works into full operation. The works are conveniently situated near the Heaton Station of the North Eastern Railway, in a suburb of Newcastle-on Tyne, and are connected to the railway by a siding to facilitate the delivery and departure of heavy goods. In addition to other well-known specialties, the firm are now busy with the manufacture of low-speed dynamos of several types. They are also carrying out a very extensive order for the Italian Government for a number of large projectors and automatic lamps of improved design for coast defence. They have also in hand some large contracts for material for the Newcastle and District Electric Lighting Company.

BELFAST, 5TH FEBRUARY, 1890.

THE DOCK LABOURERS' STRIKE.—The strike among the dock labourers still continues, and is causing much inconvenience. Ships arriving to discharge have to be content with such small gangs of raw hands as they can pick up. The strike is seriously affecting Belfast shipowners in other ports besides Belfast where the Union has power, for when their ships arrive they are rigorously boycotted. Shipowners, however, state that they intend holding out to the last against the men, and say that in a few weeks the new hands will be quite as capable as those now on strike.

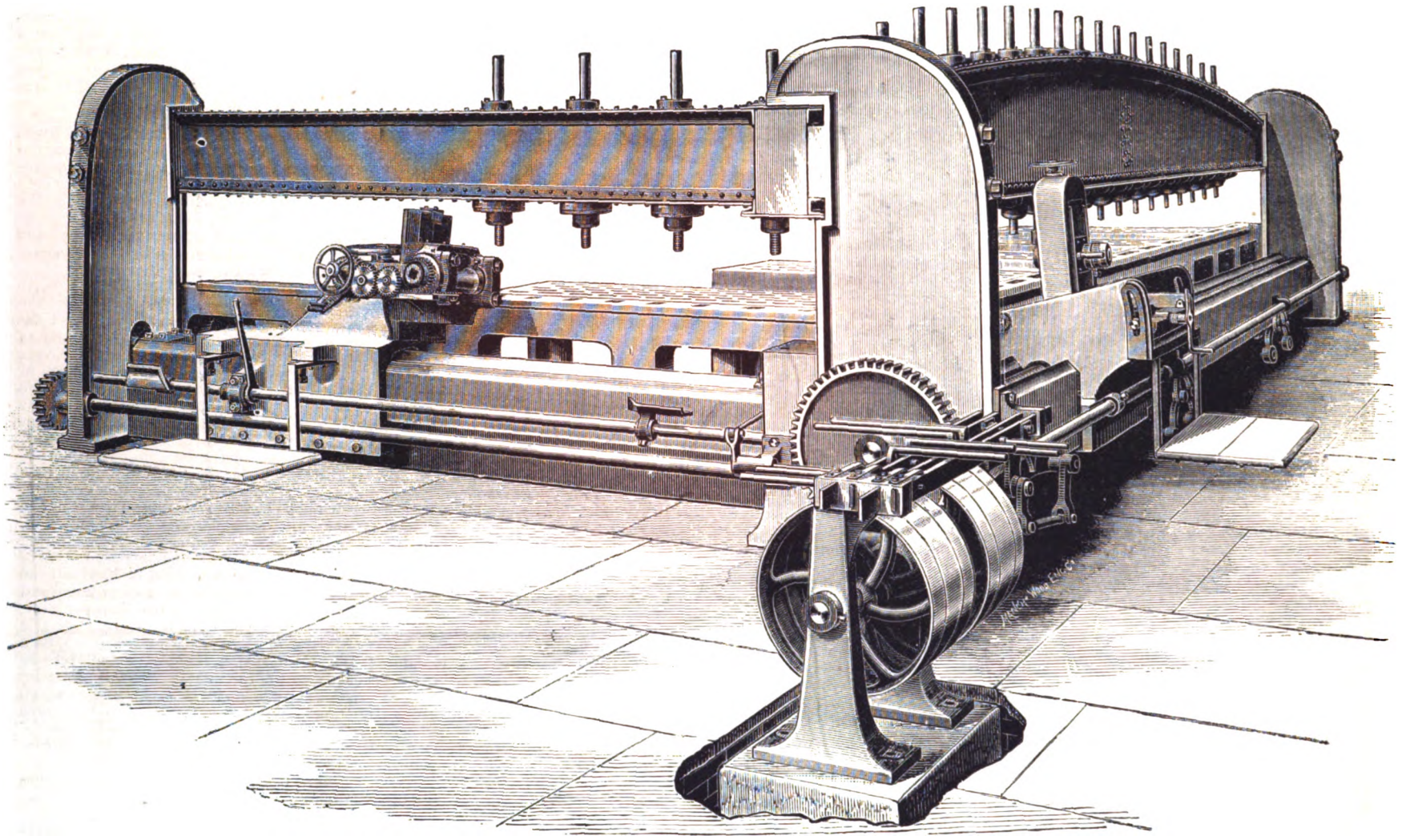
SHIPBUILDING.—All the yards continue very busy. The stocks are all full, and several vessels of large tonnage are lying in the finishing berths. Inquiries for new vessels are, however, rapidly falling off, and, as wages still have an upward tendency, it is expected that they will become still fewer. Builders are greatly handicapped at present, both from the unsteady habits of the men and from the large amount of sickness existing among them.

LINEN TRADE.—During the past week there has been a great falling off in the amount of business done. The stock of yarns remains small, and prices are firm, but the demand is very moderate. Cloth remains steady in price, and producers are mainly engaged on past contracts as sales are very small. Finished goods are not in good demand, but stocks are low and prices firm.

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PLATE PLANING MACHINE.

CONSTRUCTED BY MESSRS. HETHERINGTON & CO., ENGINEERS, MANCHESTER.



THE PROPOSED FORTH AND CLYDE CANAL.

IT is quite evident that before this canal is carried out we are to have a controversy on the merits of the different schemes, and it is well that these should be fully considered before the plans are finally decided. The Home Committee of the Glasgow Chamber of Commerce and various similar bodies have now the different schemes under their notice, and the matter is being very fully discussed in the newspapers and by various non-official bodies which are taking an interest in the subject from a scientific or a national point of view. In our last volume (pages 286 and 498) we gave a sketch of the two proposed routes; the one by Loch Lomond, which was favoured by Messrs. Stevenson, and for which they had made out approximate estimates; the other, which may be called the direct route, and which seemed to be preferred by the people of Glasgow as likely to be of most use to that city and neighbourhood. A vigorous correspondence has been kept up in favour of that route, and a preliminary committee was appointed to further its interests; the consequence is that the scheme has gained a number of enthusiastic adherents and a large amount of useful information has been collected regarding it. The committee are of opinion that the information tends to prove most conclusively that a ship canal by the direct route is practicable, not only from an engineering, but also from a commercial point of view. Mr. R. T. Moore, C.E., Glasgow, has prepared sections of the district, which show that there are about thirty or forty different seams of coal, besides other valuable minerals, extending along the whole district of the proposed route. From the report of the Royal Commission on Coal (1868–71), it appears that the Edinburgh, Fifeshire, and Frith of Forth coalfields contain more than the half of the coal in the whole of Scotland. There is no proper outlet for this great coalfield at present. The committee are of opinion that the revenue derived from this source alone would be sufficient to yield a good return on the cost of construction, but on this point they propose to submit more complete information shortly. They believe, so far as can be ascertained without an actual survey, that the line following as nearly as possible the course of the Kelvin, Bonny, and Carron is the most suitable, as by following this route it is expected that, with an improved system of locks, the average cutting along the whole route would not exceed 40ft. in depth, and that the excavation could be done for two million pounds. Adding three millions for purchase of land, construction of bridges and locks, and contingencies, it is thought that the total expenditure would not exceed five million pounds.

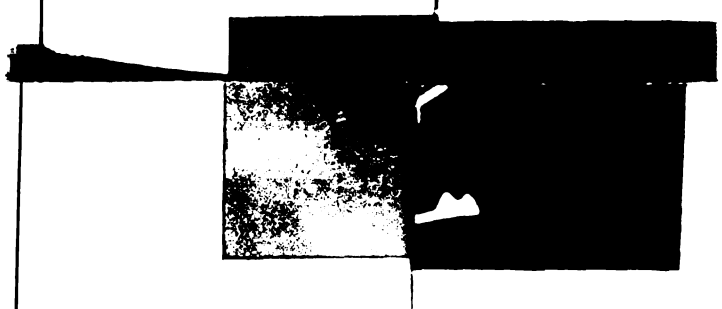
According to Messrs. Stevenson's report, the Loch Lomond route will require an expenditure of eight million pounds, so that in the matter of capital required the direct route has a considerable advantage. Before the merits of the two schemes can be properly discussed, the promoters should make a clear statement of the main objects they have in view, for it is quite evident that unless these agree the two schemes are not directly comparable. The chief object of those who favour the direct route seems to be to develop the mineral resources of the district through which the canal will pass, and to advance the manufacturing interests of Glasgow; while Messrs. Stevenson maintain that the indispensable features of the proposed canal should be that it have sufficient dimensions to allow the vessels of the Navy and the largest merchant steamers to pass freely and safely, and that without the use of hydraulic hoists and locks. The one proposal is therefore largely local, while the other is national. The Messrs. Stevenson further express the opinion that the Admiralty would never consent to the ships of the Navy entering the Clyde near Glasgow Harbour, while the owners of merchant ships would also object to Clyde dues and to the dangers arising from the restricted channel. Whether a compromise can be made of all these points and of the interests involved is a subject requiring the grave consideration of the promoters of the two schemes. We would advise them to try to place their rival proposals before the public in a somewhat more logical method than they have yet attempted, first by giving a clear statement of the chief objects they have in view, and then showing how these affect the commercial aspects of the schemes.

PLATE PLANING MACHINE.

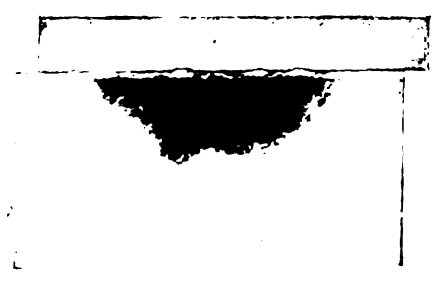
AN illustration is given above of a powerful machine which is designed to plane the edge and butt of an iron or steel plate at the same time. As shown the machine consists of a strong bed on which longitudinal and transverse slides are formed. Two tool boxes are used, each being sustained on a saddle fitting one of the slides. The necessary traverse is obtained by steel screws of large diameter and quick pitch fitting into gun-metal nuts in the saddle. When the carriages have made the required traverse—each being arranged to do so simultaneously—their direction is reversed, and at the same time the tool box is revolved, so that the tools cut during the backward as well as the forward movement. The tool boxes can also be swivelled to give any bevel to the plate edges. The driving is obtained by two open and cross belts in the manner shown. Both the top beams are made of steel, and the binding screws are strong, being arranged so that they are set down by the revolution of nuts. In this way they are not revolved, and any chance of shifting the plate is obviated. In some cases the makers fit a series of hydraulic rams instead of screws. The general design of the machine is strong, and it is very massively constructed. As shown the machine is capable of dealing with plates 27ft. 6in. long by 8ft. wide. It will be noticed that a platform is suspended from each carriage, so that the workman can accompany his work. One of these machines has been working for some time in the yard of Messrs. Harland & Wolff, Belfast, and the makers have recently completed another for a Scotch firm. Messrs. Hetherington & Co., of Manchester, are the makers.

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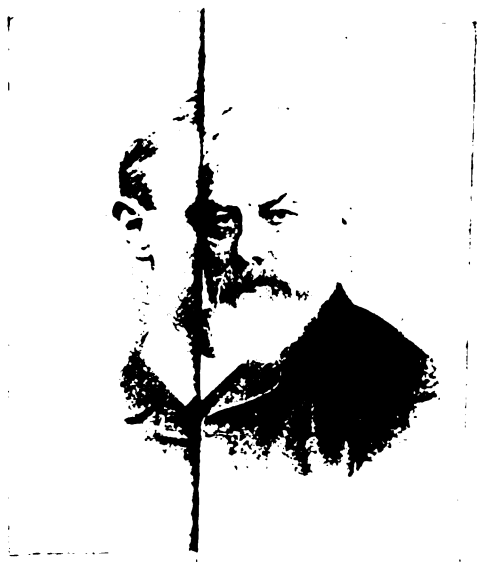
...he Forth Bridge.



EVELYN ...EL BALBIRNIE.



S. MORGAN.



ARTHUR J...OHN FYFE.



J. HENRY ZIEGLER.

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DIRECTORS OF THE FORTH BRIDGE RAILWAY COMPANY.



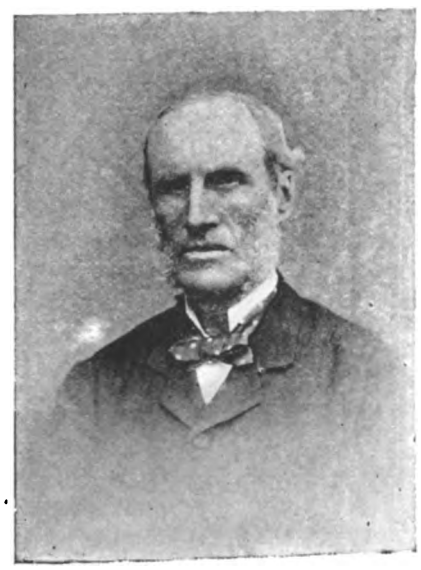
LORD COLVILLE OF CULROSS, K.T.



SIR MATTHEW WHITE RIDLEY.



JAMES HALL RENTON.



J. DENT DENT.



FREDERICK W. FISON.

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As we go to press early with certain of our advertisement pages, all Alterations to Standing Advertisements should reach the Publisher not later than 2 o'clock on Wednesday afternoon in each week.

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

Contents.

	PAGE
Wire Covering Machine (*Illus.*)	121
Notes on Patents—11. Compulsory Licences	121
The Institution of Mechanical Engineers	122
Triple Expansion Mill Engine (*Illus.*)	123
Foreign Industries (Corres.)	126-127
Improved Boiler Flues (*Illus.*)	128
The Boiler Explosion at Bennerley Furnaces	128
Gradient Indicator for Drains (*Illus.*)	128
Sand Blast for Cleaning Castings (*Illus.*)	128
Shipbuilding Notes	129
Notices of Meetings	129
Prices Current	129
Foreign Telegraphic Advices (Corres.)	129
Home Industries (Corres.)	130-131
The Proposed Forth and Clyde Canal	132
Plate Planing Machine (*Illus.*)	132
Legislation and Industry	133
The Shipping Industry	134
Lloyds' Register of Shipping and the Formation of Rules	134
The Late Gustav Hirn	135
Japanese Treaty Revision	135
The Cleveland Institution of Engineers	135

	PAGE
Letters to the Editor:—	
Large Railway Trucks for Mineral Traffic	135
Electricity in Mining Engineering	135
The Duration of our Coal Supply	135
Steam Boiler Legislation	136
Communication between England and France	136
The Institution of Civil Engineers	136
Books Received	136
Reviews	136
Improved Brick-making Machine (*Illus.*)	137
Graphic Constructions for Dynamos and Motors—IV. (*Illus.*)	138
The Aron Electric Meter	139
The Society of Chemical Industry	139
Federated Institution of Mining Engineers	139
The Utilisation of Slag	140
Notes	140
"Industries" Patent Record:—	
Applications and Acceptances	141-142
Illustrated Abridgments	142-144

To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

We cannot undertake to return manuscripts or drawings, and must request correspondents to keep copies.

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In half calf, gilt lettered, may be obtained at our London, Manchester, and Glasgow Offices, Price 20s. each.

Industries:

FRIDAY, 7TH FEBRUARY, 1890.

LEGISLATION AND INDUSTRY.

SOME three years ago we drew attention to the wave of enthusiasm for State interference with industry which was then passing over the public mind. Within a short period upwards of one hundred Bills had been brought before Parliament, not by one party alone, but by all parties, making, in more or less evident fashion, for the diminution of the range of individual freedom and the enlargement of the domain of State control. Within the past two years, however, there has been a much less definite tendency towards what may, for want of a better name, be called State Socialism. The immediate reason of this depression in the wave is not far to seek. Trade has been good during these years. The great dulness has passed away, and with it has gone also, at any rate for the time, the feeling of disquietude with economical conditions which suggests the arm of the State as the most potent to right what is obviously wrong. While workmen are idle and profits are low, labourers and capitalists alike are apt enough to avoid any strenuous study of the causes of the phenomenon of dull trade, preferring to move on to the broad shoulders of the State the responsibility of doing something to give trade a fillip. But when trade is brisk, this external pressure is absent, and statesmen, never prone to move in any direction unless urged thereto by public opinion, do not voluntarily increase their responsibilities by enlarging the area of the operations of the State. Thus we have had relief for a time from any definite wave of Stateism—to coin a term opposed to anti-Stateism, or the policy of *laisser-faire*. But in the session of Parliament about to open some old measures will be resurrected, and some new ones brought forward, whose aim will be to secure an assumed benefit for the mass of the people, and whose effects will be curtailment of individual freedom, extension of the duties of the policeman and the inspector, enlargement of the category of crime, and, may be also, defeat of the object aimed at. The Eight Hours Bill, the Steam Boilers Bill, and other measures of this order will come before Parliament next session. These few cases will not make a wave of Stateism; but they will keep the idea fresh in the public mind, they will maintain a continuity of pressure along a certain line, and will prepare the way for more drastic proposals whenever the economical situation favours their advancement. It is well to clearly recognise this, because only by basing our approval or rejection of measures of this kind upon knowledge of general tendencies can we be sure, so far as surety may be, that we are acting wisely in approving or rejecting them. With the immediate prospect before us of the discussion of at least a few proposals for the extension of the field of State influence, and with a little more remote prospect of a return of the wave of enthusiasm for these, it would be well to note some recent cases and to examine some of the general arguments for and against such legislation. Measures for the extension of State interference in affairs of industrial life, or of individual life in forms of activity otherwise than industrial, have not been promoted exclusively by any one party. During the past half century, now one party and now the other, or the third or fourth party even, has promoted measures of this kind. Sometimes, doubtless, these have been promoted out of genuine enthusiasm for public advantage, more often out of genuine party selfishness or even desire of individual self-aggrandisement. While it is true that the mediæval polity, with its pervasive system of prohibitions, indirect taxes, and privileges—class and individual—has given place to a polity comparatively free of these, it is also true that at least during the past forty-five years we have been again building up a system of protections and privileges. Some of these may be highly expedient, but their existence is unquestionable. Indeed it would take innumerable Acts of Parliament repealing others to give us even an approximation to *laisser-faire*. The curve of State interference has been a wavy curve, but it has always been far above the base line of "let alone." The Limited Liability Acts, for example, defensible as they are on many grounds—that of their fostering industrial enterprise, for instance—have the effect of granting a privilege of exemption from full responsibility for acts done in the name of shareholders in companies registered under these Acts. Association has been encouraged, but at a certain cost, both in principle and in material means. Again, the Electric Lighting Acts have undoubtedly tended to the suffocation of an industry important in other countries, and to the stultification of invention; while monopolies, whose existence they were intended to render impossible, are actually growing up under them. The Factory Acts, too, passed in a rush of humanitarian impulse, are probably to blame largely for the system of "sweating," and are certainly to blame for the large amount of work done domestically under conditions vastly inferior to those of the average factory. We may look upon such proposals altogether apart from any party bearings, and without the suspicion of class bias, since a general principle, if it be a sound one, must be used unreservedly all round.

The general, if somewhat vague, argument for all measures involving the active interference of the State, is that they will conduce to the public good; and when those who argue in this way are pressed they take refuge in the Benthamite maxim of "the greatest happiness of the greatest number." Referring to well-known criticisms of this maxim, it may suffice in the meantime to point out that, in recent times at any rate, legislation has not been characterised even by pretended obedience to the maxim, nor is it always capable of being judged by it. In legislation upon the employment of women and children in factories, for example, the ratio of these to the whole of the population is, as matter of fact, never taken into account, nor is it easy to see why it should be. The title of the State to interfere between employer and employed, and to prescribe the number of hours during which work is to be carried on, depends really upon some other consideration than the "greatest good of the greatest number," however the meaning of this always vague expression may be expanded or contracted. Given the right of the State to interfere, or granted the expediency of its doing so, the circumstances of a proportionally infinitesimal group might justify—might, indeed, on these assumptions, demand—a legislative Act. Given, on the other hand, a case in which the "good" of a certain number is opposed to the "good" of a smaller number, will the State be justified in regarding the "good" of the greater number, since the "good" of the "greatest" number—that is, the whole—cannot be secured by any action of the State? These conundrums in political ethics are, however, for those who care for such things. For the practical man, the real questions are, Ought such or

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such a result to be aimed at? and, Is it likely to be better secured by State action, or by spontaneous individual action? And here we cannot usefully stray from concrete cases. Let us take the Eight Hours Bill. A diminution of labour for those who are at present overworked is a result which will generally commend itself, permanent overwork being a disadvantage both from the individual point of view and from the point of view of national productivity. On the other hand, a diminution of the hours of labour of those who are not overworked, who do not need such diminution and do not want it, would be a sheer absurdity. Can the State secure the desirable result without also securing inevitably the absurd one? The miners have been selected as the first body of workmen for whom the eight hours day is to be obtained. But do they need it most, or do they need it at all? Their Unions are strong, their action fairly unanimous. They practically just now fix their hours of labour as no other trade does. If one party to a contract gets habitually his own way in fixing the terms of it, it is a little too much to ask that the State should pass a law which should have the effect of confirming this advantage. Besides, this arbitrary fixation of the length of a day's labour may conceivably operate injuriously to the interests of the miner. At times his day may, owing to the conditions of trade, fall short of eight hours on the average over the week, and thus, on the average over a year of varied trade he might be compelled to work a much lower average of hours than he would otherwise have worked. His earnings would thus be smaller; he would be less able to resist a reduction of wages or claim an advance when it became advisable that he should do so. But the miner, as matter of fact, has shown himself tolerably apt in managing his own affairs, and the Continental miner has at last determined to imitate his English brethren, and strike, when needs must, for higher wages. Nothing is more indicative of the economical strength of the miners' position than the Continental strikes and the simultaneous advances in wages in this country. In factories where work cannot be carried on without women and children, whose hours of labour are already fixed by law, the inspector can readily enough ascertain whether the law is being kept, though even in factories evasion is frequent; but the difficulty of preventing evasion of the law in mines, where work goes on constantly by shifts, would be extreme. Thus we are justified in concluding that the Legislature would, by the passing of the Eight Hours Bill, secure for the miners nothing that they are not amply able to secure for themselves, and would moreover find immense difficulty in securing it for them, opposed as their inspectors would be by the men themselves when their interest prompted them to work longer than eight hours, and that at the very time when watchfulness would alone be necessary. Again, the class of the community whose benefit it is here attempted to secure, needs the diminution of their hours of labour much less than those who, by the operation of the Factory Acts and from other causes, are compelled to work to exhaustion in their own homes. This class no legislation can touch, and this class has the most clamant need of the benefits the Legislature would confer. The position, then, which seems at once wisest and safest is to attempt by every means which lie in our power, whether as individuals or as members of social groups, to secure by spontaneous action what the State would wish to secure, but cannot efficiently, by compulsory action. There is a true and a false *laisser-faire*: there is the false *laisser-faire*, which, while calling to the State "Hands off!" sits still and does nothing, and there is the true *laisser-faire* which objects to State action, because private action is at once more immediately efficient and more likely to be continuous and adaptive. There is the false *laisser-faire*, which has brought upon us the assumed need for industrial legislation, and there is the true *laisser-faire*, which has wisely administered our great railways, our great lines of steamships, and thousands of industrial enterprises great and small. The valuable element in Stateism is regard for the group as well as for individuals in it, and this regard must necessarily characterise efficient opposition to State methods, as well as positive action for both individual and public benefit.

THE SHIPPING INDUSTRY.

The shipping industry is one which involves the welfare of almost all the other industries in the country, and hence it is highly necessary that no precautions should be omitted to remove causes which prevent its development, and at present, so far as we at least can learn from the reports of the various shipping associations, shipowners are in good spirits, and have few serious grievances against the Government authorities or the Legislature. This may be due in part to the influence of good trade and prosperous times, for when men are making money they are not much inclined to grumble over details, but no doubt a great part of it is due to the conciliatory spirit which has recently been displayed by the Board of Trade. Sir Michael Hicks-Beach is not only a man with a clear business head, but he also possesses that very valuable quality of being able to manage men, and at the same time practically to carry out almost all his wishes. Some of his predecessors may have had greater energy and ability, but these qualities too often carry with them an autocratic disposition which raises so much resistance, even to proposals which are good, that they accomplish less useful work than is done by very commonplace persons who are gifted with the power of managing men.

At the recent annual meeting of the Clyde Steamship Owners' Association, the President enumerated the chief points which had attracted the attention of shipowners during the past year, a few of which it may be interesting to our readers to note. The most important legislative proposals were the Railway Bills and those relating to the measurement of tonnage. The former of these was opposed vigorously by the shipowners, and with success, as the first was thrown out and the other withdrawn. The Tonnage Bill was looked upon by the shipowners as a measure whose chief object was to increase the revenues of dock companies, river commissioners, and harbour trusts at their expense, and in its original shape seemed to involve very serious consequences. In its passage through Parliament, and chiefly on account of the influence the shipowners brought to bear upon it, it was practically shorn of all the clauses which were most objectionable to owners of cargo and ocean-going steamers. The President of the Clyde Shipowners' Association, however, was of opinion that some of the owners of Channel steamers have every reason to complain of the Act as it has become law. He thinks that, in principle, they cannot object to it, as it simply abolishes double deductions on account of crew and light and air spaces, but he does not think that its action should have been retrospective, and that it should apply to steamers which were actually running and had been measured under the Merchant Shipping Acts. As a consequence of the Act, all steamers in which the deduction for machinery space exceeds 50 per cent. of the gross register are being remeasured by the Board of Trade, and without the owners' consent, and causing an additional burden to the owners of several thousand pounds a year. We are afraid that it is a necessary consequence of all legislation which is intended to remove existing evils, to press heavily on some individuals, but when it is made retrospective, a reasonable time should be allowed wherein to make the changes. In the case we are considering, however, it seems to us that the remedy to the owners is either an advance in freights or a reduction of coasting dues, and as the same class of ships is affected in the same way there ought to be little difficulty in the owners making their demands effective.

The Life-saving Appliances Act is also declared to be hopelessly impracticable, and the President expressed the opinion that, as far as he can judge, if its provisions are insisted upon, there will be nothing for it but to lay up those steamers which will be principally affected. Cargo and ocean-going steamers practically escape without any serious burden, but Channel and river steamers will find it difficult, and in some cases impossible, to carry out the requirements of the Board of Trade. It must be remembered, however, that these regulations have been drawn out, not by the officials of the Board of Trade, but by a consultative committee on which shipowners are largely represented, and it is rather a curious commentary on the efficacy of the representative system for which shipowners, and builders, as well as marine engineers, have been asking for a considerable time, to find that the first attempt has resulted in regulations which are impracticable. We suppose that the cause of this is that the shipowners on the committee have only been interested in ocean-going steamers, and have not looked after the interest of the owners of coasting and Channel steamers. The remedy for this is of course to have some one on the committee who fully understands the requirements of these latter. According to a circular sent out by the Board of Trade, the regulations are to come into force on the 31st of March next, but part of them are now postponed till the 30th June.

In these days of labour troubles and disputes, and attempts at improved organisation among capitalists and workers, it was impossible for such subjects to be left out of the President's address. Before the Association was started the shipowners in Glasgow were in a very helpless condition, but then their wants were few, and they were allowed to manage their business to a large extent according to their own wills, without the interference of the Board of Trade or any other Government Department. Now, however, legislation had become so active that the requirements of each Bill had to be very carefully studied, and very often vigorous action had to be taken, and that could only be made effective through a strong association. The President alluded to the desirability of having a national association of shipowners, and he was of opinion that if the rules of the Clyde Association were somewhat modified they would be found suitable for such a national association. Some months ago a provisional committee was appointed for the purpose of endeavouring to form such an association, and that committee seems to have thought it necessary before any progress could be made, as a preliminary step, that those existing at present would agree to merge themselves in it. This was found to be impracticable, and negotiations were dropped. The President, however, thought that the time had now come for them to make another effort to form the national association by so altering their rules, and, if necessary, changing the name of their association, as to meet the requirements of all the shipowners in the country. We would suggest that the rock on which the former negotiations failed was the attempt at too much concentration. The local associations should continue, but should send representatives to the national association, so that all interests might be considered.

It may be seen that the shipowners are beginning, like other capitalists, to observe the necessity for having some means of adjusting differences with their employés; and the President of the Clyde Association emphasised this point, and stated that in all they did they were not animated by any spirit of antagonism to the workers, and he made several suggestions for overcoming some of the difficulties with which they had now to contend. We look upon these things as very significant signs of the time; and we trust they are indicative of a state of industrial Society, in the not very distant future, when all disputes will be settled in a reasonable manner, and without recourse to the cruel and barbarous methods of strikes and lock-outs.

LLOYDS' REGISTER OF SHIPPING AND THE FORMATION OF RULES.

The result attending the recent negotiations between Lloyds' Register and the associations of engineers and shipbuilders throughout this country concerned with the question of including representatives of the latter in the Society's Executive Committee, while not all that some could have wished for, is yet highly satisfactory. What has been arranged is that six representatives of shipbuilders and six of engineers, whose appointment will lie with the Institution of Naval Architects, the Institution of Engineers and Shipbuilders in Scotland, and the North-East Coast Institution of Engineers and Shipbuilders, will meet from time to time with a sub-committee of Lloyds' specially appointed for the purpose, and will revise the existing rules of the Society or formulate new ones for regulating the construction of ships and machinery.

That the shipbuilders and engineers of this country should, as a body, have a recognised voice in the legislation by which their daily work is so much regulated and influenced is perfectly fair and reasonable. This will appear all the more unquestionable to those who know from what sources the knowledge and experience upon which such legislation is based have all along been drawn. The daily practice, skill, and experience—often dearly bought—of the shipbuilder and engineer constitute the basis, if not the whole substance, of Lloyds' rules. The practice of building ships of iron was in vogue for a quarter of a century, and was fairly perfect, before Lloyds' officials began to collect facts and figures from the more skilful iron shipbuilders from which to formulate rules and regulations. The same thing is true of the transition from wood to iron for masts and yards and of the modifications in the structure of vessels as regards double bottoms, trans-

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verse web frames, &c., and to some extent it is also true of the substitution of mild steel for common iron. This implied want of originality does not, of course, mean that there has been inefficiency or incompetency in any department of Lloyds'. The functions of the Society are not so much to originate as to formulate and administer laws. These functions it is eminently capable of discharging through its large staff of able technical officials. The Society, it is true, has in times past often lagged behind, and it was only through fear for its safety or jealousy of the growing influence of rival institutions that it was spurred on to keep pace with the enterprise and intelligence of shipbuilders and owners. The admission, therefore, of those who have undoubtedly done the herculean part in forming Lloyds' rules to consultation on matters affecting the improvement and development of these rules is a step from which Lloyds' Register, even more than shipbuilders, will reap advantage and additional prestige. Like many other old institutions—especially with the autocratic and far-reaching influence it now possesses—Lloyds' is conservative in character, and is apt to display a tendency rather to stereotype existing practice by rigidly adhering to fixed rules and figures than to encourage progress by appraising new departures at their proper value. The rules as now existing are not altogether satisfactory, and call for modification and improvement in the light of what has been transpiring in daily practice. The fresh accession of experience and skill, therefore, which will be brought to bear upon them by those actively engaged in their daily practice will render the work of improvement less arduous and difficult and the result more generally satisfactory.

THE LATE GUSTAV HIRN.

Within the past few months death has been busy among the founders of the dynamical theory of heat. First, Clausius, who developed it from the mathematical side, and then Joule, who established it on a sure experimental basis, were added to the majority, and in the middle of last month Gustav Hirn, who was equally distinguished in theory and experiment, passed away, at Colmar, at the age of seventy-four.

Hirn was born at Logelbach, near Colmar, in Alsace, on August 21st, 1815. His father was one of the partners in the cotton manufactory of Haussman, Jordan, & Hirn, and his education was almost entirely of a practical nature, being obtained either in the chemical laboratory or the mechanical department of the mill, supplemented by private study. These facts explain why his memoirs are in many cases difficult to follow, being often deficient in arrangement and concentration. A trained mathematician and physicist would have been able to put the results of his investigations in a more logical form, although it is very likely he might have had some of his originality drilled out of him. They also explain possibly why he got into controversy so often with others who were working in the same fields, and why he failed to duly appreciate their work. One of his latest works, entitled "La Cinetique Moderne et le Dynamisme de L'Avenir," was written in reply to some criticisms by Clausius, while many of his best papers on the action of steam in the engine were answers to those of Zeuner. In fact, he seemed almost to require a worthy opponent to bring out his energies, and he displayed, like many other self-taught men, rather too much confidence in his own work and contempt for that of others. We must confess, however, that although we have often found his papers very difficult to follow, chiefly on account of their diffusiveness, we have generally felt inclined to think that he had the best of the argument.

With all the freedom of a self-taught genius he allowed himself to roam over the whole field of literature, science, art, and music. He made himself acquainted with English, German, Italian, and Latin, which he used, not only for the purposes of science, but also in order that he might study the beauties of their literature. He had high qualities as an artist, and if he had devoted himself to that calling, he might have left a name which would have been enrolled among those of the best artists of his time. Although he entered business at an early age, he was fortunate enough to be above the necessity of devoting all his time to merely commercial or mechanical work, nor had he any inclination to do so. He was one of the few who remember that work in itself is not life, but only a means of life, and he endeavoured to make his life as complete as possible. His experiments ranged over physics, metaphysics, and engineering. His earlier work was taken up with ventilators, hydraulics, friction, and disquisitions on the celestial space, but he is best known to engineers by his investigations on the applications of thermodynamics to the steam engine. The results of these are embodied in his well-known treatise on the "Théorie Mécanique de la Chaleur," and in the large number of papers which have appeared chiefly in the "Bulletins de la Société Industrielle de Mulhouse." Even an outline of the work he did in connection with the steam engine would go beyond the limits of our space; but we may mention his experiments to verify the value of Joule's equivalent, not only on a small scale in the laboratory, but also on a large scale with steam engines, his analysis of the heat used in steam engines, the action of superheated steam and of steam jackets. His method of treatment has been largely adopted by subsequent writers. It is rather a significant fact that the best work in this department has been done by men like Hirn and Rankine, who have not been cramped by the training or ways of thought of any special school, a fact which which should be noted by our educationists.

Hirn's character was a reflex of his work. It was noble and lofty, perfectly upright and genuine. He had always a kind word for those who were worthy of it, although he did not hesitate to utter a stern one to those who deserved it.

JAPANESE TREATY REVISION.

The latest news from Japan about treaty revision is that the whole matter is likely to be adjourned *sine die*, and that the treaties which have been made with the United States, Germany, and other Powers, but which have not yet been ratified, will be allowed to remain in abeyance, so that no international complications may ensue. It is understood that the British Government was willing to agree to the Japanese proposals, and that the difficulty has now come from the Japanese people. The proposals involved the appointment of a certain number of foreign judges, and against this provision Japanese public feeling rebels. It is also said that, on the whole, the foreign merchants are not displeased at the collapse of the negotiations; at least, they prefer that to conditions which the Japanese now wish to insist upon, namely, that they should be entirely subject to native jurisdiction. As we have pointed out on previous occasions, if a little tact and common sense had prevailed when the revision question was started many years ago, the preliminary stages of the experiment might have been passed, and an arrangement suitable to both parties have now been come to. We are afraid that all hope of a joint native and foreign Court of Appeal is gone for ever, as the question has been taken up by the people, and no Government would stand which proposed to return to that arrangement. We suppose that things will drag on as they are for a few years, and then the Japanese demands will be agreed to. We trust that they will show by their conduct in the interval that they fully realise the responsibilities which their demands would involve. In the meantime, the progress of Japanese foreign trade will be very much hindered. We are not sure, however, but that on the whole it may be better for Japan. It is not good for a country to change its industrial and social conditions too rapidly, and it will be well if the Japanese now try to consolidate and improve what has already been commenced, before the country is fully opened to foreign capital and enterprise.

THE CLEVELAND INSTITUTION OF ENGINEERS.

The second meeting of the session was held on Wednesday, the 29th of January. After some preliminary business, Mr. M. R. Jefferds, C.E., London, read a most interesting paper on the Goodfellow and Cushman light weight, high capacity, tubular frame freight cars. Mr. Jefferds introduced his subject by showing that it was by no means a new one. After referring to the progress of the means of transport by canal and by rail, Mr. Jefferds started his subject of freight vehicles. He gave great credit to England as the father of railways and George Stephenson as the creator of the locomotive, but objected to the passenger car, as being merely the old stage coach, and the freight car, as being merely the heaviest type of farm waggon mounted on flanged wheels. In passenger and freight cars America had gone very much ahead of England. In America, where it experienced the competition of excellent water-ways, the railway carried freight at three-tenths of a penny per ton per mile. In England canals were being constructed to beat the railways, which charged for freight at the rate of a penny per ton per mile. In considering the two different systems of railway rolling stock—the farm waggon and the bogie—Mr. Jefferds declared the question for solution to be: Which type requires the greatest power to move it; which creates the greatest friction; which can traverse the curves more easily; which is the more elastic and easier on the track; which has the less deadweight or tare to its carrying capacity; which is the simpler and easier of repair by unskilled labour; which requires the fewest repairs; and which is the more durable? All these Mr. Jefferds addressed himself to in turn, and decided in favour of the bogie. He then introduced the Goodfellow and Cushman freight car, and described its construction from a wall diagram.

In the discussion which followed the paper almost the only objection taken was the unsuitability of the car to local traffic, from the lengths of its wheel base, but upon the whole great satisfaction was expressed with the principle and a strong desire to see some of the cars in the general traffic of the district.

Letters to the Editor.

LARGE RAILWAY TRUCKS FOR MINERAL TRAFFIC.

To the Editor of "Industries."

Sir,—Permit me to compliment you upon your very able editorial entitled "Large Railway Trucks for Mineral Traffic," published in your issue of the 24th inst.

You have struck the keynote, but you have not given credit where credit is due. Sir James Ramsden, of the Furness Railway, was the first man in England to introduce light weight, high capacity, bogie truck freight cars, and Sir James Allport the first to introduce the bogie truck passenger cars upon the Midland Railroad. Sir James Ramsden bought about a year ago two cars, one a low-sided gondola weighing 8 tons 4 cwt., which he has been using ever since, carrying loads of 30 to 35 tons, and the other a high-sided gondola, weighing 9 tons 6 cwt., to carry 30 tons of coal or 20 tons of coke.

Three men can shunt one of these cars loaded round a 4-chain radius curve. Five men are required to shunt one of the best four-wheeled waggons loaded with 10 tons. It will therefore be seen that three men can move as much paying load on a high capacity bogie truck car as fifteen men can move on the four-wheeled, rigid wheel base waggons now in use upon English railways. This will lead you to the logical explanation of why it is that upon the poorly constructed and flimsy railways of America they can move this traffic at 80 per cent. less than they do here, where the best railways in the world are to be found.

I hope you will have the courage to go carefully into the facts of the case and "call a spade a spade," for if you do it will be but a short time before the veil will be lifted from the eyes of the public, and they can then see themselves as outsiders see them.

Modern rolling stock upon English railways would be the means of reducing rates 50 per cent., paying shareholders larger dividends than they now receive, and quickening every branch of industry in the United Kingdom. If the change is not made the manufacturing interest will go, where the agricultural interest has gone—to the dogs.

Yours, &c.,
M. R. Jefferds.

London, January 31st, 1890.

ELECTRICITY IN MINING ENGINEERING.

To the Editor of "Industries."

Sir,—In your year's review of mining, you lay stress upon the fact that little has been done here in the direction of adopting electricity in that direction. In the matter of developing the electric lighting industry we have been very slow, but there are various theories advanced as to the causes of this backwardness. The "old Act" has been made the scapegoat in most cases, but this reason does not apply to other branches of the profession. The list of electric tramways in Great Britain makes a pettifogging total of mileage, which it is depressing to look upon. The Bills to be brought before Parliament give promise of better things this year; but it must be remembered that it is one thing to give notice of applying for powers, and another to obtain them, and if obtained to carry them into practice. In transmission of power, either in connection with mining or otherwise, things seem to be even worse. On the Continent and in the United States a great deal has been done in this direction, but from some unexplained cause the progress at home is exceedingly small. The two reasons from which to select for this are either that electrical engineers have not devoted much attention to putting the merits of such systems before colliery and mine owners, or that the latter have prejudices which it is difficult to overcome. If the cause be the first I have mentioned, this speaks little for the business enterprise of our electricians; but if it be the latter, there should be little difficulty in demonstrating the advantages which can be obtained.

Yours, &c.,
M. E.

Stratford, E., 31st January, 1890.

THE DURATION OF OUR COAL SUPPLY.

To the Editor of "Industries."

Sir,—"Who shall decide when doctors disagree?" The only conclusion to come to after comparing the estimates of the duration of our coal supply made by Professor Jevons (whose ideas as to their limit seem to have been hopelessly wrong), by the Royal Commission, by Mr. Hall, and by Professor Edward Hull (a paper by whom was read in this city but a few days ago), is that it is impossible to form any sound notion on the subject at all. Professor Jevons gave us till 1960 or thereabouts; the Royal Commission allowed us to select for ourselves among 360 years, 276 years, and 1,200 years; Mr. Hall gives 200 years; and Professor Hull a choice of 880 years or 417 years, but he prefers the latter. The matter is not a pressing one, and there is something distinctly humorous in the variations of the different prophets.

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What is of more practical importance is whether an effect will be produced upon prices, and on this point Professor Hull delivered himself to the Edinburgh Geological Society in the paper to which I have just referred. He came to the conclusion that failure of our coal supply to any appreciable extent in the near future is not to be expected, but that there will be a tendency towards a rise in the price of coal. This rise would be due, not to any appreciable diminution in the available quantity of coal, but to the increase of expense (including an advance in miners' wages) in mining, consequent on the greater depth at which coal must be worked as time goes on. Such increased expenses must, he said, of course be defrayed by the consumer, and he looked upon it as certain that within the next half century there would occur a general rise in the price of coal throughout the British Islands.

A strong recommendation was made by the author to adopt economy in the use of coal, and this, I believe, as stated in your leading article, will be largely brought about by the development of science in the branches of engineering, electricity, and chemistry.

Yours, &c.,
BLACK DIAMOND.

Edinburgh, 29th January, 1890.

STEAM BOILER LEGISLATION.

TO THE EDITOR OF "INDUSTRIES."

SIR,—The letter in your issue of the 24th ult., signed "Boiler Inspector" (?), entirely loses its importance so far as the paragraph relating to this company is concerned, from the source of its inspiration being so apparent. It is, therefore, unnecessary to notice the obvious inaccuracies it contains, further than to say that in all the circumstances the taste displayed is questionable.

My object in troubling you at all is to refer to the attack made upon the qualifications and abilities of our district inspector at Newcastle. This "Boiler Inspector" might have well spared a little more charity to a brother in trade, whatever he may have seen fit to write about a rival boiler insurance company. He says, "When the boiler inspector turns out to have been originally a jobbing blacksmith, the owner will have to be thankful for small mercies in regard to advice and inspection."

William Winship is too well-known on Tyneside to require any recommendation there, and far too modest to take any notice of this attempt to injure his reputation, but I feel I should not allow such a statement to pass. Mr. Winship joined this company after having had over twenty years' experience as a boiler inspector in the service of the Midland Boiler Insurance Company, under the care of Mr. E. B. Marten, whose title to speak on the question no one, I think, will dispute, and who wrote of him when he joined this company, as . . . . "a thoroughly reliable inspector of great experience."

The unfortunate circumstance in this case, so far as Mr. Winship is concerned, is that he had no opportunity afforded him of making a thorough examination of the boiler, and there is no doubt whatever that had he got such an opportunity the defective condition of the firebox would have been discovered.

Yours, &c.,
JNO. D. YOUNG, Managing Director,
The Scottish Boiler Insurance and Engine Inspection Company, Limited.

13, Dundas Street, Glasgow,
3rd February, 1890.

COMMUNICATION BETWEEN ENGLAND AND FRANCE.

TO THE EDITOR OF "INDUSTRIES."

SIR,—I have read the letter of Mr. Eug. Obach on this subject, and, without entering into any criticism of the scheme of Messrs. T. Obach and Lebret for crossing the Channel, I merely desire to state that the project to which I referred is not the same, but one of later date. The main features as given by me are, I am confident, quite correct, and it is quite possible that the proposal which I described was based by some one else upon the earlier one mentioned by Mr. Obach.

Yours, &c.,
T. C.

London, 4th February, 1889.

THE INSTITUTION OF CIVIL ENGINEERS.

AT the tenth ordinary meeting of the Session, on Tuesday, the 4th inst., the President, Sir John Coode, K.C.M.G., being in the chair, the paper read was on "Bars at the Mouths of Tidal Estuaries," by Mr. William Henry Wheeler, M.Inst.C.E. The paper referred to the different kinds of bars, treated of causes of their formation, and suggested remedies for their removal. Four classes of bars were described, namely—those consisting of hard material not affected by the scour of the current; those due to deposit of alluvial matter brought down by rivers; bars consisting of shingle or sand; and casual bars. Examples of each kind were given. With reference to those of the second class, a distinction was drawn between bars and deltas. The latter consisted of a continually increasing deposit of fresh material, due to alluvial matter brought down by the river currents. The former were caused by the heaping up of sand or shingle by the action of littoral currents, aided by waves and gales. Tidal bars, unlike deltas, did not increase in size after formation; the balance of forces between the conflicting currents kept them in equilibrium, and caused them to maintain their general form and position. The features of bars at the mouth of sandy estuaries were described as being of a remarkable character. Such bars consisted of one or more ridges of material, the particles of which had no coherence, yet stood with a slope much steeper than the natural angle of repose. Rising in some cases as much as from 40ft. to 50ft. above the bottom, they maintained their positions across channels having a tidal rise of from 20ft. to 30ft., with a current exceeding from 3 to 4 knots, and the direction of which was reversed three times every day; exposed to the storms and waves of the open sea, they were sometimes partly dispersed, or added to, or altered their form, but they had a normal condition to which they reverted when the disturbing causes ceased. Examples were given of the bar of the Mersey and other estuaries. The author pointed out that bars were not common to all rivers, and even where a bar existed it was not always an impediment to navigation, as the water in the channel inside the bar was frequently as shoal as on the bar. The Thames, the Humber, the Severn, the Seine, and the Scheldt were given as instances of rivers without bars; the Tyne, the Tees, and the Ribble, as illustrations of rivers where the bars did not affect the navigation. The various theories as to the cause of bars were enumerated. These were divided into two classes—one class ascribing the bar to the action of the river-currents, and the other to the action of the sea. The theories of their formation might be thus summarised:—(1). The deposition of the detritus carried in suspension in a river when it entered the sea, either from the slackening of the velocity, or from the meeting of two currents which neutralised each other, or from the effect of the conflict between the salt and the fresh water. (2.) To the form and direction in which the ebb- and flood-currents met at the outfall. (3.) To an insufficiency of back-water. (4.) To the difference in duration of the ebb- and flood-currents, and the variation in the inclination of the slope of the low-water line. (5.) To the action of littoral currents, and waves driven along the shore in piling up detritus in the direction of their greatest force, and across the mouth of the outfall. With regard to the first class of theories, the author pointed out that the alluvial matter brought down by a river was of a totally different character to that of which bars consisted, being sufficiently light to be carried out to sea in suspension; that the meeting of the fresh and tidal waters, or the conflict between the salt and fresh water, could not be the cause of a deposit sufficient to make a bar, as the point of conflict varied with every tide; that fresh water floods, from their intermittent character and small volume as compared to that of the tidal water, could have little effect on the bar or outfall channel. Attention was drawn to the fact that those rivers having the largest discharge of upland water and absence of tidal flow were most encumbered at their outfalls; that, while freshets had little or no effect in scouring away bars, they not unfrequently were instrumental, in sandy estuaries, in feeding and maintaining them by altering the low-water channels through the sand, and stirring it up and throwing the sand into the ebb current, which was thus transported to the bar. The manner in which a channel entered the sea was admitted to have a marked effect on the maintenance of the bars, which were generally found at the mouths of estuaries discharging into shallow bays, or where the outfall was at right-angles to a low flat sandy coast; whereas rivers discharging at the head of a deep bight gradually increasing seawards, or discharging at a projection of the coast-line, where the run of the tide was strong, had free outfalls. The characteristics of the principal estuaries of this country were given in illustration. As to the insufficiency of back-water, the author, while admitting the importance of conserving tidal estuaries as scouring-basins, and that a certain width of foreshore on each side of the channel was essential for properly filling and feeding them, contended that only such portion of the water entering an estuary as passed in and out by means of the navigable channel over the bar was beneficial; and that the enclosure of indents and irregular parts of the coast line, by bringing the estuary into the best form for the ingress and egress of the effective portion of the tidal water, might be of advantage; that while training walls were conducive to accretion, yet they did not necessarily decrease the tidal capacity. Training walls did not create new material, but merely led to a new disposition of the sand, the shoaling in one place being compensated by the deepening at the part from whence the sand was moved; also the deepening of the channel by the scour between the walls more than compensated for loss of shallow water over a wider area. No fixed rule could be laid down either as to the best height of the walls, or how far reclamation might be carried; each estuary must be judged and dealt with as experience taught. Several cases were quoted, showing where reclamation had been detrimental, and also where it had been carried on without injury to the bar or navigable channel. The relative scouring effect of the ebb-and the flood-tide was discussed, the opinion of the author being that these were nearly balanced, the preponderance being in favour of the ebb. As to the theories that ascribed the existence of bars to external causes while generally agreeing that this was caused by the action of the sea, varied as to the way in which it was accomplished, this action was variously ascribed:— To ground waves, which, having traversed the shore, carried with them sand and shingle into the mouth of the estuary, and formed a bank; to the action of the winds, which caused the detritus disturbed by waves to be piled up in the direction of their greatest force; to the action of on-shore waves, the crests of which, being impelled forward at a greater rate than the foot by their impetus in descending, pushed forward the mass of water in front of it, which, charged with the material on which it was driven, carried it into the mouth of the estuary; to the general tendency on all coasts of waves driven along the shore by winds, or of the littoral currents, to transport and heap up beach in a continuous line along the shore, to which operation the mouth of the estuary formed no exception. The author considered the last as the true cause. The action of gales in eroding the cliffs and breaking up the beach furnished the material which was continually being transported along the beach in the direction of the flood tide, and those on-shore winds, which, from their prevalence, had the most effect on the coast. This material was carried across the mouth of the estuary, rolled along the bottom by the flood-tide to the bank forming the bar, pushed over it, and deposited on the inner side. The ebb-tide rolled it back, and it was dispersed on again reaching the sea. The bar was thus maintained in a general state of equilibrium; if in an exposed position, increasing after gales and decreasing in calms. The conditions of estuaries favourable to the formation or absence of bars were described and illustrated by reference to the various rivers of this country. The remedy proposed for the dispersal of bars was to increase the depth of water at the outfall and the power of the ebb current. The works carried out in the Tyne, the Tees, and the Liffey were described and given as illustrations of the successful application of this remedy. It was pointed out that piers run out from the shore on a flat sandy coast were not effective unless carried to deep water, and instances were given of failure where this had been attempted. Under certain conditions, a single pier, concave in form, running out from the coast on the side of the channel from which the drift came, having its concave side towards the channel, might be effective in deepening a channel and removing a bar. The author also suggested that bars might be dispersed by eroding, or stirring up the material of which they were composed by mechanical agency, and thus taking advantage of the transporting power of the ebb current for their removal.

The views of the author were thus summarised:—(1.) That the forces which operated in maintaining the existence of bars in tidal estuaries came from the sea, and were not due to upland water. (2.) That the dispersal of bars and the improvement of the outfall channels of estuaries could be accomplished by increasing the volume and velocity of the tidal water passing over the bar, and by giving a greater preponderance to the ebb current. (3.) That in designing works for this purpose, the circumstances of those estuaries which had natural deep-water channels free from bars should be taken as guides. The lessons to be taught by an examination of estuaries having natural deep-water channels were: (*a*.) That the mouth of the outfall should be capacious enough to allow of the entry of sufficient tidal water to fill up the estuary and upper reaches of the river. (*b*.) That, to ensure a regular and undisturbed flow, the form of the estuary should be such as to afford a gradually decreasing width from the outfall. (*c*.) That the depth of water in the channel should be sufficient to allow of a free propagation of the tidal wave. (*d*.) That the longer the run of tidal water that could be given the more effective would be the scouring action, and that, therefore, all obstructions to the free flow of the tidal current were prejudicial to the outfall. (*e*.) That it was essential to secure adequate depth of the channel by natural scour, or by dredging. (*f*.) That training and fixing in one position the low-water channel in a sandy estuary was of first importance in securing the full advantage of the tidal scour, and in maintaining a deep channel. (*g*.) That water, flowing in and out of an estuary which did not pass to or from the sea over the bar, and by the main navigable channel, was of no advantage to the outfall, and was better excluded. Therefore, while it was of the utmost importance to conserve an estuary as a receptacle for the tidal water, the exclusion of such water from indents, and the cutting off of irregularities by embankments, might be carried out without detriment to the outfall. (4.) That piers carried out from the shore were useless, unless extended to deep water. That they should be so designed as, while not unduly throttling the inflow of the tidal water, they should effect the greatest amount of scouring force from the ebb current.

Books Received.

Thermodynamics, Heat Motors, and Refrigerating Machines. By DE VOLSON WOOD, C.E., M.A. New York: John Wiley & Son.

The Steam Engine and Indicator. By WM. BARNET LE VAN. Philadelphia: Hy. Carey, Baird, & Co. London: E. & F. N. Spon.

Spon's Engineer's and Contractor's Diary and Reference Book, 1890. London: E. & F. N. Spon.

Alternative Elementary Physics. By JOHN MILLS. London: Chapman & Hall.

Mechanical Graphics: a Second Course in Mechanical Drawing. By GEO. HALLIDAY. London: E. & F. N. Spon.

Solutions to the Questions in Pure Mathematics, Stages I. and II., of the Science and Art Department Examinations, 1881 *to* 1886. By THOS T. RANKIN, C.E. London: Chapman & Hall, Ltd.

Perspective Charts for Use in Class Teaching. By HENRY A. JAMES, M.A. London: Chapman & Hall.

A Handbook of Quantitative Analysis. By JOHN MILLS and BARKER NORTH. London: Chapman & Hall, Ltd.

Practical Notes for Electrical Students. Vol. I.: Laws, Units, and Simple Measuring Instruments. By A. E. KENNELLY and H. D. WILKINSON. London: "The Electrician" Printing & Publishing Co., Ltd.

Kalender für Elektrotechniker, 1890. Von F. UPPENBORN. Munich: R. Oldenbourg.

Transactions of the North-East Coast Institution of Engineers and Shipbuilders. Vol. VI. Part 1 and 2.

Aid Book to Engineering Enterprise. By EWING MATHESON, M.I.C.E. London: E. & F. N. Spon.

The "Shipping World" Year-Book for 1890. Edited by Major JONES. London: "Shipping World" Office.

The Science of Metrology; or, Natural Weights and Measures. By the Hon. E. NOEL. London: Edward Stanford.

Reviews.

HYDRAULIC MOTORS: TURBINES AND PRESSURE ENGINES. By G. R. Bodmer, A.M.Inst.C.E. London: WHITTAKER & Co.

The present work belongs to the "Specialists Series" of Messrs. Whittaker & Co. and George Bell & Sons, but exceeds any of its predecessors in size, as it contains over 500 pages of letterpress and 179 illustrations. That so large a work on hydraulic motors should be published in the English language might perhaps cause surprise, for Great Britain is not a nation directly interested to

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any extent in the utilisation of water power, and there are only very few engineering firms who make the construction of turbines a specialty. On the other hand, Canada, India, and other British colonies offer a large field for the application of these machines, to say nothing of the United States, where the use of water power is a very important element of industrial development. Thus the book will interest a large circle of readers, and should even prove useful to English engineers desirous of supplying hydraulic motors for abroad. From the general style in which the subject is treated we conclude that the author is a pupil of Zeuner, but he has extended the theory which Zeuner gave when he occupied the chair of Applied Mechanics at the Polytechnic School in Zürich, and has paid special attention to the development which had since then taken place in America.

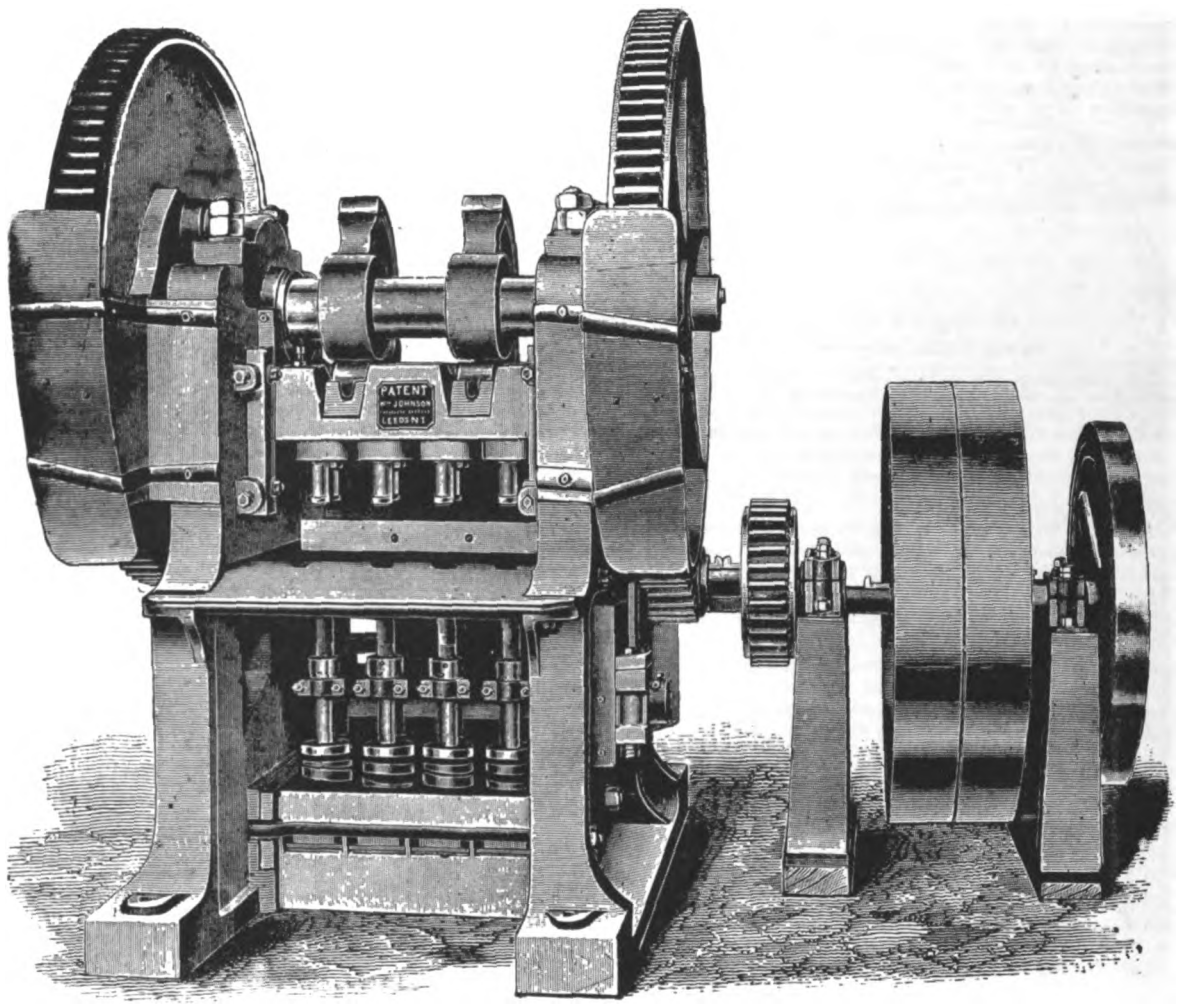
The book begins with an introductory chapter, in which an attempt is made to classify water-power engines into three types. This classification is made according to the way in which the water acts, and comprises the performance of work by kinetic energy, weight and pressure. Machines in which kinetic energy alone is used the author calls turbines, those in which the weight of water is used he calls water-wheels, and those in which the pressure alone is used he calls water-pressure engines. Convenient as it may be to thus classify the machines according to their mode of action the classification is not quite correct. As regards water-pressure engines the author's definition is no doubt sufficient, but the hard and fast demarcation between turbines and water-wheels has no existence in practice. There are many water-wheels in which the kinetic energy of the water as well as its weight is instrumental in producing power, and similarly there are turbines in which the water acts to some extent by pressure. The author's use of the term "potential energy" is also open to criticism. According to the usual conception, potential energy is that energy which is stored up in a body by reason of its position, and which can be obtained from it if we allow a change of position to take place. Only as long as the energy remains stored up do we call it potential, but the author applies the term to the energy whilst it is being given off in the shape of pressure multiplied by volume per unit of time. It would have been more correct to call this kind of energy the energy of pressure, in the same way as we might call the kinetic energy the energy of velocity. In the introductory chapter we also find a very clear demonstration of Borda and Carnot's law, and an elementary investigation of the action of water on curved vanes, a subject which is more fully treated in subsequent chapters. We are glad to see that the author has from the outset pointed out that centrifugal force need not be taken into account, its effect being fully accounted for in the general formulæ for the flow of water along moving channels.

Chapter II. treats of turbines in general, and here the author gives a definition of the turbine to which no exception can be taken. He defines it as a water-wheel in which motion of the water relatively to the buckets is essential to its action. The usual classification into reaction and impulse turbines, and the further subdivision of each class into radial, axial, and mixed flow turbines is adopted, and examples of each are given. In the third chapter the author enters more fully into the theory of turbines, beginning the investigation with a radial inward flow turbine with suction tube. As already remarked, the treatment is similar to that adopted by Zeuner, which itself is an amplification of Redtenbacher's theory, but it is worked out in greater detail, and there are also certain points in which the two differ. Thus the author takes the ratio of the total outflow area of the guide to the total outflow area of the wheel as a starting point for the design of turbines, and he defines the angles of vanes with reference to a radial instead of a tangential line in radial flow turbines, and with reference to a vertical instead of a horizontal plane in parallel flow turbines. Thus the author's formulæ differ from those previously given on account of the interchange of the sine and cosine of angles. The following chapter deals in detail with the various losses of energy occurring in reaction turbines, whilst in Chapter V. the design of these motors is given. In applying his theory to this purpose the author starts with the condition that the water shall enter the wheel without shock, and shall leave it without velocity parallel to that of the wheel. These two conditions, together with the third condition of continuity of flow, suffice for a first approximate determination of the various angles and areas, and when this has been done the working conditions of the motor and the different losses are determined in detail, and the design is altered so as to make the sum of all the losses a minimum. The various methods employed for the regulation of reaction turbines are discussed in Chapter VI., including the theory and application of the diffuser, by means of which the loss due to the energy carried away in the outflowing water is reduced to a minimum.

Impulse turbines, including the Poncelet wheel, are similarly treated in the following two chapters, but no mention is made of the Sagebien wheel, which also belongs to this group of turbines. The loss of energy due to imperfect filling of wheel buckets when the admission is partial is very fully treated, and well illustrated by diagrams. Chapter IX. contains a series of tables, which should prove useful for the design of turbines. To make the tables generally applicable the author has given them for three sets of conditions as regards volume of water and fall. The first column applies to cases where the quantity of water is great and the fall low, the second to medium quantities and medium falls, and the third to small quantities and high falls. The use of these tables is illustrated by a selection of numerical examples. The next chapter deals with the measurement of the quantity of flowing water, and contains a very conveniently arranged table of the coefficients to be used when making such measurements by the aid of a tumbling bay. Then follows a chapter containing descriptions of turbines and results of their tests, which will be specially useful to practical engineers because containing detail drawings of several of the more important turbines which have proved successful in actual work. There is given a table showing the best speeds of turbines as found by experiment, and a comparison of these speeds with the calculated speeds. The difference is in all cases small, causing less than 2 per cent. difference in the efficiency, from which we may infer that the author's formulæ are sufficiently reliable for all practical purposes. Perhaps the most interesting part of the book is Chapter X., which deals with American turbines. American engineers have been frequently attacked by their European rivals for the apparently unscientific way in which they design their turbines, and, considering the school in which the author has been trained, it would not have been very surprising had he shown prejudice against the American turbines. There is, however, no trace of such a feeling in his book, and the author investigates the merits and faults of the rival turbines with perfect impartiality. When discussing the Holyoke tests, which show generally a much higher efficiency than European engineers are disposed to admit, the author points out that these tests not only bear internal evidence of being very carefully made, but that it could not possibly be to the advantage of the company to over-estimate the efficiency of the wheels which are submitted to them, since payment for the power is made according to the quantity of water consumed. The discrepancy between American and European tests should, according to the author, be ascribed to the different methods adopted for measuring the water, and he inclines to the belief that, if precisely the same method were employed, the American wheel would show at least as high an efficiency as its European rival. The last chapter of the book contains the theory of water-pressure engines and illustrated descriptions of some leading engines of this type, including those of Rigg, Schmid, and Hastie. On the whole, Mr. Bodmer's work forms a very complete and clear treatise of the subject of hydraulic motors other than ordinary water-wheels, and is fully up to date. Some readers may, perhaps, find fault with the large amount of mathematics employed, but this in a work like the present is a necessary evil. The action of water flowing along moving channels cannot properly be treated without the application of mathematics, and if the formulæ appear rather complex, the author has done all he could to make their application easy by a series of well-arranged tables which will be found of great service to the practical engineer.

BRICK-MAKING MACHINE.

CONSTRUCTED BY MR. WILLIAM JOHNSON, CASTLETON FOUNDRY, LEEDS.



IMPROVED BRICK-MAKING MACHINE.

WE illustrate above an improved brick-making machine which has lately been introduced by Mr. William Johnson, Castleton Foundry, Leeds. The machine is adapted for making and pressing bricks and tiles on the semi-dry method, and it finishes four bricks at once at the rate of 2,400 per hour. The brick-making material to be treated may be marl, shale, or slate débris, but the machine is equally adapted for pressing all sorts of other substances into blocks, such as cement, artificial fuel, blue billy, &c. The material is fed into dies in the granulated state and slightly damped, and the plungers then compress them with considerable force. The feeding apparatus is constructed in such a manner that the dies are regularly and densely charged, and altogether the machine turns out a sounder and better brick than is usual

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GRAPHIC CONSTRUCTION FOR DYNAMOS.

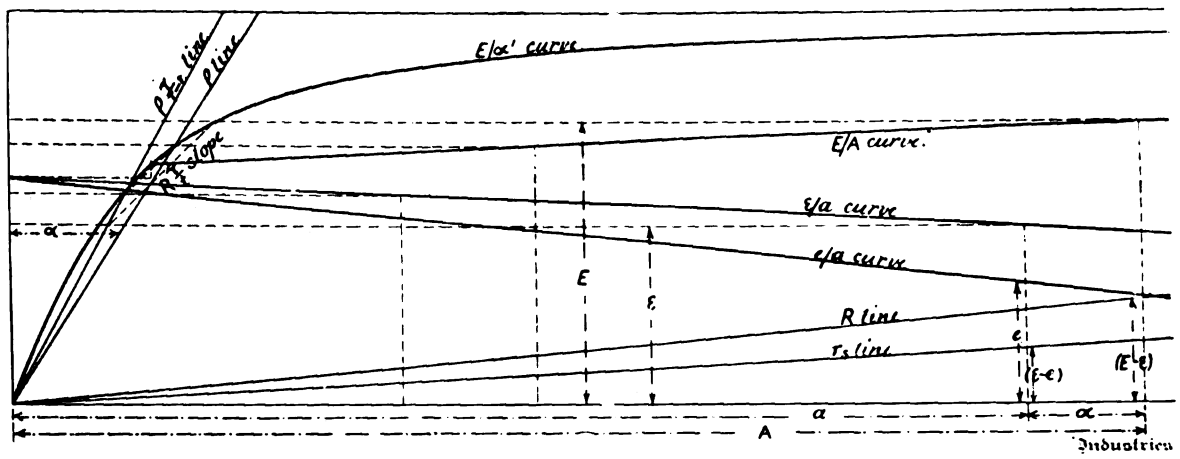


FIG. 11.

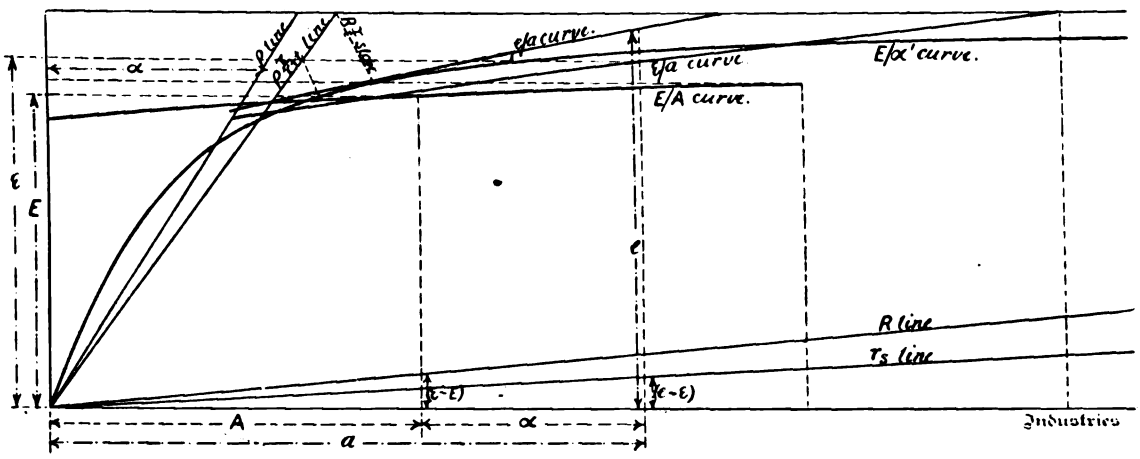


FIG. 12.

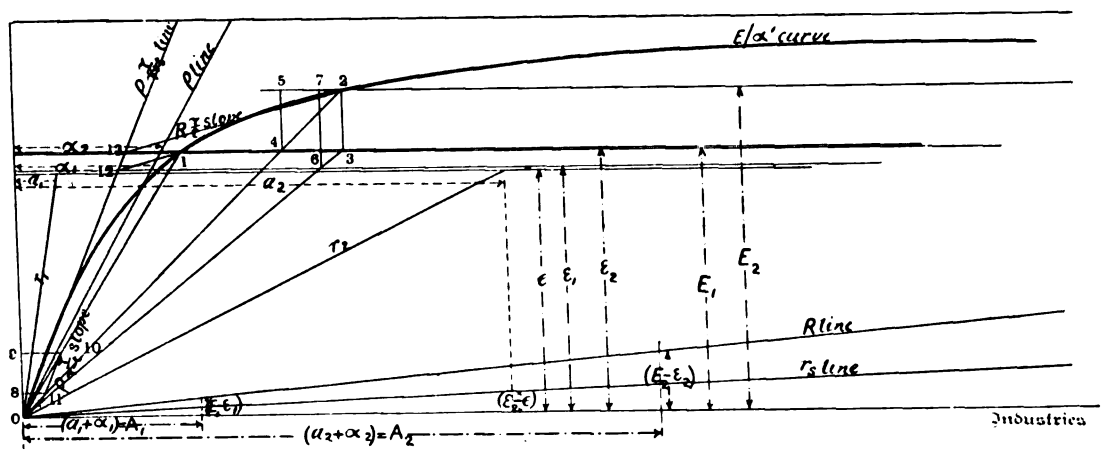


FIG. 13.

GRAPHIC CONSTRUCTIONS FOR DYNAMOS AND MOTORS.

BY PROFESSOR ROBERT H. SMITH.

IV.

(*Concluded from page* 115.)

When the series coils are placed beyond the terminals of the shunt (*i.e.*, shunt taken between brushes), the preceding constructions are modified to a slight extent only. For the generator the line whose slope is $\rho\frac{\tau}{\tau-t}$ is to be substituted for the ρ line; while in the motor construction the substituted line is to be given the slope $\rho\frac{\tau}{\tau+t}$. The reason is easily explained. The value of α^1 is now

$$\alpha^1 = \alpha + a\frac{t}{\tau} = \alpha + (A-\alpha)\frac{t}{\tau} = a\frac{\tau-t}{\tau} + A\frac{t}{\tau},$$

for the generator. Thus $\alpha\frac{\tau-t}{\tau}$ takes the place of α in the constructions already explained; and for any given value of ϵ this $\alpha\frac{\tau-t}{\tau}$ is the horizontal ordinate to the ρ line (*i.e.*, α) multiplied by $\frac{\tau-t}{\tau}$, which will be the horizontal ordinate at the same height of the line $\rho\frac{\tau}{\tau-t}$. A is still $\frac{E-\epsilon}{R}$ where R, the internal resistance, does not now include that of the series coils. The slope $R\frac{\tau}{t}$ is, therefore, now independent of the series coils' resistance, although, of course, depending on the number of turns.

Similarly for the motor the value of α^1 is

$$\alpha^1 = \alpha + a\frac{t}{\tau} = \alpha + (A+\alpha)\frac{t}{\tau} = \alpha\frac{\tau+t}{\tau} + A\frac{t}{\tau}$$

and the first term of this expression is the horizontal distance at the height ϵ of the line $\rho\frac{\tau}{\tau+t}$.

The constructions for generator and motor are illustrated in Figs. 11 and 12.

In Fig. 11, drawing any $R\frac{\tau}{t}$ line between the E/α^1 curve and the $\rho\frac{\tau}{\tau-t}$ line, its intersections with these give $(E-\epsilon)$, which again gives on the R line the value of A. From this is to be subtracted α obtained at the level ϵ from the ρ line (*not* the $\rho\frac{\tau}{\tau-t}$ line), in order to obtain a, and thus the corresponding point on the ϵ/a curve is found. Then, the r_s line being drawn (r_s = resistance of series coils), the value $(\epsilon-e)$, the e.m.f. lost in these coils, is taken from it at the horizontal distance a. This height being set downwards from the point on the ϵ/a curve, the corresponding point on the external characteristic e/a is obtained. The construction of the similar motor diagram Fig. 12 will be easily followed without further explanation.

If E_k be now taken as the height of intersection of curve E/α^1 with line $\rho\frac{\tau}{\tau+t}$ and k the slope of the E/α^1 curve at this height, these quantities have to this type of machine exactly the same relation to constancy of external voltage as in the other type. There is, however, greater difficulty in using them in solving this problem, because the position of the line $\rho\frac{\tau}{\tau+t}$ and, therefore, also the valve of k depend on t, which is the quantity to be calculated from k. It is, of course, e, not ϵ, that it is desired to keep constant.

In solving this problem we assume that, besides ρ, R, and τ, we also know r_s, the series coils' resistance. As already mentioned $R\frac{\tau}{t}$ does not now involve r_s. As the result of solving the problem, we are to find t, and this will give the length of the series coils' wire; but the resistance r_s can, of course, still be kept at the value assumed at the outset by suitably adjusting the section of the wire, or inserting a small extra resistance beyond the coils or otherwise. If this involves a waste of efficiency of practical importance, the calculation may easily be repeated with a new assumed value of r_s approximating more closely to what is found to be required.

Fig. 13 illustrates the method of procedure for a generator. The external voltage desired is e. A horizontal line at this height is drawn, and from the origin are drawn to cut it two lines at the slopes r_1 and r_2, the extreme limits of the external resistance to be used. These cut off a_1 and a_2, the extreme limits of the external current required. At these horizontal distances the corresponding values (ϵ_1-e) and (ϵ_2-e) are obtained on the line r_s, whose slope equals the series coils' resistance, and these heights being added to e give the limiting values ϵ_1 and ϵ_2 of the voltage at the shunt terminals, and from them also on the ρ line the limiting values α_1 and α_2 of the shunt current. These last being added to a_1 and a_2, give A_1 and A_2 the corresponding armature currents; and from them by help of the R line are found $(E_1-\epsilon_1)$ and $(E_2-\epsilon_2)$, and then also on the E/α^1 curve the limiting values of the armature e.m.f., namely, E_1 and E_2.

The problem is now reduced to that of drawing through the points E_1 and E_2 on the E/α^1 curve two *parallel* lines, such that their intersections with the two horizontals at heights ϵ_1 and ϵ_2 will lie on a straight line radiating from the origin.

From point 2 on E/α^1 curve at level E_2 draw the vertical 2 3 to level E_1. From the origin 0 draw the three lines 0 1, 0 2, and 0 3. The two latter lines intersect the horizontals at levels ϵ_2 and ϵ_1 at points 4 and 6. Draw the verticals 4 5 and 6 7. From the origin set off 0 8 = 2 7 and 0 9 = 2 5. Draw horizontals from 8 and 9 to intersect 0 2 and 0 1 in points 11 and 10. Join 11 and 10. This line gives the proper slope $\rho\frac{\tau}{\tau-t}$. Draw parallel to it and through the origin the line $\rho\frac{\tau}{\tau-t}$. Let it meet the horizontals ϵ_1 and ϵ_2 in points 12 and 13. Join these points with 1 and 2. The accuracy of the construction is tested by finding these last two lines exactly parallel; if they are not found to be so, the construction should be gone through again more carefully. The slope of these lines equals $R\frac{\tau}{t}$. Measure this slope and find t, the necessary number of series coils by the calculation

$$t = R\tau \div \text{this slope.}$$

The proof of the accuracy of this construction is not at all difficult, but it would occupy space unnecessarily to give it here. It will be found not difficult to make the construction so that the test for accuracy at the end shows no measurable error.

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As explained, the construction gives equal voltages at the machine terminals beyond the series coils for the two extreme limits of external resistance. For intermediate resistances the voltage will be slightly higher, the rise chiefly depending on the magnitude of the internal resistance R.

Evidently the construction remains unaltered if the constant voltage is to be maintained between two points distant from the dynamo. The only change is to substitute for r_a the whole resistance of the two parts of the circuit between the shunt terminals and the points between which it is desired to maintain constant voltage.

THE ARON ELECTRIC METER.

We herewith give a report on the performance of this well-known meter, by Mr. Gisbert Kapp, M.Inst.E.E., which he has drawn up at the request of the General Electric Company, London. It would be a matter of some importance to electric companies if other meters were subjected to similar critical examination by independent practical experts.

I have subjected the Aron meter which you supplied to a series of tests extending over about ten days, and now report to you on the result of these tests. The meter consists of a pair of pendulum clocks so geared together as to register the difference in their rates on a set of dials. One of the clocks has an ordinary pendulum, whilst the bob of the pendulum of the other clock consists of a fine wire solenoid placed horizontally and swinging within a fixed solenoid of much stouter wire, through which passes the supply current which is to be metered. The fine wire solenoid is connected in series with a resistance coil, and the two form a shunt to the supply leads. The connections are so arranged that there is attraction between the shunt solenoid and the main solenoid, and consequently acceleration of the electric as compared with the gravity pendulum, the difference in rate, which is registered on the dials, being very nearly proportional to the amount of energy passed through the meter in any given time. To find this energy we have therefore to multiply the numbers registered on the dials by a coefficient which must be determined for each meter by experiment, and which in an absolutely perfect meter should be a constant for all currents and pressures within the range of this instrument. I do not know any meter in which this coefficient is absolutely constant; it varies with the amount of current, and the amount of variation is an indication of the greater or lesser accuracy of the meter. To judge of the merits of a meter it is only therefore necessary to determine the coefficient for different currents and pressures, and to compare the coefficients with each other. The more nearly the coefficients agree the greater is the degree of accuracy attained by the meter.

I have tested your Aron meter at pressures varying between 130 and 95 volts, and with currents varying between 26 and 7 amperes, both direct and alternating. In addition I have also made a prolonged test with a direct current of 0·65 amperes.

The meter is designed for a mean pressure of 100 volts, and a maximum current of 25 amperes. I found that the coefficient is practically unaffected by variations in pressure between the limits of 95 and 130 volts. The pressure was measured by a Cardew voltmeter and by a Sir William Thomson electrostatic voltmeter. I calibrated the Cardew voltmeter by means of a Clark standard cell, and its indications agreed perfectly with Sir William Thomson's instrument. The currents between 7 and 26 amperes were measured by a Sir William Thomson ampere balance, and the current of 0·65 amperes was measured by a Sir William Thomson deci-ampere balance. With the larger currents the readings were taken every quarter of an hour, and with the smaller currents they were taken at longer intervals. In this case the current was taken through a single lamp from a secondary battery ordinarily supplying 40 lamps, and was therefore absolutely constant over a period of many hours, rendering it unnecessary to take frequent readings. The tests at high voltage (from 110 to 130 volts) were made whilst charging the secondary battery, and those at normal voltage (from 95 to 105 volts) were made whilst supplying the lamps from the battery when the current was direct, and whilst supplying the lamps from a transformer when the current was alternating. The conditions of the tests were, therefore, those which obtain in the actual use of meters.

The coefficient given by Dr. Aron for this meter is 1·07—that is to say, at about 100 volts pressure between the mains one division on the uppermost dial represents 107 watt hours. I first tested the meter in exactly the condition in which it came to me, and found that for currents varying between 25 and 15 amperes the coefficient given by the maker was nearly correct. For smaller currents the coefficient was, however, incorrect, and the error increased as the current was diminished. Thus with current required for one single lamp my test gave a coefficient of only 0·97. I found that this discrepancy was due to the fact that the meter had not been properly regulated before it was sent to me. In order that a clock-meter of this kind may register accurately, it is necessary that the gravity pendulum should have exactly the same period as the electric pendulum when no current is passing. In this meter the gravity pendulum had a longer period, and consequently the meter registered, even when no current was passing. This defect can very easily be rectified, since the gravity pendulum is provided with a weight which can be screwed up or down as may be required, in order to bring the two pendulums to absolute synchronism. I found it very easy to make this regulation, and my subsequent tests were made with the meter so regulated. I mention this matter to draw your attention to the necessity of regulating every meter after it is installed.

Test of Meter with Direct Currents.—The meter being intended for a forty-light installation, it seemed advisable to test it within the limits of current which would ordinarily obtain in such an installation; I made, therefore, prolonged tests with currents of 8 and 23 amperes, which corresponded to 12 and 35 lamps respectively. The coefficients I obtained were the following:—

With 35 lamps, 1·130; with 12 lamps, 1·141. I also made a prolonged test with a single lamp, in order to determine the accuracy of the meter at the lowest current at which it can possibly be used in practice. This test is, for all meters, the most severe, since any error, however small absolutely, becomes relatively large if the current to be metered is itself very small. I found that, even at the lowest limit of current, the Aron meter gave a remarkably accurate result, the coefficient being

With one lamp ..... 1·146.

On the basis of these figures, it is now possible to form an estimate of the accuracy of the meter when in practical use. Taking the mean between the coefficients for twelve and thirty-five lamps, I find 1·1355 as the coefficient to be used with this meter. The maximum error which would obtain if the meter were always worked at the lower, or always at the higher limit of current, would then be ½ per cent., but as in practice the meter will generally be worked at intermediate currents the probable error will be less than ¼ per cent. I need hardly say that this degree of accuracy is greater than that of any gas meter, and more than sufficient for practical purposes.

Test of Meter with Alternating Currents.—As there must necessarily be some self-induction in the fine wire coil forming the bob of the electric pendulum, the shunt current must lag behind the main current, and the acceleration will be somewhat less than with a direct current representing the same energy. It will also be evident that the difference will be the greater the higher the frequency of the alternating current, so that the coefficient of the meter as found by experiment with direct currents will not be applicable if the meter is to be used with alternating currents, and a new coefficient must be experimentally determined for every frequency. I have accordingly tested the meter at two frequences which may be considered limiting values for practical work, viz., 105 cycles per second (or 12,600 reversals per minute) and 70 cycles per second (or 8,400 reversals per minute). As regards current strength, I have in both cases made the tests within the same limits as those I adopted for the direct currents, and I give the results in the following table:—

Number of Lamps supplied.		Coefficient for a frequency of 105.	Coefficient for a frequency of 70.
35	.....	1·195	1·170
12	.....	1·220	1·194

Taking, as before, the averages between these figures, I find that the coefficient to be used with this meter is

1·207 for a frequency of 105, and
1·182 for a frequency of 70.

In either case the maximum possible error is about 1¼ per cent., whilst the probable average error will be considerably smaller than 1¼ per cent. This degree of accuracy, though not so great as that found with direct currents, is still quite sufficient for all practical purposes. The energy absorbed in the meter varies with current passing through it. At a pressure of 100 volts the energy absorbed is:—

With 1 lamp	3 watts
With 12 lamps	4 watts
With 35 lamps	9 watts

My experiments lead me to conclude that the accuracy, long range, and economy of power shown by the Aron meter make it a very satisfactory instrument, both for direct and alternating currents.

THE SOCIETY OF CHEMICAL INDUSTRY.

LONDON SECTION.

At a meeting of the London Section, on Monday, the 3rd inst., Messrs. Alfred H. Allen and W. Staveley contributed a paper on "Some Metallic Derivatives of the Phenols." The authors regretted that at this meeting they were unable to give their complete paper, but an introduction described the present process of manufacture of "neosote" from blast-furnace tar, in which they pointed out that this commercial product consisted of the homologues of phenol, and was especially valuable for its disinfectant properties. They referred to the readiness with which the sodium compounds of the phenols can be decomposed by carbonic acid, and stated that the blast-furnace gases could be employed for decomposing the sodium phenol compounds in the manufacture of neosote from the tar.

Mr. Watson Smith then read a short paper by Mr. G. Theodossieff, on "A New Process for Hardening Steel and Iron." The process consists in the employment of glycerine for tempering these materials. The specific gravity of the solution of glycerine may be varied between 1·08 and 1·26 at 15° C. by adding water according to the composition of the steel. Its temperature may also be varied between 15° C. and 200° C., according to the hardness of the metal, it being found advisable to employ a high temperature for hard steels. To increase the quenching power of the bath various salts may be added to the glycerine solution, manganese or potassium sulphate being added when a hard temper is required, and manganese chloride or potassium chloride for a softer temper. The advantages which the author claims for his method are—(1) the temperature of the aqueous solutions of glycerine may be varied within wide limits, as the boiling point of pure glycerine is 290° C.; (2) the variation in the quenching power of the solution by dissolving these salts in the liquid has a very marked influence on the degree of temper, and renders it possible to treat very different qualities of steel by this method.

Three specimens of steel were exhibited to the meeting—(1) in which no shrinkage was shown, proving that it was applicable to steel which had not been forged; (2) a specimen which had been bent on itself cold, and having a tensile strength of 65 tons and an elongation of 15 to 18 per cent.; and (3) a piece of forged steel which had been tempered by this process.

The composition of the steel from which these samples were prepared showed on analysis that it contained 0·7 per cent. carbon, 2·2 per cent. chromium, and 0·15 per cent. silicon. The author, who is engaged for the Russian Government, states that the authorities have adopted this process, and have succeeded in making a 12-inch projectile hardened by this process break through a 16-inch armour plate.

FEDERATED INSTITUTION OF MINING ENGINEERS.

On the 6th August, 1887, the late Mr. T. W. Bunning read an able paper before the North of England Institute of Mining Engineers, in which he proposed a scheme for the federation of the eight mining institutes that exist in different parts of the kingdom. Since his death the proposal has not been forgotten. The councils of the various institutes have carefully considered the matter, and the four leading institutes have federated. Independent action is left to each institute as before, but all the papers read are published in one journal. Consequently there is greater efficiency and economy in the management of the business, and a large amount of knowledge is brought to bear on the subjects discussed. The first number of the Proceedings of the Federated Institution has just been published, and contains a large amount of valuable, well-printed, and well-illustrated material in the form of papers read before the four combining institutes—the North of England Institute of Mining Engineers, the Chesterfield and Midland Counties Institution of Engineers, the Midland Institute of Mining Engineers, and the South Staffordshire Institute of Mining Engineers. The first meeting of the Federated Institution was held at Sheffield on the 22nd and 23rd ult., and the result showed the Federation to be an unqualified success, and should induce the Cornish, the South Wales, the Glasgow, and the Manchester Institutes to join the Federation.

At the inaugural meeting at Sheffield, held at the Royal Victoria Hotel, on the 22nd ult., under the chairmanship of the President, there was a very large attendance of mining engineers from all parts of the country. The first paper read dealt with the geology of the southern portion of the Yorkshire coalfield. In this paper Mr. R. Russell gave an epitome of all that is known of the geology of that district. The second paper was by Mr. G. Blake Walker, on coal-cutting machines. This was found of great interest, as it had been arranged, through the kindness of Messrs. T. & R. W. Bower, Allerton Main Colliery, and of the Wharncliffe Silkstone Colliery Company, for the members to see the coal-cutting machines at work prior to the meeting. The following is a brief abstract of Mr. Walker's paper:—

The revival in the coal trade, coupled with the fact that the thickest seams are rapidly becoming exhausted, has caused attention to be directed to thinner seams that hitherto have not been considered worth working. Interest in coal-cutting machinery is consequently reviving. The jealousy as to machinery among the miners themselves has now completely disappeared, and they are distinctly favourable to its introduction, taking care, however, that the reduction in the severity of their labour shall not bring them any reduction in the actual money value of it. Coal-cutting machines have hitherto been used for three purposes—for heading, for holing, and for bringing down the coal. For heading, the Stanley machine is the only machine that has been made a practical success. It may be considered to have solved the problem of rapid progress, the progress made with this machine being 1 yard an hour. In a trial of twenty-four hours it cut 64ft. 6in. Machines for holing or undercutting the coal have to comply with a number of conditions. A machine for this purpose must be light, so as to be managed by two men working in a confined position, and strong, so as not to be injured by falls of the roof or by rough usage. It must be narrow and simple; it should clear its own cut, and be able to cut into the straight face at the start without having a hole made for it. There should be a reserve of power, so as to enable the machine to cut through nodules of pyrites or other exceptionally hard substances. Lastly, the cutting tools must be simple, and easily changed and sharpened. Amongst the most successful compressed air machines may be mentioned Mr. W. Firth's pick, a machine introduced thirty years

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ago, and still at use at the West Ardsley Colliery; Baird's endless chain machine, which has been largely used in Scotland; and the Rigg & Meiklejohn, Gillott & Copley, and the Winstanley rotary machines. The last is not at present in use, as it has not succeeded in cutting anything very hard. It has, however, many good points, especially that of being able to cut into the face. The Rigg & Meiklejohn machine cuts from front to back on the level of the foot of the seam, whilst the Gillott & Copley machine works in the opposite direction, and thus brings out its *debris* if the cut is above the floor. In Baird's machine the cutting is done by an endless chain with cutters attached, driven round an arm extending under the coal from 3ft. to 5ft., as required. In eight to ten hours this machine will cut 2ft. 9in. deep into 100 yards. Of American machines actuated by compressed air, the Legg coal-cutter appears to be the most successful. A number of electrical coal-cutters have been used in America, the Sperry, Bain, and Lechner machines appearing to have met with success. A new machine has been successfully tried at Messrs. T. R. & W. Bower's Allerton Main Colliery, and in ordinary working averages 150 yards per shift of eight hours. In comparing the actual cost of coal-cutting by hand and by machinery, experience shows that in a 3ft. seam the quantity of slack made when the holing was done by hand was 25 per cent., as compared with 15 per cent. when done by machine. In a seam 1ft. 6in. thick the corresponding figures would be 45 per cent. and 30 per cent. respectively. A satisfactory performance in working a coal face by hand would be 100 yards per eight hours shift. The general result shows that, when machines are used, there is a saving of 8½d. to 1s. 6d. per ton, about two-thirds of which is due to the reduction in the quantity of small coal produced.

The last paper was one by Mr. A. T. Snell on the distribution of energy over large areas in mines by electricity. The paper was elucidated by effective diagrams, and was rendered of special interest from the fact that arrangements were made for the members to visit prior to the meeting St. John's Colliery, Normanton, where the author of the paper, representing Messrs. Immisch & Co., described the electric pumping and hauling plant installed by his firm. It is to be regretted that time did not permit any discussion of the papers. As this meeting was the initial gathering of representative mining engineers of the different districts, a discussion could not fail to have elicited information of value.

The meeting was followed by a dinner, which was attended by two hundred members of the Institution, with some of the leading men of Sheffield as guests. Mr. C. E. Rhodes, President of the Midland Institution, was in the chair. Later in the evening there was a reception given by the Mayor of Sheffield and the Master Cutler at the Cutlers' Hall. A large number of ladies and gentlemen were invited to meet the engineers, and a room was set apart for an interesting exhibition of mining appliances. Amongst the novelties the Thornebury miner's lamp attracted a good deal of attention. In this lamp the air ingress is entirely separate from the egress of the products of combustion. As the whole of the air supply must pass through the flame a greatly increased light is given, and as the gas can never become ignited within the gauze cylinder it is absolutely safe under all conditions.

A number of varieties of Ashworth's patent Hepple-white-Gray safety lamp were also shown. This form of lamp is of especial value for making quick tests for either low or high percentages of firedamp.

The Yorkshire Engine Company, Limited, exhibited one of their coal-cutting machines with cylinders 9in. in diameter and 9in. stroke. The total width of the machine, exclusive of the cutter wheel, is 3ft. 3in., and its weight complete 24cwt. It will undercut 39in. in hard coal at the rate of 12 yards an hour, the pressure of air required being 30lb. per square inch. It can be worked by two men, who also take up and lay down the rails on which it works.

Messrs. J. Davis & Son exhibited various improved mi ie surveying instruments and anemometers. A number of solid forged wheels were shown by Messrs. John Brown & Co.; a patent wheel lubricator was shown by Messrs. Lampen & Co.; steel pit bars and props by Mr. W. Firth; mining tools and disintegrators by the Hardy Patent Pick Company, Limited; cartridges by Messrs. R. Roper, Son, & Co.; and compensating metallic pistons by Messrs. W. Buckley & Co.

Thursday, the 23rd, was devoted to excursions. Three routes were included in the programme. The first included visits to the Aldwarke Main Colliery, Denaby Main Colliery, and the Denaby Main new sinkings; the second excursion was to the Wharncliffe Silkstone Colliery and the Lidgett Colliery; and the third was to St. John's Colliery and Allerton Main Colliery. In each case the mining engineers were very hospitably received, and, notwithstanding the inclemency of the weather, each excursion was largely attended.

THE UTILISATION OF SLAG.

On Wednesday, the 29th ult., at the Society of Arts, Mr. Gilbert Redgrave read a paper on the above subject, of which the following is a brief abstract:— The total quantity of slag produced in the manufacture of cast iron in the United Kingdom amounts to 18,000,000 tons per annum, while considerable quantities of slag are also formed in the new processes of steel manufacture and in copper smelting. Mr. Charles Wood some years ago introduced many ingenious methods for dealing with slag, and of these the various processes for utilising molten slag by casting it into blocks, the production of slag sand, and the preparation of bricks and mortar from this sand are the most important. In recent times the casting of blocks has made important progress under the Tees Scoriæ Brick Company, chiefly in the production of granitine paving setts, in which the cleaved rough surface of the slag brick is exposed to wear instead of the smooth polished surface. These blocks, being non-porous, are very durable, and at Middlesbrough a road surface exposed to heavy traffic for eleven years is still in good repair.

The annealed slag has also a strong affinity for Portland cement, and this fact has been turned to practical account by the Jones's Annealed Concrete Company, of Middlesbrough, who employ this material for paving purposes. Broken slag is also in use in various parts of the country for road-making. Slag-wool or silicate cotton, also originally obtained by Mr. Charles Wood, is also an important application of blast-furnace slag. It is obtained by causing a jet of steam to impinge upon the stream of molten slag as it issues from the furnace, and has the following properties, viz.:—(1) It is extremely light and is absolutely fireproof; (2) it is a good non-conductor of heat and of sound; and (3) it is so porous that it will absorb large quantities of water and readily retains the same for a considerable time. The slag-wool is moreover an antiseptic, and is being used for medical purposes. Large quantities of cement are also now made from slag-sand, without the addition of Portland cement, by mixing it with 25 per cent. of lime. In order to ensure a successful cement the mixture is ground in a machine of special construction termed a "homogeniser." The specific gravity of this cement is very low as compared with Portland cement, while the time occupied in setting is comparatively long. For purposes of storage it also compares well with Portland. By exposure to the air it absorbs carbonic acid more rapidly than does Portland cement, but it does not deteriorate greatly in tensile strength by long exposure. For works in water, owing to the closeness of its particles, the cement appears to be particularly well adapted. Crushed slag can be used as concrete with this cement for making sea walls. It has been in use abroad for many years, but the system of cement testing in England has militated against it having a fair trial in this country. In Germany, used alone or mixed with Portland cement, it is held in great favour. The author then gave an outline of the utilisation of Thomas slag as a manure, and pointed out the astonishing rapidity with which this fertiliser has been introduced into German agriculture, where it has exceeded the total available native production of the slag, giving rise to a large import from this country and Austria. He concluded by urging the English farmer to follow the example set in Germany, as at its present price Thomas slag meal can be obtained in this country at about half the cost of superphosphate. He added that it seemed sad that we should be importing phosphates from America in large quantities and exporting a good home-made phosphate to the Continent.

In reply to the questions which arose out of the discussion which followed, Mr. Redgrave stated that the presence of calcium sulphide in the slag was of very small importance, as up to 3 per cent. it produced no injury at all, its effect being to render the cement slower in setting.

Notes.

JAPANESE LACQUER FOR SHIPS' BOTTOMS.

The uses to which the Japanese put the lacquer for which their country is celebrated are very numerous both from an artistic and an industrial point of view. High class artistic work is most expensive, and only rich people can afford to indulge in it, the older work especially being highly prized. For domestic and industrial purposes the transformations which can be worked on paper and wood by the application of lacquer are very wonderful, and render it most indispensable for ordinary use. Some few years ago the Japanese Government decided on lacquering the bottoms of all their iron ships, and the results proved that corrosion was most effectively prevented, but the process does not seem to have been applied to any foreign ship until about two years ago, when the attention of the captain of a Russian frigate was directed to it, and lacquer was applied both to the iron and the zinc parts of the bottom. To the latter it was found that the adhesion of the lacquer was very slight, but on the iron, or rather steel, it was found that it was in an extraordinary good state of preservation, so much so that it could not be stripped off except by being scraped with a sharp instrument, and from the experience thus gained it has been decided to substitute iron on the part where zinc had been used. It would be interesting to hear the result of an experiment of the bottom of a British war-ship, and it might be worth the while of the Admiralty to arrange for this being carried out.

THE CITY OF LONDON AND SOUTHWARK SUBWAY.

The progress of these works has been very rapid during the last six months, and they are now very nearly complete. The wet gravel bed at Stockwell has been driven through, and one of the tunnels through it has already been finished. In a short time the various stations will be ready. Messrs. Mather & Platt's electric locomotive and train have been running for some time along part of the line already laid down, and Mr. Greathead, the engineer of the company, reports very favourably as to the working.

THE THEORY OF ACCUMULATORS.

M. Drzewiecki attacks the recognised theory of accumulators, but his own grounds seem assailable. He says that sulphate of lead cannot be formed on both plates on discharge, or they would become white. As a matter of fact, only about 5 per cent. is really converted into sulphate, 95 per cent. of the coating remaining idle; hence the colour does not change much. He has next got hold of the old fallacy that lead sulphate is inoxidisable. He will find it is only a question of contact. If properly pressed against the plates it goes into PbO_2 on one and Pb on the other. There seem to be no reasons to believe that basic sulphates are formed in the presence of fairly strong acid.

EDINBURGH EXHIBITION, 1890.

The applications for space in this Exhibition closed on the 31st ult., and it is estimated that the amount applied for is about double that available in the buildings at present being erected, so that an additional annexe has become a necessity, and will be proceeded with at once. The Exhibition promises to partake much more of an international character than any recent one in this country, very large demands for space having come from abroad, especially from France and Italy. In its most prominent feature—that of the applications of electricity—it will surpass anything hitherto seen, while new departures have been taken in several directions with the view of increasing its attractiveness. The Forth Bridge, which may be said to have called the Exhibition into being, will be represented in the grounds by a model in wood to a large scale, and, probably, additional models of various parts, showing the methods of construction adopted, will illustrate the history of this vast undertaking in a way both attractive to the public and valuable to the engineer. Railway exhibits generally will take a prominent place, a representative collection of early and late locomotives having been promised by the principal British railways, while negotiations are still in progress with leading American locomotive engineers with a view to their sending specimens of their best productions, to compete in open trial with our own under normal running conditions on an English line. The addition of a Fine Art Section has been decided on, and the long covered way which connects the two main buildings will be partly utilised for this, especially for works of sculpture. In the Electrical Section, one branch, of which little has been seen hitherto, electric welding, will be shown on a large scale, and among many other important exhibits a complete historical collection of telegraphic appliances, promised by the British Post Office, will doubtless prove a great attraction. The arc lighting of the buildings and grounds has been entrusted to the Brush Electrical Engineering Company, and the incandescent system to Messrs. King, Brown, & Co., Rosebank Electric Works, Edinburgh. Messrs. Galloway, of Manchester, are to supply the five principal boilers necessary for the steam power.

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Patent Record.

(Compiled from "The Illustrated Official Journal (Patents).")

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

20th January, 1890.

963. Drey, O. — Pile cutting machines.
967. Tranter, T. M. — Breechloading small arms.
969. Field, T. C. — Rotary engine.
971. Wardle, J. — Steering ships.
973. Sayers, W. B. — Lubrication of journals.
976. Furnival, Tudor, Byway, & Grimshaw — Paper cutting machines.
978. Knowles, T. — Steam engines.
986. Hall-Brown, E. — Compound engines.
989. James, W. — Sight-feed lubricators.
990. Buckley, W. — Lathes.
995. McQueen, P. — Boat detaching gear.
998. Haag, S. — Propelling vessels.
1003. Boult, A. J. — Lubricators (*Andersson & Blom*).
1005. Preiss, A. — Joint for railways.
1006. Thompson, W. P. — Pumps for viscous substances (*Lankelma*).
1008. Norl & Tillett — Wire ropes.
1009. Berr, F. — Breaks for steamers.
1010. Edwards, E. — Opening machine for cotton (*Josephy*).
1013. Guy, J. P. — Machines for making earthenware articles.
1014. Caird, D. — Metal barrels.
1019. Ainley & Oakes — Machinery for cutting holes.
1021. Moore, J. — Propelling screws.

21st January, 1890.

1030. Eves, J. V. — Frames for spinning flax.
1032. Hall, W. — Enlarging coal pit shafts.
1034. Hughes, D. — Machinery for "wood-wool."
1035. Szarbinowski, F. M. — Snow ploughs.
1039. Gimson, Gimson, Gimson, & Gimson — Burnishing machines.
1043. Edwards, W. — Sharpening files.
1044. Parkin, Frear, & Davie — Valve gear.
1045. Hill & Smith — Breechloading small arms.
1050. Bollé, C. — Dynamo-electric machines (*Gutmann*).
1057. Robertson, Orchar, Adie, & Robertson — Sewing machines.
1061. Leverkus, K. — Horse-power gauges.
1063. Holker, W. — Slide valves.
1064. Bedford & Rodger — Metallic packings.
1075. Tellering, C. — Machine for making hollow metal goods.
1077. Thornycroft, J. I. — Indicating speed of rotating shafts.
1078. Sauvée, A. — Mountings for guns (*Canet*).
1079. Baylis & Denton — Permanent way.
1080. Elster, Young, & Knapp — Nut locks.
1095. Smith, E. F. — Veneer cutting machines.
1096. Watson, Gelston, & Weed — Screw-threaded rods.
1099. Wells, C. — Steam engines.
1100. Paterson, H. C. — Furnaces with forced draught.
1101. Paterson, H. C. — Furnaces.
1103. Lässoe, V. F. — Duplex rudders.
1104. Goddard & Radford — Propelling boats.
1105. Newton, P. A. — Printing machines (*Hoe*).
1111. Moore, C. T. — Typewriting machines.
1112. Connolly, Altman, Altman, & Altman — Machines for picking skins.
1114. Gathmann, L. — Loading ordnance.
1116. Procter, Middleton, Fraser, & Carter — Manufacture of bricks.

22nd January, 1890.

1120. Parsons, C. A. — Steam turbines.
1122. Wilson, T. E. — Concentration and distillation of liquids.
1124. Helliwell, R. B. — Lubricators.
1125. Eves, J. V. — Frames for spinning flax.
1129. King, J. T. — Blast furnaces (*Kennedy*).
1134. Dixon, S. (of the Firm of Kendall & Gent) — Drilling machines.
1135. Fairweather, W. — Fringing machines.
1136. Edmunds, L. R. — Screw heads and nuts.
1139. Hurdle, G. — Self-lubricating pulleys.
1143. Chadburn, W. — Engine-room indicator.
1144. Betten, H. — Motor engine.
1150. Lindner, O. — Hot-air and gas engines.
1160. Krnka, K. — Repeating rifles.
1161. Turner, T. — Blast furnaces.
1162. Dansey, H. — Valve gear.
1164. Tavernier & Casper — Feeding boilers.
1169. Smith, M. J. — Wire netting machinery.
1170. Brown, C. A. — Furnaces for burning tan.
1171. France, E. — Knitting machines.
1179. Defalque & Chatelain — Railway axle boxes.
1180. Berthon, E. L. — Anchors.
1181. Horn, W. W. — Steam engine valve (*Haven*).

23rd January, 1890.

1191. Clegg (of the Firm of Asa Lees & Co., Ld.) & Moorhouse — Mules.
1192. Bailey & Lindemann — Pumping engines.
1193. Imray, H. — Rolling composite tubes (*Moerchen*).
1194. Morton, J. — Brick machinery.
1196. Barker, W. — Boot-finishing machine.
1197. O'Donnell & Smith — Interlocking railway levers.
1198. O'Donnell & Timmis — Railway signalling wires.
1199. Woodville, G. — Machines for pressing hay.
1200. Moore, J. G. — Valves for engines.
1202. Wood, W. — Steam cylinder drain cocks.
1204. Carter, C. — Tapering bolt holes in shaft couplings.
1206. Chumard, M. — Lifting jacks.
1207. Thompson, W. P. — Moulding boxes (*Brunelli*).
1211. Higgins, J. — Combined exhaust steam pipe and air ejector for locomotives.
1213. Grant, A. M. — Metallic packings.
1214. Kyte, G. — Hydrant valve casing.
1215. Walker, H. — Annealing furnaces.
1217. Smith & Dight — Lifting and lowering crossings, &c., of permanent ways.
1218. Kerby, J. T. — Car axle lubricators.
1223. Hyde, G. T. — Axle boxes (*Brewer*).
1232. Booth & Hardcastle — Safety device for lifts.
1234. Mannesmann, R. — Regenerative gas furnaces.
1235–6 Mannesmann, R. — Compressing air.
1239. Bethmont, D. — Instantaneous production of vapour from water.
1240. Scott & Williams — Knitting machinery.
1249. Phalp, O. — Anchor and oil distributor.

24th January, 1890.

1250. Lorrain, J. G. — Pistons (*Carré*).
1254. Wright & Nettleton — Shuttle boxes.
1257. James, W. I. — Knitting machines.
1258. Hallas, C. G. — Rolling rods.
1260. Whitworth, T. S. — Carding engines.
1263. McDougall, N. — Force pumps.
1264. Settle, W. — Drills for mining.
1274. Walker, W. — Blast pipes of locomotives.
1276. Legrund & Nottingham — Producing motive power.
1278. Sleat & Skelton — High-speed engine.
1284. Imray, O. — Furnace fires (*Mannesmann & Mannesmann*).
1285. Imray, O. — Gas producers (*Mannesmann & Mannesmann*).
1290. List & Dick — Screw propellers.
1294. Tozer & Tozer — Manufacture of buffer cases.
1297. Cresswell & Heslop — Feeding printing presses.
1301. Wells, C. — Steam engine.
1304. Younghusband, S. S. — Valve gear.

25th January, 1890.

1309. Rawstron, F. W. — Knitting machine.
1311. Gant & Moy — Releasing gear for boats.
1316. Andrew & Birks — Forging elongated shot and shell.
1317. Hassel & Holt — Carding engine flats.
1320. Avery & Avery — Weighing machines.
1327. McQuiston, W. — Nut locks.
1336. Menzies & Co. — Detaching ships' boats.
1337. Burgon & Marshall — Driving shafts.
1338. Fielding & Fielding — Jacquard harness.
1339. Hollingdrake, R. — Steam boilers.
1345. Boss, M. P. — Stamp batteries.
1348. Steinmüller & Steinmüller — Steam generators.
1352. Marjoribanks, D. S. — Manufacture of shells
1358. Boult, A. J. — Lathes (*Von Pittler*).
1359. Petibon, — — Locking railway points.
1361. Boult, A. J. — Nut locks (*Harris*).
1364. Edwards, E. — Fleece-dividing machinery (*Josephy*).
1368. Ponto, W. J. — Car coupling.
1369. Fricker, G. C. — Cleaning and annealing iron.
1370. Wolseley, F. Y. — Sheep-shears, horse-clippers, &c.

ELECTRICITY.

20th January, 1890.

993. Edmundson & Clark — Incandescence electric lamps.
1026. Boult, W. S. — Accumulator switches.

21st January, 1890.

1028. Thompson, W. P. — Alternating currents (*Gutmann*).
1031. Von Peichl, J. — Electric compass.
1068. Lückhoff & Hungerbühler — Conductors.
1072. Binswanger, G. — Electrical switches.
1094. Lake, H. H. — Storage batteries (*Ewing*).
1106. Carpenter, H. H. — Electrical distribution.
1110. Hitchcock, C. A. — Batteries (*Burnley*).

22nd January, 1890.

1159. Philips, T. W. — Insulators.

23rd January, 1890.

1226. McMullen, J. A. — Incandescent electric lamps.

24th January, 1890.

1266. Thompson, Sir W. — Mariner's compass.
1280. Baker, C. L. — Switches.
1281. Ernst, V. H. — Secondary batteries. (28th September, 1889.)
1296. Berry, A. — Electrically recording the passage of trains.
1302. Trotter, A. P. — Calculations relating to supply of electrical energy.
1306. Smith, C. — Galvanic dry elements (*Hellesen*).

25th January, 1890.

1347. Coad, T. — Fluid for primary batteries.

CHEMISTRY.

20th January, 1890.

981. Grimshaw, H. — Recovery of tannin from leather.
983. Grimshaw, H. — Soap.
984. Grimshaw, H. — Generation of carbon dioxide.
985. Grimshaw, H. — White pigment.
1015–6. Ellershausen, F. — Soda and potash.
1017. Dammann, W. — Reudering tar-oils soluble in water.
1022. Walrond-Smith, T. — Water gas.

21st January, 1890.

1053. Grimshaw, H. — Recovery of zinc.
1062. Knowles & Knowles — Azo colours.
1117. Massignon & Watel — Chromates.

22nd January, 1890.

1126. Hazlehurst & Pope — Spent soap lyes.
1157. Young & Pearn — Dyeing and bleaching.

23rd January, 1890.

1227. Miller, E. C. — Anti-friction alloys (*Magnolia Anti-Friction Metal Company*).
1237. Mannesmann, R. — Illuminating gas.
1238. Mannesmann, R. — Water gas, &c.
1246. FitzGerald & Falconer — Chlorine.

24th January, 1890.

1283. Imray, O. — Production of coke (*Mannesmann & Mannesmann*).
1300. Leigh, H. H. — Barium oxides (*De Brochocki*).

25th January, 1890.

1355. Haswell & Haswell — Coating iron, &c.

MISCELLANEOUS.

20th January, 1890.

1001. Nevill, W. H. — Artificial fuel.

21st January, 1890.

1037. Bowles, R. C. M. — Mechanical telephones.
1087. Goodall, T. — Boiling esparto grass.

22nd January, 1890.

1127. Dowson & Taylor — Fire extinguishing apparatus.

24th January, 1890.

1308. Lawson, C. — Gas meters.

25th January, 1890.

1346. Sugg, W. T. — Ventilating apparatus.
1349. Wise, W. L. — Gasification of fuels (*Solvay & Semet*).

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form, of such opposition.

Year 1888.

17007. Hook.
17496. Whitehead.
18552. Clifford.

1889.

944. Paris.
1035. Bailey & Bailey.
1070. Holmes.
1209. Lowry.
1286. McPhun.
1383. Quinsey & Blood.
1606. Nordenfelt.
1795. Hollingworth.
1831. Thompson (*Caillard & Caillard*).
1895. Day & Napper.
2117. Huppler.
2134. Enoch.
2233. Holzapfel.
2338. Boothroyd & Renouf.
2344. Ball.
2360. Brasier & Knowles.
2460. Cockburn.
2683. Kitching.
2715. Baker.
2720. Ritter.
2875. Deakin.
2876. Knight & Beckley.
2987. Warren.
3008. Maddox.
3022. Cotterell.
3032. Fooks.
3101. Furnival, Tudor, & Byway.
3233. Heys (*Depierre*).
3365. Kamm.
3293. Ahrbecker.
3527. Jones.
3387. Wise (*Hermann*).
3597. Trotman.
3574. Hatschek.
3903. Duval & Lawton.
3900. Preston & Fowler.
3904. Wallis, Wallis, Wallis, & Wallis.
4131. Miall.
4235. Conte.
4288. Besson.
4357. Bannister.
4367. Reid.
4388. Dawson.
4394. Nunn.
4417. Wise (*Messrs. Solvay & Co.*).
4455. Boult (*Schmidt*).
4481. Braunig.
4499. McKirdy, Carrick, & Binks.
4524. Shewbrooks.
4566. Preece & Sayers.
4598. Blaikie, Harper, & Campbell.
4640. Hopkinson & Hopkinson.
4647. Tangyes, Ld., Meacock, & Pendlebury.
4653. Wise (*Jönsson*).
4662. Wilson & Wilson.
4716. Johnson (*Pusset*).
4718. Ellis.
4719. Jordan.
4726. Gilson.
4754. Robinson.
4780. Holland & Page.
4788. Hardwicke.
4789. Okes.
4796. Schimming.
4810. Veit.
4831. Groc & Grebel.
4854. Carlton.
4860. Chambers.
4880. Broad & Fowler.
4888. De Facieu.
4895. Marks.
4904. Andrews.
4913. Elliott.
4915. Smith & Smith.
4923. Thomson.
4929. Corker, Liversidge, Jackson, & Woolhouse.
4931. Short.
4937. Fothergill.
4948. Field & Neal.
4949. Field & Neal.

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4957. Lindsay.
4964. Lacheur.
4976. Middleton.
4996. Dickinson.
5005. Dover.
5018. Harfield.
5040. Croll.
5046. Ambrose.
5063. Hungerbühler & Todman.
5100. Cummins.
5165. Lake (*The Secor Marine Propeller Company*).
5246. Briggs & West.
5333. Mallet.
5444. Urwick.
5563. Lake (*Lacombe & Co.*).
5616. Abel (*The Gas Motoren Fabrik Deutz*).
5649. Bear & Ransom.
5867. Graham.
5914. Green.
6005. Depoele. (7th September, 1888).
6381. Bate (*Knaus*).
6507. Evered.
7610. Telfer.
8509. Favier.
9496. Marx.
9882. Maitland.
10158. Townend, Eaton, & Townend.
10724. Blumann & Sims.
11153. Cummins.
13601. Cooper.
13821. Milchsack.
14793. Baines.
14820. Wingfield.
16098. Lake (*Brisker*).
16348. Robinson.
16649. Mullins.
17272. De Wilde & Reychler.
17602. Gavin & Thompson.
17832. Busch.
18274. Bromell.
18838. Pitt (*Johnstone*).
18894. Viehofer.
19038. Beaumont.
19423. Blankman.
19568. Dennis.
19584. Schumacher.
19689. Olsen & Kjöller.
19828. Prentiss.
20010. Bath.
10019. Allen.
20087. Wise (*Hall*).
20116. Lahr.
20180. Nenninger.
20252. Whiteley.
20305. Lake (*Holt*).
20383. Bohm.
20433. Holmes.
20448. Klauke.
20459. Barnes. (21st May, 1889).
20490. McEwen.
20571. Obermann.
20601. Bebbington.
20612. Kaye.
20650. Gray.
20708. Hett.
20714. Carette.
20717. Prentiss.
20734. Haddan (*Gillette*).
20750. Bing.
20762. Thompson (*Dick*).
4958. Lindsay.
4968. Lingner & Kraft.
4991. Yates & Kay.
4998. Bowron.
5008. Werner & Potzsch.
5037. Owen.
5042. Park.
5048. Rylands.
5067. Methven.
5083. Dunn.
5117. Moore, Murton, & Varley.
5207. Andressen.
5270. Jones.
5340. Gabet.
5549. Imray (*Farbwerke vormals Meister Lucius & Brüning*).
5635. Ramberg.
5776. Taylor & Warburton.
5910. Birdsall.
5928. Schaefer.
6152. Williams.
6206. Buette & Chevalier.
6419. Chambers.
6842. Maltby-Newton.
7981. Leedham.
8751. Hinde.
9570. Smith.
10151. Hale.
10361. Lake (*La Société Anonyme des Parfums Naturels de Cannes*).
12741. Northup.
13686. Vowles.
14677. Moffatt.
14794. Tilley.
15808. Adamsz.
16201. Sayer.
16576. Reed.
17077. Gorton.
17433. West.
17560. Adams.
17634. Grant.
18068. Redfern (*La Société Anonyme Française des Bascules automatiques*).
18911. Kristoffovitch.
19169. Brierley (*Lovs*).
19511. Crane & Windle.
19588. Schumacher.
19659. Anderson.
19786. Hyde & Horner.
19870. Lake (*The Berlin Machine Works*).
20077. Berryman.
20094. Jagerstrom.
20164. Nagle.
20235. Corbens.
20283. Browne (*Vater*).
20358. Rees.
20388. Ling.
20442. Betham & Woolnough.
20452. Hayes.
20478. Prescott.
20561. Sheppard.
20579. Crow.
20609. Kendrick.
20654. Wise (*Collin*).
20704. Powell.
20710. Fitch.
20715. Delahunty.
20726. Eynon.
20742. Imray (*Foulks*).
20754. Boult (*Drew*).
20763. Boult (*Hartung*).

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

Steam Boilers.—*J. L. White & H. S. White, East Cowes, Isle of Wight.*—The boiler consists essentially of coiled tubes, arranged in an upright position, and communicating with steam and water chambers at their upper and lower ends. The outer shell of the boiler consists of a double casing of metal between whose plates air is made to circulate. The space enclosed by the casing is divided into three longitudinal flues by rows of tubes arranged close together and connected at their ends with the steam and water chambers. In each flue are rows of double spiral tubes, placed in the flues with their axes vertical, and communicating at the top and bottom to the steam and water chambers. The steam chamber consists of a large tube fixed longitudinally at the top of the boiler, and the water chamber consists of two similar tubes placed longitudinally at each side of the bottom of the boiler. The products of combustion pass along the central flue to the back of the boiler, and then back again to the front by the two outer flues, one upon each side of it. The products of combustion thus strike against the coiled tubes and the tubes forming the division of the flues, imparting to them their heat, and so generating steam. Claim: The improvements hereinbefore described in such steam boilers as consist of tubular coils communicating at their upper ends with a steam chamber or steam chambers, and at their lower ends with water chambers—that is to say, the construction in such boilers of a middle flue or middle flues and sides, or return flues by means of tubes communicating with the said steam and water chambers.—No. 6934. April 25th, 1889. 11*d*.

Centrifugal Pumps.—*W. Beaumont, Stockport.*—The following structural alterations are made in centrifugal pumps, to obviate priming, &c. The wheel and its shaft are made preferably of brass in one piece. The vanes of the wheel are made straight, and are fixed radially to its axis, the inner ends being slightly wider than the outer ends. The wheel is fitted into a flat shell formed in halves, scroll like, so as to leave space between the periphery of the wheel and shell, which widens gradually towards the outlet formed on the side. The axis of the wheel is vertical, and a long bush is formed in the top half of the shell for its shaft. The lower half of the shell is formed with a hole concentric to the axis of the wheel for the inlet. To the inlet is attached a short piece of vertical pipe containing a lift valve if required. Three claims are made for the improvements described.—No. 2603. February 14th, 1889. 6*d*.

Reciprocating Rotary Motion.—*W. Crook & E. Entwistle, Blackburn.*—The reciprocating rotary motion is obtained from a direct rotary motion in the following manner. The shaft which receives the reversible motion is arranged between two other shafts geared together by a gear wheel upon each so that the motion of each shaft is in contrary direction. Upon each of the two outside shafts is fixed another gear wheel with only half of its periphery with teeth. The teeth of these segmental gear wheels engage in a wheel upon the centre shaft in such a manner that as one segmental wheel engages with it the other goes out of gear and so gives the centre shaft a reversible motion. One claim is made for the motion described.—No. 3768. March 4th, 1889. 6*d*.

Lubricators.—*R. W. Anderson, Liverpool.*—The invention refers to that class of oil cup known as a "sight feed," the usual form of which consists of a metal cover and bottom with a glass body connected by means of a central tube. In the illustration Fig. 1 shows the appliance in sectional elevation; Fig. 2, sectional plans; Fig. 3, a side elevation of the appliance; and Fig. 4, a plan. The top C and the bottom D are connected by a tapered tube T. A glass cylinder A is grasped between the top and bottom and constitutes the container. In the tube T is a plug V, which has a number of openings and grooves corresponding to other openings in the tube. The plug V is retained in its position by a plate J turned under the collar I. The plate J

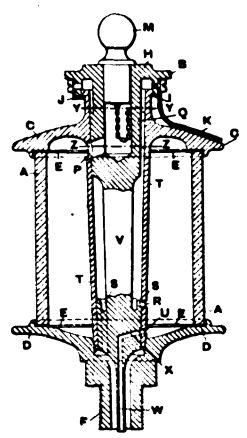


FIG. 1.

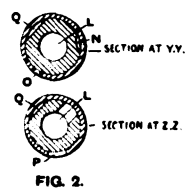


FIG. 2.

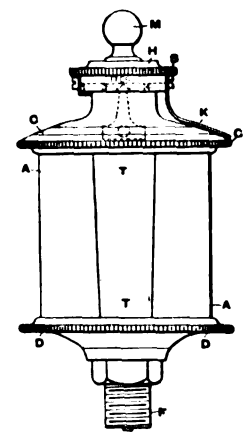


FIG. 3.

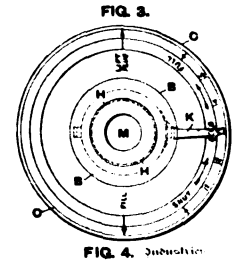


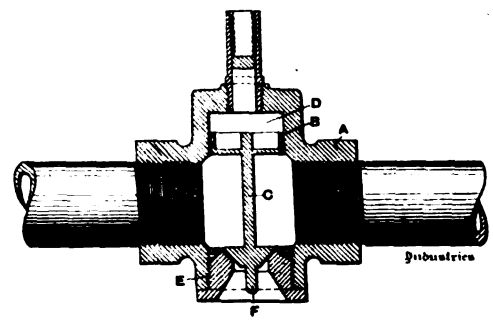
FIG. 4.

and collar I are cut away so that when the plug is turned into a certain position it can be removed from the tube. To fill the lubricator the plug V is moved until the holes L and P correspond; the plug M is then removed and oil poured in. The air displaced by the oil escapes by the hole O and the groove N. The oil is fed to the lubricated part through the hole U and passage X. The passage X and the hole U communicate direct as shown or by a tapered groove which gradually diminishes in size as the plug V is turned to regulate the flow. Air to take the place of the oil fed enters by the passage Q and the hole R, from which it ascends in bubbles to the top of A. An index arrow K is attached to the plug V to indicate the various positions required and marked upon the top C. Nine claims are made for the lubricator as described.—No. 4584. March 16th, 1889. 8*d*.

Coverings for Rollers used in Textile Machinery.—*J. Shepherd, Stockport.*—To obtain a sufficiently firm and elastic covering for the top rollers used in connection with textile machinery the inventor employs a very thin tough paper, in the form of tape, of any required length and breadth, and by the aid of suitable appliances winds the paper round that part of the roller intended to be covered. A sufficient quantity is wound to form a firm but slightly elastic body. The paper is secured to each other and the roller by glue or any suitable cement. The outer covering of paper is varnished with a quick drying varnish made of shellac and methylated spirits, to keep the rest from the bad effects of oil or damp, and to leave a smooth surface that will not collect dust and dirt. Claims: (1) Covering top rollers used in textile machinery, of whatever material or materials the rollers may be made or in parts composed, with strips of thin tough paper in the manner and for the purpose described; (2) continuous winding layer upon layer of thin tough paper upon rollers forming an outer covering of an elastic nature due to the number of fine interstices between the unattached parts that are set closely together; (3) varnishing the outer surface of paper-covered rollers used in connection with textile machinery as a means to prevent absorption of oil or grease.—No. 4592. March 16th, 1889. 4*d*.

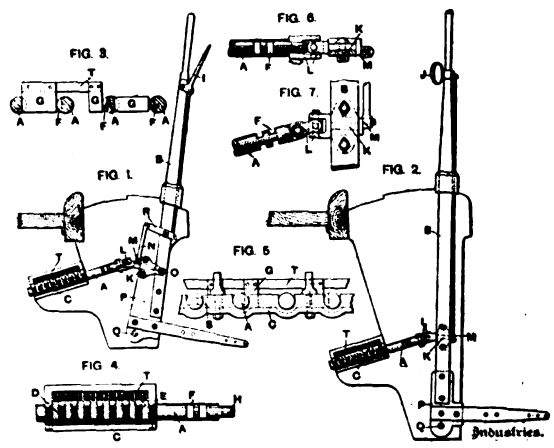
Grab Dredger Buckets.—*E. Y. Harrison, New South Wales.*—The dredger here described is constructed with two jaws, which are hinged to a common bolt. The hauling chain, which also serves the purpose of closing the jaws, is attached to the inside of one of the jaws and is passed round a pulley attached to the inside of the opposite jaw, and from that to a central pulley mounted upon the common hinge bolt. Thus, by hauling upon the chain, the jaws will be closed. The chain for opening the jaws is connected by two branch chains to the outside of each jaw, so that if the weight of the dredger is thrown upon the opening chain it draws the jaws back upon the common bolt and opens them. If the jaws of the dredger consist of prongs, the opening chain is attached by its branch chains to two plates of metal, from which other chains pass and are connected to each prong. Four claims are made for the dredger described and the modified means of opening pronged-jawed dredger buckets.—No. 11220. July 12th, 1889. 8*d*.

Fire Extinguishing Apparatus.—*J. R. Gray, Ayer, Middlesex, U.S.A.*—This is an improved fire extinguisher of the class called "sprinklers." The illustration gives a longitudinal section of the sprinkler. The casing A is adapted to be connected to the supply pipes. The casing is provided with a mouth E for the discharge of water when in operation, and a chamber D for the reception of the piston B of the valve C. The chamber D communicates above the piston B with the interior of the casing A.



In the top of the chamber D is fixed a pipe with a fusible plug. Water supplied to the casing A by the pipes exerts pressure upon each side of the piston B and upon the upper surface of the valve C, thus keeping the valve firmly upon its seat. When sufficient heat occurs to melt the fusible plug, the water escapes from the top of the piston B faster than the vent supplies it; thus the entire pressure upon the under surface of the piston is effective, and being greater than that upon the top of the valve C causes the valve to rise and the appliance to come into action. Five claims are made for the extinguisher described.—No. 12428. August 6th, 1889. 8*d*.

Interlocking Apparatus for Railways.—*W. F. Burleigh, London.*—Improvements are here described in the method of locking by the catch handle. They consist of a form of locking shaft which is attached to the lever in such a manner that to release the lever the shaft is given a partial turn on its axis by the catch handle, whilst the lever is pulled forward. By giving the shaft a partial turn the locking keys are shifted, and made to lock other levers. The illustrations show Fig. 1 a side elevation of the appliance with the locking trough in section; Fig. 2 shows a modified form of the catch lever and its connections; Fig. 3 shows the manner of applying the locking keys; Figs. 4 and 5 are portions of the locking trough; and Figs. 6 and 7 details of the appliance. Referring to the figures, A is the locking shaft, which is given a quarter turn about its axis by the catch handle I. The shaft A is connected to the lever B by a knuckle-joint O. In the shaft A are cut grooves F to receive the locking keys G, which are mounted by the slides T in the locking troughs C. To move the lever backwards or forwards, the shaft A is turned a quarter turn by pressing or otherwise working the catch handle I. By turning the shaft A the keys G are moved out of the slots



F, and rest against the fall part of the shaft A, and permits it to be withdrawn in moving the lever B forward. The locking keys, as they are shifted by one shaft, are made to lock others as shown in Fig. 3. Claims: (1) A shaft attached to the lever and arranged so as to be turned by the catch handle and moved by the lever; (2) the use of the universal or gimbal joint, herein figured L, for the purpose of turning by the catch handle a shaft or its equivalent attached to and moved by the lever; (3) arrangement of connecting slides in locking trough substantially as shown on Fig. 4; (4) apparatus arranged and combined substantially as described and illustrated on the accompanying drawings.—No. 1653. January 30th, 1889. 8*d*.

Steam Boilers.—*R. Tatham, Rochdale.*—The invention consists of an appliance for ensuring the proper circulation of the water, and to facilitate the removal of dirt, sediment, &c., from the boiler. To effect these objects the inventor arranges inside the boiler a number of brushes, which may be spiral, and mounted upon a shaft, flat and mounted upon endless bands, or any other suitable form. These brushes are made to revolve,

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oscillate, or work, so as to sweep the tubes and sides of the boiler and remove the sediment towards the mud-hole. The brushes are connected through stuffing boxes to operating mechanism outside the boiler. The brushes may be mounted upon the edges of a helical blade, so that the motion of the blade upon its axis causes the water to circulate in the boiler. Ten claims are made.—No. 1744. January 31st, 1889. 8*d*.

Pulley Blocks.—*T. Deer, Birkenhead.*—The block is constructed to permit the rope to travel in any direction without increasing the friction on the block. The block consists of a suitable framing, in which are mounted a number of small grooved wheels, whose axis are in the same plane and at right angles to radii drawn from a common centre. The rollers are arranged around this common centre equi-distant from each other, and so that the edges of their grooved faces just touch each other, and form a continuous and circular bearing face for the rope. The rope when drawn through this hole must bear upon one or more of the pulleys, which exert little resistance to its motion. The top half of the frame with a number of the top pulleys can be lifted upon a hinged joint, to insert a long length of rope and other purposes. Claims: (1) A bearing or pulley device for running gear, in which a series of pulleys, arranged radially round a common axis and capable of rotation in planes approximately radial to said axis, have the inner portion of their peripheries so located as to form a continuous movable bearing surface round the axis; (2) an improved bearing or pulley device for running gear consisting of a series of pulleys arranged radially as described about a common axis, a suitable frame or bracket supporting said pulleys and having a portion, containing one or more of the pulleys, capable of being moved aside or detached from the rest, and means for securing such movable or detachable portion into position; (3) the improved bearing bracket for running gear constructed as a whole as herein described and for the purpose specified.—No. 3343. February 25th, 1889. 6*d*.

Lifting Jacks.—*A. Jackson, Rockford, Essex.* (*C. Jackson, Carrollton, Illinois, U.S.A.*).—The lifting jack here described is for the purpose of lifting and holding in a raised position the parts of carriages and other light bodies. Fig. 1 shows a vertical section of the jack; Fig. 2 a side elevation. The rod B is free to rise and fall in the socket A. The cross-bar G of the rod B is placed under the part to be lifted, and the hand lever E raised, causing the ring D to assume a position lower down the rod B.

Fig. 1.

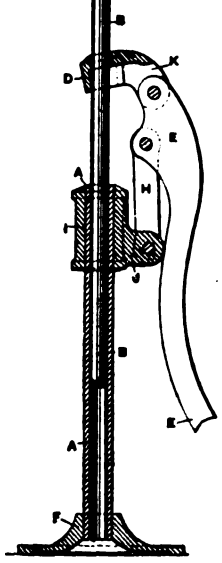
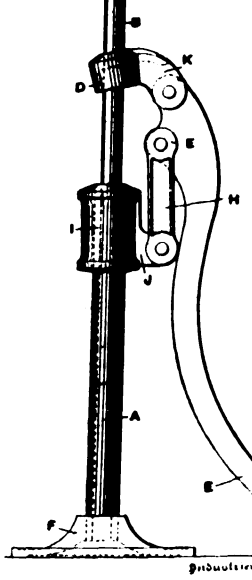


Fig. 2.



When the lever E is depressed, the ring D is tilted and grips the rod B, and a further depression of E lifts it and the load upon G. To keep the rod B in its raised position, a flat ring (not shown) of rectangular section, and having upon its under surface a projection which rests upon the bush I, is tilted by the projection and grips the rod in the same manner as the ring D. Three claims are made.—No. 7190. April 30th, 1889. 8*d*.

Slide Valves.—*J. Marshall, Gainsborough.*—The object of this invention is to provide a slide valve for steam which shall work with a minimum amount of friction and which offers a means of compensating for wear. The valve is made with its working and opposite faces parallel and with its ends at right angles. The two opposite sides of the valve are inclined inwardly from the working face towards the top or opposite face, leaving, however, a flat face at top. The ends of the valve are recessed or made hollow and a passage is made through the centre of the valve extending from the working face to the top. The valve slides in a cover bolted down to the port face of the chest and corresponding in internal shape with the external shape of the valve. In the cover channels are formed corresponding to the inlet and exhaust ports in the port face so that as the valve in its travel uncovers the ports the motive fluid enters these channels and equilibrates the pressure, the exhaust passing through the central passage in the valve to the exhaust outlet. The outside depth of these channels corresponds with the depth of the ports on the cylinder face, and the valve is made considerably narrower, so that these channels act also as supplementary motive fluid passages. In order to relieve the cylinder from excessive pressure and water of condensation the cover is provided with passages situated over the inlet ports in the cylinder. These passages are provided with valves which open to allow of the relief of excessive pressure and the escape of water of condensation. There is one claim.—No. 698. January 14th, 1889. 6*d*.

Gas Engines.—*D. B. Peebles, Edinburgh.*—In this improved gas engine the piston rod is dispensed with, and the connecting rod connected direct to a double-acting piston and plunger. In the accompanying illustrations Fig. 1 is a plan, Fig. 2 a sectional elevation of the engine. Figs. 3 and 4 are sections upon the end of a cylinder, showing the valves; Figs. 5, 6, and 7 sections upon details. A is the double-acting piston working in the cylinders B C. I are the valves controlling the admission of the working fluids to the cylinder, the valves being worked by the levers K, which are actuated by cams L upon the shaft M. The shaft M is revolved by a chain N geared to pulleys upon the crank shaft and shaft M. Referring to Fig. 3, it will be seen that three valves are shown; the valve I is for the exhaust, H for admittance of air, J for admitting the explosive mixture of gas and air. The valve J works in conjunction with the gas valve Q, Fig. 4. The gas is supplied by the pipe P, and is admitted by

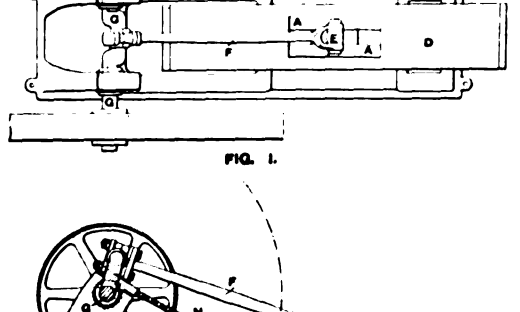


Fig. 1.

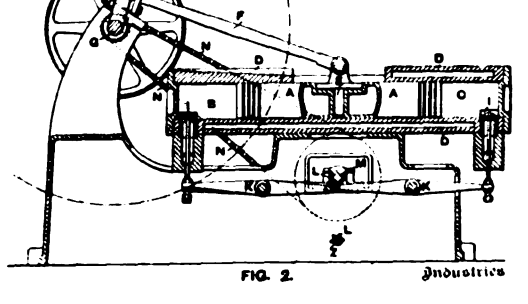


Fig. 2. Industries

the valve Q to the annular space R. The annular space R communicates with the top of the inner chamber T, to which air is admitted from the inlet U. The gas and air are thus mixed, and admitted by the valve J to the cylinder. Another form of valve to replace J is shown in Fig. 6. The gas is there admitted to the annular space W and mixes with the air passing up the space V. Fig. 7 shows a form of valve which may be used to regulate the supply of gas in combination with an ordinary rotary governor. The governor is connected by the lever A^1 to the rod E^1 of the valve F^1. Gas is admitted to the valve by the tube H^1, passing through the valve to the pipe J^1, and from there to the engine. The valve F^1 is constructed with tapering feathers, so that as it is raised more gas is allowed to pass. A gas-tight water joint is constructed by an inverted bell-shaped piece B^1 and tube C^1 in such manner as to cause no resistance to the free action of the

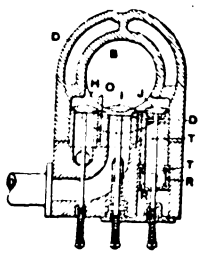


Fig. 3.

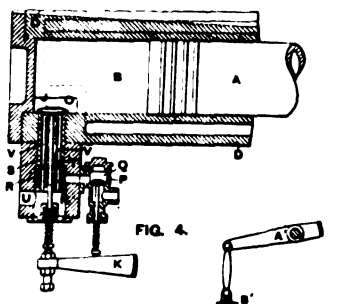


Fig. 4.



Fig. 5.

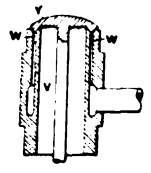


Fig. 6.

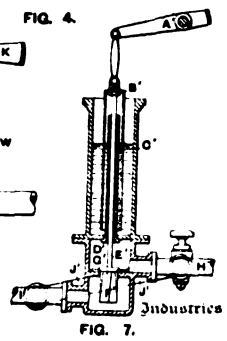


Fig. 7. Industries

governor and valve. The cycle of the engine in each cylinder is as follows:—1, outstroke taking in gas and air; 2, instroke compressing; 3, outstroke exploding; 4, instroke expelling products; 5, outstroke drawing in air to clear cylinder; and 6, instroke expelling clearing air. Claims:—(1) The improved combination of parts forming a double-acting gas motor, with the cycle of operations at each end or cylinder extending over three revolutions of the crank shaft, during one of which revolutions following one during which a charge has been ignited, and the larger part of the used gases expelled, pure or unmixed air is drawn in and expelled preparatorily to the drawing in and compressing of the next explosive charge; (2) in a double-acting gas motor placing the crank shaft in a plane above or out of the plane passing through the axis of the cylinders and connecting the crank to a stud projecting from the plunger or piston piece; (3) the improved combination of parts comprising the valves and the parts or gearing by which they are moved as described; (4) the improved combined air and gas inlet valve apparatus shown in Figs. 3, 4, and 5; (5) the improved combined gas and air inlet valve shown in Fig. 6; (6) the regulating of the supply of gas to a gas motor by means of a rotating governor combined with the valve apparatus shown in Fig 7.—No. 1957. February 4th, 1889. 8*d*.

Recovering Sunken Vessels.—*G. Barnett, Sunderland.*—The inventor employs a number of flexible water and air tight bags, which in their normal or closed condition occupy very little space. These bags in their closed condition are inserted by divers into the various parts of the sunken vessels, or attached to some part of the same, and then inflated by air pumped into them by air-pumps situated upon the vessel from which the operations are being conducted. The volume of air held within the vessel in this manner may be made sufficiently large to raise the vessel to the surface of the water. When the vessel has been raised, the inventor makes use of dished plates of metal, whose edges are covered with india-rubber or some such material, for making a joint with the side of the vessel when the plate is bolted to the vessel to cover the hole or damaged part which has caused the vessel to sink. Claims: (1) In raising sunken vessels and the like, flexible water and air proof bags, in combination with conduit pipes and air or gas compressing apparatus, arranged and operating as described; (2) for temporarily repairing holes or fissures in ships' hull plates, semi-spherical or semi-ovoidal repairing pieces, in combination with bolts, the whole being arranged and secured over the holes or fissures so as to form a water-tight joint round it as and for the purpose described.—No. 19,300. December 2nd, 1889. 6*d*.

Wire Twisting Machine.—*J. Atherton, Liverpool.*—This machine is for rapidly twisting a pair of electrical conductors that have been covered with insulating material. The method pursued is to wind one wire spirally around the other, and to afterwards pass the two over stretching drums to equalise them in length and twist. The illustrations show Fig. 1 an end elevation of the apparatus, Fig. 4 a side elevation, and Figs. 2 and 3 details. In the standards B and C is supported by

Fig. 3.

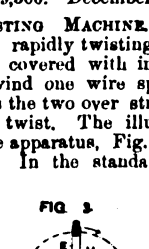


Fig. 2.

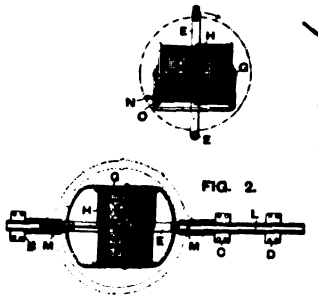
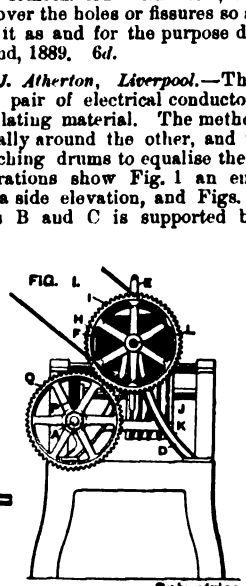


Fig. 1.



Industries.

its trunnions the frame, or flyer E. In the frame E is supported a racking yoke G by pivots entering the hollow trunnions. An uninterrupted passage is made through the spindle L, the frame E, and its trunnions, to permit one length of wire to be passed through from a bobbin (not shown). Communication is also made between the pivot M of the racking yoke and the trunnion L of the frame E, to allow the wire from the bobbin H to be passed through. The wires are twisted by first drawing them through their respective passages and winding them round the stretching drums J K. The frame E is then revolved by the belt pulley F, and the wire in the frame spirally twisted round the wire from the bobbin H. At the same time the

Fig. 5.

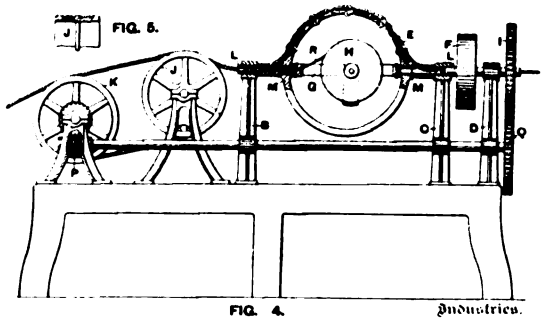
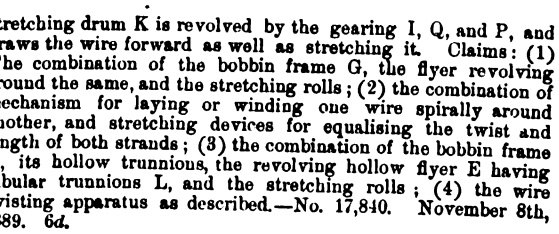


Fig. 4.



Industries.

stretching drum K is revolved by the gearing I, Q, and P, and draws the wire forward as well as stretching it. Claims: (1) The combination of the bobbin frame G, the flyer revolving around the same, and the stretching rolls; (2) the combination of mechanism for laying or winding one wire spirally around another, and stretching devices for equalising the twist and length of both strands; (3) the combination of the bobbin frame G, its hollow trunnions, the revolving hollow flyer E having tubular trunnions L, and the stretching rolls; (4) the wire twisting apparatus as described.—No. 17,840. November 8th, 1889. 6*d*.

Steam Boilers.—*H. M'Coll, Sydenham, Ireland.*—The application of this invention to boilers is to prevent the injurious action due to differences and changes of temperature occurring when water is fed into such boilers in a cold or comparatively cold condition. A feed-water heater, to remove these defects, is constructed according to this invention as follows:—A number of cylindrical shells, of graduated sizes, with end plates or castings, are combined to form a series of annular cylindrical spaces. The number of shells or space may vary, but five is preferably employed. By a connection with the feed pipe at the outer end of the heater the water first enters the central or first space, and on reaching the inner end proceeds through passages in the inner end casting into the third space. The water returns towards the outer end of the third space, and then proceeds by passages in the outer end casting into the fifth or outermost space, going through it to the inner end casting by a passage in which it reaches a delivery pipe. The second and fourth annular cylindrical spaces are open at their ends, and as the apparatus is placed in the steam space of the boiler the

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steam has free access to the said second and fourth spaces, and to the outside of the fifth space. The delivery pipe dips a short distance below the surface of the water in the boiler. Claim: The improved construction of feed heater for steam boilers, in which a number of cylindrical shells or tubes of graduated sizes are arranged concentrically, and combined with end castings, formed with passages to lead the water through some of the spaces, and to give the steam access to other spaces as and for the purpose described.—No. 2,810. February 18th, 1889. 6*d.*

PETROLEUM ENGINES.—*A. E. Tavernier & L. B. Schlesinger, London.*—The petroleum used is first vapourised in a jacket surrounding the cylinder, for the purposes of depositing impurities before entering the cylinder and to cool the cylinder itself without the employment of water as is usual. Referring to the illustrations, Fig. 1 is a vertical section of the engine or motor; Fig. 2, a plan of the same; Fig. 3, a section upon one end of the cylinder

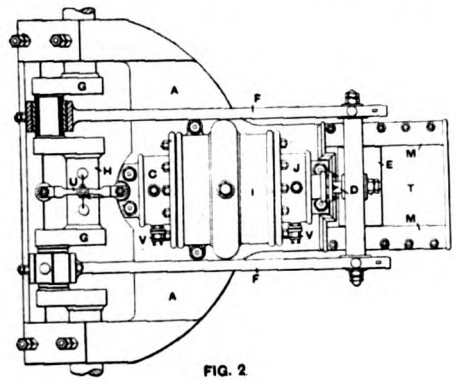


FIG. 2

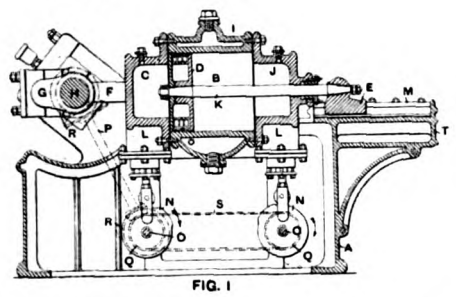


FIG. 1

through the valves; and Figs. 4 to 7, details of the engine. The engine is constructed with a cylinder B having explosive chambers or recesses C J. Its piston D is connected to a crosshead E sliding in the guides M. To the crosshead E are connected the connecting rods F, which are coupled to the cranks G G of the crank shaft H. The valves enclosed in the chambers L are worked by cam discs N, geared to each other by a chain S and to the crank shaft by bevelled gear wheels R and shaft P. The petroleum is pumped by a suitable pump (not shown) to the jacket I surrounding the cylinder. As the petroleum is vapourised, it is conducted to the valve chambers, and admitted to the ends of the cylinder by the valves. Any excess of petroleum vapourised

FIG. 3.

FIG. 4.

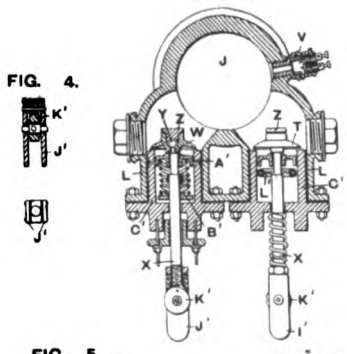


FIG. 5.

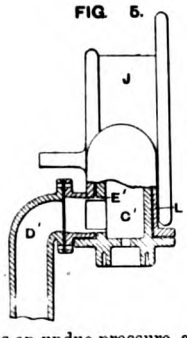


FIG. 6.

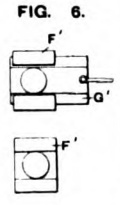
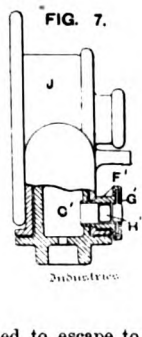


FIG. 7.



causes an undue pressure, and is permitted to escape to a condensing arrangement, and ultimately returned to the supply reservoir. Referring to Fig. 4, T is the valve for admitting the explosive mixture of petroleum vapour and air, and W the valve for exhausting the products of the explosion from the cylinder. The air is admitted to the valve chamber cylinder M by a sliding valve G^1 (see Figs. 6 and 7). The petroleum vapour is admitted to the valve cylinder M by a circular perforated ring L^1 to mix it well with the air. A governor is used to regulate the supply of vapour to the cylinder. The operation of the motor is as follows:—The fly wheel is revolved by hand to operate the feed pump and supply petroleum to the jacket. The first few explosions are caused by admitting a light hydrocarbon to the cylinder from a reservoir situated in the base of the engine. When sufficient explosions have been made to vapourise the petroleum, the petroleum vapour is used, and the connection to the light hydrocarbon reservoir closed. Gas is drawn into the cylinder in the outstroke, compressed in the instroke, and fired. The operation is the same at each end of the cylinder. The mixtures are exploded by electric sparks passing between the points in the case V. Claims: (1) In an engine or motor operated by petroleum or other hydrocarbon vapours a jacket surrounding the power cylinder for containing the petroleum or other hydrocarbon and enabling their vapours to be produced by means of the heat generated by the explosions in the said cylinder; (2) in an engine or motor operated by petroleum or other hydrocarbon vapours the combination with a jacket, such as that described in the preceding claiming clause, of means for preventing the overheating of the power cylinder, such means comprising a valve and condenser, the said valve being adapted to be opened automatically when the pressure of the petroleum or other hydrocarbon vapour rises above a certain degree, to allow a portion of the said vapour to escape, and the condenser serving to condense the said escaped portion of the vapour; (3) the improved engine or motor, substantially as described and illustrated.—No. 1603. January 29th, 1889. 8*d.*

GRINDING MILLS.—*H. Birkbeck, London. (J. Jones & A. J. Jones, Thorold, Canada).*—This invention refers to mills used in grinding wheat, &c. The mill consists essentially of a longitudinally grooved roller held stationary between two revolving rollers. One of the two revolving rollers has longitudinal ratchet-shaped furrows cut round its periphery, whilst the other is grooved similarly to the stationary and central roller. Under the ratchet-shaped furrowed roller is a stationary grooved plate provided to grind any large pieces escaping the first action. In operation, the grain is first admitted between the stationary roller and the ratchet-shaped furrowed one. After passing between these rollers it falls on to a perforated plate, which leads the coarser part of the grain to the surface of the grooved plate, whilst the finest parts in the shape of flour fall through the perforations. The coarser parts, after passing between the grooved surface plate and the ratchet-shaped furrowed roll, fall on to a second perforated plate, and the finer parts are separated from the bran and conveyed to the rest of the flour. The bran is lastly passed between the third roller and the stationary one. Claims: (1) In a grinding mill, a revolving roller having longitudinal ratchet-shaped furrows cut around its surface, for the purpose described; (2) in a grinding mill, a revolving roller having longitudinal ratchet-shaped furrows cut around its surface, in combination with a grooved or corrugated roller for the purpose described; (3) in a grinding mill, a revolving roller having longitudinal ratchet-shaped furrows cut round its surface in combination with a grooved or corrugated roller, and a stationary grooved or corrugated plate, for the purpose described; (4) in a grinding mill, a revolving roller having longitudinal ratchet-shaped furrows cut around its surface, in combination with a grooved or corrugated roller, a stationary grooved or corrugated plate, and a perforated skirt or plate, for the purpose described; (5) in a grinding mill, a revolving roller having longitudinal ratchet-shaped furrows cut around its surface, in combination with a grooved or corrugated roller, a stationary grooved or corrugated plate, a perforated skirt, or plate, and a second perforated plate with spout for the purpose described; (6) in a grinding mill, a stationary grooved or corrugated roller, in combination with a revolving roller having longitudinal ratchet-shaped furrows cut in its surface, and the revolving roller having longitudinal grooves or corrugations formed on its surface for the purpose described.—No. 18816. November 23rd, 1889.

ELECTRICITY.

REGULATOR.—*Siemens Brothers & Co., Limited, London. (A. M. Taylor, Baroda, India).*—One of the leads for the secondary current from the transformer, instead of going directly to the lamps or other objects which it works, passes on its way through the coils of a solenoid, the core of which is one of the limbs of a horseshoe or U-shaped piece of soft iron. The other limb is also the core of another solenoid, having a greater number of convolutions than the former. The latter solenoid is in a shunt circuit connecting the leads for the secondary current at points before and after it passes through the lamps or other objects worked by the current. The two limbs constituting the cores above mentioned, and their U-connection, are suspended by an adjustable spring, and are free to move up or down within the two solenoids, presenting their ends towards a stationary bar of iron. The regulator operates in the following manner:—When the expenditure of electricity is lessened, as for instance by extinguishing a number of lamps, more of the secondary current passes through the shunt coil, exciting its core magnetically, so that the cores are attracted towards the stationary iron bar and move towards it in opposition to the spring. This approach of the other core induces in its coil, which is in the main secondary circuit, a back electromotive force, reducing that of the current proceeding to the lamps. Claim: A regulator for transformed electric currents, consisting of a two-limbed solenoid, made in horseshoe form and suspended by an adjustable spring, with the ends of its cores presented towards a stationary armature, the one core having its coil in the main secondary circuit and the other core having its coil of a greater number of convolutions in a long shunt from the secondary circuit, as described.—No. 4192. March 9th, 1889. 6*d.*

INCANDESCENT ELECTRIC LAMPS.—*R. A. Sloan, Liverpool. (G. W. Wilson, Boston, U.S.A., & C. H. Brown, Newton Highlands, U.S.A.)*—This invention is an improvement in incandescent lamps, and its object is to provide a reflecting surface between the limbs of the filament to break up and distribute the light in the most effective manner, and at the same time to prevent short-circuiting or bombardment between the filament limbs, so destructive to the material of the filament. The reflector is made of a transparent non-conducting material such as glass, and is made hollow, whereby the rays of light are not only reflected from the convex surface of the reflector, but are also reflected from the concave interior surface. The reflector may be coloured to give the reflected light a distinctive character, and the hollow of the reflector might be filled with crystals such as iodine of lead. *Claims:* (1) *In combination* with an incandescent electric lamp a non-conducting transparent or coloured reflector in tubular form interposed between the limbs of the filament; (2) in combination with an incandescent electric lamp a non-conducting tubular reflector having a filling of crystals as described.—No. 18004. November 12th, 1889. 6*d.*

ELECTRIC BELL.—*F. H. Berry, London.*—A single magnetic coi is supported by a frame upon a base with its axis parallel to the surface of the base. Parallel to the axis of the coil and upon one side of it is a hammer with an adjustable spring contact working in the manner usual in electric bells. The whole is covered by the bell or gong, which is supported at its centre by the framing supporting the magnetic coil and hammer. The hammer is made to either strike against the inner surface of the bell or against a projection proceeding from it. Four claims are made.—No. 3580. February 28th, 1889. 6*d.*

CHEMISTRY.

COLOURING MATTERS.—*B. Willcox, London. (Farbenfabriken v. F. Bayer & Co., Elberfeld).*—The inventors have discovered that nigrosine, aniline black and saffranine can be converted into dyestuffs which are soluble in water by melting them together with para-phenylene-diamine. By means of this process dyestuffs are obtained which are readily soluble in water. About one part of nigrosine is heated to from about 170° to 190° C., with two parts of para-phenylene-diamine until the melt dissolves readily and completely with a clear colour in dilute hydrochloric acid. After cooling, the melt is dissolved in dilute hydrochloric acid and the dyestuff is salted out from the filtrate. The proportions may be varied and only slight differences in the colour result. Dyestuffs dyeing a deep blue-black are obtained by substituting aniline black or saffranine for the nigrosine in this example. When azo-benzene is melted with para-phenylene-diamine in the presence of a certain quantity of ammonium chloride at a temperature of from about 220° to 240° C., a dyestuff soluble in water is obtained which possesses very strong dyeing powers. Claims: (1) The process for the manufacture of indulines soluble in water by melting together the dyestuffs known in commerce under the names of nigrosines, aniline black and saffranine, and the azo compounds—viz., azo-benzene, azotoluene, benzeneazotoluene, azooxybenzene, azocxytoluene, hydrazobenzene, or hydrazotoluene, or mixtures of them with meta or para-phenylenediamine, or toluylenediamine in the presence of ammonium chloride at a temperature of 100° to 250° centigrade; (2) the process for the manufacture of indulines soluble in water (which is an oxidising process) by melting together meta or para-phenylene-diamine with weak oxidising agents—viz., quinone, chloranil, dichlor-naphtho, quinone-naphtho-quinone, or chlorimide, with or without the presence of benzoic or oxalic acid, and of a condensing agent such as chloride of zinc and chloride of calcium at a temperature of 100° to 200° centigrade; (3) the process for the manufacture of indulines soluble in water by melting together nitro-aniline (nitraniline), nitro-toluidine, or mixtures of them with hydrochloric acid salts of primary amines—viz, aniline, toluidine, xylidine or secondary and tertiary amines—viz., monomethyl-, ethyl-, benzyl-anilines; dimethyl-, diethyl-, methylbenzyl, ethyl benzyl anilines, or mixtures of them with or without the employment of some chloride of iron, benzoic acid, oxalic acid, or ammonium chloride, or both, and a condensing agent—viz., chloride of zinc or chloride of calcium, at a temperature of 100° to 250° centigrade; (4) as new articles of manufacture the products claimed in each of the foregoing claims.—No. 3529. February 27th, 1889. 6*d.*

WASHING ORES.—*G. C. Dymond, Liverpool. (O. Bilharz, Freiberg, Germany).*—In the ordinary annular ore sieving machines considerable time is lost in the frequent raising and lowering of the circular sieve plate upon which the ore is placed. To obviate this loss of time, the sieve plate is suspended from cross-bars resting upon the upper edges of the sieve box. The sieve plate is suspended from these bars by bolts fastened to bars beneath the sieve. The tops of the bolts pass through the cross-bars and are held in any desired position by thumb-screws upon their screwed part. Claim: In circular apparatus for washing, sieving, or separating ores, the application of cross-pieces connected by bolts to bars below the jigger sieve, whereby the sieve may be raised or lowered at any moment without interrupting the course of the machine as described.—No. 65. January 2nd, 1889. 6*d.*

PARA-AMIDO-PHENOL ETHERS.—*B. Wilcox, London. (Farbenfabriken v. F. Bayer & Co., Elberfeld).*—The manufacture of para-amido-phenol ethers is attended with considerable difficulty in practice, this being especially the case in the manufacture of the ethyl ether or the monacetyl combination of para-phenetidine. The nitriting of the phenol proceeds in such a manner that only about 50 per cent. of the para combination is obtained. The inventors have discovered that by conducting the process as afterwards described, phenol can be smoothly and quantitatively converted into the para-amido-phenol ether, without the formation of any bye-products. Para-amido-phenol ether or phenetidine is converted in an acid solution with sodium nitrite into its diazo compound, and the latter is caused to react on phenol in the usual manner. The resulting yellow dyestuff is converted into the para-amido-azo-phenol ether with alkyl halogens and splits up into two molecules of para-phenetidine by the reduction of this azo substance. Claims: Manufacturing para-amido-phenol-methyl or ethyl or amyl ethers by decomposing para-phenol methyl ether—azo-phenol methyl ether, or para-phenol ethyl ether—azo-phenol-ethyl ether or para-phenol-amyl ether—azo-phenol-amyl ether into two molecules of para-amido-phenol methyl or ethyl or amyl ethers by reduction substantially as described.—No. 1771. January 31st, 1889. 6*d.*

Copies of the British specifications may be obtained on application to H. READER LACK, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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POWER PUSHER FOR BRICK-MAKING MACHINES.

Messrs. Bennett & Sayer, engineers, Derby, have recently brought out an improved power pusher to be attached to their brick-cutting table. The power which is required is comparatively small, and the work is done much more steadily and cleanly than by hand. It can be fitted with the greatest ease to an ordinary hand table, and the cost of labour is thus reduced. A large number of these pushers are already in use, and we understand that they are giving satisfaction.

THE RECENT GROWTH OF TECHNICAL SOCIETIES.

I.

It is necessary, in times of progress like the present, to specialise alike in academic studies and in actual practice. The days have gone by when any one society could take up all branches of study claiming to have a scientific character. The Royal Society, the British Association, and the Institution of Civil Engineers were, within the memory of men still active, deemed to be almost sufficient to cover the whole field—the first-named society taking up pure science, the second pure and applied together, and the third applied science alone. These were aided and abetted, sometimes on the one side and sometimes on the other, by the Royal Institution, which was founded in 1799, "to teach the application of science to the useful purposes of life," and sometimes by the Society of Arts, which was founded in 1754, "for the encouragement of arts, manufactures, and commerce," and which has for many years been an *omnium gatherum* for all sorts of papers and discussions that were not sufficiently special to claim consideration elsewhere. These societies, although still retaining the lead which their earlier establishment enabled them to acquire, have been supplemented by an enormous number of scientific or philosophical bodies of a more or less special or local character. Every science has now its society. Every important science has a "local habitation and a name," not in the metropolis alone, but in each of the leading towns throughout the country. Literary and philosophical institutes, naturalist societies, natural science societies, archæological societies, polytechnic societies, field clubs, and similar bodies exist on every hand. And just as a man's social station receives a sort of stamp from the club, or clubs, of which he is a member, so a man is now-a-days known by the scientific bodies to which he belongs. Many men of science belong to so numerous an array of societies that their annual subscriptions amount to a good round sum, and have become a really onerous charge upon limited incomes. There are, however, certain societies that must be cultivated *nolens volens*. No man who wished to be regarded as a distinguished scientific authority could afford to remain outside the Royal Society, the fellowship of which is the blue riband of science, and is increasingly difficult to obtain. No civil engineer who desired to take high rank in his profession could well afford, unless, indeed, he had already made his name and his "pile," to be a stranger to the Institution of Civil Engineers. Mechanical engineers, naval architects, surveyors, electricians, chemists, iron and steel manufacturers, actuaries and others, find it necessary to join the societies established for their special interests, if they are to be in their own little world, and conversant with its affairs. The "Proceedings" or "transactions" of these several societies are annual text-books of the greatest possible value to the specialist. Their value, indeed, can only be adequately appreciated by those who are old enough to remember when no such professional *vade-mecum* was accessible, and when the engineer, the architect, or any other specialist had generally to evolve his plans by a slow and laborious process from costly experience or an internal consciousness that could not always be depended upon. The extent of the publication of the "Proceedings" of such societies is now quite portentous. Every year the learned societies of the United Kingdom shed abroad a mass of printed matter that would appal anyone who might be called upon to inquire into its extent and character. Some societies, indeed, produce several volumes annually, such as the Institution of Civil Engineers and the Chemical Society. Others, like the Society of Arts, have sufficient pabulum to run a weekly or a monthly "Journal." Others, again, publish quarterly, while still others issue half-yearly or annual volumes. But the tendency is to greatly increase this enormous mass of printed matter, and if the same rate of growth is maintained that we have witnessed during the last twenty years, we may almost literally fulfil the Scriptural hypothesis that "the world itself could not contain the books that shall be written."

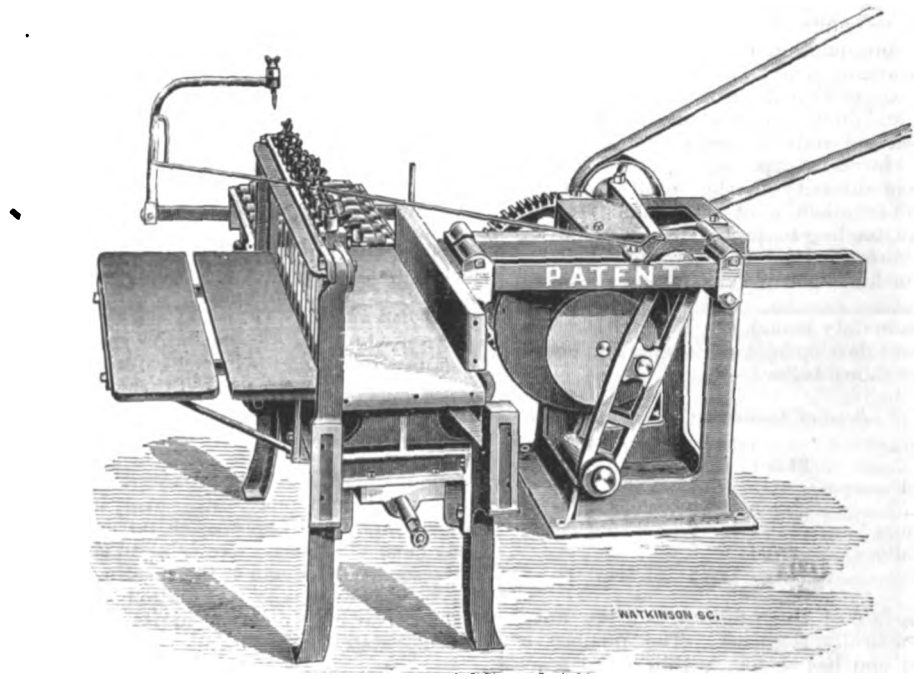
There is, as might naturally be expected, a considerable amount of competition among the various scientific societies, both for members and for papers, if they are of the right sort. This, of course, does not apply to the Royal Society, which has its number fixed by statute, and which has always more candidates and papers than it can deal with. But it is more or less true of all the others. There are many cases in which the membership and the special character of one society will overlap with another, or perhaps several others. In such cases the course that appears to commend itself, as a rule, is to join each of the competing societies. Thus, for example, the Chemical Society and the Society of Chemical Industry have largely kindred aims and common grounds, and the same membership. So with the Institutions of Civil Engineers, Mechanical Engineers, and Naval Architects, and, though perhaps to a less extent, the Iron and Steel Institute. So also with the various Institutes of Mining Engineers and the Institution of Mechanical Engineers. It often happens, accordingly, that papers are read before one society that appear on the face of them to be better adapted for, and more special to, the "Proceedings" of another. As an example, all appears to be fish that comes to the net of the Institution of Civil Engineers—which claims to represent every branch of applied science, although perhaps with doubtful propriety—of the British Association, and of the Society of Arts. The scope and range of these bodies give them the means and the opportunity to command a greater variety in their "Proceedings" than would be proper in, say, a society of electricians or a mining institute. This creates a wholesome rivalry, which is not without real gain to the institutions themselves and to the cause of science generally. So, again, with the information supplied by the various societies at home as to the "proceedings" of kindred and cognate learned societies abroad. Some of the principal scientific bodies have made a special feature in their "Proceedings" of presenting "Abstracts," which usually contain the pith of papers read before foreign bodies, or published in foreign periodicals. This work is now thoroughly well done for the sciences of chemistry, metallurgy, and civil engineering, as well as, though perhaps to a more limited extent, for mining and electricity. The learned societies have in this respect taken up, and discharged with much greater efficiency, the work that was formerly done to a greater or less extent by the old-fashioned book clubs.

In spite, however, of the conspicuous importance which has been attained alike in science and in society, by the so-called learned societies, their affairs are seldom obtruded upon public notice, except through their work. The public has hardly stopped to realise that these bodies have become a great influence in the land—great for the diffusion of arts, of manufactures, of material power, and of general intelligence. This influence has been greatly accentuated during the last few years, which, however, is only another way of saying that the progress of applied and pure science during that period has been more remarkable than usual. As an example the Institution of Civil Engineers may be referred to. That society twenty years ago had a membership of only 2,234, whereas up to the 22nd ult. its membership was 4,726; the property of the Institution, exclusive of the valuable library, having within the same period increased from a few thousands to over a hundred thousand sterling. Formerly, scientific bodies had to lay their heads where they could, and commonly they found very cold quarters unless they happened to get under the sheltering wing of a beneficent patron. Now they have their local habitations in palatial mansions, the home of pure science being Burlington House, and the home of the Civil Engineers being little short of magnificent, while the Society of Arts, the Institution of Mechanical Engineers, the Surveyors' Institute, and other bodies have each premises worthy of their several exalted stations. One of the inevitable results that have attended the growth of scientific sociology within the realm has been the accumulation of considerable wealth by the leading bodies, and the hope of accumulations on the part of others. Although some societies still accept Government aid, such as the Royal Society and the Institution of Naval Architects, science, on the whole, is fairly self-supporting, and does not give the State much trouble.

It is not without interest to take some notice of the character of the investments that appear to be preferred by the administrators of our scientific societies. Railway securities are much more in vogue than any other. The Institution of Civil Engineers, for example, have invested in railways some £29,000. These are exclusively British lines. They have also gone in for "the sweet simplicity of Three per Cents.," now reduced by Mr. Goschen's conversion scheme to 2¾ per cent., to the extent of £6,000. These sums are irrespective of the trust funds placed at the disposal of the Institution for investment by Telford, Manby, Miller, and Howard, most of which have been invested in Consols. The Institution of Civil Engineers have, however, laid out the greater part of their surpluses in the acquisition of real estate, the freeholds of 24, 25, and 26, Great George Street, having been acquired by them, so that they are their own landlords. The value of this investment, which can hardly fail to improve, is returned at £40,000. The Institution of Mechanical Engineers has limited its investments to the debenture stock of British railways, and of the Aire and Calder Navigation, but they have besides, like the Institution of Civil Engineers, a substantial interest in the firm of Sir J. Whitworth & Company, acquired by bequest. The market value of the investments of the Institution of Civil Engineers at the end of March last was £98,042 13s. 10d.; while that of the estate of the Institution of Mechanical Engineers was £21,900, the two

POWER PUSHER FOR BRICK-MAKING MACHINES.

Constructed by Messrs. Bennett & Sayer, Engineers, Derby.



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societies having thus a total reserve of £119,942 13s. 10d. Compared with these two most of the other scientific societies are comparatively poor—first, because their membership is generally less; secondly, because their entrance fees and annual subscriptions are lower; and, thirdly, because their outlay is relatively higher. Civil engineering, as defined by the Council of the Institution, covers a very wide range, so that every branch of applied science, whether rightly or wrongly, is embraced within its pale, while mechanical engineering, if it has not quite so wide a scope, has, at any rate, affinities with every trade and industry that uses or requires mechanical aids.

There is a fair presumption that the affairs of our scientific societies are, in general, well administered—in the first place, because they have usually capable permanent officers; and in the next place, because those officers are assisted and controlled by a council of good social position and business experience. There is, however, a remarkable diversity in the results that are brought out by an examination of their annual reports and balance-sheets, tending to prove that each has its own way of administering its own affairs, and does not slavishly imitate or lean upon the example of its neighbours.

Taking, first, as in duty bound, the Royal Society, we find that the recent development of income and expenditure has been as shown below:—

Items of Income.

	1878.	1888.
Subscriptions	£1,001 0 0	£1,036 0 0
Entrance fees and compositions	250 0 0	318 0 0
Sale of "Proceedings"	871 12 7	594 6 5
Bequests and donations	2,700 0 0	—
Dividends, rents, &c.	2,796 18 8	3,466 17 3

It looks, on the face of these figures, as if the Royal Society were practically stagnant. The number of fellows is limited, and has seldom, within recent years, exceeded 525. It is evident also that the "Proceedings" are less sought after than they were, their sale having apparently been reduced by nearly £300 during the ten years. It is a question with many men of eminence whether this Society is quite entitled to the place it occupies as the foremost body of its kind in Anglo-Saxondom. It is certainly hardly liberal enough for the present age, following the devices of antiquity rather than advancing to meet the new developments of to-day, and excluding from its pale many men who would be an honour to any body. The Society has a library of 40,000 to 45,000 volumes, and it awards five medals, four annually and the fifth biennially, which have been competed for by the most illustrious men of science for generations.

It is difficult to discover exactly what is the value of the property owned by the Royal Society. They have real estates at Mablethorpe, Lincolnshire; at Acton, Middlesex; at Lewes, Sussex; and at Lambeth Hill. They have, under the Stevenson bequest, one fourth of an annual interest on £85,336 Government annuities and bank stock, they have over £20,000 in reduced 3 per cent. annuities, £15,000 on mortgage loan at 4 per cent., over £16,588 in consolidated bank annuities, £10,000 in Italian irrigation bonds, £6,000 in London and North-Western 4 per cent. debentures, and investments in British and Indian railways. In 1878 these several properties were worth well on to £100,000, and produced about £2,797 as ordinary, and a much larger amount as trust fund income. In 1888 the trust funds of the Society brought in an income of £16,147, including sales of stocks, of which £15,771 was expended, £7,990 being spent on scientific relief, grants, and investments, and £6,346 on donations, grants, &c. Under the Gassiot trust an annual payment of about £500 is made to the Kew Committee. At the end of 1888 the Society had a total income from ordinary investments and trust funds of £19,612, which would represent an investment of nearly £400,000 at 5 per cent. interest. A large part of this income was, however, realised from sales of stock, so that it is difficult to say what the net annual income really is.

The outlay of the Royal Society has been as under:—

Items of Expenditure.

	1878.	1888.
Salaries and wages	£1,146 3 0	£1,675 3 8
Printing and illustrations	2,144 1 0	2,593 10 8
Soirée expenses	77 19 6	109 1 4
General office expenses, &c.	392 15 3	861 6 2½
Purchase of land	228 0 0	—
Donation and law charges	6 15 10	96 14 8

The expenditure for the year 1888 includes an item of £79 for the installation of the electric light into the Society's rooms. The expenditure has, it will be seen, advanced to a larger extent than the income, but a society possessed of such wealth and occupying so high a pedestal may well be excused if it is independent of ordinary considerations of finance. This, at any rate, appears to be the view of its chief administrators, who have distinguished themselves by reducing the number of fellows from 798 in 1850 to 597 in 1870, and to about 500 at the present time.

The "Parliament of Science," as it has been termed, the British Association for the Advancement of Science, has made steady and consistent progress of late years. The income as between 1878 and 1888 has varied as shown in the following table:—

Items of Income.

	1887.	1888.
Subscriptions and compositions, including ladies' tickets	£2,760 0 0	£4,650 0 0
Sales of "Proceedings"	110 14 0	190 5 5
Dividends	249 13 9	295 8 2
Other items	42 15 1	78 10 6
Total	£3,163 4 10	£5,214 4 1

Some years ago, the question was seriously debated whether the functions of the British Association had not ceased. It was contended that, as every branch of science had now its own special society or institute, there was no need for a general scientific society, intended "to promote science and direct general attention to scientific matters," but it has been found that even if this function is not so important as it was, there is another expressed in the constitution—that of "faciliting intercourse among scientific men"—which is greatly appreciated. The annual meetings of the Association are the agreeable rendezvous of men representing every branch of scientific inquiry; and if it happens, as no doubt it does, that many members attach more value to the recreative than to the scientific aspects of the meetings, no one is hurt thereby. This pic-nic Association tends, however, to become increasingly lavish in its expenditure, as the following statement shows:—

Items of Expenditure.

	1878.	1888
Salaries	£495 0 0	£538 15 0
Rent	104 5 0	117 0 0
Printing	585 6 3	2,198 10 0
Meeting expenses	1,231 16 8	314 18 2
Grants	1,080 11 11	1 511 0 5

The accounts are not presented in quite the same form for these two years, so that an exact comparison of items is impossible. In 1878, for example, the item of expenditure on the Dublin meeting included printing, binding, &c., besides the Proceedings or Report; whereas for 1888 the printing is quite a distinct item. All that is possible is to group the two items of meetings and printing, when the totals come to £1,817 2s. 11d. for 1878 and to £2,513 8s. 2d. for 1888. It appears, however, that part of this difference is accounted for by the payment of accounts that should have been paid and included in the balance-sheet for 1887. The expenditure, like the income, varies greatly from year to year, according to the place and character of the meetings. The actual number of members on the books is stated to be about 4,000, but the income fluctuates between £1,300 and £3,200, according to the attendances.

The Society of Arts is one of the largest miscellaneous societies that does not cultivate any art or science in particular, although having done, and still doing, a useful work. Its income has been as follows:—

Items of Income.

	1878.	1888
Subscriptions	£6,537 6 0	£6,296 8 0
Sales of "Journal"	205 16 10	143 10 0
Advertisements	1,603 4 4	923 1 9
Dividends, rents, and interest	656 0 6	965 5

The Society of Arts has a special income from examination fees, which, in 1888, amounted to £311 13s. It has also smaller items of income from fees for the use of the meeting room, and from the sale of special reports, such as that of the Canal Conference held last year. It is not satisfactory to find that the income of this useful body has fallen off; and the fact is, perhaps, a sufficient proof that any body that wishes to prosper nowadays must be distinctly special, and must both enlist the sympathies of, and show itself particularly serviceable to, a particular art or craft. The expenditure of the Society of Arts has varied over the same period as follows:—

Items of Expenditure.

	1878.	1888.
Salaries, &c.	£1,672 2 1	£2,046 2 11
Rent, taxes, and repairs	1,114 9 7	743 16 6
"Journal"	2,558 15 2	2,247 7 8
Conversazione	218 7 10	407 5 6
Advertisements	832 19 8	438 18 4

The Society of Arts' accounts show that while in 1878 they received a gross income of £1,603 4s. 4d. from advertisements in the "Journal," the expenditure on advertisements, presumably in securing this income, seeing that ordinary advertising is provided for under the item of office expenses, and absorbed a further £44 13s. 6d., amounted to £832 19s. 8d. This is, of course, a very large item to be expended for such a purpose, and if it was not so expended the accounts are not so clear as they should be. Besides the items given above the Society has incurred a large expenditure for medals, lectures, and other purposes, and in 1888 they incurred an outlay of £683 in a competition for prime motors.

(*To be continued.*)

TRAINING FOR TRADES AND CRAFTS.

By Henry Dyer, C.E., M.A.

I.

The development of machinery has been the direct cause of the demand for improved technical, and for a change in general, education, about which we have heard so much during recent years. The immense number and variety of our manufactures have brought about a complete social and economic revolution, which has entirely altered the conditions under which trades and crafts are learned. In the old days, not only was the master himself a craftsman, but he took a personal interest in the education of his apprentices, who were often members of his own household, and the conditions of admission to the trades-guilds were such as to ensure that proper use had been made of the advantages they had had by all who wished to become members. Thus a high degree of manual skill was generally attained, and the secrets of the trades, which, of course, were simply the concentrated results of past experience, and what we now generally call "theory," were handed down from generation to generation.

All this was changed, however, with changing social conditions. The working master became a capitalist and a non-worker, who had neither the time, inclination, nor ability to instruct his apprentices, who were for the most part allowed to pick up their trade as best they could, while the division of labour made it impossible for them, unless in a few favoured cases, to have any experience except in a very limited part of the trade. On the other hand, the trades unions have confined their attention almost entirely to the question of wages, and have made no attempt to test the ability of their members either in the theory or practice of their work. The fact is, we have all, both employers and employed, trusted too much to our immense natural resources and our accumulated experience, while on the Continent, and even in a new country like America, the changed conditions of the times have been recognised, and attempts have been made to methodise the training which is necessary in the different departments of trade, and apprenticeship and trades schools have become common. The consequence is, that we do not now hold the pre-eminent position we did thirty years ago. It is not necessary to enter into either a description or criticism of these schools, as the opinion has been expressed by all concerned in this country—at least by all whose opinions are worth anything—that the manufactory or workshop must remain the place where the chief part of the practical training in trades and crafts is to be given. At the same time, it is admitted that the changed conditions of production render necessary a specialised training which cannot be wholly attained in the workshop.

To prevent misunderstanding, and to keep the discussion within reasonable limits, it will be convenient if we explain what we mean by the terms *apprenticeship* and *technical education*. Apprenticeship is the process of training which is undergone by anyone who wishes to learn the practice of any craft, art, trade, or profession. Technical education, on the other hand, is a term of more limited meaning, and implies a general training in the principles of applied science and instruction in the application of these to special trades or professions. Of course, if we took the term simply in its etymological sense, it would go further than this, and include the practice of the work, but, as already explained, in this country at least, the technical school is not intended to take the place of the workshop, but only to supplement its teaching. In the workshop the apprentice learns methods, and in the technical school the corresponding reasons, that is to say, in the former he is chiefly taught to imitate, whereas in the latter he is trained to think. It is too often assumed, however, that men are best taught to think by attendance at lectures, in which information is pumped on them by an eloquent enthusiast, or packed into them by a systematic "Dryasdust" from the resources of his own extensive reading, or, as is too often the case nowadays, from a well-crammed text-book, which has been written after a careful study of the

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idiosyncrasies of the examiner, on whose decisions the fates of the students and the teachers largely depend. Pumping and cramming are both useless in so far as education is concerned, and very often produce hatred and despair in the students, and inevitably lower the ideal of education.

In a well-organised technical school, therefore, the education is made real by giving the students an intellectual interest in their work. Lectures, drawing office, and laboratory work all lead to this end, and are treated as forming parts of the same class. In the lecture room principles are explained and illustrations given; in the drawing office results are delineated graphically; while in the laboratory experiments are made to confirm known principles or to ascertain new laws and properties of materials and machines. It must be distinctly understood that a laboratory is *not* a workshop. In a workshop the object is to attain manual dexterity, and the operations are repeated under the same conditions; in a laboratory the conditions are varied in nearly every experiment, so that the student may obtain practical knowledge and be prepared to act under any emergency. Work in a laboratory pre-supposes a certain amount of manual training. In our present disorganised system it may be necessary, occasionally, to give a little of this in the laboratory, but the place for it is either in the elementary or the secondary school, both of which should train the eye and the hand at least as much as they cram the brain. Drawing and manual training work of various kinds would serve to make the instruction real, and could be done without adding very much to the expense of the school, but it pre-supposes teachers who are real teachers, and who have liberty to develop their work in a manner suitable to the requirements of the scholars.

It must be admitted that the present systems of elementary education and of apprenticeship are not at all designed to the best advantage of either the masters or the apprentices. The mechanical mental drill of the school room has not been found to produce intelligent and active-minded boys, and is in danger of leading to the substitution of equally mechanical manual drill—in fact, into the conversion of the elementary school room into a toy workshop, and of the secondary school into an establishment for the training of apprentices, as is now being done to a considerable extent on the Continent and in America. Such trades or craft schools have their uses, especially in the smaller and more artistic classes of work, but if the employers of labour neglect their evident duty in arranging for the training of a due proportion of apprentices, and so render such schools necessary, it is their business to support them, and not expect that to be undertaken at the public expense. The cry for improved technical education has met with a feeble response on the part of the workmen, as they think, and, in fact, as they say plainly, that the whole movement is intended for the benefit of the employers, and to relieve them of their proper duties; and it must be admitted that to a large extent they are right. If employers of labour had continued to take even a small personal interest in the education and welfare of their apprentices, we would not have heard much of the cry for improved technical education. This could have been done at a comparatively small expense, and at very little trouble. In some of the more artistic trades, as already explained, special schools, or classes in existing schools, might be necessary, especially where the work was subdivided to a very large extent, but for the most part the apprentices could get all the theory they want in the ordinary classes for science and art, while the workshop or manufactory would continue to afford opportunities for obtaining the necessary practical skill. Success in any trade or profession does not depend so much on the amount of information which may have been crammed into the learner's head as is often supposed. Lord Armstrong recently pointed out that it depends incomparably more upon his capacities for useful action than upon his acquirements in knowledge, and he therefore urged that the education of the young should be directed to the development of faculties and valuable qualities, rather than the acquisition of knowledge, which may be deferred to more mature age. British engineers and British workmen generally have been able to hold, what their Continental neighbours consider more than their own, chiefly on account of their good practical training and sound common sense, two qualities which are not always possessed in any great degree by those who have spent an undue proportion of their time at schools or colleges. These may make arrangements for more systematic instruction in the different parts of a trade, but they cannot impart the true spirit of the successful manufacturer, which is only to be got in the atmosphere of the actual workshop. Therefore any system of training which keeps the young men or women from actual contact with the conditions of everyday work should not receive any encouragement, not only on that account, but also because it relieves employers from what ought to be part of their recognised duties, and tends to perpetuate a stereotyped form of instruction. When the school is entirely separated from the workshop the teaching is sure to become antiquated and deadened by official routine.

We sometimes hear candidates for Parliamentary honours saying that they are in favour of education being free, from the elementary school to the university and the technical college, and every opportunity being given to all who had the necessary ability to take up any department for which they were inclined. Whatever arguments there may be in favour of elementary education, in so far as it is compulsory, being relieved from the direct payment of fees, so that each one in the land may have an opportunity of making something like a fair start (a matter which is practically settled in the affirmative in so far as Scotland is concerned), and however advisable it is to arrange an educational ladder which will lead from the lowest class in a Board school to the highest class in a university, it must never be forgotten that the overcoming of difficulties is the most useful part of a man's education, and nothing should be done which would destroy his self-reliance and determination. It is well known that when men fail in life it is generally not so much from want of knowledge as from want of natural capacity, energy, and perseverance. Universal free education is therefore only an ideal which should be realised when we have a more perfect state of society.

(To be continued.)

NOTES ON PATENTS.

III.

TRADE SECRETS.

It often becomes a matter of some importance to an inventor whether he should keep an invention to himself or obtain protection by letters patent. The question is frequently asked, Is it worth while to patent an invention? This resolves itself purely into a matter of profit and loss. A manufacturer, however, has frequently to consider whether he cannot get more out of his invention by keeping it to himself. One course or the other must be adopted at once, as the profitable use of an invention will preclude him afterwards from obtaining valid Letters Patent. It is true that the product does not necessarily reveal the machine or the process by which it was made, but the rule is founded on public policy. An inventor in England is not allowed to practise his invention for, say, four or five years, and then, finding he can keep its secret no longer, apply for Letters Patent.

There are some inventions which, from their very nature, it would be preposterous to treat by way of trade secret. There are a few inventions consisting of processes which are capable of being so dealt with. Even in such cases, if an inventor wants to do anything beyond manufacturing in his own works he must patent. If, for instance, he wishes to license, or sell, either at home or abroad, he must patent. It is evident that, for all practical purposes, a trade secret is not a negotiable property. The great advantage of a trade secret is that the owner has the most perfect monopoly, *while it lasts*. If Letters Patent are applied for, rival manufacturers are at once informed of the new departure. The inventor may have to protect himself by expensive litigation. One advantage of a trade secret is that there is no fear of other persons obtaining a compulsory licence of the invention. There is always present the disadvantage consisting in the risk of disclosure, but there is the possibility of a longer monopoly than fourteen years, which is the limit of Letters Patent. There are many cases in which inventions have been worked as trade secrets for years. In more than one case which has come to our notice an invention has been lost on the death of a partner or foreman who knew it. The great practical objection to a trade secret is the difficulty of keeping it secret. There have been successful instances where it has been done in mechanical cases by dividing the work amongst a variety of hands, so that one hand only knows the details, and not the entire work. In the glass and china trade there are instances of trade secrets having been kept for many years. In these cases the invention has been in the knowledge of the principal, and perhaps his manager. In the manufacture of alloys trade secrets have been kept for years.

There are some cases where, to ensure the secrecy of processes, operatives have been chosen for their dulness or want of perception; chemical substances have been disguised and misnamed; the dials of pressure gauges have been altered, and the scales of thermometers have been graduated on a false basis. These expedients have, to a certain extent, proved successful; but where, however, the invention is known to the operatives, the risk of its disclosure is very great. The most effectual means of preventing such disclosure is to retain a part of the wages. It is the custom of one large firm, not only to divide the work, but to retain, in addition, a part of the pay (known as "bonus pay") for three years. This has the effect of keeping the men in the master's employ; and the pay is forfeited if they enter the service of a rival manufacturer. Where this system of deferred pay is in force, the men, on entering, are actually sworn in to keep the secrets of the business. The retention of a part of the pay is a most powerful weapon. Sometimes trade secrets consist of workmen's expedients or trade tricks, which do not amount to the dignity of patentable invention. Patents should of course not be applied for in such cases.

There are a great number of large works in which a stranger is not allowed to enter; on the other hand, however, there are large works where the entry of strangers is quite disregarded. Sunday afternoon is a very favourite time for visitors to go over works. The inquisitive stranger has plenty of time, little fear of being disturbed, and absolute quiet; there being no one about except, perhaps, a furnace-man who has to look to his fires on Sunday afternoons, and who has probably been the means of the intrusion.

Where there is an honest watchman, the stranger may find greater difficulty. There are some manufacturers who prefer to pay the police for extra external watching than to trust to a watchman inside. This method of robbing a man of his industry is most unfair and discreditable. It is impossible to come to any other conclusion, having regard to the clandestine way in which the information is obtained. Confidential assistants are bribed; operatives and mechanics are decoyed into the service of a rival manufacturer; works are visited against the wishes of the owners—acts which no honourable manufacturer would sanction. It may be said that these expedients are sanctioned with a view to the detection of infringements. The most casual observer will see that the object in view is different. There is a great distinction between obtaining information for the purpose of stealing another man's industry and gaining information for the purpose of detecting infringements and so securing to the patentee what the Crown has allowed him.

The English law does, to a certain extent, recognise a trade secret as a species of property. Inventors who have trade secrets are not obliged, when in the witness box, to answer questions by which such a secret would be revealed. This has been twice decided—viz., in the dye case of the Badische Anilin und Soda Fabrik *v.* Levinstein, and in the electrical case of Edison *v.* Woodhouse. The law in several European States goes much further than the English law. It is a criminal offence for a workman to disclose the secrets of his master, the penalty being fine or imprisonment.

A consideration of the foregoing remarks shows that it may occasionally be good policy for an inventor to keep an invention a trade secret. Of course, no hard-and-fast rules can be laid down; but in practice it can only be done where the inventor merely wishes to have the use of his invention himself, and where there is a reasonable chance of keeping the invention secret. The balance is greatly in favour of a patent, now that the question of subject-matter is so well defined.

PROTECTIVE CEMENTS AND WEIGHT-SAVING IN SHIP STRUCTURES.

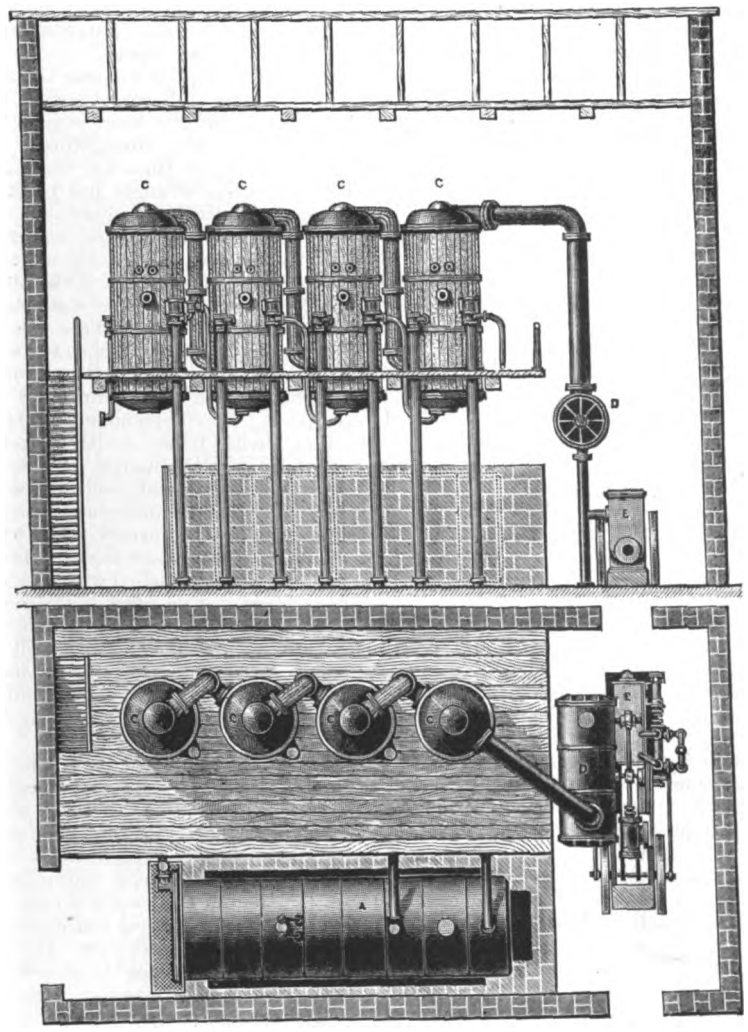
Two elements in the structural character of most modern ships render the need for internal protective coatings even more imperative than formerly. One is the use of mild steel, and the other the carrying of water ballast in minutely divided cellular double bottoms. Extensive experiments made by various authorities have shown that unprotected steel plates corrode almost 40 per cent. faster than plates of common iron. Actual experience with steel vessels demonstrates their liability to more rapid deterioration through corrosion than iron vessels, even though equal care may have been taken to treat them with protective coatings. Moreover, the diminished thickness of the material in steel vessels, as compared with iron, is a condition imposing necessity for protective measures. This necessity is rendered still more imperative through the almost constant presence of gritty sea-water in ballast bottoms, together with the minute subdivision into compartments and the intricate cross-framing which form a distinguishing feature in modern steamers. While the almost constant presence of water ballast tends very materially to increase the rapidity of internal corrosion, the subdivision spoken of at the same time aggravates the evil, through rendering these parts less accessible for cleaning and coating.

What has been said of internal deterioration generally, as affected by the presence of water ballast, applies of course with greater force when the influences at work in specific parts of the vessel, and the consequences flowing from given kinds of cargoes, are considered. The corroding properties of gritty bilge-water in constant motion are active enough under even ordinary conditions, but with

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CHAPMAN'S QUADRUPLE EVAPORATOR.

CONSTRUCTED BY MESSRS. FAWCETT, PRESTON, & CO., LIVERPOOL.



SECTIONAL ELEVATION AND PLAN.

the increased temperature due to such cargoes as grain or wool, and especially with the air charged with acids and sulphates from wet coals, these deleterious properties are doubly potent. The top surface of the inner bottom plating, under the engines and boilers, is peculiarly liable to corrosive influences. The presence of chemically charged hot ashes in and about the stokeholds, and the general prevalence of coal dust and moisture throughout the whole machinery space, are factors in the rapidity of deterioration in this part. To allow for what has evidently come to be regarded as inevitable, careful builders adopt iron in place of steel at this part, and even increase the requisite thickness of plating. Others specially coat the plating with cement, composed of equal portions of Portland cement and sand, and in not a few cases galvanising of the plates is resorted to. Inside the cellular bottom itself, under the engines and boilers, corrosion and pitting are most serious, unless coating is resorted to at first, which, from the intricacy of framing, is most difficult of accomplishment. Even at the best influences are at work incidental to position which are most deleterious. Owing to the continual change of temperature to which the plates below the boilers are subject, through the boilers being alternately off and under steam, the heat, conducted by the plating to the contained water, gives rise to a moistness more serious and detrimental in its properties than the water itself. While conditions calculated to diminish the natural lifetime of a steamship have thus been accumulating during recent years, it is curious to consider that there has been simultaneously in progress a tendency to restrict the amount of the protective coatings applied to the insides of vessels. This tendency is directly due to the desire to reduce structural weight, and thus effect a gain in deadweight carrying capability. This desire has, in its turn, for the most part arisen from a consideration of what the substitution of mild steel for iron has effected in this direction, although the restrictions as to cargo carrying, imposed by recent load-line legislation, have also doubtless operated to render weight-saving more imperative.

The most commonly approved medium for protecting the interior surfaces of ships has long been a mixture composed of Portland cement and sand-substances—in themselves of high specific gravity, but often rendered doubly weighty by careless and ill-advised application. Attention has naturally, therefore, been directed to restricting the amount of this heavy item in ship construction to the smallest possible minimum. In many cases, however, the judicious limit has been exceeded, and the thinness of the Portland cement coating has constituted but a questionable protection to the coated surface. Although apparently impervious, cement concrete, as applied to vessels' bottoms and bilges, is more or less porous, and is especially so, of course, if the layer be of the minimum thickness, and the concrete badly compounded. Examples of the truth of this are common in house structure, as the frequent presence of damp concrete floors amply demonstrates, and instances are not wanting of vessels coated with Portland cement having been unexpectedly found to have suffered for lengthy periods through the presence of water between the cement and shell plating. The hardness and rigidity of Portland cement also renders it very liable to crack away from the plating when any strain is thrown upon it, or when subject to expansion and contraction. From these and other causes—such as hole boring, or replacement of rivets after repairs—loosening of the cement takes place, and, however limited the space actually affected may be, it will quickly be found to become a starting point for the ingress of water and resultant corrosion. This will rapidly spread, and may only be discovered by chance after most serious damage has resulted. Moreover, if applied in frosty weather, or with the least admixture of mud or grease, such as is so plentifully present in vessels while under construction, the adhesiveness of cement concrete is most seriously impaired. These and other such considerations go far to prove that, from the point of view of protective efficiency, as well as that of economy in structural weight, Portland cement, as commonly applied, is not the best coating for ship interiors. Bituminous or asphaltic substances, which preceded the use of Portland cement for such purposes by many years, but which the carelessness of manufacturers and others charged with their use allowed to get into disrepute—are of course acknowledged to be the most preferable from the point of view of first cost. Satisfactory marine cements of this class have been manufactured which only weighed about one-fourth the weight of Portland cement. Now, however, that the exigencies of ship design and construction have operated to improve its manufacture and application, lightness is not the only qualification this class of marine cement is found to be possessed of. Professor V. B. Lewes, of the Royal Naval College, Greenwich, in a paper read before the Institution of Naval Architects last spring, indicated a decided preference for bituminous coatings. Referring to the porousness of Portland cement, especially in the case of a thin coating, and of the liability this occasioned for its being permeated by liquids and gases and rapidly corroding the plating, Professor Lewes said: "It is for this reason that I consider bituminous or asphaltic varnishes, freed from any traces of acid and applied hot. or sound tough paint, preferable to cement, as, although they are not so hard, yet, if serious corrosion should be set up, it is easily discovered and stopped before much damage results; whilst, being impervious to moisture, deleterious solutions, either from the coal bunkers or cargo, would be prevented from acting upon the skin of the ship." The tendency to blister and soften under the heat of tropical climates is the principal objection still urged against the employment of bituminous cements as usually made and applied, yet the fact remains, as maintained by Professor Lewes, that cements of the bituminous order, if scientifically manufactured and properly applied, will, in the long run, prove preferable. Instances of the truth of this in actual experience are not wanting, and two may be here mentioned. The British India steamer "Kurrachee," which was built fully twenty-five years ago, in undergoing a general survey, and having her old boilers replaced by others in Calcutta, when she was about twelve years old, had all parts of her inner bottom examined, and particularly that part under the boilers. To carry this out effectually a great number of coolies were employed with chipping hammers for many days cutting out what appeared, to the correspondent reporting the circumstance, a "kind of pitch," underneath which every particle of the steamer's plates and angle-irons was found to be, not only in a perfect state of preservation, but actually retaining a "steel-coloured bloom," perfectly bright, smooth, and indicative of highest quality and condition. So long ago as December, 1867, at the request of Messrs. Brown & Simpson, shipbuilders, Dundee, Mr. William Briggs, of Arbroath Chemical Works, coated the barque "Havilah" with his marine cement—since, under the name of "Tenax," greatly improved upon—and so recently as December last, twenty-two years after application, Mr. Briggs received from Mr. P. C. Svarrer, of Fano, who sailed the vessel as master until 1888, and is now her owner, positive assurance that "the cement in the bottom is still as good as when it was put in," and that the "surveyors, in re-classing her, have also said that they have never seen the cementing better than in the case of the 'Havilah.'" No loosening of the cement has ever taken place, and it sticks well to the frames, so that "there is neither rust to be seen thereon or on the plating."

These cases afford ample justification for the very evident and growing desire of owners and builders to adopt the lighter bituminous coatings now being manufactured. Mr. Briggs, already named, and perhaps other manufacturers as well, may, by skilful attention to the preparation and special care in the application of bituminous cements, probably outrival the commonly adopted Portland mixture, at least, in those vessels designed as deadweight carriers. Already very many builders and owners are strongly disposed in favour of the lighter medium. The gain in carrying, and consequently in earning, capacity which it ensures is in itself a powerful argument in its favour, but surely every additional reason exists for its almost universal adoption when, as the result of past and recent experience in actual service, it can be proved to afford more ultimate and efficient protection, less cost of upkeep, and prolonged lifetime to a steamer.

CHAPMAN'S QUADRUPLE EVAPORATOR.

THERE has recently been fitted at the Hendon Paper Works, Sunderland, by Messrs. Fawcett, Preston, & Co., Limited, of Liverpool, one of Chapman's patent multiple effect evaporating apparatus, for which several important improvements are claimed. First, that more soda is recovered; second, increased evaporative efficiency, with reduced fuel consumption; and third, the water evaporated from the black liquor is chemically pure. The action of the apparatus is as follows:—All the waste liquors blown out of the esparto boilers to be treated are constantly fed by the donkey engine into a steam generator A (see plan above), and from these liquors all the steam required to work the apparatus is generated.

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The liquor passes from the generator into the first vessel of the evaporator C C C C (see illustration), and then in succession into the second, third, and fourth vessels. The steam generated in the generator passes into the heating drum of the first vessel, the steam generated in the first vessel passing into the drum of the second vessel, as also the heated water condensed in the drum of the first vessel, and so on in the case of every vessel, the steam generated in it, as well as that condensed in its drum, pass into the drum of the succeeding vessel. There are thus five evaporations for one application of heat, in the last two evaporators the process being carried on under vacuum, produced by engine at E (see plan) in connection with surface condenser D. At the time of our visit, in the first effect the steam gauge showed 2lb. pressure, in the second zero, in the third the vacuum was 13in., and in the fourth 27in. Sight holes are provided, so that the progress of boiling the liquors can be observed, and, after five or six weeks in continuous action, there were no indications of choking of tubes. In ordinary multiple effects a regulating valve is fitted to each vessel for the purpose of adjusting the feed from one pan to the other, in order to maintain the relative difference of pressures between the vessels, corresponding to varying initial pressures and temperatures of steam and liquor supplied to the first vessel, involving a considerable amount of experience and judgment on the part of the attendant to keep the apparatus in proper working order; but in the Chapman system there is only one regulating cock for liquor and one for steam in the whole apparatus, and the temperatures and pressures in the various vessels adjust themselves to suit any fluctuations that may take place in the pressures or temperatures of the steam or liquor. Mr. Goodall, the manager of the Hendon Paper Works, to whose courtesy we are much indebted, gives the actual work performed by this new plant as follows:—200,000 gallons of black liquor of 5¾ Tw. at 160° Fahr. are reduced to 29,370 gallons of thick liquor of 46½° Tw. at 125° Fahr., ready for the roasters, by an expenditure of 20 tons 11 cwt. 3 qrs. of small coal, equivalent to an evaporation of 37lb. of water per pound of coal used, and to 10½ cwt. coal per ton of ash recovered, not including the coal used at the roaster.

BOULT'S CYLINDER-LUBRICANT TESTER.

We illustrate in the accompanying engravings, Figs. 1 and 2, an oil tester designed by Mr. W. S. Boult, Assoc.M.Inst.C.E., of Bank Buildings, Liverpool, for testing lubricants under the actual working condition—*i.e.*, at the temperature of the steam, gas, or air in which they may be used. Although many lubricants are very efficient at ordinary temperatures, they fail absolutely when submitted to the high temperatures of the steam in the present high pressure engines. The apparatus is exceedingly simple, and consists simply of a revolving journal in bearings surrounded by an oil bath, a Bunsen burner to give the required temperature, a thermometer to ascertain the temperature, a counter to register the revolutions, and a dynamometer to indicate the pressure caused by the friction. Fig. 1 is a section of the machine through the journal. This journal is an expanding one, as shown at D D, and is pressed against the bearings by means of the internal spring E, the pressure of which against D D is regulated by means of the screws B B. The journal is attached to the horizontal shaft shown in Fig. 2 by means of clutch gear, and on the shaft is the pulley, to be driven from any available power; thus the journal, with the internal spring E and regulating screws B, rotates to any required velocity. The bearings, with the oil bath C and the thermometer, hang on the journal and are free to move, the weight of these parts giving the necessary resistance between the bearing and journal. Projecting from one side of the bearing, is a small arm (Fig. 2), to the end of which is attached a chain passing to the rack and pinion of the dynamometer, the latter being simply a weighted rod acting on the principle of the ordinary letter weigher. Any resistance, therefore, which is offered to the rotating journal tends to carry the bearing round with the journal; this action is communicated by means of the lever and chain to the arm of the dynamometer and is at once indicated on the dial. The operation of testing is as follows:—The oil to be tested is carefully measured in a graduated glass pipette syringe and ejected on the journal D; the oil bath C is previously raised to the required temperature, the set-screws B are slackened so as to allow the spring E to have the full pressure, and the journal is made to rotate at about five to six hundred revolutions per minute. Observations are then taken of the number of revolutions and the indication on the dial of the dynamometer, which is graduated to indicate in pounds the absolute friction on the rubbing surfaces. The apparatus is generally run until a rise of 50 per cent. in the friction is indicated; beyond this stage the oil is practically unfit for use. The advantages of this apparatus are (1) the friction surfaces are easily maintained at a uniform temperature; (2) the pressure on the journal is constant; (3) the lubricant is completely retained on the friction surfaces; (4) the friction and the distance travelled is automatically and accurately measured. The apparatus is manufactured by Messrs. W. H. Bailey & Co., of Salford. A table of the tests made by Mr. Boult on the various lubricants which are now in the market is given above.

BOULT'S CYLINDER-LUBRICANT TESTER.

Reference Letter.	Appearance in ⅛in. Glass Tube.	Consistency at 60° Fahr.	Nature.	Duration. Mins.	Duration. Ft. Run.	Average Coefficient of Friction.
A	Completely opaque; black	Thin	Mineral	71	46,505	·0165
B	„ „ „	Nearly solid	„	149	97,595	·0229
C	Very dark reddish brown	Thick	„	122	79,910	·0216
D	Red; slightly cloudy	Very thick	Mixed	175	114,625	·0201
E	Completely opaque; black	Solid	Mineral	124	81,220	·0232
F	„ „ „	Nearly solid	„	120	78,600	·0254
G	„ „ „	Very thick	„	50	32,750	·0186
H	Dark orange; very cloudy	Solid	„	69	45,195	·0236
I	„ „	Nearly solid	Mixed	247	161,785	·0236
J	Brown; bright	Thin	Mineral	155	101,525	·0156
K	Dark amber; bright	„	„	237	155,235	·0156
L	„ orange; cloudy	Nearly solid	„	210	137,550	·0178
M	Amber; bright	Extremely thin	„	118	77,290	·0119
N	„ „	„ „	Mixed	35	22,925	·0108
O	Dark red; clear	Thick	Mineral	360	235,800	·0203
P	„ not quite clear	„	Mixed	222	145,410	·0172
Q	Completely opaque; black	„	„	70	45,850	·0197
R	„ „ „	Thin	„	126	82,530	·0182
S	Dark orange; very cloudy	Solid	„	183	119,865	·0220
T	„ „	„	„	206	134,930	·0188
U	Milk-white	„	Tallow	96	62,880	·0156

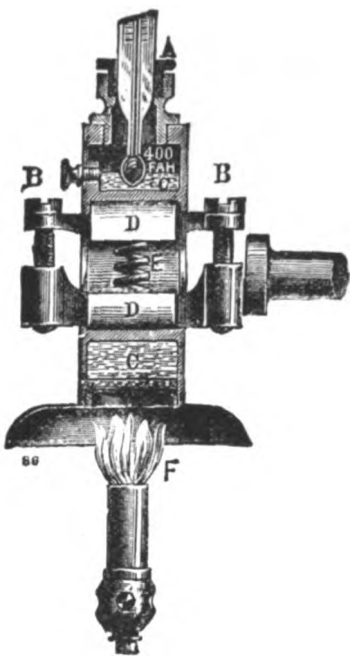


Fig. 1.

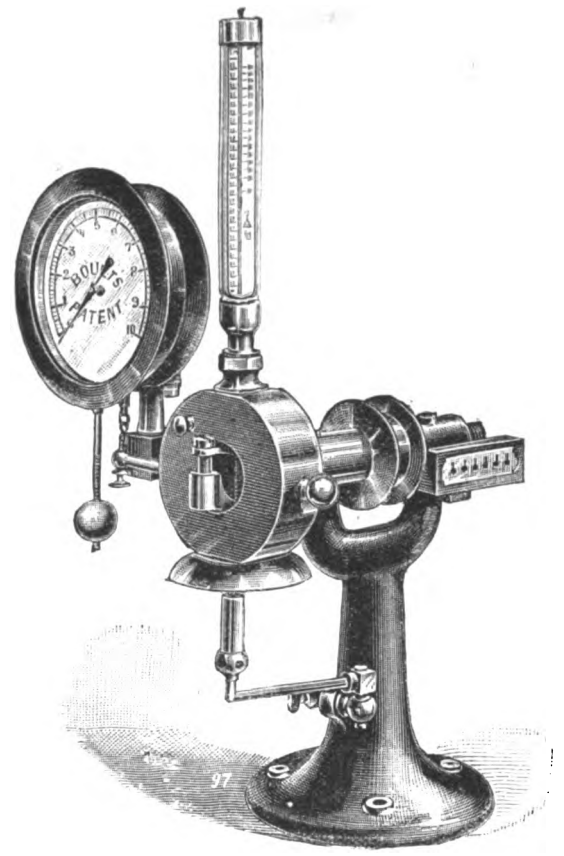


Fig. 2.

THE TUNNEL UNDER THE CLYDE.

Arrangements are now being made for beginning work at the tunnel under the River Clyde at the harbour of Glasgow, of which Messrs. Simpson & Wilson are the engineers, and Messrs. Hugh Kennedy & Sons, Partick, the contractors. Numerous proposals have been made at different times for facilitating cross-river communication for vehicles and passengers, including improved ferry-boats, overhead bridges, and a tunnel, or rather several tunnels. The latter has been pushed on entirely by private enterprise, while the two former have generally had a certain amount of official patronage. In the meantime the official schemes seem to have been withdrawn until the results of the private enterprise are seen, another example which shows how desirable it is to allow ingenuity and energy to have free scope and not to be damped by official routine. There will be three tunnels laid alongside each other, with only 2ft. between them, and they will be formed of cast iron segments of 16ft. diameter. The inner tunnel will be for foot passengers, and the two outer ones for vehicles. At their highest point the tunnels will be 15ft. below the bed of the river, and 35ft. and 46ft. respectively below low and high water levels. The shaft on the north side of the river is to be at a point about 400ft. west of Finnieston Street, and about 60 yards from the quay wall. It will be 80ft. in diameter, and 72ft. in depth. The one on the south side will be very similar, and each will be provided with hydraulic lifts. The central tunnel for passengers will, at both ends, rise by a stiff gradient to within a few feet of the surface, thus obviating the necessity for hoists, against which there seems to be a prejudice in the public mind. The whole arrangement will be lighted by electricity, and seems well designed to meet the objects in view, and as it is proposed to make the charges light, no doubt it will be largely taken advantage of.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

(FOR LATEST TELEGRAPHIC DESPATCHES SEE PAGE 153.)

PARIS, 11th February, 1890.

COAL.—Coal continues to rise steadily in price. Fortunately the winter has been exceptionally mild; had it been otherwise the scarcity of fuel would have occasioned a serious disturbance of the equilibrium of trade. As it is, the coal mining industry is in an abnormal condition. To increase the output the colliery proprietors are engaging agricultural labourers as putters and drivers. Even under this extra pressure the production falls short of the demand. The prices paid are above what the most sanguine ventured to hope for six months ago. Briquettes, which a short time ago could be bought for 8s. 6d. a ton, now sell readily at 24s. This form of fuel is in specially strong demand. It has been steadily in favour in the last two years, and it appears likely that its manufacture will constitute a very important branch of the coal mining industry in the near future. Experiments made at the Anzin collieries have shown that when properly made these blocks will keep without appreciable deterioration for at least ten years.

IRON.—The amount of business transacted in the market of Paris just now is small, consumers limiting their purchases to the bare needs of the moment. But thanks to greater activity in the provincial markets prices are firmly maintained. There are this week no new features to report in the business of the provinces; but the tendencies of the past few weeks continue, and even manifest themselves more distinctly in some districts, notably in the Loire-et-Centre, where a strongly marked upward movement is in progress. The situation generally is strong and the prospect cheering.

CHILDREN'S LABOUR IN FACTORIES.—The commission appointed to examine the Bill passed by the Senate relating to the labour of women and children in factories and workshops has refused to adopt the wording of the Bill as it stands, and it has decided to open a Parliamentary inquiry concerning the regulation of night work for women in various industrial establishments, and also to take the opinion of the Academy of Medicine on the hygienic question.

EXHIBITION OF AGRICULTURAL MACHINERY.—The annual Agricultural Exhibition is now being held in the Palais de l'Industrie. In the machinery section there are 4,344 exhibitors, who have brought together a very complete collection, including some machines and implements of new design. The Palais is just now well worth a visit from foreigners who may be staying in the French capital.

ELECTRIC LIGHT IN WARFARE.—Some interesting experiments have been made at Toulon to ascertain the accuracy of aim when the electric light is used for night attacks. A large gun—19 c.m. calibre—was mounted on a revolving platform, which also carried an electric projector. The mark to be hit was from 3 to 4 kilometres distant, and the only light was that of the projector. It was found that the gun could be discharged with as great rapidity and precision as was attained in daylight.

THE INTERNATIONAL SOCIETY OF ELECTRICIANS.—This society met at Paris on the 5th inst. M. Hippolyte Fontaine read an exhaustive paper on the electric lighting at the late Exhibition, and compared the practical working of the various systems. M. Violet described a new arrangement for reading the indications of mirror galvanometers, by means of which the space occupied is reduced and the operations simplified.

BERLIN, 10th February, 1890.

FLAX AND YARNS.—The Trautenau market for linen yarns is somewhat less animated. The attendance is good, but buyers seek to deal at lower rates, and, as spinners are firm in their demands, business is limited to the strict necessities of the moment. The finer numbers of linen yarns and the coarser numbers of tow yarns are most inquired after. At Bielefeld the market is more active, and a large amount of business in "futures" is being transacted.

THE GLASS TRADE.—The makers of table and lamp glass have formed themselves into a syndicate, and have made financial arrangements with a Berlin banking house with a view to facilitate the export trade.

THE SOAP TRADE.—The prices of soft soap were, in the early part of last year, so depressed by excessive competition that the margin for profit vanished altogether. In the months of June and July a rise of from 2s. 6d. to 3s. per cwt. in the price of linseed oil enabled the makers to obtain an advance which the market readily accepted. But within the last few months potash has risen about 20 per cent. in value, and coal has advanced in a much larger proportion. The soap makers have therefore determined to announce immediately another considerable advance in the prices of their produce, the present rates having again become unremunerative.

SHIP CARPENTERS' WAGES.—The strike of ship carpenters at Hamburg has ended in the concession to the men of the following rates of wages:—From March 1st to October 27th, 0·45 mark (5·4d.) an hour, and from October 28th to the end of February, 0·48 mark (5¾d.).

CHEMNITZ KNITTED GOODS TRADE.—The Chemnitz knitted goods trade has greatly fallen off of late, and manufacturers now are not able to keep their hands employed. Only the cheaper kinds of goods are in demand. The trade with England, formerly so brisk, is greatly depressed. To recover some of this trade, manufacturers are seeking to deal directly with the retail sellers.

RAILWAY ROLLING STOCK.—The lowest tender for the recent contract for the construction of 250 goods waggons for the Warsaw and Vienna Railway was made by the firm of Van der Zypen, of Deutz, near Cologne. Notwithstanding the duty of 180 roubles per axle, they were able to underbid the Warsaw makers by 15 per cent.

ELECTRIC LIGHTING.—The municipal authorities of Cassel have decided to light that town by electricity.

THE DESPATCH VESSEL "METEOR."—The fitting up of the despatch vessel "Meteor," launched from the slips at Kiel the other day, is being pushed on with all possible speed. At the present moment her engines are being put in. These are extraordinarily powerful relatively to the size of the ship. They are triple-expansion engines of the vertical type. The boilers are of the locomotive type, and are four in number. With these engines, which are capable of developing 5,000 i.h.p., the vessel is expected to make from 22 to 24 knots an hour. Her displacement is 950 tons.

A SIBERIAN RAILWAY.—The Government of Russia have decided on building a railway right across Siberia, and plans have been drawn up for its construction. The line is to be 4,300 miles long, is to take ten years in building, and is to cost 250,000,000 roubles. This is a comparatively low figure, but the quality of the work will be sacrificed for simplicity of construction.

VIENNA, 10th February, 1890.

THE COAL MARKET.—On account of the weather the demand for coals on the Vienna market decreased last week, but the stock of the Northern Railway Coal Depôt, which is usually high, diminished away, and now scarcely amounts to 300 waggons. The colliery owners are fearing a strike, and they are very busy for this reason to produce the necessary quantities for industrial purposes. This circumstance presumably will be followed by a general increase of prices. The Nordböhmische Kohlengewerkschaft, in Brux, has issued its shares, of a total value of 4,200,000fl., and has brought a great number of Northern Bohemian collieries for the price of 3,800,000fl.

THE IRON MARKET.—The decrease of the prices of warrants at Glasgow and Middlesbrough for the moment checked our market; but as all branches have such a large number of orders on hand, the old firmness soon re-entered, and now the tendency is again towards improvement. Bohemian and Styrian works have declared an increase in the price of wire-nail and foundry work. The locomotive manufactory of Wiener-Neustadt has received an order from the Bustehrad Railway for fifteen locomotives. The extraordinarily good business which has been done this year by the locomotive and waggon builders has had its effect already, for a large establishment for waggon and machine construction is to be erected near Brunn by Messrs. Lederer & Porges, of Koenigsfeld. The new establishment will give employment to some hundred hands.

RAILWAY TRAFFIC IN AUSTRIA DURING 1889.—The official reports on this matter, issued a few days ago, show that the total income of the Austrian railways last year was greater than in 1888, but the takings per kilometre were the same. The total receipts amounted to 280 million florins, being an increase of 10·4 million florins over 1888; but the total length of our railways was 25,561 kilometres last year and 24,707 kilometres in 1888. In both cases the relative receipt was the same—*i.e.*, 10,912fl. per kilometre.

SHIPS OF WAR.—The naval officials of Austria some time ago ordered a cruiser from an English firm of shipbuilders, and a commission went to England a week or two ago to test it. The trial trip was so unsatisfactory, and the construction was considered so faulty, that the commissioners have recommended the Imperial Government not to accept the vessel. This course has been followed by the Government, and they have definitely declined to take over the cruiser.

THE LABOUR QUESTION.—Dr. Singer, of the Vienna University, has been gathering statistics as to female labour in the five principal countries of Western Europe. From these statistics it appears that 20,000,000 women are employed regularly in factories, shops, &c.; of this number 4½ millions are in England, 3¾ millions in France, 3½ millions in Italy, 5 millions in Germany, and 3½ millions in Austria.

BRUSSELS, 11th February, 1890.

THE COAL MARKET.—The coal market is gradually resuming its customary appearance, and things are settling down again after the strike. Several of the harder sorts of coal, such as anthracite, when mixed with coke, are now being used in blast furnaces. In anticipation of the approach of the season for burning bricks the association of producers of Charleroi and Basse Sambre have fixed 15fr. as a basis price for close-burning coal. The domestic sorts do not share the same briskness as manufacturing qualities on account of the general mildness of the weather.

THE IRON MARKET.—The lowering of the prices of English irons has caused some uncertainty in the Belgian markets, and there is a slight halt in the sale of pig. Some of the makers have decreased their prices, but the syndicate of Luxembourg producers have sold all their iron, and have no need to follow the Belgian lead. The Etablissements Nicaise and Deleuve have obtained the contracts for the construction of the coal stations in the Netherland Indies The contracts for the 3,500 waggons for the German railways have been awarded mostly to Belgian makers, who quoted a lower price than German manufacturers.

THE TRADE OF ANTWERP.—The trade of Antwerp is seriously declining. In 1889 there was a decrease in the tonnage of 467 tons, while in the whole of the eight years ending with 1888 there was only an increase of 900,000 tons; in 1880 the total was 3,063,829 tons; and in 1888, 3,920,714 tons. Rotterdam, on the other hand, is making remarkable progress. During the nine years ending with 1889 her trade sprang from 1,681,690 tons to 2,721,479 tons; while the trade of Antwerp only increased in the same period from 2,766,806 tons to 4,355,511 tons. The tonnage entering Antwerp in 1880 exceeded the combined trade of Rotterdam and Amsterdam by 400,000 tons, while now it is 150,000 less. Other towns also have been striving to deprive Antwerp of her trade, notably Bremen, Flushing, Dunkirk, Marseilles, and Bordeaux. In 1880 Antwerp had at her command the entire transit traffic between South and East Germany, Northern and Eastern France, Switzerland, Austria, England, and America; but it is now being distributed between the ports above named. It appears that excessive dues have driven the shipping from Antwerp Harbour. For example, ships of 1,800 tons have to pay in the Scheldt taxes to the amount of 400fr., which they do not have to pay either at Hamburg or Rotterdam.

DÜSSELDORF, 11th February, 1890.

COAL.—The strained relations between the colliers and their employers keeps the market in a sensitive state. Much interest attaches to to-morrow's tendering for 100,000 of locomotive coal for the Bavarian State railways. The price is likely to be 20s. on railway at Gustavsburg. The latest list of prices issued by the "Coal Club" contains the following quotations:—Gas coal, 16s. to 18s.; free burning coal, rough, 12s. 6d. to 13s. 6d.; large, 15s. 6d. to 16s. 6d.; washed nuts, 14s. to 16s.; dry burning coal, rough, 12s. 6d. to 13s.; large, 16s. to 19s.; nuts, 17s. to 20s.; small, 7s. to 8s., foundry coke, 29s. to 31s.; blast furnace coke, 28s. 6d. to 31s.; briquettes, 16s. to 18s. a ton, at the pits or ovens.

IRON.—The iron market has assumed a quieter aspect. The current of business is, however, steady, and prices are very firm. The firmness is due rather to the prospect of higher prices for raw materials than to any indications of a heavier demand for iron. The Exchange meeting on the 6th inst. was well attended, but buyers confined their operations to small transactions. The members of the Rhenish-Westphalian pig iron syndicate met at Cologne last week, and agreed to continue the present minimum prices, production being below consumption, stocks practically exhausted, and the prospects of the coal trade uncertain. A resolution was passed continuing the common sales bureau for forge pig till the end of 1891. The first contract for steel rails tendered for in the present year was for 5,400 tons for the Erfurt Railway. Rhenish-Westphalian manufacturers alone tendered, the lowest offer being 165s. a ton at works by Krupp, of Essen. The highest tender was 170s. Business in rolled wire is unsatisfactory. For drawn wire there is a fairly good demand.

FUSION OF POWDER WORKS.—A scheme for the fusion of the Rottweil and Hamburg and the Rhenish-Westphalian Gunpowder Manufacturing Companies is under consideration. An application is to be made for a quotation of the shares of the latter company on the Berlin Stock Exchange.

THE HENSCHEL LOCOMOTIVE WORKS.—At the Henschel Locomotive Works at Cassel, the three-thousandth locomotive was completed on the 1st inst. To celebrate the event a sum of £500 was distributed among the workmen, and a fund was established for the erection of fifty workmen's cottages.

PRICE OF PAPER.—At the meeting of the paper makers of the West of Germany, held at Cologne last week, it was decided, on account of the increased cost of coal, chemicals, and raw materials, to advance the prices of paper in a corresponding degree. A special union of the manufacturers was then formed to protect their common interest. Nearly all those present joined this association.

LILLE, 11th February, 1890.

IRON.—There is considerable activity in the iron market of this district, and a fair prospect of brisk trade for many months to come. Manufacturers have sufficient work in hand to keep them going till June, and fresh orders come to hand to keep their order books filled well ahead. The following are the prices now current:—Bars, 160s.; joists, from 164s. to 168s.; common plates, 200s. a ton. These advanced rates are readily paid.

TEXTILE MANUFACTURES.—Though the degree of activity in the market for linen goods is somewhat less than it was a week ago, the turnover for the last week is satisfactory in quantity, and the current of business is strong, considerably above the average for this season. Paris houses are buying largely, but provincial consumers hesitate. Prices show no important change, but the market is very firm. There is nothing new to report of the woollen goods trade at Roubaix. Business continues brisk, and the outlook is encouraging. The market for raw wool has, however, given way a little. A further decline is probable.

FLAX AND YARNS.—The flax market is moderately active. Walloons from Douai and Bergues sell readily. Prices remain unchanged for common qualities, but the better sorts are much sought after, and are higher in price.

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More business is being done in Russian flax. There is not much doing in tows. Business in yarns is still restricted to the needs of the moment. Sales are effected with difficulty. No concessions in price, however, are made. The demand for jute yarns continues brisk, but the coarser sorts are less inquired after.

AMSTERDAM, 10th February, 1890.

The Proposed Maritime Harbour at Scheveningen.—Having found that this scheme, which virtually will make the Hague a seaport town, has excited some interest in England, I append the following particulars:—A Royal Commission having recommended certain works to carry out the plan, a small Anglo-Dutch syndicate, at whose head are two gentlemen named Steers and Clifford, has elaborated a project in accordance with that recommendation. The new maritime harbour is to be created at the mouth of the fresh-water canal, where a pier for steamers will be constructed, having connection with the Holland Steam Tramway, and being protected by two moles projecting into the sea 950 metres. These two moles will form an entrance from the sea 110 metres wide. Next to the maritime harbour there will be the mercantile harbour, with extensive quay walls, warehouses, &c., and to the north of that the harbour for fishing craft, providing room for some 300 smacks, Scheveningen being one of the centres of the Dutch fishing trade. These plans have been approved, it is stated, by an eminent English engineer, whose name does not transpire, and are also sanctioned by the Government engineers.

The Goldfields of Guiana.—It is stated that Holland has withdrawn her reserves, to which I alluded in my last letter, and that, consequently, the Czar of Russia will be asked once more to act as high arbitrator in the dispute between the Dutch and French Governments.

The Fisheries in the Maas.—Holland has invited the powers that are with her interested in the fisheries of the Maas to meet in a conference for the settlement of the long-standing fishery questions. The delegates of France, Germany, Belgium, and Holland will assemble at the Hague in June next.

The New Tin Island in East India. The Singkep Tin Company, concessionaire of the island of Singkep, has raised its capital from 1,250,000 to 1,500,000 guilders—say, £125,000—to ensure the regular working of the tin mines. Singkep promises to become a formidable rival to its great tin-producing neighbours, Banca and Blitong. Its size is about 50,000 hectares—say, 123,550 acres—and it belongs, as I have already stated, to the Lingga Islands, a group off the east coast of Sumatra, and formerly belonging to Johore and Malacca. The tin mines of Singkep are supposed to be of great antiquity. They were hitherto worked by the native Sultan, who is a vassal of Holland. He exported the ore to Muntok, the capital of Banca, or to Singapore, but Singkep tin was not known by itself in the European market, being sold for Banca or Blitong.

Export of Hungarian Produce and Commodities to Holland.—The Market Halls Company of Amsterdam is negotiating with the Hungarian Government for the regular export of Hungarian products and commodities to Holland, which are to be retailed by the above-named company. Its director has left Amsterdam for Budapest, at the request of the Minister of Commerce there, to settle the details of this scheme. In connection therewith, an important report has just been laid before the Municipal Council of Amsterdam by the commission appointed for the purpose of studying the means of increasing the transit trade of the Dutch capital. The commission suggests the appointment of a special committee to work out the details of a project which is contained in the above-mentioned report, and which includes the following main features:—The establishment of important quays, warehouses, and other facilities for international commerce around the existing ones on the Y, a general lowering and equalisation of all dues, a better system of railway accommodation, and the placing of the whole of the maritime harbour under the management of an independent board, in the English fashion. The same special committee will also have to study a gigantic scheme of a bridge across the Y.

Cotton "Futures" at Amsterdam.—Dealings in cotton "futures" at Amsterdam are to be centralised through the medium of the Produce Clearing House there, as from the 1st March next.

New Industrial Company.—At Amsterdam the Javasche Cultuurmaatschappy has been brought out, with a capital of 2½ million guilders (a little over £200,000), under the management of Mr. N. P. Van der Berg, the late chairman of the Java Bank. The new company proposes to buy coffee and other estates in Java, also several sugar factories, for the purpose of working them, and engaging in produce trade generally.

COPENHAGEN, 8th February, 1890.

Wood Pulp.—The manufactory for chemical wood pulp at Delaryd, Sweden, is a very important concern. By several years' careful and patient experimental working the process which is adopted here has been perfected, so that the works now turn out wood pulp of exceptionally good quality. The fibres are long and strong, and the Delaryd wood pulp is extensively used in various countries for mixing with wood pulp of inferior quality. The method of working at this establishment is to some extent a secret, which it is no wonder they want to keep as long as possible in these days of excessive competition within the wood pulp industry. The establishment employs about a thousand hands, in addition to which a number of other persons obtain employment through it. Everything is as practically arranged as possible. The works have their own railway, a somewhat modified style of the Decauville system, over which it seems to possess several advantages, inasmuch as it is understood to be both cheaper, faster, and more durable than the other. A Swedish locomotive, specially constructed for this line, costs only about one-third of what one for the Decauville railway costs, and yet the Swedish locomotive is simpler, stronger, and handier for its purpose than the other, and has four sets of wheels. The railway at Delaryd will be extended this year with some five kilometres. The following particulars of the Delaryd railway may be of interest:—The gauge is 650 millimetres, weight of rails 7 kilogs. per metre, greatest rise 1 in 25. They have two locomotives, both made at the Delaryd Engineering Works—a smaller four-coupled three tons, and a larger eight-coupled six tons. The latter pulls 60,000 kilogs., with a rise of 1 in 50; the usual speed is 18–20 kilometres per hour. The rolling stock consists of twenty trucks for wood and peat, and the capacity of the line is said to be marvellously large. No accidents have ever happened there. The Helga River, at the borders of which the works are located, not only supplies the greater part of the power for the various machinery, but also for the electric lighting of the whole establishment. The electric lighting is also exceptionally well arranged, and care has been taken that there is ample power. A great deal of money is saved annually by the works making and using their own peat, instead of coal. While the latter would cost about 50,000kr. annually, the former only entails an expenditure of some 20,000kr., which is nearly all paid in wages, another benefit to the neighbourhood. About 350 men are engaged in making peat about 100 days annually, assisted by six steam engines of 60 h.p., a water wheel, and 15 peat machines. The annual production of peat amounts to ten million pieces, and the supplies seem to be almost inexhaustible. The demand for Delaryd wood pulp is so great that it has been on the tapis to work also on the Sundays, but out of regard for the men this plan has not been carried into effect. The annual production is at present about 2,500,000 kilograms chemical wood pulp, bleached and unbleached, which finds a ready market in England, France, and America, and there is no doubt that the works are capable of still further extension.

MADRID, 10th February, 1890.

Asturian Coals.—The price of coals in Asturias has been raised in consequence of the demand that has sprung up on account of the rise in England. At the present moment gas coals are selling at about 12s. on waggon. The gas works of Madrid save the whole freight from England and the 1s. import duty by buying Spanish coals, but they cannot get a regular supply to the extent they require. As the gas works of Madrid sell their coke at a high price and never have any in stock, their retorts are heated by some very inferior native coal. They do not sell their tar well nor use the ammonia liquor.

Customs Reform.—The commission appointed to study the customs reforms and to examine the question of treaties in connection with the approaching end of most of them in 1892, have fixed the 27th inst. to receive written information. As to the English treaty it will not make any difference at all whether it is renewed or not, and trade will go all the same. As to the French treaties great fears are shown that our neighbours will refuse a renewal. Such an occurrence might be followed by some advantage to Spain.

NEW YORK, 1st February, 1890.

Elevated Railroads.—The report of the elevated railroads of New York for the year 1889 has just been issued. It shows that 182,413,987 passengers have been carried last year without one being injured through the carelessness or other fault of the management. The same claim has been made for previous years, and as the total number of passengers carried since the lines were erected has been 1,251,967,720, it is quite a satisfactory showing.

Bursting of Glass Furnaces.—At the tank factory of the Chambers-McKee Company, at Jeannette, Pa., two of the furnaces burst, temporarily suspending the oporation of the plant. This plant is the first of its kind in America, and has become famous through the importation of English glass blowers to operate it. The report says that the natural gas had been turned on too strong, and the chemicals not properly attended to, when two out of the three furnaces burst, about 135 tons of glass being lost. Eight hundred men are temporarily idle, as it will take some time to repair the damage.

River and Harbour Improvements.—The Senate Committee has decided to report several Bills making appropriation for carrying on some of the larger works without waiting for the regular Bill. An appropriation of $5,000,000 for the St. Mary's River and Hay Lake project, known as the "Soo" Canal, will be made, and one of $500,000 for the improvement of the Columbia River in Oregon. General Comstock and Major Ernst, of the Engineer Corps, were given a hearing on a Bill for a deep-water harbour at Galveston, Texas. Galveston, in their opinion, was the best place on the Gulf coast, west of New Orleans, for a deep water harbour. The demands of the great South-West required that a harbour should be established on the Texas coast, to give a convenient and comparatively cheap outlet for the cattle, grain, and other products of that section.

Profit Sharing.—The operatives of the Bourne Mill, Fall River, Mass., were last week paid the first dividends on mill earnings ever received by operatives in an American cotton factory. The plan was adopted last spring, and was to divide a sum not less than 6 per cent. of the total amount paid in dividends to stockholders for six months beginning July 1st, the amount paid to each operative being in proportion to the total wages earned. The dividends paid to stockholders amounted to $32,000, and $2,000 was paid to the operatives, which was 3¼ per cent. of the total wages earned by each. Out of 483 operatives employed 401 were entitled to a share in the profits. The Bourne Mill pays the same wages as other mills, and the system of profit sharing has worked such good results that it will be continued for another six months.

Naval Affairs.—The Senate Naval Committee has put itself on record as favouring very large appropriations toward rebuilding the Navy. The Committee reported favourably on a Bill to build eight battle-ships of 7,500 to 10,000 tons, two armoured coast defence vessels, three gunboats, and five first-class torpedo boats. These will cost in the neighbourhood of $50,000,000, and an appropriation of $7,000,000 is made to begin with. Some of the members of the Committee dissent from the report, and, as stated in my last letter, there is hardly a possibility of any such extended increase in the Navy being authorised by this Congress. The United States' sea-going torpedo boat No. 1 was launched, and the Herreshoff Manufacturing Company's works on the 23rd inst. The fires were started as the vessel started into the water. Steam was raised in 32 minutes for running her auxiliary machinery.

Tube Works Removal.—The extensive Tyler Tube Works, of South Boston, Mass., are to be removed to Washington, Pa., and the engineer of the company is at work on the plans for the new mills, which will be considerably more extensive than the present works. The reason for the change is that fuel and raw materials cost too much for transportation to Boston, leaving little or no profit in the business.

Pennsylvania Railroad.—The statement for December and the year 1889 has attracted general attention. The net increase in earnings is equal to nearly 6 per cent. on the stock, a remarkable result when the interruption to traffic and the loss of property at Johnstown are taken into consideration. The statements so far made are only preliminary. There is little doubt that the final figures will show that the gross earnings of the Pennsylvania system and auxiliary roads during 1889 were $130,000,000. The increase in the company's business has been general in all the departments, and, notwithstanding the depression in the coal trade, the fuel traffic of the company was greater than in 1888.

The Coal Trade.—The anthracite trade continues very dull, and it is almost impossible to sell the domestic sizes. The demand for manufacturing sizes is all that could be expected. The restriction now going on does not help the trade much, and a further decrease in the output will be necessary if the weather is unfavourable in the east during the next two months. In the west the weather has been seasonable, and it is now colder in this section than at any previous time during the winter, and this must increase consumption if it continues. The shipments for the past week have amounted to 490,000 tons, a falling off of about 140,000 tons as compared with last year. Bituminous coal is active, and prices are easier.

Colorado Coal.—The advance in Colorado coal during the past few weeks has been equal to 15 per cent. Under the new management the business of the company is rapidly increasing. In the coal and coke departments the increase in net earnings has been from $8,000 in September to $35,000 in December. The real estate developments at Pueblo being particularly advantageous, the company having sold $150,000 worth in one day. There is a larger and more profitable market for pig iron, and the company will shortly erect two new blast furnaces. The steel rail plant promises to add largely to the net income, as the output can readily be all sold to Colorado roads, and having its own raw materials for Colorado business has an advantage over Chicago of from $6 to $7 per ton. The pits will soon be at work, and will turn out about 50 tons per day.

The Iron and Steel Trade.—Business has not improved during the past week, and evidences of weakening are becoming stronger. Steel is holding its own, but pig iron and some lines of manufactured iron are weaker. There is a great deal of business being done, but there is an immense output, and the market is in danger of too much to sell. In pig iron the tone is decidedly weaker, although prices are nominally unchanged. Buyers can, however, place their orders to better advantage than for some time past. In manufactured iron there is nothing encouraging in the outlook. The demand is slow, and manufacturers still complain of delay in specifications, so that while some of the mills have all the orders they desire they are running short of work. Nominally prices are unchanged, but on any good order concessions of perhaps a dollar per ton can be obtained. Prices are at about 2c. for best refined bars, 2·35c. for plates and angles, with the usual advance for steel. There is a fair demand for steel billets, which are from $38·25 to $39 per ton. Rails are quoted at $36, but on desirable orders concessions are said to have been given lately. Mills are well supplied with orders, and the general outlook is satisfactory.

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THE STEAM ENGINE INDICATOR.

At a meeting of the Owens College Engineering Society, Manchester, held on the 4th inst., Mr. C. F. Budenberg, M.Sc., read a paper on "The Steam Engine Indicator."

In commencing his paper Mr. Budenberg first referred to the work done by Watt, and remarked that as made by him the indicator was a remarkably perfect instrument, the correction of its errors having been a somewhat difficult task. The defects arising from the long spring used by Watt when high speeds were obtained were first overcome by Mr. Richards in the well-known instrument bearing his name. A description of the Richards indicator was then given, and its chief features dealt with. The author said that the different springs supplied with the instrument were identified in terms of their displacement in fractions of an inch under a pressure on the piston of 1lb. per square inch, or a direct load of ½lb., the springs being numbered accordingly. The scales were usually multiples of 4 or 8, so as to allow of the use of an ordinary inch scale, and the divisions were uniform throughout on the assumption that the deflection of the spring throughout the scale is directly proportionate to the load. This was not strictly true, and it would be more accurate to divide each scale separately from the spring instead of forcing the spring into a predetermined scale. The error was not large, being, as determined by Professor Reynolds and Mr. Brightmore, about one per cent. in ordinary good springs. Mr. Budenberg then described the manner of testing and adjusting the springs, and advocated their construction from double coils, as the risk of breakage was diminished and the pressure of the coil balanced. The diagrams obtained by the Richards indicator formed a fairly satisfactory record, and the limits of speed at which it can be employed were determined by Professor Reynolds, who showed that to be free from oscillation the speed must not exceed 69, 105, and 155 revolutions per minute when using the 1/20th, 1/50th, and 1/100th springs respectively. The object of recent improvements had been to reduce the inertia of the parallel motion so as to obviate the oscillations of the pencil and enable the instrument to be used at the high speeds now common. A description of the Thompson indicator was then given, and it was pointed out that the parallel motion used had the advantages of being lighter, more stable, and more compact, than the Richards. The parts having a large range of motion were reduced in weight to a minimum, and the heavier members had a comparatively small motion. The rods were all in one central plane and with one exception were long, the number of joints was reduced, the joints were made with large bearing surfaces, and the angle of movement was comparatively small. The objections existing against Richards, arising from the easy flexure of the cross-bar by the pressure of the pencil, the sluggishness arising from wear, and the oblique pressure on the small link coupling the piston rod to the horizontal bar, were entirely obviated by the Thompson indicator. The coupling of the horizontal rod and piston in the latter was effected by a connecting rod attached to the piston by a ball joint provided with means of adjustment. The cock was made with a passage ½in. diameter instead of ⅜in. as in the Richards. The piston movement was multiplied in the proportion of one to four, the diagram produced being 3in. in height. A smaller size of the Thompson was made for special purposes, which weighed only 5lb. instead of 11lb. in the larger size. The Crosby indicator was of American origin, and was—although slightly varied in detail—similar in principle to the Thompson. The stroke of the piston was ⅜in., being multiplied six times, giving a diagram 2¼in. high. The links were made short, and the angle of motion was large. In consequence the friction and wear were increased, and this, owing to the large multiplication, was a very serious matter. Adjusting screws were provided to take up the wear, but this appeared to be too delicate for ordinary practice. This was the chief objection to the Crosby indicator, which, while a very efficient instrument for scientific observation, and excellently constructed, was so lightly made as to be easily damaged and made inaccurate. At high speeds it was also affected by the vibration of the engine. Mr. Budenberg then briefly referred to the Kenyon indicator, which, he thought, was objectionable for steam-engine work, but Professor Unwin had used it successfully for hydraulic testing. The Tabor indicator, like the Crosby, was of American origin. It differed from the Thompson in the fact that the pencil rod was constrained by guiding it in a curved slot provided in a stationary plate, the curve being nearly a true circle of an inch radius. The friction naturally arising from such an arrangement was obviated by the use of a roller on a pin in the sliding bar. By this arrangement the weight of the parallel motion was reduced, the multiplication being in the proportion of one to five, the motion of the pencil being 3¼in. and the stroke of the piston ·65in.

Mr. Budenberg then proceeded to deal with the method of taking indications, remarking that variations arose in diagrams taken alternately from each end of the cylinder owing to the variations in the work of the engine during different strokes. Only by simultaneous indications at each end could absolutely accurate results be obtained, and a double indicator was described which was practically a combination of two acting upon the pencil simultaneously. Two pistons were fixed upon the same spindle, and were respectively subject to the pressures on both sides of the engine piston. One spring only was used, being compressed upwards or downwards according to the direction of the resultant pressure on the

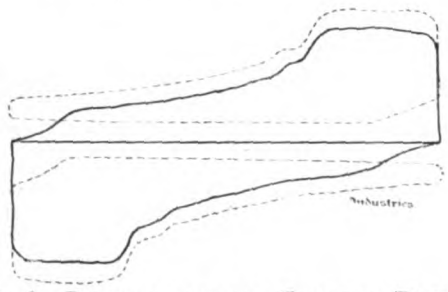


Fig. 1.—Diagram from the Thompson Double Indicator.

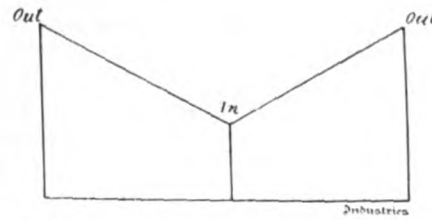


Fig. 2.—Diagram Showing Tension of Cord due to Varying Tension of Drum Spring.

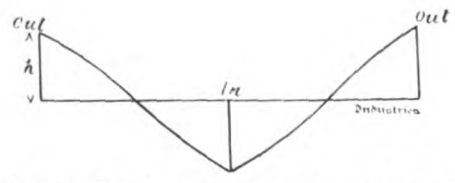


Fig. 3.—Diagram Showing Tension due to Inertia of Drum.

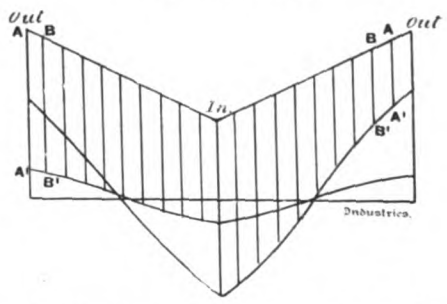


Fig. 4.—Combined Diagram for Two Speeds—for Slow Speed on Left, and for Fast Speed on Right of Diagram.

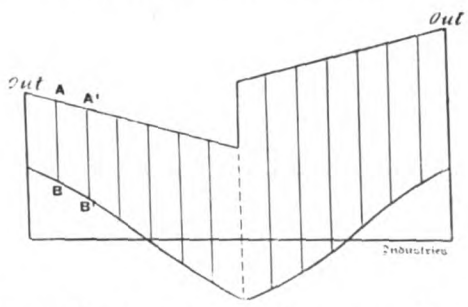


Fig. 5.—Combined Diagram Showing the Effects of the Varying Tension of Drum Spring, Inertia, and Friction.

engine piston. The diagram was, therefore, partly above and partly below the atmospheric line, as shown in Fig. 1; its distance from the latter represented the actual resultant pressure on the piston rod, and its whole area represented the actual work during one revolution. If necessary, diagrams could be taken from each end alternately, these being shown by the dotted lines in Fig 1. A peculiarity of the double instrument was that its indications were independent of the barometric pressure, the piston rod being equilibrated for it. The pipes and cocks must be of large size, so as to avoid any throttling, and if this was done, the errors of which so much had been written were entirely avoided. After dealing with the essentials of an indicator and of accurate observations, the author summarised the results of Professor Reynolds' paper before the Institution of Civil Engineers in 1885. Dealing with the causes of errors therein laid down, he said that the error caused by the oscillations depended not merely on their magnitude but chiefly on the smallness of their number in a revolution, and gave some figures showing the limiting speed for various springs in the Richards and Thompson indicators. One of the most remarkable of the results of Professor Reynolds' researches was to show that the effect on the area of the diagram of the friction of the drum was considerable, a reduction of from 10 to 20 per cent. being frequently produced. The manner in which the variation of the tension of the drum spring during one revolution was shown diagrammatically (Fig. 2); the vertical ordinates represented the tension on the cord due to this cause at all points of the stroke. The effect of the inertia of the drum was more complex, and might be represented as in Fig. 3, the vertical ordinates representing tension of the cord due to the inertia of the drum. Starting at zero, the tension was reduced during the first half of the stroke, the degree of reduction decreasing until about quarter-stroke, and increasing until mid-stroke. The inertia increased the tension during the latter half, the action being reversed during the out-stroke, as shown in the diagram. These two diagrams were combined in Fig. 4, which represented the variations of the resultant tension on the cord due to these two causes. The effect of the friction of the drum was to produce a force always opposing the motion of the drum, and therefore increasing the tension during the outward stroke, and reducing it during the inward stroke. At the end of the stroke the direction of this force changed suddenly, this effect being shown in Fig. 4, which was introduced on the diagram already made for the spring variation and inertia. If y = amount of stretch of the cord per pound of tension F = force in pounds necessary to overcome the tension of the string, then y F would represent the stretch due to the friction, and it was found that the least amount of this was $\frac{1}{40}$in. per foot length of cord. At the commencement of the stroke, the tension changed suddenly to 2 F, and the drum would remain stationary, while the engine piston moved through a distance equivalent to 2 Fy of the drum motion. If, therefore, the steam admission took place instantaneously at the commencement of the stroke, the effect considered would cause a displacement of the admission line of 2 Fy, the diagram being proportionately shortened. This was found to amount to 20 per cent. with an ordinary cord, but was reduced when a wire was employed. A different length of cord being used at the two ends of the cylinder, the effect was greater in the diagram from the back than from the front end of the cylinder. Fig. 5 is a combined diagram of the effects of the varying tension of the drum spring, inertia, and friction.

In the discussion which followed the reading of this paper Professor Reynolds said that the improvements made upon the Richards indicator in recent years were of great value, and they were now highly perfected; and that instrument still remained the one in most general use. With reference to the play in the joints after a little wear, this would produce in a diagram 3in. high comparatively little effect. If, however, the Richards was used for high speeds with smaller diagrams, the effect of the play would be very serious. A clear distinction should be made between high and low speed instruments, as the requirements were different in each case, and the same indicator would not act well under both conditions. For low speeds he preferred the Richards or the large Thompson, for high speeds the small Thompson or the Crosby. He did not agree that metallic pencils were better than graphite, and he preferred the latter. He had been particularly struck with the arguments in favour of double indication, and thought that the diagram obtained by the indicator shown might be found extremely useful if the difficulty of condensation and re-evaporation in the pipes could be overcome. He was not satisfied that this would be met by increasing the size of the pipes. The opinion was generally held that oscillations should not show themselves in the diagram at the commencement of the stroke, and too much pressure was put upon the pencil in consequence, but the result was that the friction set up had considerable effect upon the diagram.

Mr. E. G. Hiller said the parallel motion of the Tabor allowed an exact straight line to be obtained if the slot took the form of an ellipse, and the motion must therefore be more exact than the Thompson. At the same time the movement of the roller in the slot necessitated a certain amount of play. Referring to the various methods of adjusting the springs, he said that the only accurate one would consist in adjustment under direct steam pressure.

Mr. E. Worthington said that in indicating loco-

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motives running at high speeds with the difficulties then existing, he thought metallic pencils much preferable to graphite. He had obtained good diagrams from locomotives with the Richards at speeds corresponding to 300 revolutions per minute.

Mr. Ingham, having worked with Mr. Kenyon in developing his indicator, said that they had experienced great difficulties owing to the continual variations of the indications. The atmospheric line was never twice in the same position, and the work as calculated continually varied. The great difficulty appeared to be that the pencil could not be made to describe a line proportional to the movement of the piston, as the free end of the tube described a circle or similar curve.

Mr. Foster preferred the method of attaching the lower end of the spring in the Crosby to that in the small Thompson, as the weight of the moving parts was less. He also thought the weight of the piston in the latter might be reduced, having, after long use, found no difficulty with the Crosby, in which the piston was much lighter.

Mr. Budenberg promised to make further investigations as to condensation in the pipes when the double indicator was used. A good deal could be said for and against both kinds of pencils, and he did not take any particular side in the matter. With reference to the indication of locomotives, the good results obtained by Mr. Worthington no doubt arose from the fact that the compression was very considerable. The difficulties with the Kenyon indicator could be explained by the effect of temperature on the tube, and perhaps the variations of the atmospheric line could be accounted for by the accumulation of condensed water in the tube which would weight the tube and alter its indications. He thought the effect upon the diagram of the weight of the lower boss in the small Thompson would be very small indeed.

Notices of Meetings.

NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS. Tuesday, February 18th, 8 p.m. Ordinary Meeting. Papers to be read: – "The Shanghai Water Works," by J. W. Hart, M.Inst.C.E.; "The Tytam Water Works, Hong Kong," by Jas. Orange, Assoc.M.Inst.C.E.; "The Construction of the Yokohama Water Works," by J. H. T. Turner, Assoc.M.Inst.C.E.

PHYSICAL SOCIETY.—Friday, February 21st, 5 p.m. Papers to be read:—"On a Carbon Deposit in a Blake Telephone Transmitter," by F. B. Hawes; "The Geometrical Construction of Direct-reading Scales for Reflecting Instruments," by A. P. Trotter, B.A.; "A Parallel Motion Suitable for Recording Instruments," by A. P. Trotter, B.A.; "On Bertrand's Refractometer," by Prof. S. P. Thompson.

ROYAL INSTITUTION OF GREAT BRITAIN. Friday, February 21st, 9 p.m. Shelford Bidwell, M.A., F.R.S., on "Magnetic Phenomena."

PRICES CURRENT, 12TH FEBRUARY, 1890.

Quotations at per ton, unless otherwise specified.

METALS.

Spelter: Ordinary	£23	0	0	to	£23	10	0	
Copper: British Cakes and Ingots	56	0	0	„	57	0	0	
„ Chili Bars, G.O.B.'s	46	17	6	„	47	5	0	
„ Other sorts, G.M.B.'s (equal to Chili Bars)	46	17	6	„	47	5	0	
„ Manufactured (strong)	64	0	0	„	.....			
Lead: Common Pig	14	0	0	„	14	10	0	
„ English Sheet	14	10	0	„	15	0	0	
Tin: Straits	91	0	0	„	91	10	0	
„ Australian	.....			„	.....			
„ English Ingots	96	5	0	„	.....			

Messrs. Carrick & Brockbank, Manchester, report as follows:—

COPPER: The market continues flat, and prices lower. The present disorganisation of the pig iron market, and the continued high rate for money, have had a very depressing effect upon prices of other metals. It is now urged by some that the fall is justified by the slackened demand and the scarcity of orders offering, but consumers generally follow the lead of speculators, and any improvement in prices would, no doubt, bring in a large number of *bonâ-fide* orders, which have been held in abeyance. It is reported that the French holders of copper are maintaining a waiting attitude, believing that a recovery will take place shortly. Should the stock of copper, which is now in strong hands, be kept off the market, and a revival of demand spring up during the present month (which is not unusual after a quiet and dull January), there would soon be a steady improvement in the position of copper. At the moment Chili bars are very low, being quoted at £46 15s. to £47 5s. cash. Manufactured has been reduced £2 per ton, and is now quoted £64 sheets and £67 bottoms.

TIN has been depressed in sympathy with other metals. On the 5th quotations for foreign were £93 15s. to £94 2s. 6d. for cash, after which prices steadily declined to £90 5s. to £90 15s. yesterday. To-day an active market is reported at improved rates, viz., £91 to £91 10s.

LEAD has been exceptionally dull for the last few weeks. The arrivals from Spain and Australia during the past month have been considerably above the average, while the demand for consumption has been small.

SPELTER is weaker owing to the slack demand for galvanising and brass purposes. Some of the large consumers have resold their stocks of spelter, and this has forced down the price much below the actual position of the market. There is very little spelter in stock anywhere, and the consumption has for some time been unusually large, even without the galvanisers orders.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best £ s. d.	
Middlesbro' Bars	7 17 6	.....	8 7 6	f.o.t. wks.
„ Angles	7 12 6	.....	8 2 6	„
„ Plates	7 17 6	.....	8 7 6	„
Staffordshire Bars (cheaper makes)	8 15 0	.....	9 5 0	London.
„ Angles	8 15 0	.....	9 5 0	„
Crown Sheets	8 15 0	.....	9 5 0	„
„ Hoops	8 2 6	.....	8 12 6	„
"Siemens-Martin" Steel Boiler Plates			10 0 0	„
„ Ship and Girder			9 0 0	„

Market quiet somewhat.

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	80/-	..... 72/6

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

CHEMICALS.

		£	s.	d.		£	s.	d.
Acid: Carbolic Crystals	lb.	0	0	11	—	.....		
„ „ Liquid	gal.	0	1	2	—	.....		
„ Citric	lb.	0	1	7	—	.....		
„ Oxalic	„	0	0	3¼	—	.....		
„ Sulphuric	ton	1	10	0	—	.....		
„ Tartaric	lb.	0	1	4	—	.....		
Alum: Lump (powder 10/- ex.)	ton	4	17	6	—	.....		
Ammonia: Carbonate	lb.	0	0	3½	—	.....		
„ Muriate (Grey)	ton	22	5	0	—	.....		
„ „ (White)	„	26	0	0	—	.....		
„ Sulphate	„	11	15	0	to	11	17	6
„ Liquor	lb.	0	0	3½	—	.....		
Antimony	ton	.....			—	.....		
Bleaching Powder	„	5	0	0	—	5	2	6
Bisulphide of Carbon	„	13	10	0	—	.....		
Borax	„	30	0	0	—	.....		
Benzole (90 %)	gal.	0	4	1	—	.....		
„ (50/90 %)	„	0	3	4	—	.....		
Copper Sulphate	ton	26	0	0	—	.....		
Copperas	„	2	0	0	—	.....		
Kieserit	„	.....			—	.....		
Lead: Nitrate	„	22	10	0	—	.....		
„ White Sugar	„	24	0	0	—	.....		
„ Brown „	„	19	0	0	—	.....		
Potash: Bichromate	lb.	0	0	4	—	.....		
„ Caustic	ton	22	0	0	—	.....		
„ Carbonate	„	19	10	0	—	.....		
„ Chlorate	lb.	0	0	4½	—	.....		
„ Prussiate (Yellow)	„	0	0	10½	—	.....		
„ Sulphate (Basis 90 %)	ton	9	10	0	—	.....		
Precipitate: Red	lb.	0	3	1	—	.....		
„ White	„	0	3	2	—	.....		
Salts: Epsom { Bags	ton	3	0	0	—	.....		
Salts: Epsom { Casks	„	3	15	0	—	.....		
„ Glauber	„	1	10	0	—	.....		
Sulphur: Sublimed Flowers	„	9	0	0	—	.....		
„ Recovered	„	4	10	0	—	.....		
Soda: Ash	deg.	0	0	1¼	—	.....		
„ Caustic (White 70%)	ton	8	10	0	—	.....		
„ „ „ 60%)	„	7	17	6	—	.....		
„ „ (Cream 60%)	„	7	5	0	—	.....		
„ Crystals	„	2	12	6	—	.....		
„ Bicarbonate	„	5	5	0	—	.....		
„ Hyposulphite	„	6	5	0	—	.....		
Solvent Naphtha	gal.	0	3	6	—	.....		
Tartar, Cream of	cwt.	5	12	6	—	.....		
Zinc Sulphate	ton	7	10	0	—	.....		

Messrs. S. W. Royse & Co., Manchester, report as follows:—

CHEMICALS.—During the past week matters have considerably improved in the alkali markets. Caustic soda has advanced very strongly, but is now stationary. Bleaching powder is in better demand at somewhat higher prices. Soda ash scarce. Soda crystals and bicarbonate of soda firm. Sulphate of ammonia continues to droop. Benzoles are easier. Carbolic acids unchanged. Creosote in rather short supply. Sulphate of copper is almost unobtainable on spot, but more freely offering for forward delivery.

OILS.

		£	s.	d.
Cocoanut: Cochin	per tun	26	0	0
„ Ceylon	„	23	10	0
Cottonseed	„	21	15	0
Cod	„	19	0	0
Lard	„	37	10	0
Linseed	„	21	10	0
Palm, Lagos	„	23	10	0
Rapeseed: English	„	32	15	0
Seal: Pale	„	26	10	0
„ Brown	„	19	0	0
Sperm	„	46	0	0
Whale	„	24	0	0
Turpentine	per cwt.	1	15	9
Coal	per gal.			
Petroleum (Refined)	„	0	0	5¼
„ Spirit	„			

FOREIGN TELEGRAPHIC ADVICES.

(From our own Correspondents.)

PARIS, Feb. 13.—*Iron.*—The market generally is without change. An uneasy feeling prevails, arising from the sharp relapse in England and the consequent check to business in Belgium. Prices remain firm, but buyers are holding aloof. The works in the Nord are now well supplied with coal. In the Haute-Marne the demand for wire continues unabated. In the Ardennes symptoms of weakness are appearing in the iron market.

Metals. The market for metals is inactive. Copper remains at last week's prices, but the demand for consumption is feeble. Tin continues its retrograde movement, having lost a point or two within the last few days. Lead is firmer, and has recovered a point. The demand for spelter is weak, and prices are quoted a little lower.

BERLIN, Feb. 13.—*Bourse.*—The fact that buyers are more numerous than sellers, and the momentary panics, which occur sometimes several times a day, show a want of confidence in the situation. Industrial securities have suffered severely. All classes have declined in value. Shares in colliery companies have receded considerably. Iron and steel works are weaker on the obviously false report that pig iron has become unsaleable.

Coal - The supply of Westphalian coal and coke for industrial purposes is insufficient to satisfy the demand. Washed smiths' nuts, 26s. to 28s. 6d.; foundry coke, 40s. 6d. to 42s. 6d.; blast furnace coke, 39s. 10d. to 41s. 6d. per ton delivered in Berlin.

Metals. – The tone of the metal market is somewhat weak. Though some concessions in prices have been made by sellers buyers manifest no disposition to operate beyond the needs of the moment. Copper is lower: Mansfeld refined, £60 to £61 10s.; English brands, £57 to £60. Tin has given way: Banca, £102 to £105. Lead is firm at last week's prices. Spelter is quoted a little lower. Ordinary Silesian, £25 15s. to £26. Antimony regulus has receded 20s.

BRESLAU, Feb. 13.—*Coal.*—The demand for coal is falling off, so that the railways can now cope with the trade. The shrinkage is due to a slackening demand for house coal, a consequence of the mild winter, and to the completion of the extra storing which has of late being going on at the railway depôts in view of another strike of colliers.

Iron —The demand for pig iron being still in excess of the production our market remains unaffected by the relapse which has occurred in some of the foreign markets. Cast iron scrap is much sought after at 90s. a ton for good quality. Finished iron and steel is in strong demand, all classes being inquired after. Business brisk in wire and wire nails. Prices generally above syndicate minimum. Engineers and machine makers report increasing activity.

Metals.—The market is steady for zinc. Spelter is firm at last week's prices. Manufacturers, being sold several months forward, are not disposed to seek fresh orders by offering concessions in price. Lead is very firm, stocks in hand being practically nil.

DUSSELDORF, Feb. 13.—*Coal.*—The advance of from 1s. to 2s. a ton which has occurred within the last few days is willingly paid. Export orders to Belgium are being refused. Everybody is stocking, in anticipation of the threatened strike of colliers. The attitude of the latter is disquieting.

Iron.—The market for pig iron is quieter. Buyers are few and transactions unimportant. Prices remain firm, however, and have even slightly advanced for Thomas pig. For finished iron and steel of all classes except wire the market is active. But wire and wire nails have advanced in price from 10s. to 15s. a ton, to cover the increased cost of the raw materials. Rolled wire, 195s.; wire nails, 220s. a ton

STETTIN, Feb. 13.—*Iron.*—The relapse in the English and Scotch markets has been hitherto without influence on the market here. Quotations remain: English No. 3, 90s.; Scotch, 100s. to 105s.; German bar iron, 215s.; and common plates, 250s. to 280s. a ton.

CHARLEROI, Feb. 13.—*Iron.*—The relapse in the English iron markets has alarmed buyers here, and business is very slack in consequence. Sellers, however, maintain their prices. Some manufacturers quote above the syndicate minimum. The Couillet and the Acoz companies have divided between them the contracts for 40,000 iron sleepers (about 1,300 tons) for the Congo railway. The price is 189s. 6d.

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HOME INDUSTRIES.

LONDON 13th February, 1890.

The Money Market.—The hold of the Bank of England on the money market having slackened a little through the course of events bringing more money under command of outside lenders, there has been an easing of the tension which has existed for some weeks. The Stock Exchange readily felt the effects of this during the settlement this week. In the first place, the quantity of stock to be carried into the new account was comparatively small, and the rates charged for loans to continue transactions became lighter. This gave a distinct impetus to speculative activity, the first securities to respond being those of the British railways. The opening of the new account was signalised by a rebound in nearly all these stocks, good returns from the Brighton line, a favourite barometer of this department, giving the keynote to the market. The American railway market has been neglected, and Canadian railways, though rather more in favour, have not been prominent. The Mexican Railway having failed to maintain its good traffic returns, its securities have receded again. Foreign stocks have not been greatly in evidence. Egyptians and Brazilians have risen slightly, but the publication of the terms of the new loan was followed by a drop in Russians. Mining stocks still lack favour, copper shares falling with the metal market, and gold shares have few friends. Nitrate securities fail to rally, and among the features of the week was a sharp trouble in brewery shares.

Companies.—The following companies have been registered since our last report:—The Cardonnel Tin-Plate Co., Ld., with a capital of £20,000; W. & H. Foster, Ld., with a capital of £350,000, to take over the business of Messrs. W. & H. Foster, worsted spinners, &c., Bradford; The Belmez Coal Co., Ld., with a capital of £140,000, to acquire certain coal mines in Spain; The Standard Rubber Stamp Manufacturing Co., Ld., with a capital of £1,000; The Borneo (Sambas) Exploration Co., Ld., with a capital of £100,000; The Princesa Gold Mining Co., Ld., with a capital of £125,000, to acquire certain claims in Mexico; The Colonial Manganese Co., Ld., with a capital of £8,000, to work manganese and other minerals in New Zealand; The Windsor Reef, Ld., to carry on mining operations in South Africa; The Kondaho Petroleum Syndicate, Ld., with a capital of £35,000; The Monte Video Tramways Co., Ld., with a capital of £100,000; The Ludrig Coal and Ore-Dressing Appliances, Ld., with a capital of £200,000, to acquire the business of the Ore Machinery Co., makers of mining machinery, &c.; The Port Talbot Tin-Plate Co., Ld., with a capital of £35,000; Hutton's Brewery, Ld., with a capital of £100,000, to acquire the business of R B. Hutton, North Saltley; The Elkhorn Mining Co., Ld., with a capital of £200,000; The Mutual Telephone Co., Ld., with a capital of £100,000; The United States Metallic Packing Co, Ld., with a capital of £15,000; The Somersetshire Manganese and Iron Ore Co., Ld., with a capital of £25,000; The Embossing and Sand Blast Printing Co., Ld., with a capital of £2,500; R. & T. Clayton, Ld., with a capital of £10,000, to acquire any mill for spinning and weaving cotton; Trent Gas Engine Co., Ld., with a capital of £15,000, to acquire certain patents; The Mount McClellan Mining Co., Ld., with a capital of £300,000, to carry on mining operations in Colorado.

The Board of Trade Returns.—The January returns give no ground for complaint, and though the imports show no very great expansion, the increase in the value of the exports is exceedingly satisfactory. The value of the month's exports was £21,586,752, as compared with £20,527,037 in the same month of 1889, being an increase of £1,059,715. The Eastern markets have been unsatisfactory for textile goods, and the exports of yarns and textile fabrics consequently show a decline, having fallen from £9,970,972 to £9,853,489. Metals and articles manufactured therefrom (except machinery) have advanced from £3,056,923 to £3,577,155, this being largely due to higher prices. Machinery and mill work, which amounted to £1,112,981 in January 1889, were £1,352,223 this January, while chemicals rose from £658,719 to £689,818. The imports amounted to £38,143,850, as compared with £38,058,318, being an increase of £85,532. There are decreases under various heads, and the total would have shown a falling off had it not been for the large advance in the imports of wool.

The Navy.—A serious accident happened on board the "Barracouta" during her trial trip last Friday. It will be remembered that, a week or two ago, the trial trip of this vessel had to be postponed on account of a defect in the engine cylinders. On the trip under natural draught last Friday all went well until suddenly the draught in the furnace was reversed, and the flames and smoke burst out through the door of the furnace and entered the stokehold. One man was killed and all the other occupants of the hold were seriously injured. An inquiry as to the cause of the accident is now being held. It may be mentioned that after this accident the vessel steamed back to port under half-steam pressure without any recurrence of the mishap.

Institute of Marine Engineers.—A meeting of the Institute of Marine Engineers was held in the Langthorne Rooms, Stratford, E., on the 31st ult., when a paper on "Ventilation and Heat Radiation," by Mr. A. Sommerville, was read. The paper dealt with the prevailing condition of things as regards the ventilation of steamers, the inadequate means provided for lessening the amount of heat radiating from all parts of the machinery, and the results which followed directly and indirectly. The elementary principle on which ventilation is based was shortly touched upon, and the difficulties in the way of applying a perfect system to the various styles of buildings, and the still greater obstacles in the way of applying such to the engine-room and stokehold, were referred to. The difficulties experienced by engineers and the responsibilities resting upon them in the discharge of their duties in the more modern steamers were also remarked upon.

The Royal Laboratory, Woolwich.—Mr. H. T. Ashton, M.Sc., Victoria University, has been appointed by the Secretary of State for War as assistant engineer in the Royal Laboratory, Woolwich. Mr. Ashton was educated at Owens College, Manchester, where he gained the Certificate in Engineering, and has since been employed in the works of Messrs. Wm. & Jno. Yates, engineers, Blackburn.

MANCHESTER, 13th February, 1890.

The Manchester Ship Canal.—The Consultative Committee completed their visit to the ship canal works a few days ago. They found the work in a very advanced condition in many sections. At the Eastham end great progress has been made with the entrance locks, and both there and at Latchford and Barton the large lock gates are in course of construction. The railway diversions are rapidly approaching completion, and generally the work is well ahead of time.

The Iron Trade.—Trade has somewhat improved owing to the better state of things in the Glasgow market. It is thought that the weakest point has been passed, and that the clearing out of several speculators which has taken place will steady the market again. Buyers are on the alert to secure a favourable market, and as there is a little give in quotations additional business has been negotiated. There is a general confidence in an advance, as the statistical position, in spite of the abnormal state of things since the beginning of the year, has strengthened and not weakened. It is known that a number of large works are likely to be carried out shortly, and a large accession of shipbuilding orders is looked for. Under these circumstances the news in this market is rather hopeful than otherwise. An addition to the metallurgical industries of this neighbourhood is about to be made. It is intended to commence works for the manufacture of all kinds of steel castings by the methods patented by Mr. J. E. Bott. The board of directors is a strong one financially, and in this respect the new company will stand well.

Warp Balling Machine.—Mr. J. H. Stott, of Rochdale, has just perfected a machine for making warp balls which will be of interest to all manufacturers. Instead of forming the ball by winding it on a mandril kept in frictional contact with a revolving drum, he uses a vertical mandril in a swing cradle, to which an oscillating motion is given. Surrounding the mandril is a light iron ring or flyer running freely on anti-friction bowls and driven by frictional contact with a bowl. By an ingenious arrangement the warp is guided to the guide roller on the flyer by two rollers, one carried on the centre spindle of an arm and the other at its end. In this way any variation in the tension of the warp causes the arm to oscillate slightly and turn the shaft on which it is fixed. Fastened on the latter is an arm or cradle carrying the friction bowl. In this way the velocity of the flyer is regulated in exact accord with the tension of the warp, and the traverse of the latter accelerated or diminished. This is one of the chief features of the machine, and another novelty is that the ball is formed directly from the creel. This saves a good deal of labour and space, and in this respect the machine is noteworthy. A marking apparatus is fitted by which the cuts can be marked as desired. The machine is a great advance on any of the kind previously made.

The Linen and Jute Trades.—There is a decidedly increased feeling of confidence in home trade circles, less grumbling being heard as to the condition of business, while reports of greater activity are frequent. The new year's samples have brought in good orders, and mills are fully engaged, the only discouraging feature being in connection with the heightened cost of production, which in the case of a Northumberland concern has been so heavy that an application for provisional liquidation in Chancery has been made. Fuel is much too dear considering the price at which linens are now being sold by manufacturers. A new factory for the weaving of damasks is about to be erected in Kirkcaldy, a fact which indicates the activity prevailing in certain sections of the trade at the present time. Fancy jute goods, such as Brussels carpets, are moving off well, and there is an average business for the season passing in jute mattings. Linen threads are unaltered, but satisfactory quantities continue to be purchased by the large ready-made clothing manufacturers at Hebden Bridge, Leeds, and elsewhere. Prices are on a level with those current at the commencement of 1888.

GLASGOW, 13th February, 1890.

Shipbuilding.—There is a report that Messrs. A. & J. Ingles, Pointhouse, Glasgow, have secured an order for a 5,000 ton steamship for the British India Company. A four-masted steel ship, of 2,300 tons, has been ordered from Messrs. Duncan & Co., Port Glasgow, by Messrs. Gibson & Clark, Waterloo Street, Glasgow. The vessel is to be ready in June. A fire took place on Monday evening in the shipyard of Messrs. Robert Duncan & Co., Port Glasgow. The joiners' shop, a building of 350ft. in length, was completely destroyed, and damage effected to the extent of £10,000.

Pig Iron.—The "clearing out" process that has been going on for some time past in the iron market culminated on Monday morning, when, under the influence of one or two small failures and the apprehension of more to follow, sales of Scotch warrants were made at the opening of the market at 51s. 6d. to 51s. 1½d. cash, but gradually it was felt that the selling was pretty well exhausted, and that the bulk of the iron had passed into strong hands, while legitimate demand was coming on at the lower range of prices that had been established; and when Monday's very heavy settlements had passed off safely, confidence seemed restored, and sellers had no further cause to throw away their iron. There was a quick recovery on Tuesday, Scotch going to 53s. 6d cash. At that point there was a little reaction, but afterwards the market became steady.

Engineering.—General engineering is still in a very brisk state. Orders are every week being refused by firms whose resources are not equal to the output demanded.

The Forth Bridge.—The arrangements for the opening of the Forth Bridge by the Prince of Wales on the 4th March have now been finally settled. Instead of staying at the New Club, Edinburgh, the Prince is to stay with the Earl of Rosebery at Dalmeny. The directors' train will leave Edinburgh (Waverley Station) about eleven o'clock, and the Prince of Wales and party will join the train at Dalmeny Station. The train will then cross the bridge and proceed to Inverkeithing, as formerly provisionally arranged. On returning to North Queensferry, the party will embark on board two steamers, and, after being afforded an opportunity of seeing the bridge from the Firth—a proceeding whose enjoyment will depend entirely upon the state of the weather—will rejoin the train and cross the bridge to South Queensferry. At the connecting girder on the south side the train will stop, and the last rivet will be driven by the Prince. A banquet will be given by the directors at South Queensferry after the ceremony. Proposals are on foot to have a public holiday in some of the large towns in Scotland on the 4th March.

The Edinburgh Electrical Exhibition.—A singular proposal has been made in connection with the Electrical Exhibition to be held in Edinburgh this summer. This is to erect in the grounds of the Exhibition a model of the Forth Bridge, on the scale of ½in. to the foot. The model would thus be 300ft. long, and the headway under the centre of the spans would be 12ft. It is said that the Edison-Swan Company are willing to fit up such a model with 5,000 incandescent lamps. A deputation from the executive of the Exhibition waited on the directors of the Forth Bridge Railway Company with reference to the matter, but no decision has yet been arrived at.

The Gold Extracting Companies.—The Cassel Gold Extracting Company has just resolved to increase its capital by the issue of 30,000 new £1 shares. This makes the total capital of the company £180,000. The Australasian Gold Extracting Company (Pollok's Patents), Limited, has just been formed. Shares to the amount of £100,000 are to be taken as part payment by the parent company (Pollok's Patents Company), and the remainder of the capital (£150,000) was offered to the public for subscription. Applications were lodged for £190,476, or about 25 per cent. more than was asked for.

(From our own Correspondents.)

LIVERPOOL, 12th February, 1890.

The West Lancashire Railway Company.—In the half-yearly report of the directors, just issued, it is stated that the gross revenue for the half-year was £11,539 19s. 7d., as against £11,178 9s. 11d. of the corresponding period last year. The expenditure has been £10,429, showing a profit of £1,110. Considerable progress is being made with the Blackpool Railway, which will form an important branch of the West Lancashire line, and most of the land has been acquired for the undertaking.

Floating of the S.S. "Ligurian."—An interesting marine operation has just been performed on the River Mersey. On the 30th November last the "Ligurian," laden with Egyptian cotton, was run down while entering the dock by the steamer "Iowa," and literally cut in two, but kept afloat sufficiently long to be beached at Egremont. The stern half was towed to Messrs. Clover's shipyard, the watertight bulkhead preventing it from foundering; the other half will be towed from Egremont in a similar manner, and the two pieces joined together. A similar accident happened to the "Tudor," which was successfully floated and repaired in a similar manner last month, and now sails under the name of the "City of Belfast."

New Boats for Woodside Ferry.—The Birkenhead Town Council have just given Messrs John Jones & Sons, of Liverpool, an order for the building of two new double twin-screw passenger steamers, at a cost of £25,800. The boats are to carry 600 passengers, at a minimum speed of 12 knots an hour.

LEEDS, 12th February, 1890.

The Iron and Steel Trades.—Business has been somewhat restricted in the past fortnight, in consequence of the speculative condition of the iron market. Though

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inquiries are far less numerous than they were a month ago, there does not appear to be great eagerness on the part of manufacturers to sell, the chief reason for this being that the orders booked are ample for months to come. On the other hand, it is said that in some quarters the recent falling off in the demand for raw material is provoking fears as to the future. The unsettled state of the market has told against the inquiries for finished iron and steel from the Colonies and Australia. Prices obtained a fortnight ago are still adhered to with few exceptions, and with the contracts entered into the bulk of the finished iron makers and steel manufacturers are in a position to wait future developments. The engineering trade is still marked by great activity. There is hardly a firm which is not working full time, and several of the principal shops have work for fully six months ahead. One or two minor trade disputes are pending. Leeds boilermakers have served their employers with notices for an advance of 2s. per head all round.

THE COAL TRADE.—The West Yorkshire Coalowners' Association was represented at the meeting of colliery proprietors which was held in London on the 10th to consider the proposed formation of a colliery proprietors' federation and the demand of the colliers for a 10 per cent. advance in wages. The decision of the coalowners to resist the demand has created no surprise in the trading circles of this district. There is no doubt in the reality of a falling market with regard to house coal, both in price and demand, and indications are not wanting of a smaller inquiry for coke. Steam coal continues to be much sought after. As to the position of the colliery owners, it is hardly disputed that the contracts entered into have not been so remunerative as was anticipated, owing to the rapid advance in the cost of labour and materials.

SHEFFIELD, 12TH FEBRUARY, 1890.

RAILWAYS.—The first sod of a new local line of great importance was turned on Friday last by Earl Manvers. The main line from Beighton Junction to Chesterfield is 10¾ miles, and from Staveley to the junction with the Great Northern Railway at Annesley is 16¼ miles, making a total of 27¼ miles. This line will tap a coalfield estimated to contain 800,000,000 tons of coal. The present annual output of the collieries served by the new line is 17,000,000 tons.

COAL.—The colliery owners of South Yorkshire held a meeting on Tuesday, at Sheffield, to consider the question of miners' wages. There was a large attendance, most of the principal owners in the district being represented. The tone of the meeting was decidedly against any advance being conceded. No less than 35,000 men are concerned in this agitation.

IRON AND STEEL. The directors of Messrs. Vickers, Sons, & Co., Limited, have intimated to the shareholders that a further dividend for the year 1889 will be distributed shortly. Messrs. Henry Bessemer & Co., Limited, have issued a very satisfactory account for the past year's work, which is their first year as a limited company. A profit of £37,138 has been made. Several other local companies also announce substantial dividends. Pig iron has fallen from 10s. to 15s. per ton, and no doubt a corresponding reduction will be made in merchant and bar iron. The most serious item in the production of iron at present is the high price and scarcity of coke.

NORTH STAFFORDSHIRE, 12TH FEBRUARY, 1890.

THE IRON TRADE.—There is no complaint amongst the finished iron makers of the district with regard to orders or specifications this week. Prices are perhaps slightly weaker, bars selling at about £8 15s. to £9 per ton. Pig iron is in good demand, and prices show no signs of weakness. Middlesbrough iron is being brought into the district, and can be bought at lower prices than those ruling for local brands.

THE COAL TRADE.—The cold weather of the last few days has given a spurt to the sale of fuel for domestic consumption, and prices, which were showing signs of weakness, have hardened again.

DERBY, 12TH FEBRUARY, 1890.

THE MIDLAND RAILWAY.—The Company are seeking powers to raise £1,500,000 additional capital for the construction of branch lines in this district and other purposes. It is stated that an offer of £110,000 has been made for the whole site of the St. Pancras workhouse, which adjoins the Company's premises, with a view to an extension of their accommodation in North London. So great has the crush of goods traffic been of late that the directors have found it desirable to cut down permanently the number of passenger expresses in order to make way for luggage trains. The decision of the Board to sacrifice half-empty passenger for well-filled goods trains derives justification from a comparison of the passenger and goods traffic on this line. The goods receipts for the last half-year amount to £2,869,000 in a total of £4,221,000, or 65 per cent. of the whole, as against 57 per cent. in the case of the London and North-Western and 58 per cent. in that of the Great Northern Railway. Since 1881 the Company have expended more than a million and a half in buying up the coal waggons formerly owned by private traders, a policy that it is believed has greatly facilitated operations in the mineral department. An important change has been made with through goods trains between Bristol, Derby, and Scotland, some 24 of which will cease to pass *vid* Normanton, and will be worked *viâ* Pontefract over the Midland and North Eastern lines, effecting a considerable saving of time. The directors have recommended a dividend of 6¾ per cent. per annum for the last half-year.

COAL AND IRON.—Slack for steam purposes and coke are in good request, but the mildness of the season has caused a falling off in the demand for house coal. The whole of the capital for the Bolsover Colliery Company, Limited, has been subscribed, and it is announced that the plant for the colliery has been ordered. The coal, which is known as the "top hard coal," will be worked at a depth of between 300 yards and 400 yards. The Kilbourne Colliery has been re-started, with a capital of £20,000. The Erewash Valley Ironworks at Ilkeston have lighted their No. 1 furnace, which has been idle during the last six years. It has a producing capacity of about 400 tons of pig iron per week. The other furnaces of the company are undergoing repairs, and it is hoped that they also will shortly be in blast.

THE GAS WORKS.—The Derby Gas Company seek powers to raise £200,000 for extensions, which the Corporation, who themselves are promoting an application to the Board of Trade for supplying the electric light to the borough, will oppose.

CARDIFF, FEBRUARY 12TH, 1890.

COAL AND COKE.—The steam coal market continues exceedingly active, and buyers are quite at the mercy of colliery owners. One strange feature in the position is that inferior coals have advanced to a greater value proportionately than first-class qualities. Prices of large steam coal f.o.b. Cardiff are as follows: First quality, 15s. 9d. to 16s. 3d.; second, 15s. 3d. to 15s. 6d.; third, 14s. 9d. to 15s. Tonnage is plentiful, and, as freights outwards for the Mediterranean keep low, contractors are shipping as much as possible in view of a probable advance in freights. The coke market is not quite so active, but as all sellers are fully sold prices for odd parcels show no sign of weakness.

IRON AND STEEL.—In the pig iron trade the drop in Scotch warrants has completely suspended business. Makers, however, are firm in their prices, in view of the high prices for coal, coke, and iron ore, and, with the workmen's demands, it is difficult to see how they can give way. The trade cannot long remain as it is, and the general opinion seems to be that the legitimate trade is really no worse than when warrants were 12s. to 13s. higher than they are now. The same applies to steel, and for steel bars makers are firm at £7 15s.

IRON ORE.—Prices for Rubio ore are 17s. c.i.f. Cardiff or Newport, 18s. Middlesbrough, 18s. 3d. Glasgow. Sellers will not make any reduction on this price, and, as ironmasters are fairly well bought, the business transacted has been of a very limited nature.

MIDDLESBROUGH, 12TH FEBRUARY, 1890.

PIG IRON.—After the discouraging collapse of prices in the pig iron market, it is pleasant to have to report a reaction. Yesterday, there was not only a more numerous attendance on 'Change, but there was a greater eagerness to buy. Prices had fallen to 52s. 6d. for No. 3 G.M.B. prompt delivery. The market opened with this price, but it soon rose to 53s. and 53s. 6d., where it now stands. This was mainly owing to the favourable telegrams from Glasgow, where the chief business in Cleveland warrants is now carried on. Makers have never given in to the lower prices, but hold out for 60s. Those in want of iron take warrants in preference. Makers are confident of better prices shortly, and hold on at their own price. In hematite East Coast brands are quoted nominally at 78s. per ton f.o.b. for Nos. 1, 2, and 3 makers' iron. The stock in Connal's store yesterday amounted to 182,523 tons as against 184,227 tons a week ago, showing a decrease of 1,704 tons over the week.

SHIPMENTS OF PIG IRON.—The shipments have rallied considerably, and contrast more favourably with those of last month and the same month last year. Up to the 10th of the current month they amounted to 18,351 tons, against 15,380 tons to the 10th of January, and 14,507 tons to the 10th of February, 1889. Scotland is again taking her share, as also are Germany and Holland. There are signs, in fact, of a revival of the demand for pig iron both at home and abroad, and makers seem to be warranted in their expectations of higher prices in the immediate future.

MANUFACTURED IRON AND STEEL.—The demand for forge pig iron keeps it still 3s. or 4s. in advance of No. 3, so that, though the latter is 53s. 6d. per ton, the former cannot be had under 57s. per ton. This shows the steady pull on it by the wrought iron manufacture. Although there is little doing in the way of new orders, those in hand keep up the demand. Prices, however, are weaker in some lines. Iron ship plates are at £7 10s.; ship angles, £7 5s.; common bars, £7 10s. per ton, less the usual discount, f.o.t. on trucks at manufacturers' works. Steel ship plates are at £8 10s.; ship angles, £8 5s.; rails, £6 12s. 6d. per ton f.o.t. on trucks.

SUNDERLAND, 12TH FEBRUARY, 1890.

SHIPBUILDING AND MARINE ENGINEERING.—The dearth of new orders continues, and the demands for increased wages on the part of workmen have not ceased. The fitters and other members of the Amalgamated Society of Engineers have been temporarily quieted by being granted 1s. per week increase, with the understanding that a further similar increase, and reduction of working hours on Saturdays, shall be considered at an early date. Messrs. Wm. Allan & Co., of the Scotia Engine Works, are not bound by the decision, as they are not in the employers' association. This firm state that they cannot grant any increase, but in April or May they will perhaps be able to arrange to cease working on Saturdays at 12 a.m. instead of 1 p.m., as desired by the workmen.

SHIPPING.—Outward freights, despite fluctuations, have improved, but homeward prompt business from the Black Sea and Mediterranean is not satisfactory, and owners find great difficulty in obtaining remunerative freights. In the American market, which has so far been very firm and promising, forward fixing threatens to cause a collapse. The local coal shipments are still far from satisfactory, owing to the deficient outputs of the collieries.

RIVER WEAR COMMISSION.—The annual returns are fairly satisfactory, the revenue having increased from £131,864 12s. 2d. to £134,437 2s. 2d. for the year ending December 31st, 1889, an increase of £2,572 10s. This is in spite of a falling off in the clearances and in the coal shipments. 6,824 vessels, of 2,531,174 tons, were cleared, as against 6,997 vessels, of 2,539,502 tons, in the previous year, the falling off being entirely in the coasting trade. The coal shipments of the year were 4,122,509 tons, a decrease of 68,217 tons, entirely due to the stoppage of Silksworth Colliery by a strike.

NEWCASTLE, 12TH FEBRUARY, 1890.

SHIPBUILDING.—The outlook at the moment in the local shipbuilding trade is very different from what it was twelve months ago, when there was scarcely an empty berth to be seen on the river, and employers were at their wits' ends to secure a sufficiency of labour to carry on operations with the necessary despatch in the various departments. Now there are vacant places to be observed in the building space of even the most important establishments, and employers, instead of having to keep importuning the trade union agents for fresh supplies of workmen, are, generally speaking, somewhat overburdened with labour, and more likely to diminish than increase the number of men employed. There continues to be a very marked absence of inquiries, and scarcely any new contracts are being placed. All appearances, indeed, point to the conclusion that, what with the large production of last year and the high prices of the present, the demand for new tonnage has received an effective check, and the present activity in the building yards cannot therefore be long maintained. In spite of the very palpable change that has taken place in the prospects of the industry, the workmen are agitating for further advances of wages, and an important section have recently sent in a claim for an increase of 3s. per week. The splendid steamer "Eagle," which has just been completed by Messrs. Hawthorn, Leslie, & Co., for a Russian firm, is to take her trial trip this week, prior to her departure from the port. The vessel is expected to prove the swiftest as well as the largest merchant steamer that has yet been built on the river, and, from the great care that has been bestowed on her construction, there can be no doubt that in other respects also she is quite an exceptional vessel. At other yards on the river the finishing touches are being put to a considerable number of vessels, some of which are being fitted up for the accommodation of passengers.

ENGINEERING. The wages question in the local engineering trade has been settled by the concession of 1s. per week advance by the employers, but it is understood that the question as to the 12 o'clock stopping time on Saturdays will be raised again at the end of the month. Messrs. R. Stephenson & Co., of the South Street Works, have just commenced the construction of the largest set of triple expansion engines yet built by them. They are intended for a vessel to be built at the firm's yard at Hebburn. The locomotive department is extremely busy, the firm having engines in hand for home and foreign railway companies. At Messrs. Watson & Son's establishment, High Bridge, business continues active, the demand for the special ships' pumps manufactured by the firm being particularly good.

THE COAL TRADE.—The coalowners, at a meeting held on Saturday, decided to refuse the advance asked for by the Northumberland miners, but indicated their willingness to reconsider the matter when the ascertainment of prices is taken for the months of December, January, and February. The shipments of coal and coke at Tyne Dock for the week ending February 8th amounted to 111,053 tons, being an increase of 23,767 tons as compared with the shipments for the corresponding week last year.

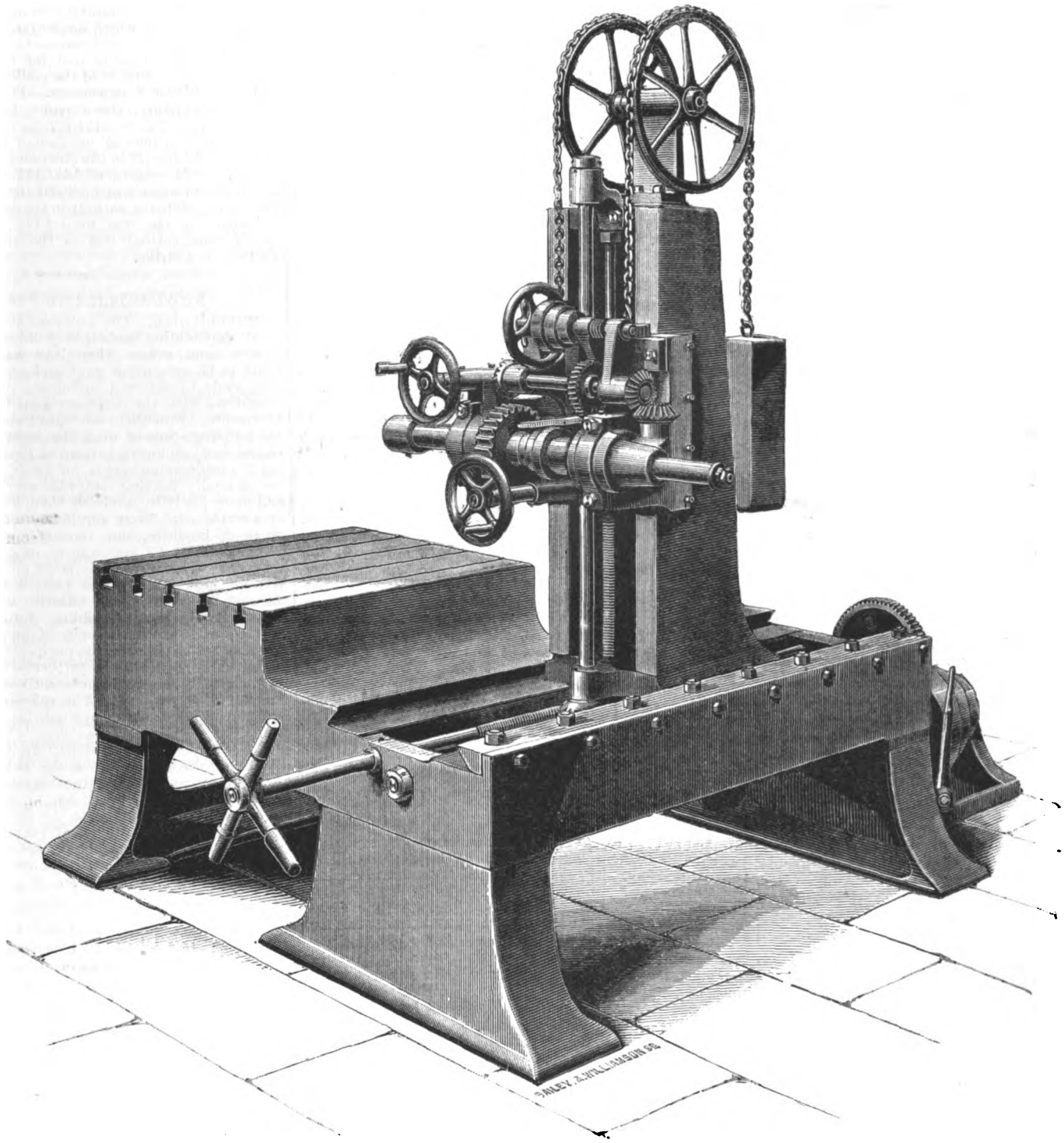
DUNDEE, 12TH FEBRUARY, 1890.

JUTE AND FLAX TRADES.—Advices from Calcutta state that the market for loose and baled jute is showing a downward tendency. In this market there is at present comparatively little doing, either in spot parcels or on contract. Jute yarns are in better request and prices have improved. The demand for Hessians is also brisker, and advices from New York report a firmer market there this week. Burlaps 40in. 10½oz. are quoted at 5¼c. to 5⅜c. per yard, compared with 5⅜c. to 5½c. last week A decline in the rates asked for flax has led to an increase in business, and a considerable number of contract transactions are reported. Complaint continues to be made of the influence exercised by foreign yarns in depressing home yarns. For linen cloth orders are coming in satisfactorily. In the fine goods produced in the Fifeshire district the demand on home account is not coming up to expectation. Orders for export are satisfactory, and manufacturers are well employed.

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HORIZONTAL DRILLING AND BORING MACHINE.

CONSTRUCTED BY MESSRS. HETHERINGTON & CO., ENGINEERS, MANCHESTER.



HORIZONTAL DRILLING AND BORING MACHINE.

WE illustrate above a useful horizontal drilling machine designed for a variety of work where it is difficult to fix the article to be drilled. It has a massive bed, formed with a transverse slide, in which the vertical standard is fitted. The latter is of strong design, and has a carriage or headstock fitted to a vertical slide on the face of the standard. The wearing surfaces in both the transverse and vertical slides are broad, giving great rigidity. The boring spindle is borne by the carriage in hardened necks, and has a variable self-acting feed by means of a rack and pinion, which can be readily disengaged so as to give a hand feed. The illustration will show that the machine is powerfully geared in the carriage, and that a stepped cone is fixed on the driving shaft, two changes of gear being also added. If necessary, a reversing motion can be fitted for tapping, the carriage being balanced as shown. The illustration represents a machine with a table 3ft. by 2ft. 6in., a horizontal traverse of 3ft., the spindle having a vertical movement of 2ft. and a self-acting feed of 12in. Messrs. Hetherington & Co., of Manchester, are the makers.

COMMERCIAL EDUCATION.

THE Conference which was held in London recently, under the auspices of the London Chamber of Commerce, and with the Lord Mayor in the chair, marked an important step in the advancement of that department of technical education which is of special use to those engaged in commerce. We have often pointed out that, if employers would only take a little more interest in the subject, the problem of technical education could easily be solved. If they encouraged, or if necessary, insisted on their young men supplementing their experience in the workshop, manufactory, or office by classes in which they obtained a knowledge of the theory of their work, their requirements would be fully met without any very elaborate organisation. The object of the Conference was chiefly for the purpose of bringing about co-operation between teachers and employers, both of whom were represented by leading men.

The Lord Mayor pointed out that commercial education was becoming at the present day a question of bread and butter, and further, that the competition of foreign clerks with those of our own country was increasing rather than diminishing. The scheme which had been arranged by the London Chamber of Commerce had been revised by a special committee and by the Oxford and Cambridge Examining Board, and had thus been brought into conformity with the wishes of men of business and of educationists, and it had been prepared so as to be adaptable to commercial and industrial centres throughout the kingdom. The London Chamber only undertook examinations and management of the scheme in regard to the Metropolis, and it was hoped that similar arrangements would be made for other large centres. The scheme sought to supply inducements to schoolmasters and pupils, such as hitherto had not existed in this country, but which had long been in action in France and Germany under the military system, as in those countries young men passing their school examinations were able to complete their military obligations with one year's service, whereas they were obliged to serve three years if they failed in their examinations. The London Chamber of Commerce had succeeded in obtaining the co-operation of over 200 firms in the City, who agreed to give preference in employment to young men who had taken certificates under the scheme. It had also obtained from its members offers of various prizes and scholarships to be given for the highest passes under the scheme, or for passing in particular subjects.

Another object of the Conference was to make the scheme widely known, in order that it might be taken up in as large a number of other towns as possible.

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

Contents.

	PAGE
Power Pusher for Brick-making Machines (*Illus.*)	145
The Recent Growth of Technical Societies	145
Training for Trades and Crafts—I.	146
Notes on Patents—III. Trade Secrets	147
Protective Cements and Weight-Saving in Ship Structures	147
Chapman's Quadruple Evaporator (*Illus.*)	148
Bouit's Cylinder-Lubricant Tester (*Illus.*)	149
The Tunnel under the Clyde	149
Foreign Industries (Corres.)	150-151
The Steam Engine Indicator (*Illus.*)	
Notices of Meetings	152
Prices Current	153
Foreign Telegraphic Advices (Corres.)	153
Shipbuilding Notes	153
Home Industries (Corres.)	154-155
Horizontal Drilling and Boring Machine (*Illus.*)	
Commercial Education	156
The German Emperor and the Labour Question	157
The Progress of Forced Draught	158
Commercial Morality	158
The Railway and Canal Traffic Act, 1888	158
Coal, Iron, and Cognate Industries	159
Clyde Shipbuilding in January	159
Letters to the Editor:—	
Continuous Brakes for Goods Trains	159
Steam Boiler Legislation	159
Adjustment of Labour Disputes	159
Books Received	160
Reviews	160
The Physical Society	160
The Pollok Gold Extracting Process (*Illus.*)	161
The Institution of Electrical Engineers (*Illus.*)	162
The Society of Chemical Industry	164
Notes	164
"Industries" Patent Record:—	
Applications and Acceptances	165-166
Illustrated Abridgments	166-168

To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

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Industries:

FRIDAY, 14TH FEBRUARY, 1890.

THE GERMAN EMPEROR AND THE LABOUR QUESTION.

THE rescript of the German Emperor gives a fresh turn to the discussion upon the labour question. It does not yet appear whether he has been inspired by the State Socialism of Bismarck, or by the professorial Socialists in the chairs of political economy in Berlin and elsewhere, or whether his manifesto is simply an astute political move to outdo the Social-Democrats and thus to cut the ground from under the feet of the rapidly growing Social-Democratic party in Germany. The most favourable view of the action of the Emperor William is that he has set before himself the enormous task of settling the wages question, not only for Germany, but for the civilised world. If he has really set himself to do this, we can at least admire the gallantry of the attempt, however little faith we may have in the success of it. If the not unnatural suspicion is well founded, that political expediency, and not enthusiasm of humanity, has produced the manifesto, the Social-Democratic, or rather the Radical, party in Germany may be trusted to discredit it. In the meantime, we are bound to take the manifesto seriously, and to ask ourselves what it really means and what its probable results may be. As might be expected from a Government which is even yet largely despotic, the indication which the Emperor William gives of his theory of the State is practically that of a State in which the dominant power is the King, who is the father of his people. "It is the duty of the State," he says, for example, "so to regulate the duration and nature of labour as to ensure the health, morality, and economic wants of the working men, and to preserve their claim to legal equality." This theory is certainly not that generally current in England and in America. In both countries, in spite of an intermittent and frequently unobserved tendency in the actual practice of legislation to increase the power of the State, the general tendency of public opinion is that that power should be curtailed rather than extended. In so far as the Anglo-Saxon people may be taken as a gauge of progress, and their tendencies assumed to be in the line of it, the conclusion would be that the Emperor William's opinions and proposals are alike reactionary. We were at that stage long ago. The writings of English statesmen in the reign of Queen Elizabeth exhibit many passages parallel to that we have quoted from the speech of the Emperor William; but we have progressed a great deal since then. In fact, our theory of the State has pretty well been reversed. Instead of regarding the State as being bound "to regulate the morals and the economic wants" of men, we now-a-days look upon it as being a rather greedy monster, who devours a large portion of our produce, and who requires to be very strictly chained up indeed. The paternal theory, whatever charms it may have in the Fatherland, has few charms for English people, in spite of our intermittent relapses into belief in the efficacy of governmental management of individual concerns.

The attempt, however, of the young Emperor to initiate a formal discussion of the labour question by European rulers and statesmen is gallant enough. He may not succeed in effecting any material good by it—it would be passing wonderful if he did—but the natural ambition of a young ruler has at least been gratified. He has propitiated King Mob by an old expedient, with which King Mob has for a time almost invariably rested content. "We must inquire, we must inquire," is, after all, a specious enough cry for most ears; and the Emperor William, disturbed as he has been by the strikes in Westphalia, has become alive to the fact that, with the example of English and American workmen before them, German workmen will not be patient under the military discipline and wretched wages to which they have been accustomed, and therefore his sudden interest in the working class has a feasible enough explanation. It may be that he has been really affected by the position of German labour, and that he has been engaged in economic researches into the "standard of comfort." It is a not uncommon practice for students of such subjects to rise from a study of the elements of them with a burning zeal to redress the wrongs of the whole world at once. There is a suggestion of some such *naïveté* in the rescript of the Emperor. The neophyte jumps to the conclusion that nothing short of wholesale reorganisation by the single governmental act of superior persons will meet the case of the working class, and he forthwith appeals to the world for those superior persons to come forward and reform it. Meantime his own backyard may be breeding a pestilence. In some such form is the Emperor William, who convenes sovereigns together to discuss the wages question of the civilised world, while he naïvely admits that in his own mines things are not as they should be. Indeed, if Germany has been for a time the headquarters of more than one of the schools of political economy, it has also been for a time the headquarters of that exaggeration of the commercial spirit which refuses to discuss with labour, as if employment were not, as it really is, a contract, a matter of business, and not a matter of sentiment. While it would be preposterous to insinuate that industrially Germany is an Augean stable which needs cleansing by this young Hercules, it is fair enough for us to say in reply to his proposals—leave the German workmen and employers to fight it out together as English workmen and employers have done, or, better still, encourage arbitration by facilitating the establishment of, or by establishing, boards of arbitration. But in any case do not begin by demoralising the people you want to serve. If it is the duty of the State "to regulate economic wants"—(surely he means the supply of them and not the wants themselves)—if it is the duty of the State "to regulate health and morals," what is the duty of the individual man? Mazzini's famous essay on "Rights and Duties" should be read, as the antidote of a stout old Republican to such Imperial nonsense as this.

There is a certain importance in the emergence of this question at such times as these, for opinion is indeed seething with new social and industrial ideals, and, though the economic forces are stronger than Emperors, and even than Iron Chancellors behind them, the very expression of such opinions, inept as it is in many ways, is an evidence of the force which such ideas are possessing. Following upon our leader of last week, and our previous consistent declarations on the subject, we may repeat that we view with a kind of disinterested curiosity such efforts as those of the German Emperor, realising, as we must, that after all the State must do but little, because, in the nature of things, it is powerless when the forces are against it. To distrust the action

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of Governments, to avoid bureaucracy, to shun industrial legislation, and to welcome spontaneous association or individual action for the public good—this, in effect, must be the policy of a new movement separate from all the tweedledum and tweedledee of party politics. If, as is not unlikely, the Convention on Labour which the German Emperor, if he receives sufficient encouragement, must now summon, results merely in admitting the ineptitude of the State to deal, either in wholesale or in retail, with effective amelioration, much good will have been done. A change in the attitude of the public mind towards the powers and sphere of the State may even be effected. The importance of such a Convention would lie, however, not so much in any immediate practical results that might arise from it, as in the mere fact of industrial problems having thrust themselves into the place previously occupied by dynastic and territorial questions. The reception of this proposal by different Governments of Europe, and the alacrity, or want of it, which some of them may exhibit in responding to the invitation, will be very eagerly discussed. More than this, such are the effects of international rivalry, that it would be entirely what might be expected if France, stung by the ursurpation by her rival of a *rôle* to which she herself has some historic claims, embarked on a labour propaganda more drastic even than that proposed by the Germans, and thus disputed with them their position as the friend of the proletariat. History has repeated itself strangely, for there have been times when King and people have combined against the nobles; and now we find the same with a difference—the King attempting to effect an alliance with the people against the middle class. The conflict of modern ideas with ancient forms like semi-despotic monarchy produces strange results indeed.

It may be questioned whether the proposal is at all likely to be accepted gratefully by the extreme party in Germany. They, almost to a man, would regard a Republican form of Government as being a necessary part of such social reconstruction as the Emperor William indicates in his rescript. For the labour question to be settled by a semi-absolute Monarch would not be at all welcome to those who regard political freedom as the only security for industrial freedom.

THE PROGRESS OF FORCED DRAUGHT.

There are few subjects connected with steam engineering about which we have less definite information than what is usually called "forced draught," although the name is not by any means definite. All draught, in a sense, is forced draught, for we have either to pull it along by means of a chimney or blow it along by means of fans or a current of steam. The ordinary chimney has, however, come to be looked upon as the natural method, while the artificial methods in use are: (1) The steam blast, such as we find in locomotives, by which the products of combustion are ejected from the chimney by means of the exhaust steam; (2) an air-blast delivered under the fires with a closed ash-pit, such as has been designed by Mr. Howden; (3) the closed stokehold system, in which the boiler room is made air tight, and air is forced into it by a fan until the pressure is above that of the atmosphere, the only vent being through the furnaces to the funnel. In making comparisons of results, the object in view in applying the forced draught must be clearly kept in mind. If the boiler be simply looked upon as an apparatus for burning coal economically, the closed ashpit system has hitherto been regarded with the greatest amount of favour. But if the boiler be looked upon as an apparatus for generating the greatest amount of steam in a given time, as is required in ships of the navy, it is maintained by those who have had experience of the system that the closed stokehold gives by far the best results that have yet been obtained. Whether the improvements which are being made in this system have been sufficient to combine in it both advantages is a point regarding which, as yet, we have no definite information, and the experience gained by the Inman liners, "City of New York" and "City of Paris," both of which are fitted with closed stokeholds, would be a valuable addition to our knowledge of the subject, and we hope that in due time it will be forthcoming. Mr. Howden's system has been applied to the White Star liners "Teutonic" and "Majestic," and by-and-by their performances will afford a direct measure of the comparative results of the two methods.

Of course Mr. Howden thinks his own system the best, and states that, notwithstanding the improvements which have been made on the stokehold system, he considers it radically defective, and he predicts that two years from this it will be found that it has not been successful. We infer that he means by that time it will have rendered the boilers useless, and, therefore, that the apparent economy has not been real. It is never safe to prophesy, or to rely on a prophecy, and in the absence of definite information we will not venture to express an opinion on the subject. Mr. Howden has, however, published some results of his own system, which will be of interest to marine engineers and shipowners, and of which we will give an abstract.

For what is usually called natural draught in an ocean steamer, the i.h.p. obtained per square foot of fire-grate is from 9 to 12. For an "Atlantic racer" with triple expansion engines, worked up to their utmost possible power, the i.h.p. per square foot with natural draught may be assumed as 12. The "City of Paris," with its closed stokehold, gave 15 i.h.p. per square foot of grate, or an increase of power of 25 per cent. Mr. Howden states that fully eighteen months ago he undertook to refit one of the "Clan" line of steamers with triple expansion engines and one single-ended boiler of 3 furnaces, having 50 square feet of fire-grate, and a total heating surface of 2,338 square feet. From this boiler he undertook to give an average of 1,000 i.h.p. in ordinary working at sea, or 20 i.h.p. per square foot of fire-grate. It was found on trial that the engines gave an i.h.p. of 1,300, or 26 i.h.p. per square foot of grate. The results otherwise were also so satisfactory that the company resolved to have six of their steamers refitted with exactly the same engines and a single main boiler, and the results have been most satisfactory, and they have been taken from actual performances at sea, and not from ordinary trial trips. They show on an average a consumption of coal of 1·25lb. per i.h.p., and 23·66 i.h.p. from each square foot of fire-grate; and if the style of firing which obtains in Atlantic racing steamers were adopted, this could easily be increased to 25 i.h.p. per square foot of fire-grate. Comparing this with the highest natural draught power of 12 i.h.p. per square foot, and 15 i.h.p. per square foot of the "City of Paris" with closed stokehold, it shows an increase of 108 and 66·6 per cent. respectively. The coal consumption in the "City of Paris" has not been published, but 1·25lb. per i.h.p. per hour, the quantity used in the "Clan" liner, is the least known of any sea-going steamer.

Mr. Howden will shortly have completed nine sets of engines and boilers on his system for Messrs. George Smith & Son's Calcutta steamers, so it is quite evident that it is being appreciated by shipowners, not only for its great economy in coal consumption, but also in wear and tear, as compared with boilers with ordinary draught, and he has published evidence on this point, which, however, we need not reproduce. Until we have more definite information with regard to the economical performances of steamers with closed stokeholds, we will not pronounce a definite opinion on the relative merits of the two systems, and we trust that this information will be forthcoming. In the meantime, however, Mr. Howden remarks, that why it is that the use of the closed stokehold system is continued by the Admiralty, and is fitted in Atlantic steamers, when it is shown beyond cavil that a system greatly superior in every respect exists, is a question somewhat difficult to answer. Possibly some of our readers may have some remarks to make on the other side of the question.

COMMERCIAL MORALITY.

"Palm oil" is a colloquial but expressive term to indicate bribes given as so-called commissions to influence orders or to pass work not properly carried out. Most commercial men have noticed the recent case tried before the Central Criminal Court, in which Bell's Asbestos Company figured as prosecutors. As shown by this case authenticated bribing cases are necessarily hard to find, as the parties concerned, for their own purposes, keep the matter to themselves. Bribing is as invisible as a current of electricity, but its presence and influence are just as much felt. The existence of "commissions" is so well known that it is needless to give instances. It is to the advantage of both giver and accepter to keep the matter in the dark. Where, however, certain parties disagree, light is sometimes thrown upon the transaction. The Salford Corporation and the Metropolitan Board of Works cases are possibly within the recollection of most readers. Few persons, however, are aware of the extent to which the practice goes. We have the greatest sympathy with firms who will not tolerate it, for we know instances where the system has been the cause of mischievous results. The coal merchant finds that a complaint is lodged against the coal which he has delivered to a gas company, and he may recollect that he originally obtained the order against adverse influences which he could not fully understand; and this complaint comes forward when the coal contracts are to be renewed. An investigation may show that the gas has not been properly purified, or something has been omitted; but, whatever it is, he loses the contract. The oil manufacturer may find that his lubricant is complained of - the quality is not good, and the bearings heat. An inquiry may possibly show that foreign substances have been introduced into the oil; and that a twist of the spanner has been the cause of the heating. It is hard enough to detect the practice in small concerns, but in large businesses, where the principals do not and cannot look after the details, it is almost impossible. The principal must rely on his assistant to report, and this is necessarily the case with all companies, corporations, and Government departments. We know that the practice has taken a wide root, and that there are good firms who give "commissions." They say in mitigation, but not in defence, that the practice is adopted by competitors, and that, therefore, the "usual commission" must be given. The whole theory of such "commissions" is rotten—the giver is as culpable as the receiver—"It is twice curst." It is a distinct bribe to another person's servant to obtain an order. The price is loaded so as to carry the "commission," which should belong to the purchaser by way of discount, and not to his agent. Payment to one's own agent by way of commission is right enough - lawyers, architects, auctioneers, brokers, and travellers are frequently paid by their own principals in this way. What we do take exception to is the acceptance of commission from anyone but the receiver's own principal. In the report of the case above alluded to, it would seem that the "commissions" paid by the company were entered in their books as "extra wages." If it is an honest practice, why should not they be entered correctly?

So far as we can see, there is nothing to be said in favour of commissions. An employer is entitled to have from his employés and agents unbiassed advice; and he is deprived of the benefit of that advice and judgment if the agent is in the pay of someone else. That particular form of jobbery which is known as "commissions" could be easily put down by a short Act of Parliament making it penal to give them and for an agent to receive them without the consent of his principal. We commend this subject to the notice of any Parliamentary member anxious to improve our commercial morality.

THE RAILWAY AND CANAL TRAFFIC ACT, 1888.

The inquiry before the Board of Trade into the classifications and schedules submitted by the railway companies in compliance with the provisions of the Railway and Canal Traffic Act, 1888, is still proceeding. The case for the companies has been concluded, and that for the traders is now under the consideration of the Court. The prospect of any conclusion of the proceedings within a reasonable time still seems remote, as many witnesses have yet to be called, and sittings will probably have to be held in Wales, Scotland, and Ireland. When the arguments and evidence are concluded the presiding officials will have a mass of matter before them which must involve lengthy consideration. In opening the case for the traders, Mr. Balfour Browne, Q.C., rightly pointed out the extreme importance of the matter to the whole country. If any practical schedule and classification is the outcome of this inquiry the internal trade of Great Britain must be regulated by them for many years to come. A review of railway legislation shows that a long interval has elapsed between the various efforts that have been made by Parliament to regulate railway charges, and it is impossible to conceive, after the enormous expense to which all parties are being put and the very exhaustive inquiry in progress, that railway legislation will be broached again at any rate in the nineteenth century. The traders first complain of the meagre information afforded by the railway companies on the all-important point of the cost of terminals and the general cost of working as compared with actual rates in force, and the maxima for which the companies are now contending. With regard to the vexed question of terminals, the traders admit that some charge should be allowed for loading and unloading, this being already authorised by statute in most instances, but they contend that a maximum charge based on the cost should be fixed by Parliament for every different service performed; that where there exist private sidings or no service is performed a rebate should be allowed; and that as in the case of rates, traders should be entitled to see

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particulars of every terminal charge made. With regard to the classification, complaint is made that many articles are not specified, and that every article known to commerce must be included. It is also contended that there should be one classification only, instead of a statutory or maximum, and a working or current one, as proposed by the companies. It is a stereotyped assertion that the proposed classification involves rates higher than those now in force, in order to leave a margin for heavier charges in times of good trade, or to meet contingencies, and that there is no immediate intention of bringing them to bear. The traders insist that one working classification with fixed rates is essential.

To put the whole matter briefly, the railway companies are making every effort to not only maintain their existing charging powers, but to increase them, while the traders are engaged in the apparently somewhat forlorn hope of materially reducing them.

COAL, IRON, AND COGNATE INDUSTRIES.

The Board of Trade Returns for the first month of the present year have now been issued, and in relation to the industries under review must be considered of a satisfactory character. The total value of the imports was £38,143,850, being an increase of £85,532 as compared with January, 1889. The total value of the exports was £21,586,752, being an increase of £1,059,715 as compared with January, 1889. The total quantity of iron and steel exported was 302,751 tons, valued at £2,531,563, as compared with 300,324 tons, valued at £2,158,679, in January, 1889. We append our usual tabular statement :—

	Month of January, 1890.		1889.
Pig and puddled	£246,702	...	£153,690
Bar, angle, &c.	137,160	...	135,925
Railroad.....	538,682	...	376,275
Cast and wrought	484,238	...	398,969
Hoops, sheets, &c.....	341,942	...	327,541
Unwrought steel	147,504	...	106,842
Unwrought copper	165,118	...	53,224
Coals	1,356,001	...	1,059,683

Turning to the home markets we find a feeling of uncertainty with regard alike to the course of demand and prices. The speculative "bearing" of the Scotch and North of England markets, which has proved so successful, has disorganised the army of buyers. The feeling of confidence which prevailed at the opening of the new year has given way to one of doubt, and, in the minds of those inclined to pessimism, to one of fear. It is, perhaps, unwise to prophesy, as the course of trade is notably of a vagrant character, but the signs of the commercial times still point to a further measure of improvement. It is quite possible that during the next few weeks the Glasgow "bears" may turn to "bulls," and a sharp rally in prices occur. Legitimate trade is still good, and the order books of manufacturers bear evidence that a large bulk of business is still being transacted.

CLYDE SHIPBUILDING IN JANUARY.

The first month of the new year has given decided indications of a coming lull in the shipbuilding industry. The paucity of orders booked throughout the country is remarkable, and only two vessels of about 1,000 tons were secured by Clyde shipbuilders. The number of inquiries, too, fell considerably below the average for the past five or six months. This may in a measure be attributed to the less profitable rates of freight which now exist.

The total tonnage launched was 19,712 tons, which exceeds the average for the corresponding month during the last ten years by about 6,000 tons. The most noteworthy vessel put into the water was the high speed paddle steamer "Princess Victoria," built by Messrs. William Denny & Brothers, Dumbarton, for the joint committees of the Portpatrick and Wigtownshire Railways for their service between Larne and Stranraer. Her principal dimensions are:—Length between perpendiculars, 280ft. ; breadth, 35·5ft. ; and depth, 14ft. In this vessel a new departure has been made from the ordinary practice in paddle steamers, by placing the first-class accommodation amidships immediately forward of the machinery.

The following are the particulars of the vessels launched during the month :—

Screw Steamers.

By Messrs. Caird & Co., Greenock :—"Wistow Hall," 3,200 tons. Built of steel, and fitted with triple expansion engines of 2,000 i.h.p. by Messrs. Caird & Co., for general cargo trade. Owners, Sun Shipping Company, Liverpool.

By Messrs. R. Duncan & Co., Port Glasgow :—"Ascension," 450 tons. Built of steel, and engined by Messrs. Rankin & Blackmore, Greenock, with triple expansion engines. Owners, Messrs. Morton & Williamson, Glasgow.

By Messrs. D. Dunlop & Co., Port Glasgow :—"Francisco Vidiella," 450 tons. Built of steel, and engined by the builders. Owners, Messrs. Vincente, Martinez, & Co., Monte Video.

By Messrs. Fullerton & Co., Paisley :—"Rostrevor," 200 tons. Built of iron, and fitted with compound engines by Mr. Wm. Kemp, Govan. Owners, the Newry and Kilkeel Steamship Company.

By Messrs. Murdoch & Murray, Port Glasgow :—"Roseneath," 2,650 tons. Built of steel, and supplied with triple expansion engines by Mr. Wm. Kemp, Govan. Owners, Messrs. P. H. Dixon & Harrison, Glasgow.

By Messrs. Mackie & Thomson, Govan : —"Persis," 1,900 tons. Built of steel, and fitted with triple expansion engines of 900 i.h.p. by Messrs. Muir & Houston, Glasgow. Owners, Messrs. Aitken & Walker, Glasgow.

By Messrs. Murray Bros., Dumbarton : —A screw steamer, 450 tons. Built of steel, and engined by Messrs. Matthew Paul & Co., Dumbarton, for Clyde owners.

By Messrs. McArthur & Co., Paisley :—"Nautilus," 360 tons. Built of steel, and fitted with engines of 350 i.h.p., for coasting traffic. Owners, Messrs. Webster & Co., Cape Town.

By Messrs. Russell & Co., Port Glasgow :—"Bremerhaven," 3,330 tons. Built of steel, and fitted with triple expansion engines by Messrs. Duncan Stewart & Co., Glasgow, for the oil trade between New York and the Continent. Owners, Messrs. Herman Stursberg & Co., New York.

Paddle Steamers.

By Messrs. Wm. Denny & Bros., Dumbarton :—"Princess Victoria," 1,000 tons. Built of steel, and engined with compound engines by Messrs. Denny & Co., Dumbarton, for passenger and cargo traffic. Owners, Portpatrick and Wigtownshire Railways Joint Committee.

By Messrs. A. & J. Inglis, Glasgow : —"Rasmara," 900 tons. Built of steel, and supplied with engines of 2,000 i.h.p. by the builders, for service between Rangoon and Moulmein. Owners, British India Steam Navigation Company.

Sailing Vessels.

By Messrs. D. & W. Henderson, Partick : —Six lighters, 222 tons each. Built for the Colonial Sugar Refining Company, for trade in the Australian rivers.

By Messrs. Russell & Co., Port Glasgow :—"Glen Cona," 2,500 tons. Built of steel. Owners, Messrs. W. O. Taylor & Co., Dundee.

By Messrs. A. Stephen & Sons, Govan : —"Fascadale," 2,100 tons. Built of steel. Owners, Messrs. J. & A. Roxburgh, Glasgow.

Analysis of Launches.

	Steamers. No.	Tonnage.		Sailing Vessels. No.	Tonnage.
Great Britain	8	10,750	.....	2	4,600
South America	1	450	.....	—	—
Australia	—	—	.....	6	222
South Africa	1	360	.....	—	—
United States.....	1	3,330	.....	—	—
	11	14,890		8	4,822

Letters to the Editor.

CONTINUOUS BRAKES FOR GOODS TRAINS.

To the Editor of "Industries."

Sir,—I was pleased to see your article on "Large Railway Trucks for Mineral Traffic," published in your issue of the 24th ult., and also the letter of Mr. R. Jefferds, in your issue of last week, drawing attention to the importance of light weight, high capacity, bogie truck freight cars in the economy of railway working. Equally important in my opinion is the equipment of goods trains with quick-acting continuous brakes. This is another instance in which American practice is in advance of English practice. The introduction of large railway trucks will facilitate the introduction of continuous brakes, as the cost of equipment with a powerful brake is practically the same whether the truck is large or small. Many of the freight trains in the States are now fitted with these quick-acting brakes. In some trials made by the Westinghouse Brake Company in the United States with 50 freight cars it was found that the farthest brake from the engine was applied in two seconds, thus making the application of the brakes on each car practically instantaneous.

As the velocity of compressed air at 60lb. above the atmosphere is about 1,800ft. per second, and as the brake is applied 1,900ft. from the engine in two seconds, the air passes through the train at nearly its maximum speed. A whole train of fifty cars at forty miles an hour was brought to a stand in 580ft. on the level. In one instance, the train running at nineteen miles an hour was stopped in 78ft., two car lengths.

The introduction of continuous brakes on goods trains would enable the speed of the service to be increased, besides avoiding the frequent accidents which we hear of happening to goods trains, but which, as they only destroy rolling stock and plant, are not dwelt upon so largely as if life and limb were at stake. The placing of a good, reliable, rapid continuous brake in the hands of the engine driver would be like placing a good helm to a ship in the hands of the steersman. The engine driver would run his train quickly on its journey, steering his way at any speed he desires, through the network of signals on his route. The train, regulated by the driver's valve, answers to the slightest touch of the driver from stop up to full speed ; and thus, paradoxical as it may appear, a good, reliable, rapid brake for stopping the train would actually increase its speed, and enable the journey to be more quickly performed, thereby saving the time of drivers and guards and the expenditure of fuel burnt on the journey.

Those of your readers who travel on the Brighton line will have noticed the speed with which the passenger trains come running into the stations, and how quickly they are brought to rest, the driver having in his hands a reliable and powerful brake in which he can put confidence and which he uses at the right moment.

The cost of equipping goods trains with continuous brakes would be saved if only one accident was prevented. Our English companies are rather slow to act in introducing new features into their working, but one would have thought that the experience of numerous accidents would have led them ere this to the use of continuous brakes for all trains, without waiting for the States to lead the way. Even now, although continuous brakes have been in use for many years on most passenger trains, yet it has been found necessary at last for the Board of Trade to compel the adoption of automatic continuous brakes to *all* passenger trains. Let us hope that so many years will not elapse before the same rule is applied to goods trains, and that shortly we shall find the same brake power in use for goods traffic as for passenger traffic. My impression is that, as the greatest economy is found with large trucks for mineral and other heavy traffic, so will that economy be increased by using the quickest, lightest, and most reliable continuous brake.

Yours, &c.,

J. E.

London, February 11th, 1890.

STEAM BOILER LEGISLATION.

To the Editor of "Industries."

Sir,—Those of your readers who have taken sufficient interest to read my letter of the 24th ult. under this heading will agree that Mr. Young's attempt to dismiss it in his letter in your last week's issue as a mere attack upon his "district inspector" is a very small device. No such thing was intended, and it will not bear any such construction. It is and was intended as an attack upon the stand taken by the Scottish Boiler Insurance Company in declaring "they held no duty to the insured," and particularly with regard to their carrying their views into practice, by not even sending an inspector of any kind to see the boiler of the s.s. "Perseverance" before insuring it, it being my opinion, and probably that of all competent boiler inspectors, that reliable inspection is the only reason for the existence of boiler insurance companies. I think Mr. Young has unnecessarily brought the name of his district inspector into the matter. The real question at issue does not refer to an individual only, but to the class and requirements of inspectors employed by boiler insurance companies.

I enclose for your perusal transcript of the evidence taken by the shorthand clerk to the Commissioners of the Board of Trade at the formal investigation upon the cause of the explosion of the boiler of the s.s. "Perseverance," from which you will see that the expressions I have quoted in my letter of the 24th ult., relating to the manner in which the Scottish Boiler Insurance Company performs its duties and carries on its business, were made by Mr. J. D. Young, managing director, and by Mr. Henderson, the counsel appearing for this company, and in the exact words I used.

It is difficult to see, therefore, where the "obvious inaccuracies," Mr. Young refers to in my letter, exist.

Yours, &c.,

Boiler Inspector.

Manchester, February 11th, 1890.

ADJUSTMENT OF LABOUR DISPUTES.

To the Editor of "Industries."

Sir,—We have the honour to enclose you a copy of the final report of the Conciliation Committee of this Chamber, as adopted at the Special Council meeting, held on the 6th inst.—We are, Sir, yours faithfully,

John Lubbock (President).
Kenric B. Murray (Secretary).

Further Report of the Labour Conciliation Committee to the Council of the London Chamber of Commerce.

Your Committee has endeavoured to devise some practical methods for carrying out the scheme contained in the interim report provisionally adopted by the Council on the 12th December.

The Committee offers the following suggestions :—

I. That a permanent body be constituted, to be called "The London Conciliation Board," which shall be affiliated to the London Chamber of Commerce, and that its composition shall be as follows, viz. :—

(*a*) Twelve members representing Capital or Employers, to be elected by the Council of the Chamber.

(*b*) Twelve members representing Labour, to be elected by the employed.

(*c*) To these shall be added representatives from the separate Trade Conciliation Committees as hereinafter referred to.

(*d*) The body thus constituted shall add to their number six other members, who from their position, authority, or experience, may be useful in promoting the objects of the London Conciliation Board, three to be appointed by the Labour representatives on the Board, and three by the representatives of Capital.

(*e*) Four members—viz., the Lord Mayor of London, or some member of the Corporation to be nominated by him, the Chairman of the London County Council, or some member of the Council to be nominated by him, a representative of the London Trades Council, and a representative of a London Labour Organisation to be selected by the Labour Representatives on the Board.

The elections shall take place every three years, and the first election shall take place on the

II. The duties of the London Conciliation Board shall be as follows :—

(*a*) To promote amicable methods of settling Labour disputes and the prevention of strikes and lock-outs generally, and also especially in the following methods :—

1. They shall, in the first instance, invite both parties to the dispute to a friendly conference with each other ; offering

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the rooms of the Chamber of Commerce as a convenient place of meeting. Members of the Committee can be present at this conference, or otherwise, at the pleasure of the disputants.

2. In the event of the disputants not being able to arrive at a settlement between themselves, they shall be invited to lay their respective cases before the Committee, with a view to receiving their advice, mediation, or assistance. Or, should the disputants prefer it, the Committee would assist them in selecting arbitrators, to whom the questions at issue might be submitted for decision.
3. The utmost efforts of the Committee shall in the meantime, and in all cases, be exerted to prevent, if possible, the occurrence or continuance of a strike or lock-out until after all attempts at conciliation shall have been exhausted.

The London Conciliation Board shall not constitute itself a body of arbitrators except at the express desire of both parties to a dispute, to be signified in writing, but shall in preference, should other methods of conciliation fail, offer to assist the disputants in the selection of arbitrators chosen either from its own body or otherwise. Any dispute coming before the Board shall, in the first instance, be referred to a Conciliation Committee of the particular trade to which the disputants belong, should such a Committee have been formed and affiliated to the Chamber.

(*b*) To collect information as to the wages paid and other conditions of labour prevailing in other places where trades or industries similar to those of London are carried on, and especially as regards localities either in the United Kingdom or abroad where there is competition with the trade of London. Such information shall be especially placed at the disposal of any disputants who may seek the assistance of the London Conciliation Board.

III.—The separate Trade Conciliation Committees shall be composed of equal numbers of employers and of employed.

Each trade shall elect its own representatives, employers and employed voting separately for the election of their respective representatives. The number of members and the general rules of procedure shall be determined by each particular trade, subject to the approval of the London Conciliation Board.

The Trade Conciliation Committees shall be affiliated to the London Chamber of Commerce, and shall be represented upon the London Conciliation Board. Any Trade Conciliation Committee constituted as above, representing a body or trade in the Metropolitan districts of more than 1,000 individuals, shall send two representatives to sit on the London Conciliation Board, one being an employer and the other an operative workman, each to be separately elected by employers and employed respectively. In the case of Trade Conciliation Committees representing bodies or trades in the Metropolitan districts smaller in number than 1,000 individuals, two or more such committees may unite together to elect joint representatives to the London Conciliation Board.

It shall be the duty of the Trade Conciliation Committees to discuss matters of contention in their respective trades; to endeavour amicably to arrange the same, and in general to promote the interests of their trade by discussion and mutual agreement. In the event of their not being able to arrange any particular dispute, they will refer the same to the London Conciliation Board, and in the meantime use their most strenuous endeavours to prevent any strike or lock-out until after the London Conciliation Board shall have exhausted all reasonable means of settlement.

They may from time to time consider and report to the London Conciliation Board upon any matter affecting the interests of their particular trade upon which it may be thought desirable to employ the action or influence of the London Chamber of Commerce as a body.

IV.—The London Chamber of Commerce places its rooms at the disposition of the London Conciliation Board and of the Trade Conciliation Committees for holding their meetings. Any alterations in the rules and regulations of these bodies which may be from time to time proposed shall be submitted for approval to the Council of the Chamber.

V.—The above regulations shall be subject to bye-laws, to be specially framed for the purpose, and which shall be open to amendment as required from time to time, on agreement between the Council of the Chamber of Commerce and the London Conciliation Board.

Signed { His Eminence Cardinal Manning. / The Right Honourable Sir Henry Isaacs (Lord Mayor of London). / Sir John Lubbock, Bart., M.P. / Sir Albert Rollit, M.P. / Sir James Whitehead, Bart. / Sir Vincent Kennett-Barrington. / R. K. Causton, Esq., M.P. / Samuel Montagu, Esq., M.P. / S. B. Boulton, Esq. (Chairman). / H. O. Arnold-Forster, Esq. / E. H. Carbutt, Esq.; and / Kenric B. Murray (Secretary). } Members of the Committee.

January 31st, 1890.

Books Received.

American Railroad Bridges. By Theodore Cooper. New York: "Engineering News" Publishing Company.

Fire Brigade Drills, with Hints on Management.

Rules and Regulations for Volunteer and other Fire Brigades. London: Shand, Mason, & Co.

Electric Light: its Production and Use. By John W. Urquhart. London: Crosby Lockwood & Co.

Traité Elémentaire de L'Energie Electrique. Par E. Hospitalier. Paris: G. Masson.

Trade Marks; their Object, Use, and Protection. By D. Fairburn Hart. London: *The Shoe and Leather Record.*

Reviews.

"The Electrician" Electrical Trades Directory and Handbook for 1890. "The Electrician" Printing and Publishing Company, Limited.

There is nothing very new to be said about the latest issue of the "Electrical Trades Directory." Information on current topics is up to date, and the general tables and data are gradually being perfected. Mr. Curtis Hayward has specially written a "Digest of the Law of Electric Lighting" for this issue of the Directory, and the book also includes a series of useful notes on "Patents, Designs, and Trade Marks," by Mr. J. C. Chapman. In looking through the Biographical Notices we are struck with the absence of some well-known names. We would suggest also that the names should be in strict alphabetical order. The portraits are still of a very low order; indeed, it is a question whether the subjects of them consider themselves flattered or otherwise by the inclusion of their portraits in the series.

We must give the compilers of the Directory great credit for their work, for a vast amount of research and accurate method is required in bringing a publication of this sort to such perfection.

Modern Workshop Practice, as applied to Marine, Land, and Locomotive Engines, Floating Docks, Dredging Machines, Bridges, Shipbuilding, Cranes, &c. By John G. Winton, Author of "Modern Steam Practice," &c. London: Crosby Lockwood & Son. 1889.

This book is one of Weale's Rudimentary Series, and in the sample before us has attained to the honour of a fourth edition, which is stated to have been "much enlarged and carefully revised." The new matter, which occupies somewhat over forty pages, relates chiefly to locomotives, gas and its manufacture, and steam fire engines. As the book is of small size, and the total number of pages is only 342, with moderately large type, it will be evident, from the imposing list of subjects with which the work is supposed to deal, set forth in the title, that the majority of these must necessarily be very briefly handled. The bulk of the space has been devoted to marine, locomotive, and land engines, and shipbuilding; on some of the other subjects so little is written that it is difficult to understand why they were not omitted altogether. A very large proportion of the information on marine engines and shipbuilding is obsolete; with the exception of a few pages of generalities on high-speed engines, and about three-quarters of a page on steel ships, this part of the work seems to have been simply transferred wholesale from one edition to another. As the particulars given are mainly of a class which if not up to date are almost worse than useless, the defect is especially unfortunate. The matter relating to locomotive engines is somewhat better, because, in the first place, it comprises much of the additions to the present edition, and, in the second place, the alterations effected in locomotive practice have not been during the last twenty years of such a sweeping character as those introduced in marine engineering. Even in this department, however, the detail drawings shown appear to be of rather ancient date. Considering the general character of the work we are agreeably surprised to find compound locomotives, including those made by Mr. Webb, mentioned at all, although the statements regarding them cannot be credited with any specific value. To land engines a few pages are devoted, for the greater part to single-acting pumping and beam engines of a type rendered venerable by age. Bridges are disposed of in nine and a half pages, while on "Air Furnaces in General Use" we are treated to five pages, and, to conclude the volume, half a page on "Tools" is thrown in.

In its present state we cannot conscientiously recommend this book. It is hard to say, after perusing it, which feeling predominates in our mind, wonder as to why it should have been published, or surprise that, being published, it should have attained a fourth edition. To be of any real use, "Modern Workshop Practice" must be entirely re-written, and embrace not more than two subjects instead of half a dozen.

THE PHYSICAL SOCIETY.

The annual general meeting of the Physical Society was held on the 7th inst., Professor Reinold, F.R.S. (President), in the chair. The reports of the Council and of the treasurer were read and adopted. The former stated that there had been a very satisfactory increase in the number of members during the year. The number now exceeded 360, of whom 80 were Fellows of the Royal Society. During the year the Council had proposed to change the time of meeting of the Society from Saturday afternoon to Friday evening. The change was adopted by the members by a vote of 129 to 30, and had resulted in a larger attendance at the meetings. During the year the second volume of the translations of important foreign memoirs had been issued to the members, and it was hoped that a third volume would be published early in the present session. The Council had to regret the loss by death of three well-known members—James P. Joule, Warren de la Rue, and Father Perry. A valuable collection of books had been given to the Society by the Royal Astronomical Society. From the treasurer's report it appeared that the balance of the Society had been increased by £120 during the year. The result of the new election of officers was declared as follows:—President, Professor W. E. Ayrton, F.R.S.; vice-presidents, Dr. E. Atkinson, Walter Baily, M.A., Shelford Bidwell, F.R.S., and Professor S. P. Thompson, D.Sc.; secretaries, Professor J. Perry and T. H. Blakesley, M.A., M.I.C.E.; treasurer, Professor A. W. Rücker, F.R.S.; demonstrator, C. V. Boys, F.R.S.

The paper on "Galvanometers," by Professor W. E. Ayrton, F.R.S., Mr. T. Mather, and Dr. W. E. Sumpner, was then resumed by Professor Ayrton. A long table of numbers accompanying the paper, and representing the results of experiments on many galvanometers, was explained. From this it appeared that galvanometers of the D'Arsonval type were exceedingly efficient in proportion to the amount of wire used in the coils. It was for this reason that voltmeters with strong permanent magnets could be made sensitive even with an exceedingly large external resistance in series, so as to diminish the power absorbed by the instrument. The space occupied by the wire was so exceedingly valuable that the extra resistance did not too much diminish the sensibility. The most sensitive galvanometers should, therefore, be made of the permanent magnet type. If, however, the magnets were to form part of the moving system, as in most galvanometers, the experiments showed that instruments of the Rayleigh, Gray, or Rosenthal type were the best. The coils should be numerous and small as Mr. Boys had previously shown. As an astatic system of needles sets itself perpendicular to the earth field, it was recommended that astatic galvanometers should be placed so that the needles pointed east and west. The controlling magnet would then not need to be turned round as it was raised or lowered. It was recommended to calibrate low resistance ballistic galvanometers for quantity by measuring the deflection for a known current. This obviates the necessity for large condensers or high potentials. The method, although not new, is not described in text-books. In conclusion, Professor Ayrton asked for information with regard to microscope galvanometers.

Mr. C. V. Boys thought that the factor of merit of galvanometers should not be given in scale divisions per micro-ampere under the condition of constant controlling moment. This gave too great an advantage to instruments of the Gray or Rosenthal type. Great sensibility could be obtained by diminishing the moment of inertia of the suspended parts, the practical limit being determined by the trouble due to the silk fibre. Spider lines, when used in place of silk fibres, gave better results. It was possible, by using a good suspending arrangement, to use needles $\frac{1}{8}$in. long and a period of 20 seconds, and to gain a sensibility far greater than those indicated in the paper. Ballistic galvanometers should be made with needles as light as possible. The method proposed of winding the central part of the coil in the opposite sense to the rest would probably not be good, owing to the unevenness of the field produced. The conclusion come to by the authors, that D'Arsonval galvanometers of great sensibility should be made with small coils placed in a very strong field, was one he had himself come to, but had finally abandoned, owing to difficulties caused by diamagnetism in the copper, and to excessive damping due to Foucault currents.

Mr. J. Swinburne thought that the factor of merit of a galvanometer should be determined differently according as it was to be used for the measurement of current or quantity, or for null methods merely. He saw no great advantage in making practical instruments proportional. The name D'Arsonval should be dropped, as the instrument denoted by it was invented by Varley years ago. He would like to know the relative sensibility of the telephone and the Lippman galvanometer.

Professor Fitzgerald stated that Lord Rayleigh had shown that the microscope method of observing angular deflections was as sensitive as the ordinary method of mirror and scale, even when only the mirror was used as a pointer, so that if a pointer were attached it would be far more sensitive. The drawback, however, was that it was impossible to distinguish with the microscope between lateral displacements of the needle and the angular motion whose measurement was required. To get over this error it was necessary to read both ends of the pointer, but this was hard to do.

Professor Ayrton replied to the different points raised in the discussion.

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THE POLLOK GOLD EXTRACTING PROCESS.

Some months ago we referred to this interesting process for the extraction of gold from its ores. Since then, however, much progress has been made towards carrying out the process on more of a commercial scale than had at that time been attempted, and although the present works of the company, situated in Old Keppochhill Road, Glasgow, which we had an opportunity of visiting on the 29th ult., are still little more than what might be called experimental works, they are sufficient to test the value of the process as a commercial success.

The Pollok process is, like the great majority of gold extracting processes which have been hitherto patented, a *chlorination* one—*i.e.*, the reagent used for the purpose of dissolving out the gold from its ores is chlorine. The special feature of the Pollok process is the method in which the chlorine is applied—a so-called *hydraulic* chlorination method—*i.e.*, the chlorine after being liberated is liquefied by hydraulic pressure. This process, it is claimed by the patentees, is applicable to all ores or tailings containing gold, and especially to refractory and float gold ores. Being an eminently cheap process, the estimated cost of treating a ton of ore under present circumstances being not more than eight or nine shillings, it will be seen to be peculiarly suited for dealing with that large class of refractory ores which are unable to be treated by the older and more expensive amalgamation processes, which consequently have hitherto been allowed to accumulate in such large quantities in different parts of the world. As the process thus promises to be of great commercial importance, a more detailed account of its methods may not be without interest to our readers.

The works at Keppochhill Road have been in operation for the last two months. The gold ore at present under treatment is from Chili. It contains, according to assay, 3 oz. 6 dwt. per ton. Out of this quantity of gold 3 oz. 1 dwt. is extracted by means of the Pollok process. The following are the different operations which the ore is submitted to in this extraction process. The ore is first crushed by an ordinary crusher, and is rendered sufficiently fine to pass through a sieve containing 30 meshes to the linear inch. Too great fineness, it may be remarked in passing, is not desired in this process, as it is found to impede subsequent operations. In the case of very refractory ores a greater degree of fineness is desirable than in ordinary ores. In the case of what are known as float gold ores, the ore is brought, immediately after being ground, to the chlorinating cylinder. In the case, however, of refractory ores containing sulphur, iron pyrites, copper, lead, &c., the ore must be previously roasted. The object of roasting the ore, in such a case, is to remove the sulphur, oxidise the iron, &c., and thus to render the ore of a porous nature. The result of such previous roasting is to save the chemical reagents afterwards used, and to permit of the gold contained in the ore being more easily dissolved by the chlorine. In the case, however, of very poor refractory ores, the ore before being taken to the furnace is treated in a stamp battery and concentrated by vanners. In this way a very poor ore, which it would be impossible to treat profitably otherwise, is concentrated some ten times. Thus, an ore containing no more than 5 dwt. of gold per ton can, under favourable circumstances, be worked with profit.

The furnace at present used by the Pollok Company for roasting their ores is the common hearth furnace, and holds some 2½ to 3 tons at a time. It is capable of roasting about 12 tons of ordinary ore in a day, and burns in the operation about 1½ tons of coal. In working abroad, however, the company purpose using a revolving furnace holding 8 tons at a charge. This furnace, it is calculated, would be capable of roasting 30 tons of ore in a day, and would burn from 2 to 3 tons of coal. The chief benefit of a revolving furnace, it may be here pointed out, is that it feeds, stirs, and discharges automatically, thus saving labour—a most important consideration abroad. The time required for roasting the ores varies with the nature of the ore, some requiring a very much longer period than others. The average time is from four to six hours. Ores which have been previously concentrated in the manner above described require a considerably longer time. After being roasted the ore is raked out on to a cooling floor. It is next conveyed to the chlorinating cylinders (Figs. 1 and 2), of which there are two at present in work. One of these (Fig. 1), designed by Mr. Stephen Alley, is made of light steel—it only weighs 25 cwt.—and is lined with a thin coating of india-rubber, which protects the steel from the action of the chlorine. It has an automatic valve for charging and discharging, and a delivery pipe. There is also an escape valve on the top of the cylinder. The other cylinder, we may mention, is lined with wood. The rubber used for the purpose of lining the cylinder is about an eighth of an inch in thickness, and is made of pure rubber and not

THE POLLOK GOLD EXTRACTING PROCESS.

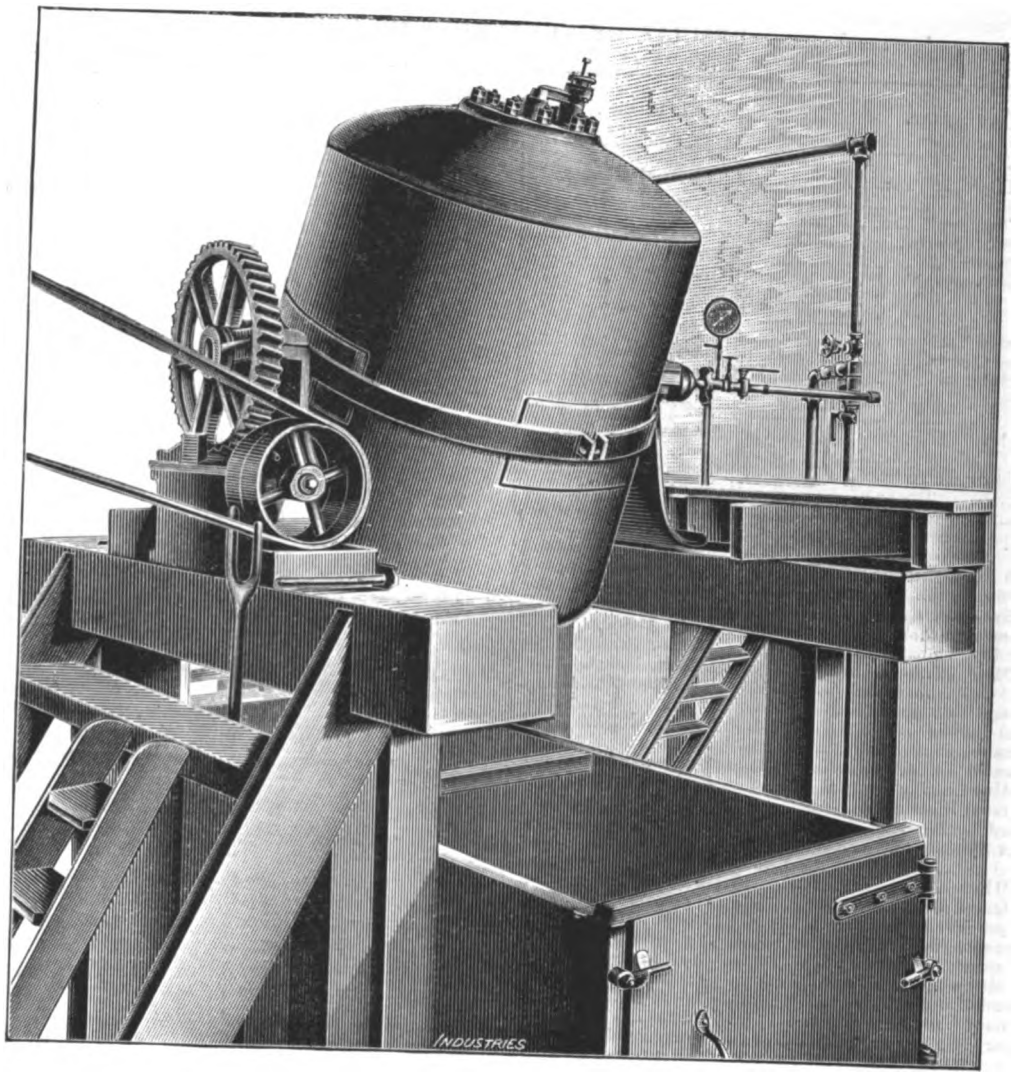


Fig. 1.—New Chlorinator and Filter Bed.

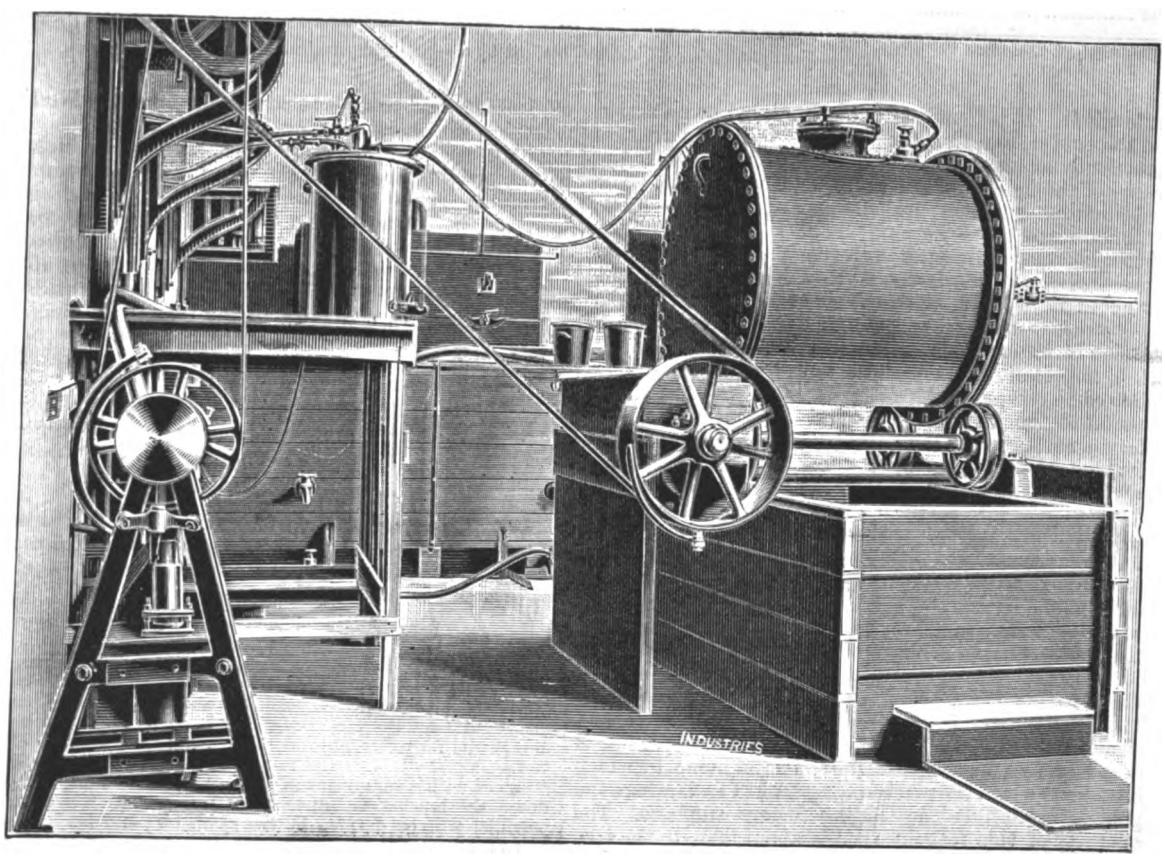


Fig. 2.—Original Chlorinator and Precipitating Tanks.

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THE POLLOK GOLD EXTRACTING PROCESS.

RESULTS OF TREATMENT OF ORES.

Ore.	Locality.	Gold present by Assay.	Gold Extracted by Process.	Gold in Refuse.	Percentage obtained.
Sheba Tailings	Transvaal	48 dwt.	46 dwt.	2 dwt.	96
Mixed Lot	,,	24 ,,	23¼ ,,	1 ,,	97
De Kaap Tailings	,,	33½ ,,	32½ ,,	1 ,,	97
Reliance Reef Quartz	,,	11 ,,	11 ,,	trace	100
Bendigo Quartz	Victoria	1,789 ,,	1,760 ,,	*22 dwt.	98
Day Dawn Quartz, No. 1	Queensland	130 ,,	127 ,,	3 ,,	97
,, ,, No. 2	,,	22¼ ,,	22 ,,	trace	99
,, ,, No. 3	,,	11 ,,	11 ,,	,,	100
Concentrated Tailings	,,	22 ,,	21 ,,	,,	95½
Swazieland Quartz	South Africa	17 ,,	16 ,,	1 dwt.	94
City and Suburban	Transvaal	250½ ,,	241½ ,,	8¾ ,,	96
Crown Ore	New Zealand	76 ,,	71 ,,	4½ ,,	94
,,	,, (Silver)	884 ,,	779 ,,	100 ,,	88
Transvaal Gold Exp. Co.	Transvaal	30¼ ,,	28 ,,	2 ,,	92
,, Tailings	,,	7½ ,,	6½ ,,	1 ,,	87
Mount Shamrock Tailings	Queensland	8¾ ,,	8½ ,,	trace	97
,, Ore (*a*)	,,	17¼ ,,	14 ,,	3¼ dwt.	81
,, ,, (*b*)	,,	915 ,,	834 ,,	*81 ,,	91
Caledonian Extended	New Zealand	105 ,,	96½ ,,	8½ ,,	92
,, Tailings	,,	9¼ ,,	8½ ,,	1 ,,	90
Mariner's Lode	Queensland	28 ,,	23¾ ,,	4¼ ,,	85
Ravenswood Ore	,,	40 ,,	35¾ ,,	4¼ ,,	90
Golden Egg Quartz	Transvaal	107 ,,	102½ ,,	4½ ,,	96
Dick's Luck Ore	South Africa	164 ,,	132 ,,	*32 ,,	80½
Glasdyre Ore	Wales	42 ,,	36 ,,	5 ,,	86
Loando Mine	Dakota, U.S.A.	2 ,,	2 ,,	nil	100
Bethango Ore	Queensland	54 ,,	49½ ,,	5¼ dwt.	91
Cumberland Tailings	,,	19¼ ,,	17¼ ,,	2 ,,	89
Arsenical Pyrites	Tasmania	48 ,,	43 ,,	4½ ,,	90
Concentrates	Wales	4,430 ,,	4,200 ,,	*210 ,,	95
Concentrated Tailings	Morgan Mine, Wales	25 ,,	22½ ,,	2½ ,,	90
Venus Mine	New Zealand	30 ,,	27 ,,	2¾ ,,	90
Concentrated River Sand	Assam	65½ ,,	64 ,,	1½ ,,	97
Westward Ho Mine	Queensland	28 ,,	25 ,,	2¼ ,,	90
Lochaber Syndicated, No. 1	Nova Scotia	4 ,,	3¾ ,,	¼ ,,	94
,, ,, No. 2	,,	14 ,,	13¾ ,,	¼ ,,	98
Astyra Mines	Turkey	14 ,,	13¼ ,,	1½ ,,	95
Gipsey Queen Reef	Transvaal	143 ,,	134 ,,	10 ,,	93½
per Mr. Jones	Spain	14 ,,	12 ,,	2 ,,	86
New Organos (Arsenical Pyrites)	Colombia, S.A.	118 ,,	91⅜ ,,	3 ,,	78
Great Eastern Extended	New Zealand	194½ ,,	184½ ,,	10 ,,	95
Devala Moyar	India	20¾ ,,	18¾ ,,	2 ,,	90
Rio Grande Do Sul	Brazil	38½ ,,	36½ ,,	2 ,,	95
Indian Gold Mine Company	India	34½ ,,	32½ ,,	2 ,,	94
Tinnamary Mines (*a*)	French Guiana	64 ,,	61 ,,	3 ,,	95
per Mr. Irvine	West Coast of Africa	138½ ,,	132½ ,,	4 ,,	95½
per Mr. Stranger	Australia	10 ,,	9 ,,	¼ ,,	90
Stafford Mine	U.S.A.	17 ,,	19 ,,	trace	100
Monroe ,,	,,	21½ ,,	21¾ ,,	¼ dwt.	100
Edwin Bray Concentrates	South Africa	55 ,,	55 ,,	2 ,,	97
Westward Ho Mine	Queensland	14 ,,	11¾ ,,	2 ,,	84
Ore	Dutch Guiana	4 ,,	3¾ ,,	trace	93¾

* Three-fourths of this gold can be obtained by a second chlorination.

vulcanised. It is found that the chlorine has no action on the rubber, and that the wear and tear from friction practically amounts to nothing. It will be seen that the value of the india-rubber lining is thus very great. The chlorinating cylinders are charged as follows:—First, 80lb. of nitre cake—forming about 2 per cent. of the whole charge—is dropped into the cylinder; then two tons of the ore; and lastly, 60lb. of bleaching powder—or about 1½ per cent. of the whole charge. The charging aperture is then closed, and a steam injector is turned on, forcing in water till the pressure rises from 70lb. to 100lb. It is important that all the air in the cylinder should be allowed to escape, as the presence of air is most detrimental to the action of the chlorine, as it mixes with the gas and prevents it liquefying. The cylinder is then revolved, thus mixing up the ore with the bleaching powder and the nitre cake. The chlorine which is thus liberated goes into solution, and the pressure forces the strong chlorine liquor into the pores of the ore, previously rendered porous by roasting. The period during which the cylinder is revolved varies from one hour to an hour and a half. At the end of this time the contents of the cylinder are discharged on to a filter bed placed below. The waste chlorine is blown off, and largely recovered by being passed through slaked lime and thus absorbed. The filter is made of steel wire lined with india-rubber. The charge after being decanted on to the filter bed is filtered, the chlorine liquor, containing the gold, is drawn off by a specially designed vacuum pump, by which it is pumped into the precipitating tank (Fig. 2), where the gold is precipitated by adding ferrous sulphate. The quantity of this reagent used is about 30lb. to the ton, or 1½ per cent. The precipitating tank is fitted with a conical-shaped bottom, on which the gold precipitate settles. As soon as the liquor has become clear it is run off, and the gold paste is removed and fused, in Hessian crucibles, with borax into gold bars.

The chief advantages of this process, as claimed by the patentees, are:—(1) The rapid and complete extraction of the gold by the use and application of hydraulic pressure, a machine weighing 25 cwt. being able to put through 24 tons in twelve charges in twenty-fours; (2) the use of dry chemicals, which can all be safely and cheaply packed, shipped, and carried.

The table embodies some of the results obtained by the treatment of ores by the Pollok process.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

At the meeting of this Institution, on the 13th inst., Mr. James Swinburne read a paper on "The Theory of Armature Reactions in Dynamos and Motors," of which we give an abstract as follows:—

It seems to be generally supposed that electrical engineers are in full possession of means for designing a dynamo or motor. This is no doubt the case as regards very small machines, and when considered with reference to no load. As not only the excitation necessary at full load, but also the best dimensions of the magnets and the proper shape of the pole-pieces, depend on the armature reactions, and as the armature reactions are of immense importance in large machines, such machines cannot be designed with accuracy unless the armature reactions and position of the brushes at full load can be foretold. The magnetic potential will be denoted by the symbol Ω; and for want of a unit of its own, it may be measured in ergs. An ampere-turn thus gives a magnetic potential of $4\pi/10$ ergs, or 1·26 ergs.

As single-magnet machines are very largely used now, and a type can be taken which is approximately that used by most of the large representative makers, such a machine may be taken as an example. A formula which gives the size of iron, and the excitation needed, will then be worked out.

The vertical line through the centre is taken as at zero magnetic potential at no load. Assuming the length of the core to be the same as that of the pole-pieces, and calling the external radius of the core r, and the radial depth of the discs b, and the length of core a, and the armature induction B_a, the surface integral of the induction, or what may be for shortness called the total armature induction, is $2\,a\,b\,B_a$. The desired armature induction is here assumed. The distance, l_a, which represents the length of iron that has to be magnetised to the induction B_a, depends on the arc of embrace of the pole-pieces; but a large error in the estimate of this length causes a very small error in the design of the machine, as very little of the excitation is spent on this part of the magnetic circuit. The fall of magnetic potential over $\frac{1}{2} l_a \frac{1}{2} l_a B_a/\mu$, and may be written $\frac{1}{2}\Omega_a$. The induction in the air gap depends on the armature induction, the radial depth of the discs, and the pole-face angle. It will be written B_g. The line integral of the induction across the gap is $\frac{1}{2} g B_g$, where g is the distance across the gaps. $\frac{1}{2} g B_g$ may be written $\frac{1}{2}\Omega_g$. The fall of potential from the middle of the yoke to the pole-piece depends on the length of the circuit and the induction. It may be written $\frac{1}{2} l_m B_m \mu$, or $\frac{1}{2}\Omega_m$. As the other half of the magnetic circuit is similar at no load, the line integral of the magnetic force needed in the shunt is $\Omega_s = \Omega_m + \Omega_g + \Omega_m$. As to the length of the field magnets, it depends on the total excitation needed.

At full load the armature induction has to be increased to allow for the resistance of the armature and series coils, and sometimes for the leads also. A higher value is therefore taken for B_a, and therefore for Ω_a. The effect of the armature current itself may be divided into two components; and in the case of a drum armature, which may be taken for the sake of simplicity, the electrical effect is the same as if the external conductors were connected across the ends as shown in Fig. 1. There is thus a belt of current-turns opposing the field excitation, and another belt acting at right angles to it. These may be called the back and the cross ampere-turns, and the induction produced by them, the back and the cross induction respectively. The breadth of these belts, or the number of turns in each, depends on the lead of the brushes. For the present the lead of the brushes may be assumed. The extra difference of magnetic potential between the pole-pieces due to the back current-turns is $\pi C n_b/10$, where C is the armature current in amperes, and n_b the number of external armature conductors in the belt of back turns, n_a being the number of external armature conductors. This may be written,

$$\Omega_b = \pi\ C\ n_b/10 \qquad \ldots\ldots(1)$$

The difference of potential of the pole-pieces at full load is this: $\Omega_a + \Omega_b + \Omega_g$; and Ω_a and Ω_g are greater than at no load, because the armature and gap induction are higher. The difference of potential between the pole-pieces may be shortly written, Ω_p. In a given type of dynamo the percentage of waste field varies directly as the difference of potential of the pole-pieces, provided the field magnets are not strongly magnetised, and is independent of the linear dimensions. The actual waste field, however, varies directly as the difference of magnetic potential between the pole-pieces, and directly as the linear dimensions, or as the diameter of the armature. If the armature cross-sectional area is $2\,a\,b$, and the armature induction is B_a, and if the field induction desired is B_m, the cross section of the field magnets must be

$$A_m = 2\,a\,b\,B_a/B_m + r\,\Omega_p/M\,B_m \qquad \ldots\ldots(2)$$

where M is a coefficient depending on the type of the machine. This coefficient can be readily determined from another machine of the same type but of different size, and an error in its estimation makes comparatively little difference in the dynamo.

In ordinary single-magnet machines M is generally above ·08 to ·085; in double-magnet machines it is less. Of course a great deal depends on the mounting of the dynamo. A machine let into a bed-plate, as is often necessary in the case of direct-coupled engines, has more leakage.

An equation for the shunt and series excitation is now to be found. From (1) the field induction is found—

$$B_m = 2ab\ B_a/A_m + r\Omega_p/MA_m \qquad \ldots\ldots(3)$$

Giving the value of B_a and Ω_p at no load, the value of B_m at no load is obtained. The shunt excitation is thus

$$\Omega_s = l_a\ B_a/\mu_a + g\ B_g + l_m\ B_m/\mu_m \qquad \ldots\ldots(4)$$

in ergs, or this number divided by 1·26 in ampere-turns. By giving the full-load values of B_a and Ω_p the total excitation,

$$\Omega_s + {}_m = l_a\ B_a/\mu_a + \pi\ C\ n_b/10 + g\ B_g + l_m\ B_m/\mu \qquad \ldots\ldots(5)$$

is obtained, and, of course, the difference gives the series excitation. Of course the full-load field induction has already been assumed in finding the size of the magnets.

It must not be forgotten that all this time it has been assumed that the load of the brushes, and therefore Ω_b, is known.

Returning to Fig. 1, a closed line, $a\,b\,c$, may be drawn which is interlinked with all the armature conductors under the pole-piece. The magnetic potential round this circuit is

$$\Omega_c = \theta\ n\ C/10 \qquad \ldots\ldots(6)$$

where n is the number of armature conductors, and C is the armature current as before, and θ is the angle of embrace of the pole-piece. As the permeability of the iron, both in the part of the armature and of the pole-piece through which this line passes, is great, the whole difference of potential may be taken as being between the core and pole-piece. The induction under the leading corner, due to cross current-turns only, is then $-n\,C\,\theta/2g \times 10$, and under the trailing corner it is $+n\,C\,\theta/(2g \times 10)$. The field is thus weakened under one corner, and, provided the permeability of the iron is practically infinite, equally strengthened under the other, being at its normal value half-way down. The cross induction has in this case no direct effect in increasing or lessening the e.m.f. of the machine. If a dynamo were enlarged to scale, the field excitation would increase as the linear dimensions, but the armature current-turns, assuming the same current-density, would increase as the square of the linear dimensions. Machines with single magnets, and fairly large outputs for the size of their armatures, become difficult to design when they have armatures above 35 to 40 cm. diameter. If the pole-pieces are made small, so as to carry the induction due to the field coils without saturation, one side will be to some extent saturated

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by the additional induction due to the cross current-turns. If the armature is Gramme-wound, the lower brush will then need more lead than the upper, and sparking at the lower brush in single-magnet Gramme machines thus frequently arises. This effect is sometimes very marked in machines with cast-iron pole-pieces.

A double-magnet two-pole machine can be made up to a larger size than a single by shaping the pole-pieces so as to throttle the cross induction. A common type of machine is shown in Fig. 2 with the pole-pieces so cut. If it be assumed for the moment that the armature-section current can be reversed with no appreciable field, the largest pole angle that can be used is when the gap induction due to the field excitation is equal and opposite to the cross induction under the leading corner; that is, when

$$\theta = 2\sqrt{[(b\ g\ B_s \times 10)/n\ C\ (r \times \tfrac{1}{4}\ g)]} \quad \ldots\ldots\ldots\ (7)$$

As the armature sections need a sensible field to reverse them, the pole angle must be less than this.

As a convolution passes under a brush its current falls from the normal to zero, and then rises to the normal in the other direction, and the brush leaves the commutator strip just at that instant, else there would be sparking. To find what field the convolution must be passing through to produce this result, the variation of the number of lines of induction through the convolution must be found, and the time of short-circuiting known. Any lines of induction through the convolution must pass, 1st, round by the field magnets, thus taking the same course as the field-magnet induction; 2nd, through the armature and air gap in the same way as the field induction, and then from pole to pole across the external air like the field leakage; 3rd, through the iron of the armature in the immediate vicinity of the conductor, and round the conductor by the air. Fig. 5. In a Gramme armature there are two more paths—4, like 3, only inside the armature ring, and 5, round the ring. The last is neutralised by the reversal of the opposite section, and if an uneven number of sections were used the closed armature circuit would damp it. As to the first, any variation of the induction of the field magnets would be damped by the closed copper field-magnet coils, not to speak of the closed armature coils forming the belt of back ampere-turns. In addition to this, if the current died away, and increased up to its normal in the opposite direction uniformly, the current-turns linked with the circuits 1 and 2 would remain constant, for on one side there is a constant increase of back current-turns, and on the other the reversed or forward turns are again crossing the lines 1 and 2. There could thus only be variation of induction round circuits 1 and 2 if the current in the section did not change uniformly. Any change in the induction round such a circuit as 2 would be damped by the Foucault currents produced in the pole-pieces, as the current is small and the frequency enormous.

The third course—3—may be treated as if the convolution were stretched out straight in air. The self-induction could then be calculated. As half the circuit round the wire is through iron, the self-induction may be doubled. The conductor may be taken as a linear conductor, and the self-induction of the active part taken within reasonable limits. To give some idea of the magnitudes dealt with, we may take, as an example, a drum armature of 15 cm. radius and 38 cm. length, with 120 external conductors, giving 100 volts and 400 amperes at 800 revolutions per minute. Working out the self-induction and resistance of a convolution roughly at $1{,}236 \times 10^{-9}$ and ·000456 ohm, the electromotive force necessary to bring the current to 200 amperes comes out ·274 volt and the field needed to reverse is $B_g = 685$.

The field necessary for the reversal of the current in a section being known, the position of the brushes can be determined.

If the armature had no current the field would fall off very quickly round the armature after emerging from under the pole-pieces. At no load, for instance, the disposition of the lines of induction is, roughly, as shown in Fig. 4. In this case the lines that enter the uncovered part of armature are all cramped together at the pole corners. The lines leaving the shanks of the magnets pass right across and do not enter the armature at all.

If the cross current-turns are alone considered, a disposition, roughly, as shown in Fig. 5, is obtained. There are no lines across, so the lines are cramped together where they leave the armature only. If Figs. 4 and 5 were superposed, the opposite inductions would be equal quite close to the leading pole corners. The exact position would be difficult to determine, but by such a rough method as that just described the position can be found so as to make no sensible error in the calculations. It is clear, then, that except in the case of very small machines, or machines with very light loads, the position of non-sparking of the brushes is close under the leading pole corners.

A glance at actual machines shows that the conclusion here arrived at theoretically—that the brushes are almost under the leading pole corners—is correct. The angle of lead of brushes at full load thus depends on the pole angle, and the back potential, Ω_b, can now be given in the form $(\pi - \theta)\ nC/10$.

Equation (5), for the full-load excitation, can therefore be written,

$$\Omega_{s\text{-}m} = l_a\ B_a/\mu_a + (\pi - \theta)\ n\ C/10 + g\ B_g + l_m\ B_m/\mu_m \ldots (8)$$

Equation (2), for the cross-sectional area of the field magnets, also becomes, in full,

$$A_m = 2ab\ B_a/B_m + r\ [l\ B_a/\mu_a + g\ B_g + (\pi - \theta) n\ C/10]\ /MB_m \quad (9)$$

Probably the greatest problem that still remains for dynamo makers to grapple with is that of lessening or avoiding sparking at the brushes. At present it is necessary to move them whenever the load of the machine is altered. An attendant is therefore necessary if the brushes are to be kept in good order.

As a very weak field is enough to reverse the current in a section, a small pole-piece might be so applied to the armature as to reverse the sections at any convenient place. If the reversal could take place in such a position that the brushes would have a negative lead, the back current-turns would be converted into forward current-turns, and a machine could be designed to give constant electromotive force, or even a higher electromotive force at full load, without any series winding on the magnets at all. Reversing pole-pieces, as they are called, were brought out some two years ago. Fig. 6 shows a simple case. Two reversing pole-pieces are shown. In order that there may be some induction in the same direction as that in the left limb of the magnet, it is clear that the line integral of the magnetic force from A to B must be positive. If the brushes are under these reversing pole-pieces the line A B passes through the neutral points, and the cross potential is $\pi\ n\ C/10$. Each reversing magnet must therefore have

ARMATURE REACTIONS IN DYNAMOS AND MOTORS.

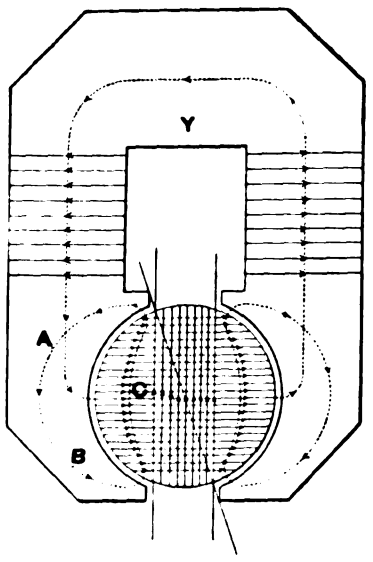


FIG. 1.

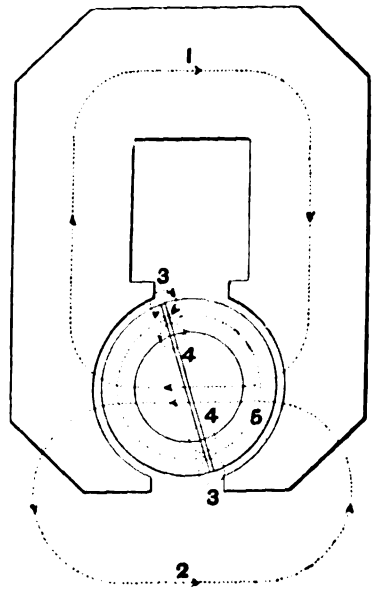
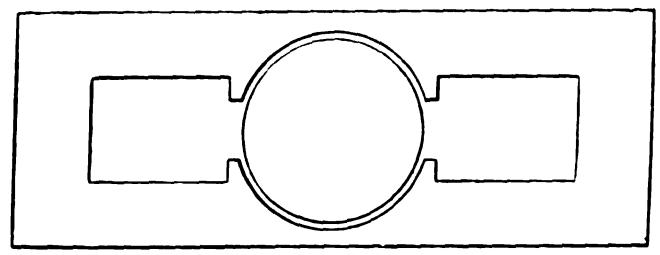
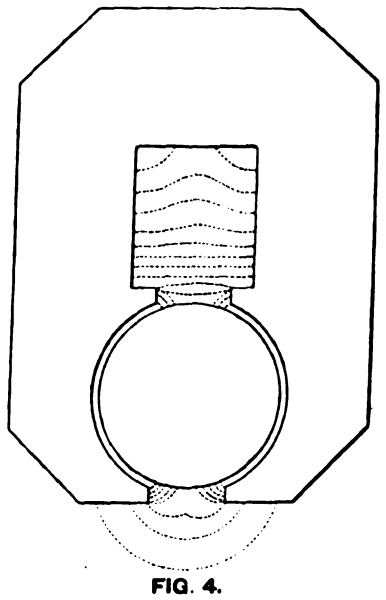
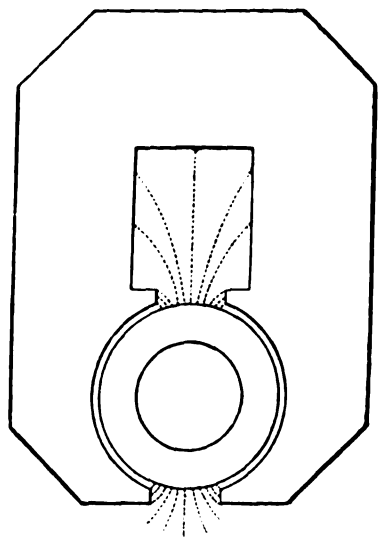


FIG. 3.


FIG. 2.


FIG. 4.


FIG. 5.

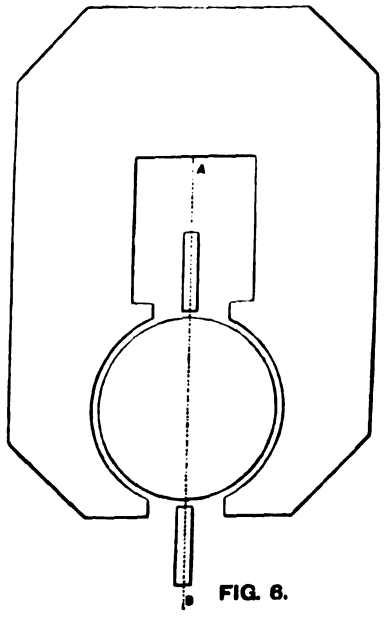


FIG. 6.

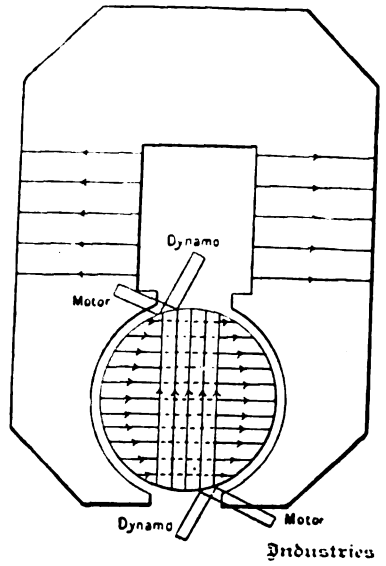


FIG. 7.

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$\frac{1}{8}$ *n* C ampere-turns on it to counteract the cross current-turns, and a few more to cause the reversal. In large machines these pole-pieces are thus difficult to work in.

If the reversing pole-piece A is made larger, and attached to the yoke, the same number of current-turns is necessary, as the yoke is at the same magnetic potential as the centre of the armature, if the magnet limbs have equal coils, and the left pole-piece is not highly magnetised.

It is probable that some form of reversing pole-piece will come into general use.

The advantages to be gained by such an arrangement are very great. The brushes do not need to be shifted as the load varies, which saves attendance and wear. Back current-turns are avoided, and this reduces the expense in the series field windings, and saves power now wasted in them. The field magnets can be made smaller, and the induction in them will be the same at full load as at no load, so that the electromotive force will not be unstable at light loads—a state of things which is not always avoidable at present.

Having discussed the theory of dynamos, its application to motors is, of course, exceedingly simple. A motor is nothing but a dynamo running the other way, as a dynamo is a practically reversible machine.

Fig. 7 shows a dynamo armature with the position of the brushes and the back and cross armature windings. For simplicity the brushes are shown as touching the outside of the armature instead of the commutator.

Suppose the direction of the currents in the field and armature to remain the same, but the direction of rotation of the armature to reverse, the dynamo then becomes a motor. The brushes must be inclined the other way, as shown dotted, otherwise the ends would catch in the commutator. The cross and back turns remain as before, so that the armature current opposes the field excitation. It has sometimes been said that the armature current assists the field in a motor, but this can only take place if the brushes are given a negative lead. The same result is obtained in a dynamo by putting the brushes back; but in both cases, of course, this leads to excessive sparking. It is sometimes imagined that some effect of the convolutions being commutated acts differently in a motor, but a glance at the diagram shows that the action is completely reversed. The section being commutated in a dynamo, opposes the movement of the armature; in a motor it assists the armature. No appreciable Foucault currents can be caused by the reversal of the section. If any were, they would assist the dynamo and oppose the motor, so that they would also be reversible.

There is no point in which the dynamo is not perfectly reversible, and there is no foundation for the idea that a motor should have a large armature and a weak field. In so far as any motor departs from the design of a good dynamo it is bad.

Of course the winding of the field magnets in a motor is different.

The winding and design of magnets of motors has received but little attention. Suppose a motor is to run at constant speed on a constant-potential circuit. The shunt excitation is

$$\Omega_s = l_a B_{ao}/\mu_o + g B_{go} + l_m B_{mo}/\mu.$$

At full load the armature induction must be reduced so that the full-load current passes. If E is the terminal electromotive force, and R the armature resistance, the armature induction at full load $B_{af} = B_{ao}(E - CR)/E$, and the gap induction is also reduced in the same proportion. The full-load magnetic potential of the field coils is

$$\Omega_{s+m} = l_a B_{af}/\mu_a + (\pi - \theta)\, n\, C/10 + g B_g + l_m B_m/\mu_m \quad (8)$$

The alteration of the first and last terms makes so little difference to the value of Ω_{m+s} or Ω_s that it may be disregarded. The full-load excitation is thus increased by $(\pi - \theta)\, n\, C/10$, and decreased by the difference between $2\, g\, B_{go}$ and $2\, g\, B_{gf}$. That is to say, extra field excitation is needed to counteract the back current-turns on the armature, and less excitation is needed to produce the reduced air gap induction. If these are equal, the machine will keep constant speed when shunt-wound. In a small or slow machine the armature loss is large; in a large one the back induction is great. A small machine, therefore, needs backward-wound series coils, and a large one forward-wound. If $(\pi - \theta)\, n\, C/10 = 2\, g\, B_{go} - 2\, g\, B_{gf}$, the shunt ampere-turns needed at no load and full load differ only by the difference of excitation needed to magnetise the iron of the field magnets and armature.

As the field induction in a motor is highest at no load, the area of cross section is

$$A = 2\, a\, b\, B_a/B_m + r\Omega_p/MB_m \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

it is thus somewhat smaller than in the case of the corresponding compound-wound dynamo.

As a shunt machine is simpler to make than a compound, and as a differentially wound motor may start backwards, shunt winding is preferable. Within wide limits of size constant-speed motors can be designed with simple shunt winding. All that is needed is to make Ω_b equal to $2\, g\, B_{go} - 2\, g\, B_{gf}$. $\Omega_b = (\pi - \theta)\, n\, C/10$, and $B_g = 2\, a\, b\, B_a\, \pi/(a + d)(r + \frac{1}{2} g)\, \theta$, where d is an allowance for fringe, and θ is also made a little large to allow for fringe. This gives

$$\pi\, \theta - \theta^2 = 20\, a\, b\, B_a\, \pi/(a + d)(r + \tfrac{1}{2} g)\, n\, C \quad \ldots\ldots (10)$$

This appears complicated, but when the symbols are replaced by numbers for an actual machine, of course it is quite simple. It will be found that in very small motors this makes the pole angle too small, while in large machines the pole-pieces would embrace the armature so much as to cause excessive magnetic leakage and reversed induction under the trailing corner, unless the pole-pieces are designed to obviate this.

A properly designed direct-current motor has also the very convenient property of running at approximately constant speed, even if the electromotive force on it varies. If the field and armature are not highly magnetised the armature induction varies approximately as the electromotive force on the shunt. The armature induction, and consequently back electromotive force, of the machine thus varies as the electromotive force on the mains, which is just the condition wanted for constant speed. A direct current motor will therefore preserve approximately constant speed, not only with varying load, but also with varying electromotive force.

This paper has been devoted to direct-current dynamos, as the corresponding treatment of alternating-current machines is hardly ripe for discussion yet, though of enormous importance, as the whole theory of running machines in parallel and of alternating motors depends upon it.

THE SOCIETY OF CHEMICAL INDUSTRY.

MANCHESTER SECTION.

On the 4th inst. two papers were read by Mr. W. Younger, F.C.S., the first being on the "Reduction of Arsenic Acid by Hydrochloric Acid." The author has used this reaction for estimating arsenic in various compounds as follows:—Potassium iodide and hydrochloric acid are added to a solution of arsenic acid; arsenious acid is produced, and iodine is liberated in an amount directly proportional to the reduction. The solution is then boiled, neutralised with sodium bicarbonate, and titrated with iodine and thiosulphate. This method gives results comparable with the sulphurous acid method, and by its use very small quantities of arsenic can be easily estimated—*e.g.*, ·0187 per cent. arsenic in oil of vitriol. Various experiments to prove the accuracy of the reaction have been made.

In a short discussion which followed the reading of the paper, Dr. G. H. Bailey said that, although the application of the reaction to the estimation of arsenic might be new, yet the principle involved had long since been described by Bunsen and Fresenius, and had been generally employed in the laboratory.

The second paper, which was on the "Analysis of Deacon Gases," was a short addition to a previous paper by the author. The gases produced in the Deacon chlorine process consist of chlorine, hydrochloric acid, nitrogen, air, and aqueous vapour. The first paper referred especially to the detection and estimation of small quantities of hydrochloric acid in the presence of chlorine. In the present paper the author gives a method for the complete analysis of the gases. He absorbs the moisture in strong sulphuric acid, the chlorine and hydrochloric acid in an arsenious acid solution, the oxygen (which is calculated to air) in cuprous chloride, and obtains the nitrogen by difference. The aspiration of the gases from the decomposer is accomplished by the graduated cubic box figured in the first paper.

After the above papers some discussion arose with respect to the Technical Instruction Act, 1889, but it was decided that a full discussion on this subject should be postponed to the next evening.

NEWCASTLE SECTION.

At a meeting of this section, on the 6th inst., Mr. Shaw drew attention to the formation of sulphate of copper in the copper flues of gas stoves; and Mr. Lovibond stated that he had noticed an encrustation of the same salt in a brewer's copper which had burnt through in less than two years owing to the use of an inferior coal containing much sulphur.

Mr. Morrison read a paper on "Personal Recollections of the Bachêt Soda Process." An experimental plant was set up at the salt works at Walker-on-Tyne to work out on a practical scale Bachêt's process for the manufacture of caustic soda by the decomposition of salt with litharge, the litharge being regenerated with lime. Owing to the enormous bulk of water which had to be employed, as well as the large quantity of costly litharge in proportion to the almost minute amount of caustic obtained, the experiment proved a failure, as under favourable conditions the cost of production was too great.

Notes.

CHINESE DEFENCES.

Whatever vacillation the Chinese may seem to show in the matter of railway development, there can be no doubt that they follow with unswerving resolution their plans for coast defence, for which they always seem to be able to find money when it is wanted. We learn that they have recently placed with Krupp, of Essen, an order to the amount of £250,000 for guns for the defence of the Veiho. They have almost as much competition for their favours from the makers of guns as they have from the financiers who wish to do themselves the honour of lending them money, but the representative of Herr Krupp is credited with an unusual amount of energy and tact, which seems to carry the day. Not only the coast defences, but also the navy, is receiving attention, and Admiral Lang has brought it to a wonderful state of efficiency, considering the difficulties he has had to overcome. It is further reported that an order has been sent to this country for a considerable amount of machinery and other appliances for the manufacture of steel rails, and we think it will be found, as we have often pointed out that there is considerable method in what seems to be the obstructive methods of the Chinese. They no doubt recognise the advantages of Western industries, but they have their own ideas as to the methods by which they should be introduced into their country, and their policy is to place themselves in a position to withstand foreign aggression, and to allow the industrial and commercial changes to be brought about slowly, no doubt with a considerable amount of foreign assistance, but at the same time largely by the development of their own resources.

MACFARLANE'S FACILEGRAPH.

This ingenious appliance for the engineer's desk is intended to replace the somewhat expensive ruled paper for scale drawings and diagrams. The principle of it is extremely simple. The leaves of the book are semi-transparent, and behind these is placed, when in use, a card, upon which thick black lines are rules. The lines on the card may indicate any desired scale, or adopt any angle or curve. Drawings to any scale may thus readily be made. The publishers intimate that they can supply cards with any desired arrangement of scales, lines, and curves, provided a sufficient quantity be ordered. The Facilegraph must be of great use to the engineering student for work both at home and in class, and also to the engineer in ordinary practice.

THE PROPOSED FORTH AND CLYDE CANAL.

The promoters of both the Loch Lomond and the direct route schemes are displaying considerable energy in their prosecution of them. The former had a meeting in Edinburgh recently, at which arrangements were made for bringing their plans prominently before the public. The latter have instructed Messrs. Crouch & Hogg, civil engineers, Glasgow, to make a survey of the route and report to them, so that we ought soon to be in a position to discuss both plans on their merits. In the meantime, however, Mr. William Smith is energetically bringing his plans for a ship railway before various public bodies, and they have been very favourably received. The great argument put forward in favour of the Loch Lomond route has been that it is the only one suitable for ships of war, but a letter has just been received from the Secretary for Scotland, in which it is stated that, after having consulted with the naval and military authorities, the Prime Minister and the Secretary for Scotland are of opinion that her Majesty's Government would not be justified in incurring financial responsibility in regard to the proposed undertaking. This may only mean that public opinion has not yet been brought sufficiently to bear on the Government, but at any rate it shows that at present the schemes must be discussed chiefly on their commercial merits.

THE END OF THE GAS STOKERS' STRIKE.

After a duration of two months the dispute between the gas workers, coal porters and the South Metropolitan Gas Company came to an end last week, and we must confess to a considerable amount of disappointment over the whole affair. The men claim that they are going back perfectly unfettered by the bonus agreement, and that the removal of this obnoxious obligation is highly satisfactory to them. At the time the bonus system was proposed we pointed out some of its objectionable features, and we hoped that when these had been removed that it would have been adopted in a modified form, but the men evidently prefer to trust to their trades unions for the improvement of their position rather to any scheme which seems to them to fetter their liberty and place them more completely in the hands of the employers. They ought, however, to remember that every form of partnership lessens to a certain extent the liberty of the partners, but it ought to strengthen their confidence in their good intentions, and they should try to make arrangements which will bring them and the employers into closer relations, and so prevent disputes of all kinds. A social and industrial partnership is a higher ideal to aim at than the raising up of two opposing forces ready to do battle whenever an opportunity is offered of the one overcoming the other. It has been arranged that, except where mutually agreed the Company is to revert to the eight hours system as in operation previous to the strike instead of the longer hours now worked. As, however, many of the new men prefer the two shifts system, because it gives them longer intervals of rest, some of the stations will be worked on that system. Although the struggle has ended in a *fiasco*, we trust that it will at least have taught both parties the necessity for mutual forbearance, and for at least intelligent discussion of differences before force is resorted to.

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Patent Record.

(Compiled from "The Illustrated Official Journal (Patents).")

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

27th January, 1890.

1374. Kelley, J. ..... Printing machines.
1378. McMullin, G. B. ..... Railway chairs.
1383. Johnson, R. ..... Rotary blower.
1384. Griffiths, Griffiths, & James ..... Railway couplings.
1387. Mason, T. ..... Looms.
1389. MacLaine & Fraser ..... Flax spinning machinery.
1402. Southon & Boxall ..... Railway signals.
1404. Ross, A. S. ..... Dredging apparatus.
1405. Thompson, W. P. ..... Roving frames (*Kraegft*).
1406. Critchley, T. ..... Spinning machinery.
1408. Weber & Schubert ..... Looms.
1416. Lindsay, W. ..... Delivering grain from vessels.
1418. Rammage, A. W. ..... Metal framing for fireproof floors and walls.
1435. Hopkinson & Hopkinson Water gauges.
1436. Turner, S. ..... Looms.

28th January, 1890.

1444. Roots, J. ..... Rotary engines.
1449. Birks, B. ..... Forging projectiles.
1451. Clegg, R. ..... Brake and starting apparatus for tramcars.
1453. Knight, C. A. ..... Feed water purifiers.
1454. Bean, E. C. ..... Stop motion for fanning machines or sewing machines.
1455. Jenks, T. ..... Machines for mowing grass.
1459. Hoyle & Shackleton ... Combing machines.
1465. Butterworth, J. ..... Steam traps.
1466. Wrigley, Paterson, & Taylor ..... Spindles.
1469. Mills & Sutcliffe ..... Mules.
1476. Boult, A. J. ..... Tuyeres (*Schweickhart*).
1480 Barraclough, F. ..... Flying machines.
1483. Atherton, J. ..... Middlings purifiers.
1484. Mewburn, J. C. ..... Compressed air motor (*Proell & Kummer*).
1488. Müller & Bach ..... Sewing machines.
1492. Crooke, W. T. ..... Brazing hearths.
1493. Rossney & Cutler ..... Gas engines.
1497. Lake, H. H. ..... Anti-friction bearings (*Elliott*).
1498. Espinasse, P. ..... Railway sleepers and chairs.
1499. Stiles, C. ..... Lubricators.
1500. Whitehead, E. E. ..... Stave jointing machines.
1507. Hardingham, G. G. M. ... Harvesters (*McCormick*).
1508. Hardingham, G. G. M. ... Sheaf carriers for harvesters (*McCormick*).
1509. Hardingham, G. G. M. ... Lathes (*McCormick*).
1515. Newton, H. E. ..... Liquid and gaseous fuel furnaces (*Macdonagh, Rock, Wood, Wilkinson, Plummer, & Wilkinson*).
1517. Keys, W. W. ..... Digesters for paper pulp.
1519. Malta-Müller & Hansen Brakes for ships.
1520. Marsland, Schneider, & Thorne ..... Life rafts.
1525. Button, Peters, & Goodsell ..... Kilns.
1531. Sanders & Ewing ..... Cutting and punching machine.

29th January, 1890.

1535. Wilkinson, G. ..... Axle boxes and bearings.
1538. Bagshaw, Bagshaw, & Bagshaw ..... Friction clutch.
1539. Hyde, T. ..... Wire and metal bars.
1545. Elliott, G. W. ..... Tapping machines.
1546. Nuttall, Holt, & Mitchell ..... Couplings for tramway engines, &c.
1570. Bells & Quirk ..... Steam turbines.
1571. Edmiston, J. B. ..... Purifying feed water.
1573. Rack, A. ..... Malt kilns.
1577. Wohle, S. ..... Packing for joints, glands, &c.
1582. Hopkinson & Hopkinson Safety valves.
1585. Mattock & Mattock ... Looms.
1586. Tavernier & Casper ... Gas engines.
1590. Marshall, M. ..... Typewriters.
1593. Jobling, J. C. ..... Coupling for pipes.
1598. Horn, W. W. ..... Knitting machines (*Kelly & Jenckes*).

30th January, 1890.

1601. De Palacio, M. A. ..... Aërial tramway lines.
1605. Munro, A. ..... Typewriting machines.
1606. Longworth, J. ..... Rotary engines.
1608. Stephenson, J. E. ..... Weaving.
1611. Wilson, W. M. ..... Baling presses.
1614. Smithers, J. ..... Carpet-beating machines.
1624. Holdich, A. H. ..... Controlling the flow of steel from the ladle.
1627. Robertson, J. ..... Metal tubes.
1630. Goodall, J. H. ..... Machinery for grinding grain, &c.
1633. Knecht & Knecht ..... Sharpening teeth of saws.
1634. Burton, G. D. ..... Forgings.
1635. Michaud, J. ..... Rotary printing press.
1648. Stirckler, A. E. ..... Machines for lasting boots.
1659. Plisson, P. ..... Lubricating apparatus.

31st January, 1890.

1663. Taylor, W. ..... Cotton openers.
1664. Ainsworth, J. T. ..... Mules and twiners.
1667. Rowley, N. ..... Street-sweeping machines.
1673. Johnson & Cammann ... Flexible rotary driving shaft.
1677. Monk, H. ..... Cartridge-making machine.
1679. Tweedy, G. ..... Steering apparatus for ships.
1680. Robinson, W. J. ..... Roving frames.
1686. Burton, C. W. ..... Combined air-compressors and steam engines.
1693. Tomkins, W. ..... Marine propellers.
1702. Craven, G. H. ..... Dyeing machines. (22nd July, 1889.)
1710. Howard & Jordan ..... Printing presses.
1711. Hardingham, G. G. M. ... Harvesters (*McCormick*).

1st February, 1890.

1713. Green, W. ..... Paper machine.
1714. Adair, J. ..... Dough machines.
1718. Marchant, G. M. ..... Expanding plug for parallel screw valves.
1722. Teer & Forknall ..... Printing machines.
1724. Sivewright, G. W. ..... Floor plates for vessels.
1726. Haden & Bales ..... Lubricating bearings of propeller shaft.
1733. Spencer, J. F. ..... Charging open-hearth furnaces.
1751. Walker, H. C. ..... Protective apparatus for lifts.
1752. Riedler, A. ..... Blowing machines.
1754. Höper, G. ..... Dense metal castings.
1756. Wohle, S. ..... Lining pipes, tubes, and vessels.
1761. Smidth, V. F. L. ..... Feed-water heaters.
1762. Hirschberg, R. ..... Railway sleeper (*Hagarty*).
1772. Sloan, J. ..... Apparatus for hulling grain.

ELECTRICITY.

27th January, 1890.

1390. Balch, W. ..... Batteries for firing explosives.
1391. Balch, W. ..... Electric firing battery.

28th January, 1890.

1495. Lake, H. H. ..... Accumulators (*Johnson*).
1516. Spagnoletti & Crookes Cut outs.
1529. Taylor, J. D. ..... Electric signalling apparatus.
1530. Olán, J. W. T. ..... Measuring currents.

29th January, 1890.

1534. Wilkinson, G. ..... Driving gear for electric cars.
1555. Elliott, G. W. ..... Magnetic separator.
1559. Blackwell, H. C. ..... Cut-out and switch.
1596. Lake, H. H. ..... Electric lamps (*Jenkins*).

30th January, 1890.

1618. Trezise, J. M. G. ..... Automatically breaking and making an electric circuit.
1619. Shilton, L. ..... Electric bells.
1629. Boult, A. J. ..... Accumulators (*Di Giovanni*).
1638. Harcourt, H. M. ..... Electric railway alarm.
1644. Lineff, A. L. ..... Electric traction.
1646. Brewster, P. C. ..... Safety devices for electric lines.
1658. Elieson, C. P. ..... Electricity meters.

31st January, 1890.

1700. Russell & Scott ..... Arc lamps.

CHEMISTRY.

27th January, 1890.

1393. Phillips, J. W. ..... Polishing tin plates.
1407. Lange, M. ..... Nitrotoluol.
1422. Vale, A. A. ..... Cumarone (*Chemische Fabriks-Actiengesellschaft*).
1427. Netto, M. ..... Alloys.

28th January, 1890.

1443. King, J. T. ..... Reduction of metallic ores (*Adams*).
1522. Johns, T. H. ..... Coating iron with tin.
1524. Wischin, G. ..... Nitrates of manganese.

29th January, 1890.

1579. Imray, J. ..... Colouring matters (*La Société Anonyme des Matières Colorantes et produits Chimiques de St. Denis, Poirrier, & Rosenstiehl*).
1583. Radlauer, S. ..... Ethyl chloral methane.
1584. Ellershausen, F. ..... Soda and potash.
1589. Kingzett, C. T. ..... Disinfectants, &c.

30th January, 1890.

1623. Warner, W. ..... Treating sewage.
1625. Lowndes & Kaller ..... Extraction of gold, &c.
1641. Dähne, F. W. ..... Refining copper ore, &c.
1647. Hopkinson, J. ..... Hardening metallic alloys.
1650. Perls, M. ..... Soap.
1653. Kennedy, G. ..... Sulphate of ammonia plant.
1654. Parrington, M. B. ..... Manufacture of lime.

31st January, 1890.

1682. Heathfield, R. ..... Coating metal sheets with metals.
1684. Boult, A. J. ..... Paints (*Bibikor*).
1688. Shillito, T. R. ..... Colouring matters (*Geigy*).
1694. Ormerod, D. ..... Alloys.
1698. Heyer, C. ..... Carburetting gases.
1699. Imray, O. ..... Colouring matter (*Farbwerke vormals Meister Lucius & Brüning*).

1st February, 1890.

1771. Shillito, T. R. ..... Colouring matter (*Geigy*).

MISCELLANEOUS.

27th January, 1890.

1400. Jucker, J. ..... Spindles.
1412. Bergman, T. ..... Incandescent gas burners.

28th January, 1890.

1446. Maddox, J. P. ..... Fabric for belting.
1461. Smith, Smith, & Smith Scouring and washing wool.
1462. Whiteley & Whiteley Extracting moisture from wool, &c.
1533. Horn, W. W. ..... Elastic chain (*Redwood*).

30th January, 1890.

1607. Smith, Smith, & Smith Dyeing wool, &c.
1651. Perls, M. ..... Manufacture of paper.
1652. Barnett, Baron D. ..... Extracting oil from fibrous materials.
1656. De Chardonnet, H. ..... Artificial silk.

31st January, 1890.

1669. Barber-Starkey, W. J. S. Fire and temperature alarms.

1st February, 1890.

1731. Ramsden & Hall ..... Lock nuts.
1757. Lewes, V. B. ..... Anti-fouling compositions.
1760. Taylor, J. ..... Ventilation.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form, of such opposition.

Year 1889.

1266. Mannion & Hewitt.
1432. Ridgway.
1842. Varney.
1920. Cuggia.
1967. Seefels.
2039. Self.
2118. Taylor.
2155. Sörensen.
2350. Bell.
2537. Shilton.
2665. Kerse.
2895. Calway.
3127. Crawshay.
3406. Bird.
3795. Gaertner.
3851. Hellewell.
3961. Mandleberg, Rothband, & Mandleberg.
4067. Middleton.
4461. Johnston.
4537. Hodgkinson.
4551. Hayward.
4649. Greenall & Bishop.
4721. Fleuss.
4775. Muir.
4819. Park.
4850. Turner.
4882. Gilchrist.
4955. Brin's Oxygen Co. & Murray.
5091. Wilmot.
5128. Rienessl & Von Medvey.
5162. Hodgson.
5224. Webster & Taylor.
5258. Hudson.
5286. Coward.
5291. Zipernowsky, Déri, & Blathy.
5323. Barnes.
5328. Morton.
5361. Moss & Hunt.
5364. Slater.
5373. Turner.
5382. Joicey.
5403. Boyes.
5410. Heys (*Greening*).
5431. Kessler.
5460. Peel.
5467. Lucas.
5491. Pearce & Jackson.
5503. Liebert.
5510. Davy.
5516. Sherwin.
5537. Briggs.
5575. Matlock.
5604. Schott.
5622. Pearson.
5688. Lynde.
5691. Edwards.
5736. Partridge
5835. Shanks.
5887. Southall.
6147. Showell.
6414. Smith & Green.
7277. Drinkwater.
7927. Andrews.
9339. Glover.
12470. Chapman.
13051. Peirce & Luther.
13598. McPhail, Simpson, & Simpson.
14645. Thompson (*Wright*).
15855. Robinson & Robinson.
16108. Cooper. (12th April, 1889.)
16673. Saunders, Kerry, & Kerry.
1398. Ford.
1691. Holden & Brooke.
1889. Appleing.
1962. Dennys.
2020. Mooney.
2091. Fraser.
2144. Piers.
2182. Möhrstadt.
2377. Holzapfel.
2545. Druiff.
2699. Simon.
3065. Squire.
3283. Butlin.
3622. Green.
3827. Foulkes & Clay.
3939. Duval & Lawton.
4023. Long.
4063. Vale.
4115. Dunlop.
4478. Walton.
4541. Farmer & Reid.
4597. Young & Beilby.
4715. Peasgood.
4757. Walker & Leek.
4805. Waide.
4843. Herbert.
4872. Morris.
4925. Kaufmann.
4966. Gray & Clement.
5078. Barthel.
5102. Pangbourne.
5145. Dinsmore.
5157. James.
5200. Steinberger.
5248. Harrap.
5264. Lambert.
5287. Levi & Carré.
5309. Evans.
5320. Milby.
5326. Shillington & Hanna.
5358. Power.
5362. Birkin, Birkin, & Weiss.
5381. Williams & Holland.
5384. Heathman.
5404. Shervey.
5423. King.
5455. Gadd & Drey.
5465. Whitfield.
5481. Elgood, Elgood, & Elgood.
5507. Gale.
5514. Stevens & Johnson.
5521. Brown.
5538. Dorman.
5599. Hattersley & Hill.
5613. Milovanovitch.
5647. Schmitt.
5690. Schofield.
5697. Kelly, Spencer, & Spencer.
5884. Wilkinson.
5967. Gardiner.
6292 Durnford.
6998. Wiesener.
7387. Palin.
7998. Butlin.
10271. Bayley.
12489. Hebblewaite.
13509. Beston.
13659. Wise (*Kramer*).
14413. Shanks.
15083. Justice (*Becher*).
15880. Robinson.
16392. Boult (*Kornacher*).
16503. Barnes. (20th March, 1889.)
16885. Lake (*Thomas*).

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16797. WYLD.
17536. ALLISON (*The Spiral Weld Tube Company*).
17998. COLLEY.
18514. ADAMS & PATTERSON.
18793. THOMPSON (*James Philip O'Brien & Bernard Van Leer*).
19761. THOMPSON (*Urbelacker*).
19820. ROBERTSON.
19890. AIKEN.
20073. RADCLIFFE.
20279. CHORLEY.
20316. MACLAURIN & CRANSHAW.
20519. GEIERSBACH.
20616. VON ROHONCZY.
20693. GILLETT (*Kelly & Kelly*).
20740. CLARK (*Hofe*).
20753. BÉNIER.
20794. STOCK & HAUSMANN.
20841. BOULT (*Auerswald & Hoffmann*).
20849. CAHN. (28th May, 1889.)
20901. HALL & CARHUFF.
20928. FITZPATRICK (*The Improved Zig-Zag Grate Bar Company*).
20981. NEWTON (*The Fuel, Gas, & Light Improvement Company of America*).
17293. PARSONS & BOURGAIZE.
17904. BUSCHEK, GANZERT, & SCHIEL.
18268. THOMPSON (*King*).
18775. RAPER & RAPER.
18971. WELDON.
19002. SEARLES.
19186. ALLISON (*Ross & White*).
19770. MIALL.
19873. POWERS.
20005. HAMP.
20159. KRUEGER.
20293. IMRAY (*Sneider*).
20361. PAUL.
20364. PICHLER.
20520. WADDINGTON.
20670. LIBBEY.
20731. MACAN (*Richard Thompson*).
20780. CRUIKSHANK (*Thomson*).
20805. LAKE (*Schefold & Penn*).
20845. MCEWEN.
20846. HADDAN (*Engel*).
20878. DAVIDS.
20906. LAKE (*Amborm*).
20968. ODELL.
20980. NEWTON (*The Fuel, Gas, & Light Improvement Company of America*).
20988. CLARKE.
20990. HUSSEY & HATCH.
20992. WOODALL.

1890.

21. ANGUS.
25. LEE.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

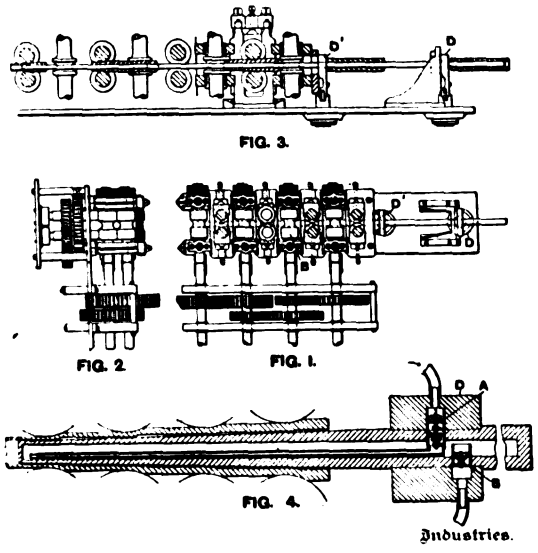
ENGINEERING.

CARDING ENGINES.—*J. M. Hetherington, Manchester.*—The object of this invention is to render more perfect the enclosure of the main carding cylinder at the breast or part of the engine which extends from the "taker in" cylinder to the chain of flats, the intention being to prevent the escape of air, and, as a consequence, of dirt and fibres. To obviate this defect, a curved shield is employed, which extends outwards from the aforesaid breast cover, and partly around the flats which are upon the carrying wheels, the inner and preferably beveled edge of the shield being either in close contact with the upper edge of the breast cover, or being separated by as little space as desired. The shield is suspended from the brackets supporting the carrier wheel in such a manner as to permit of adjustment towards the axis of the carrier wheel and the breast cover. Two claims are made.—No. 3913. March 6th, 1889. 6*d*.

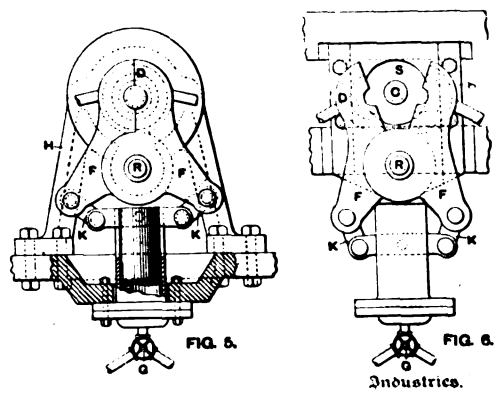
STEAM HAMMERS.—*J. A. Facer, Germantown, U.S.A.*—The invention refers to the use of steam hammers for the purpose of forming wheels for cars. The object is to make a finished wheel from a solid bloom or ingot of steel by forging the ingot under heavy steam hammers having suitably shaped dies. The car wheel made in this manner is compact and homogeneous as to metal, and possesses a hardened surface due to the forging. Further details of the invention may be gathered from the claims. Claims: (1) In a steam hammer for forging wheels, the combination of the hammer die and anvil die having recessed surfaces corresponding to the shape of the sides of the finished wheel, a projection upon one side of said hammer die and supporting devices to support the blank in an upright position against the vertical face of the anvil die and under the projection on the hammer die; (2) in a steam hammer for forging wheels the combination of a hammer and an anvil die having their surfaces formed to correspond to the shape of the finished wheel when the dies are in contact, a projection carried by said hammer die and supporting devices to support the blank in an upright position under the said projection; (3) dies for forging steel wheels consisting of the combination of an anvil die having a large depression or recessed portion upon its face adapted to receive the entire wheel blank including the flange, in combination with a hammer die formed with a small depression upon its face corresponding only to the side of the wheel and corresponding with the recessed portion in the anvil die to shape the blank into a finished wheel, and provided on its front part with a projecting hammer part arranged above the support on the anvil die and shaped to correspond to the tread and flange of the wheel; (4) dies for forging steel wheels consisting of the combination of an anvil die having a large depression or recessed portion upon its face adapted to receive the entire wheel blank including the flange, and a support in front and at a lower level than its face and formed to correspond to the tread of the wheel, including a groove for the flange, and also with a lateral support for the wheel when resting upon the front supports, and removable pin or part detachably connected with the anvil die opposite to the lateral support to hold the wheel blank in position while being turned, in combination with a hammer die formed with a small depression upon its face corresponding only to the side of the wheel and corresponding with the recessed portion in the anvil die to shape the blank into a finished wheel.—No. 17109. October 29th, 1889. 8*d*.

GAS ENGINES.—*H. Williams, Stockport.*—The improvements are particularly applicable to the "Stockport" type of gas engines with cylinders arranged tandem on opposite sides of the crank shaft and they are to ensure the delivery of a full charge of explosive mixture from the compression to the power cylinders. The compression cylinders are situated immediately below each of the power cylinders. The ends of the two power piston rods are fitted together to form a crosshead through which the crank-pin passes. According to the invention the crosshead is formed with a downward projection which carries a stud constituting a crank-pin for a connecting rod secured to the piston of one of the compression cylinders. This compression cylinder piston is adjustably connected to the other, so that the movements of both are simultaneous. By driving the piston of one compression cylinder from a separate and independent crank-pin as described a longer stroke can be given to it than that of the power piston, so that after the power piston has finished its instroke the compression piston below still continues to move inward and drives a full charge of gas and air into the power cylinder. Claims: (1) In a double-acting gas motor engine of the type specified, the combination with the power cylinders, their pistons and rods connected by a crosshead to the crank-shaft, of a separate and independent crank-pin carried by a projection from said crosshead, said crank-pin being connected to and operating the respective pistons of the compression cylinders as described and for the purpose specified; (2) refers particularly to appliance as shown in the drawings of specification.—No, 3820. March 5th, 1889. 6*d*.

ROLLING SEAMLESS TUBES.—*W. P. Thompson, Liverpool.* (*C. Kellogg, Findley, U.S.A.*)—The inventor describes an appliance for rolling seamless tubes from hollow steel ingots. The machine consists of a series of pairs of suitably shaped rolls, each successive pair being driven at a greater speed than the preceding pair, and a tapered or conical mandril placed between the series of rolls. Means are provided for placing the ingots on the mandril whilst others are being rolled, thus making the working of the machine continuous. In the accompanying drawings, Fig. 1 is a plan of the machine; Fig. 2, an end elevation; Fig. 3, a sectional elevation of the machine showing the operation of feeding and reducing a series of ingots simultaneously; Fig. 4 is a horizontal section



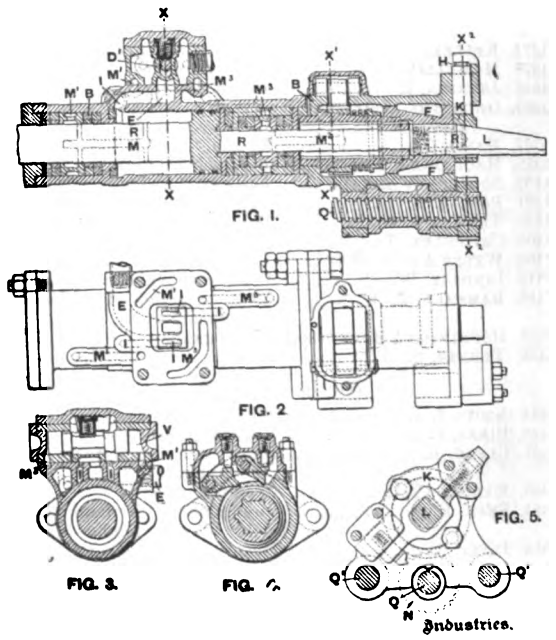
taken longitudinally through the mandril, showing the means of controlling a flow of water to the hollow mandril to cool it, and also showing the gradual reduction of an ingot; Fig. 5 shows an enlarged elevation view of the grip D for holding the mandril in place—the grip is here shown closed; Fig. 6 shows a similar grip D^1 opened. The grips are opened one at a time as is shown in Fig. 3 to pass the ingots on the mandril. They are held closed by a pressure of fluid acting upon the bottom of the piston which is connected to the arms F by the links K. To open the grips, the pressure is removed from the piston by a three-way valve G,



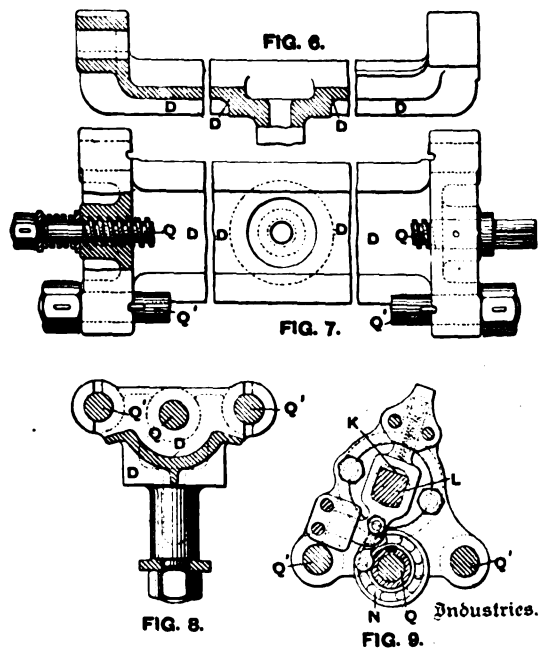
and the jaws then drop open. The jaws of the grips are made to close into grooves in the mandril. The mandril is made tapered, so that the resistance between the mandril and ingot only takes place at the points where the rollers act. The rollers are shown, each pair with their axes at right angles to the preceding pair, the object being to reduce the tube uniformly. The cooling water is passed into the mandril through check valves A and B situated in the grip D. These check valves open and close automatically as the grip is opened and closed. Eight claims are made for the form of tube rolling machine described and the details.—No. 2933. February 19th, 1889. 8*d*.

RAILWAY TRACKS.—*J. H. Clarke, Glenmary, U.S.A.*—The track described in this specification is constructed entirely of iron, and is self-supporting, the usual cross-ties and small fastenings being dispensed with. The chairs for the rails are made to cover a large surface, and are hollowed on the underside. The rail is supported centrally upon the chairs and the inner edge of the foot of the rails is held by an overlapping lug or lip of the chair. A bar of metal is placed between each pair of chairs to keep them at the proper distance according to the width of the track. To this distance bar are bolted hooks which pass under the rail upon each side of the chairs, and grip the outside edges of the foot of the rails. The hooks constitute with the lug upon the chairs a firm grip for the rails, whilst the distance bar prevents the chairs coming closer together and the hooks prevent them spreading. The chairs are constructed with their inner deflected edges longer than the outer, so that as they bed themselves, due to weight upon the rails, the gripping device tightens. The chairs may be circular and their undersides concave or pan-like, or they may be straight on their undersides with oblique anchoring lugs to enter the soil. Seven claims are made.—No. 18053. November 12th, 1889. 6*d*.

PERCUSSIVE ROCK DRILLS.—*A. W. Daws & T. W. Daws, Laurvig, Norway.*—Improvements are here introduced into a machine drill described in a former specification, No. 10738, 1887. They consist of—1st, an improved arrangement of the passages formed in the piston rod for the purpose of actuating the valve of the cylinder; 2nd, of an arrangement of parts enabling the same machine to be fitted to different sized saddles; 3rd, of an improved feed for advancing the drill; and 4th, an improved block or bearing for fixing or combining the rotating gear and feed gear of the drill. Referring to the figures, Fig. 1 is a longitudinal section of the drill; Fig. 2, a plan; Figs. 3, 4, and 5, sections upon the lines X X,



X^1 X^1, and X^2 X^2 respectively; Figs. 6, 7, and 8, elevations and plan of the drill saddle; and Fig. 9, a modified form of Fig. 5. In carrying out the first improvement, the passages M M^2 in the piston rod R are made of such length that one end of each is outside the stuffing boxes B when the other end is in communication with one of the ports M^1 M^2 of the valve cylinder V. This enables the motive fluid to be exhausted from the valve cylinder with certainty at the time motive fluid is admitted at the opposite end. The improved saddle is shown in Figs. 6, 7, and 8. A cast metal bracket D supports two guide rods Q^1, upon which the drill casing slides, as shown in Fig. 9. The feed screw Q is arranged between the guide bars Q^1 and is automatically worked forward



by the lifter L, raising the frame K and with it the spring catch which engages in the notches of the wheel N. The lifter L is connected to the piston rod R by a swivel joint to permit the latter turning. Another construction of this movement is shown in Fig. 5. The fourth improvement consists in the method of providing a bearing for the rifled bush Y of the rotating gear in the block F. The block F in its longitudinal section has the form of a cone, except the ends, which are circular plates. The circular ends are to fit the drill casing. The block F also acts as the guide for the lifter L and end of the piston rod R. Six claims are made for the improvements described.—No. 3691. March 2nd, 1889. 8*d*.

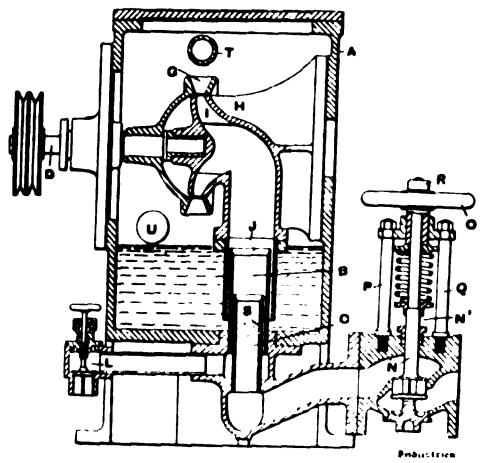
PILING WROUGHT-IRON PUDDLE BARS.—*R. P. Gubbins, London.*—The invention relates to improvements in piling or preparing the puddle bar previously to its being reheated and rolled into finished iron, and is performed as follows:—The bars

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are indented whilst hot by passing between suitable rolls, in such a manner that they are nearly cut in two upon opposite sides and at regular intervals apart. The effect of this almost cutting the bar in two on opposite sides is, that it readily assumes a zigzag form, and can, upon applying pressure to it in the direction of its length, be easily and speedily folded together, taking the form of an ordinary puddle bar pile. If there are too many folds or layers in it, some of them may be easily removed, as they are attached to each other by a very slight connection; if the pile be too small, a piece or two more may be laid on top of the folded ones in the usual way, and thus piles of any weight formed. The folded pile being hot and immediately put in the reheating furnace, a great saving of heat follows the use of this system. The rolls for making the indentations in the bars are of such width apart as to pass the pile-bar without elongating it much. In the surface of the rolls are fixed knives such that as the bar passes between the rolls it is cut nearly through at regular intervals but from opposite sides. Claims: (1) The combination of the "piling rolls" and the knives fixed to the "piling rolls," for cutting almost in two the puddle bar at regular intervals apart on opposite sides as described; (2) the process of folding a puddle bar into a compact mass, ready to be reheated as described; (3) as an article of manufacture the folded pile.—No. 16109. October 12th, 1889. 6*d*.

Turbines.—*N. W. Curtis & A. E. Carey, London.*—The object of this invention is to simplify centrifugal apparatus worked by fluids. The illustrations show in Fig. 1 a section upon the side elevation; Fig 3, a section upon the parts F H; and Fig. 2, a section upon a modification of the apparatus. In the case A is mounted the spindle D which carries the piece F with vanes G. Projecting into the piece F is a part H with vanes I

FIG. 1.



curved in contrary direction to those in the piece F. The part H supports one end of the spindle D, and it has at its base three pipes J, B, and C, in communication with water, air, and steam supplies. The pipe C is in communication with the steam valve N, the pipe B with an air valve L, and the pipe J in communication with the water supply in the tank. The action of the apparatus is as follows:—The hand wheel O is turned until the spring P is so far compressed as to force the valve N from its seat against the steam pressure at the back. Steam then flows through the pipe C into the pipe B and draws water at a high temperature through openings S in the tube B. The mixed steam

FIG. 2.

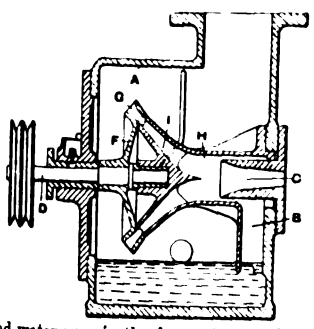
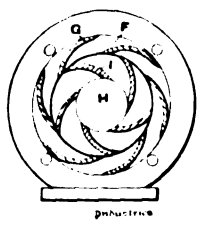


FIG. 3.

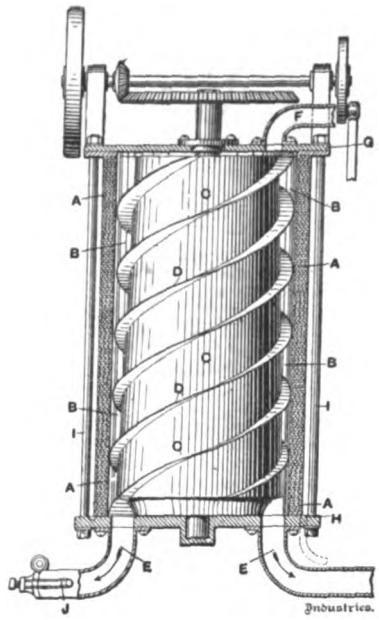


and water pass in the form of spray into the pipe J, and a further supply of water is drawn up between the pipes J and B, the whole being impelled past the vanes I of the case against the vanes G of the disc or wheel F, causing the disc or wheel and its shaft D to revolve. The water in the case A is kept at the requisite temperature by means of a regulated inflow at T and outflow at U. The spring P acts as a regulator on the valve N to control the passage of steam to the apparatus. In the modified form shown in Fig. 3 a single jet pipe C is used and water suction pipe B. Claims: (1) Apparatus for obtaining motive power by the action of a mixture of steam and water in the form of spray; (2) apparatus for obtaining motive power consisting of a disc and case provided with vanes and steam and water supply ways; (3) stop valves combined with screw and spring gear.—No. 1862. February 2nd, 1889. 6*d*.

Screw Conveyer.—*L. Hopcraft, London.*—The conveyer is designed to convey coal and other material in any desired direction instead of in a straight line as hitherto. According to the invention the screw conveyer is constructed in sections, each section carrying a part of the helical blade. These sections are mounted loosely upon a non-rotatable rod curved to the shape of the direction in which it is desired to convey the coal or other material. Between each two sections is placed a gimbal or universal joint, provided with two pairs of trunnions, each pair at right angles to the other pair. One pair of trunnions take into recesses or bearing in one section, and the other pair of trunnions into bearings in the next section. A hole is made in the gimbal joint for the passage of the non-rotatable rod. By this system of connecting the different sections to each other, a continuous helical blade is formed, and the whole of the sections rotated together. Claims: (1) The construction of a screw conveyer in sections fitted together by gimbals or universal joints working upon a central rod bent to the required shape, in the manner described; (2) a feed regulating device, consisting of a cone with a prolonged wing or blade mounted upon the non-rotatable shaft, and having a thread working in a corresponding groove of the same pitch as the blade to adjust the position of the cone beneath the supply pipe, to regulate the supply; (3) the improved screw conveyer constructed, combined, and operating as described.—No. 2581. February 13th, 1889. 8*d*.

Steam Engines.—*R. H. Edgerton, Philadelphia, U.S.A.*—In this engine the piston has a combined or simultaneous reciprocating and rotary movement for imparting motion to a driving shaft without the intervention of crossheads, pitmans, or cranks. The piston is mounted loosely upon its rod which passes through both ends of the cylinder and constitutes the motor shaft. The piston rod is connected to the piston by a feather so that the rotation of latter about its axis cause the former to rotate with it. In the surface of the piston, which is made of great length, is cut a groove, the course of the groove being elliptical. In this groove works a pin firmly fixed to inside of the cylinder at its centre. As the piston is forced from end to end of the cylinder the pin travels in the groove of the piston and causes the piston to revolve. Disc-shaped valves are situated at each end of the cylinder for the admission and exhaustion of the working fluid. They are attached to the piston rod with which they revolve. Seventeen claims are made for the engine described.—No. 18996. November 26th, 1889. 8*d*.

Separating Solids from Liquids.—*F. H. Danchell, Maidstone.*—In apparatus at present in use the process of separation of the solids from the liquid is not continuous; but in the apparatus described in this invention the process is made continuous and much time saved. The illustration shows a vertical section of the machine. A A show a series of rings in close proximity to each other each ring consisting of an annulus of metal flat in cross section and of shallow depth, interstices between the adjacent rings forming the channels of escape for the liquid. The mixture to be separated is passed in by the pipe F. The solid matters are retained in the space B formed between the walls of the inner barrel C and the pile of rings A. These solid matters are carried by the helical blades D down the spaces B towards the



outlets E E to be conveyed away. The space B is of diminishing area from the uppermost part to the lower portion owing to the barrel C being formed of increasing diameter from top to bottom. The rings A are held firmly together by plates G H and bolts I. The apparatus is revolved by suitable gearing shown at the top of the machine. The outlets for the solid matters are fitted with valves J, which retain them until sufficient pressure has been brought to bear on them by the helical blades D to remove all the liquid. Claims: (1) The employment as filtering media of plates of metal of annular or equivalent form, held superposed in series one upon the other, and kept in close proximity to each other, the small interstices between the adjacent plates forming channels of escape for the liquid, but preventives to the passage of more solid matters; (2) in apparatus for separating solid matters from liquids, a series of plates held superposed in close proximity to each other, the small interstices between the adjacent plates forming channels of escape for the liquid, but preventives to the passage of more solid matters, in combination with means—as the helical screwed barrel C D—for conveying away the solid matters as they are separated, and means for supporting, containing, and driving the same; (3) the general arrangement and combination of parts forming apparatus for separating solid matters from liquids by the aid of a series of plates held in close proximity to each other, the small interstices between the adjacent plates forming channels of escape for liquid, but preventives to the passage of the more solid matters.—No. 499. January 10th, 1889. 8*d*.

Gas Motors.—*A. J. Boult, London. (E. Capitaine, Berlin.)*—The invention relates to the distributing mechanism for gas motors, and its object is to enable the toothed wheel ordinarily employed to be replaced by a crank or an eccentric. For the purpose of operating the valves at each alternate revolution only an arm is pivoted to the eccentric rod to alternately strike and miss the valve rod. To this arm is pivoted a plate in the shape of a cross, having a spring bearing to form a resistance to any change of position relative to the arm. The arms of this plate are approximately at right angles to the axis of the valve and eccentric rods, and tends to be held in this position by two springs attached to the cylinder. The operation is as follows: When the arm pivoted to the eccentric rod strikes the valve rod and thus shifts the valve, one arm of the cross-shaped plate strikes, in its movement forward with the arm, a pin upon the cylinder. The plate is thereby moved out of its normal position relative to the arm, and its top end displaces one of the springs attached to the cylinder. At the end of the return stroke when the arm moves away from the end of the valve rod, the spring upon the cylinder thrusts the arm aside by reason of the plate's spring joint holding the plate in its displaced position. In the next stroke forward the other arm of the plate strikes a second pin on the cylinder and makes the plate assume its normal position so that it will strike the valve rod the next stroke. Two claims are made.—No. 121. January 3rd, 1889. 8*d*.

Manufacture of Tuyeres.—*W. Webster, Sheffield.*—The tuyeres to which this invention particularly refers are such as are used for conveying the blast to Bessemer converting vessels An improvement is made in the machines for the manufacture of these articles by perforating them at the time of moulding. In the illustrations given, Fig. 1 is an elevation partly in section of a complete machine, Fig. 2 shows two completed tuyeres in the act of being removed from the machine, Figs. 3 and 4 show a completed tuyere, and Fig. 5 shows a horizontal section of the machine upon the line X X. C is the cylindrical press containing the plastic material for making the tuyeres. At the bottom of the chest C are two apertures leading into the moulds B B

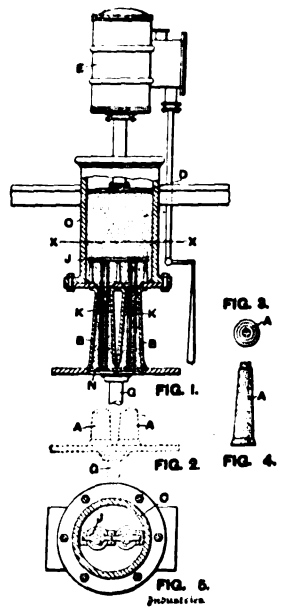


FIG. 3.

FIG. 1.

FIG. 4.

FIG. 2.

FIG. 5.

in which the tuyeres are formed. Rods K K are suspended from a cross-bar J, and pass down through the apertures and the moulds B B to holes in the plate N, which keeps them in their proper position during the moulding. The plate N can be lowered from the moulds by the rod G to remove the tuyeres, as shown in Fig. 2; parts of the tuyeres there shown are broken away. The plastic material is pressed down into the moulds and around the rods by the piston D, actuated by steam or hydraulic power in the cylinder E. When the moulds are filled, the table with the tuyeres is lowered, and the tops of the tuyeres cut off either by hand or automatically. The core rods may be fixed to the plate N instead of the crosshead as described. Claims: In machinery and appliances for the manufacture of tuyeres made from refractory material in a plastic state, the arrangement and combination of parts and appliances by means of which such tuyeres may be produced either by hand or power, so that the perforations or holes are formed therein during the operation of moulding, and when a tuyere so made is ejected from the mould, and cut off to the required length and lifted off the table, it is complete and ready for drying and baking.—No. 3096. February 21st, 1889. 8*d*.

Cutting Metals.—*B. C. Tilgman, Philadelphia.*—The cutting and abrading of metals is assisted in this invention by the application of electricity to fuse or soften the part of metal operated upon. In the practical application of the invention an electric current is used of large quantity but low intensity. The metal object to be operated upon forms one electrode, while the other (preferably the cutting tool) is made to come in contact with the metal object at the point where the mechanical cutting action is taking place. The passage of the current from one electrode to the other at the point of contact, which is also the point of maximum electrical resistance, softens or fuses the metal at that point. When the tool itself constitutes an electrode, it is preferably made similar to a milling cutter to avoid heating of its cutting part. The different teeth are brought then into action with rapid succession. The whole operation can be performed under water, or the tool and work artificially cooled. Claims: (1) The process of cutting and abrading metals, which consists in heating by an electric current successive small portions of the metal surface and simultaneously removing the heated metal by an abrading tool; (2) the process of cutting or abrading metals which consists in passing a current of electricity through the successive points of contact of the metal being treated and the abrading tools; (3) the process of cutting or abrading metals which consists in passing a current of electricity through the successive points of contact of the metal being treated and a rotating abrading tool.—No. 19869. December 10th, 1889. 8*d*.

Pulveriser.—*T. R. Jordan, London.*—The pulveriser is designed for crushing ores and such like substances. The main object of the invention is to simplify the construction and reduce the wear and tear of the parts; also to make the wearing surfaces easily removable. The apparatus comprises a receptacle or pan which is provided with a circular crushing path, and is arranged to be rotated about an inclined axis. In this pan are placed heavy spherical mullers or balls, which, by the rotation of

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the pan, are caused to roll and revolve about their axes on the said crushing path, the inclined position of the pan keeping them practically in the same position in the lower part of the pan. The ore or other substances is fed into the pan, which is open at the top, and after undergoing the action of the balls passes through a meshed surface of the pan. The meshed surface is conical, in the central part of the pan, so that as it assumes the highest position in the rotation of the pan it becomes level with the bottom of the crushing surface, and the material flows over it. Provision is made for the introduction into the pan of a jet of water, which is so regulated and directed as to wash the crushed or pulverised material over the meshed surface and cause the smaller particles to fall through and be conveyed away. Seven claims are made.—No. 3,298. February 23rd, 1889. 11*d.*

SCREW PROPELLERS.—*C. Inwood, Gravesend.*—The object of this invention is to reduce the slip or difference between the linear advance of the vessel propelled and that of the screw propeller due to its pitch, and the formation of the blades in such a manner that they shall be of great strength and rigidity in combination with lightness, and the whole of their surface effective for propulsion. The blades are made of sheet metal of the same gauge from the tip to the root. The blades are U-shaped, and each one joins the boss at two places, parallel to each other and of a given pitch, and arranged round each end of the boss equidistant from each other. Claims: (1) The construction of screw propeller blades with helical propelling surfaces in combination with the propeller boss forming a figure after the manner of an open triangle or U; (2) the construction of propeller blades with two roots, each joining opposite ends of the boss, helically deposed and arranged that no portion shall overlap that of another in line with the axis of rotation or advance.—No. 18431. November 19th, 1889. 6*d.*

BOILER FURNACES.—*E. Hales, Philadelphia, U.S.A.*—In the illustrations, Fig. 1 is a front elevation of the furnace, Fig. 2 a section upon the side elevation, A is the container for the fuel, which is fed in at the top and descends by gravity to the bottom. In the bottom part of the container A are openings C and N; the bottom itself is entirely open, and the fuel rests upon the accumulated ashes F. Air for combustion is supplied through the opening E, closed at will by the suspended door K. The air passes through the fuel in the lower part of the container A, and forms combustion. The products thus formed are conducted on by the draught into the flue B beneath the boiler D. To allow fresh fuel to descend the ashes are cleared away from under the fuel gradually. Claims: (1) The method herein described of

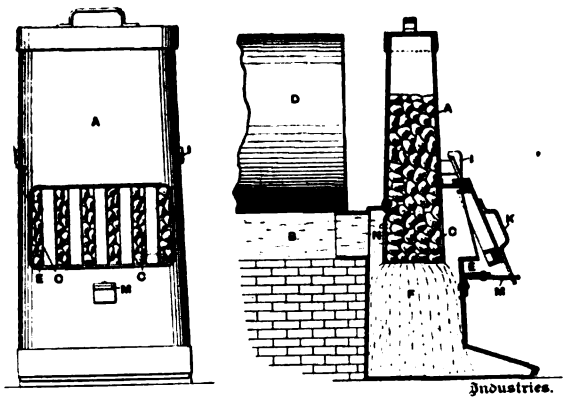


FIG. 1. FIG. 2.

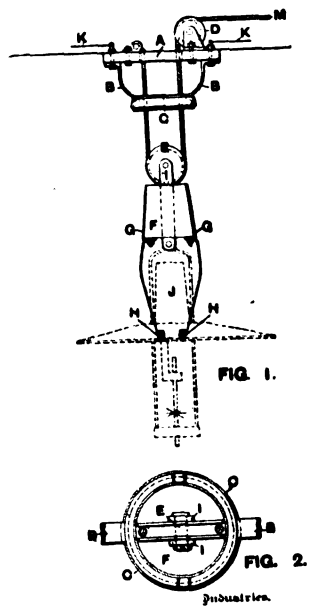
burning fuel in furnaces for steam boilers and other purposes, which consists in storing and feeding the fuel in a vertical chamber having grated side openings, supporting from lateral displacement the burning fuel, and the fuel to be burned on a bed or bank of ashes in the lower portion of the furnace, igniting the fuel lying between the grated side openings, and drawing off the products of combustion, and supplying the air which supports combustion, at right angles to the vertical body of the furnace; (2) a grateless furnace for steam boilers and other purposes, consisting of a vertical chamber, in which the fuel being burned is supported by a bed of ashes in the lower portion of a vertical chamber; (3) a grateless furnace for steam boilers and other purposes, consisting of a vertical chamber, in which the fuel being burned and the fuel to be burned is supported by a bed of ashes in the lower portion of the vertical chamber; and (4), (5), (6), (7), referring more particularly to the parts as illustrated.—No. 18502. November 19th, 1889. 8*d.*

SHEDDING MECHANISM OF LOOMS.—*T. A. Hinchliffe, Denby Dale, & R. Ross, Bradford.*—Improvements are here made in "Howles" and similar shedding mechanism of looms in which motion is communicated from the jack levers to the healds by means of leather straps passing over or under guide pulleys. The improvements consist in replacing the leather straps by suitable chains, particularly to those parts exposed to excessive wear. This overcomes the disadvantage experienced in practice of the rapid wear and stretching of the straps. The chains are formed with flat links adapted to pass smoothly over the guide pulleys. Claim: The combination with a shedding motion of a loom of a chain or chains adapted to pass round a pulley or pulleys, and transmit motion from the jack levers to the healds as described.—No. 2186. February 7th, 1889. 6*d.*

CONDENSERS.—*D. Halpin, London.*—The condensation is conducted by bringing the steam into intimate contact with a current of air. The exhaust steam is caused to escape through a nozzle that is presented to the air-inlet orifice of a rotary fan, so that both the exhaust steam and a current of air are drawn into the centre of the fan. This combined current of air and steam is caught up by the rapidly revolving blades of the fan and thoroughly intermixed as it passes to the periphery of the fan, so that by the time it reaches that point the steam is condensed and the resulting water of condensation thrown to the sides of the fan casing, where it is collected and led away, whilst the blast of air can be utilised for other purposes. A lining of wire gauze or other suitable material is provided at the periphery of the fan to catch up and retain the water thrown against it by the fan blades. The fan is preferably specially constructed, and a second one can be employed to condense any steam that should escape the first operation. The mixture of air, water, spray, and any uncondensed steam might also be made to pass from the fan into a chamber containing groups of tubes so arranged that the mixed current is first made to pass transversely against the outer surfaces of the tubes, on which that portion of the water already condensed would be collected, and flow downwards into a receptacle, while the air and any uncondensed steam is made to flow through the tubes so as to condense the remainder of the steam held in suspension. Claims: (1) The herein-described method of condensing exhaust or waste steam by intimately mixing its current with an air current from which the water of condensation afterwards separates; (2) for effecting admixture of steam and air currents for the purpose above referred to, a propelling apparatus or fan arranged and operating as described.—No. 4340. March 12th, 1889. 8*d.*

ELECTRICITY.

SWITCHES FOR SUSPENDED ARC LAMPS.—*F. Wagg & W. Hudson, London.*—The switch is constructed to automatically "cut out" a lamp by simply lowering it, and to dispense with the usual slack wires, &c., that constitute the "leads." Referring to the figures, A is a disc of wood or non-conducting material permanently fixed in the position from which the lamp is to be hung. Bolted to the block A are springs B B for supporting a split ring C, which is surrounded by an elastic closing band. The lamp is fastened to strips of metal I which support the pulley E and a tapered block of non-conducting material F. A rope

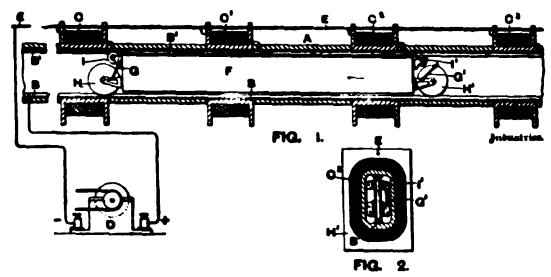


passes around the pulley E and a pulley D for raising and lowering the lamp. Strips of metal G G are attached to the block F and electrically connected to the terminals H H of the lamp. The springs B are also electrically connected to the main "leads" K K. In the position shown in Fig. 1 the lamp is lowered and is "cut out" of current, and the current passing uninterrupted through the ring C. By raising the lamp by the rope M the wedge F will pass into and separate the ring C, and put the strips G in contact with the separated parts of the ring, and so pass the current through the lamp. Claims: (1) The method and arrangement described; (2) the absolute safety from electric shock directly the lamp is lowered, forming its own "cut out;" (3) the taper plug, with insulated strips and split ring, with connecting springs and india-rubber band, forming a switch in the manner described; (4) the application of the switch arrangement to either "parallel" or "series" system of lighting; (5) the arrangement by which the lamp is raised and lowered, and prevented from twisting and preventing the polarity of the carbons.—No. 2742. February 16th, 1889. 6*d.*

ELECTRIC METERS.—*W. P. Thompson, Liverpool.* (*H. C. Tudor, Rosport, Luxemburg*).—In electric meters whose motive apparatus is either a clock motion or an electrical one derived from the distributing circuit in which the apparatus is placed, the motors must be very regular in their action if the periods during which the intensity of the current is to be registered are to follow each other at regular intervals. The object of this invention is, first, to regulate the motion by making it dependent on the motion of a governing apparatus, and, secondly, to abolish the necessity of periodical winding. The governing apparatus preferably used at centres of distribution is composed of a pendulum which establishes and interrupts at intervals the source of electrical energy supplying the motive apparatus of the meters. The motive apparatus of each meter consists of a simple ratchet wheel governed and actuated by a hooked lever. The lever is worked by the armature of an electromagnet alternately magnetised and demagnetised by the current that is controlled by the governor. The ratchet wheel advances one tooth at each contact, and so describes a complete revolution at the end of a certain number of contacts; and since the wheels in each meter have the same number of teeth they will all revolve at the same rate, which rate is controlled by the governor. Claims: (1) In a system of distribution of electric energy the employment of a series of meters, the registering apparatus of each of which is actuated by a uniformly intermittent and simultaneous movement regulated by a governing apparatus at any convenient point on the circuit and transmitted in a similar manner to that employed with electric clocks, whereby the quantity of electricity consumed at different points during equal periods of time may be registered; (2) the improvements in or appertaining to electric meters as described.—No. 2168. February 7th, 1889. 8*d.*

SWITCHES.—*H. Parker & E. S. G. Rees, Wolverhampton.*—In a switch constructed according to these improvements there are two diametrically opposite fixed contacts, between which there is a stud on which a cross-bar is pivoted so as to be capable, when turned in one direction, of disconnecting the fixed contacts, and thereby opening the circuit. An inclined plane is employed in combination with the cross-bar in order to compel the movement of the cross bar along the stud during a portion of its rotation. A spring preferably coiled around the stud is arranged so as to tend to force the cross-bar into the open position. In opening the circuit just as the ends of the cross-bar are about to leave the fixed contact bars or brushes, the spring and the inclined planes combine to force the ends of the bars suddenly out of contact, and thus make a quick break of the circuit. Claims: (1) An electric switch constructed and operated as described; (2) in an electric switch the combination and arrangement with two fixed contacts of a centrally pivoted cross-bar working during a part of its rotation on an inclined plane, a spring, and a handle or key for operating the same as described. No. 3907. March 6th, 1889. 6*d.*

ELECTROMAGNETIC DESPATCH APPARATUS.—*H. J. Haddon, London.* (*J. T. Williams, New York, U.S.A.*)—This apparatus is intended for the transportation of letters and packages. Fig. 1 shows a longitudinal section of the tube with a carrier, and Fig. 2 a transverse section of the same. In the tube or guide A there are two metallic rails B B¹. The rail B is continuous, but the rail B¹ is made in sections insulated from each other. At certain distances along the tube there are solenoids C C¹ C² C³. These solenoids are electrically connected to each of the different sections of the rail B¹, and also to a continuous conductor E. The conductor E and the rail B are connected up to the different poles of an electric generator D. The body of the carriage F is made of soft iron, and it travels upon wheels H H¹, I I¹, which run upon the rails B B¹. The wheels H I and H¹ I¹ can be electrically connected respectively by switches G and G¹. If it is required to send the carrier in the direction indicated by the arrow, the wheels H I are connected by the switch G, and so electric communication is formed between the poles of the



generator D and with the solenoid C in circuit. The solenoid C is thus vitalised, and draws the carrier along with it until it forms fresh connections with the succeeding solenoids. Claims: (1) The combination with the guide A, the continuous rail B and the sectional rail B¹ secured in said guide, the continuous conductor F and the solenoids C C¹ C² C³, mounted on said guide, of a wheel carriage F, the wheels of which engage the rails B B¹, and are in metallic contact with the same and with each other, and suitable connections between the solenoids, the conductor E, the rails B B¹, and a generator of electricity; (2) in an electromagnetic despatch apparatus or port electric a carriage F, provided at each end with a pair of wheels, which are insulated from each other, and a switch mechanism for bringing the wheels at each end in metallic connection.—No. 17765. November 7th, 1889. 6*d.*

CHEMISTRY.

FRACTIONAL DISTILLATION.—*B. Hoff, Galicia.*—The inventor describes a modification of the process of separating liquids of different boiling points by means of fractional distillation. The liquid is first vaporised, and the gases thus generated are passed through a series of chambers in which there is a condensing surface of silicious material, such as flint. The gases of the liquid with the highest boiling point are condensed in the first chamber, and those of the liquid with the lowest boiling point in the last chamber. The surface and capacity of each chamber are of course regulated according to the constituents of the mixed liquid under treatment. Claims: (1) The process whereby gas from several liquids of unequal boiling point is conducted through a vessel under one single distillation only, without using cooling water for condensing, the vessel containing silicic acid, &c., so that the gases of higher boiling point are condensed, whilst the gases of lower boiling point escape in the shape of steam, and are only ultimately condensed in the cooler as a pure product; (2) for apparatus described.—No. 3468. February 26th, 1889. 8*d.*

COLOURING MATTERS.—*T. R. Shillito, London.* (*J. R. Geigy & Co., Basel*).—This invention consists of the synthesis of tricarbo acids of aurine and its homologues by the oxidation of salicylic acid or β-cretosonic acid and one of the methane derivatives, such as methyl alcohol, methyl aldehyde, dioxydiphenylmethane dicarbo acid, &c. As an example of the process, two parts of salicylic acid are dissolved in fifteen parts of concentrated sulphuric acid and four parts of methyl alcohol. This solution is heated to about 70° C. and then 1½ parts of sodium nitrate are added. After a short time the solution becomes green, and it is then poured into water. The new product is precipitated. One claim is made.—No. 3333. February 25th, 1889. 4*d.*

Copies of the British specifications may be obtained on application to H. READER LACK, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every 10d. or fraction of 10d. Remittances exceeding one shilling must be made by Post Office Order.*

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ON THE COMPOUNDING OF LOCOMOTIVES BURNING PETROLEUM REFUSE IN RUSSIA.*

In fulfilment of his promise made in a former discussion upon the Compounding of Locomotives (Proceedings 1886, page 391) the author has much pleasure in now communicating to the Institution the results of the experience he has thus far acquired in the compounding of existing petroleum-burning locomotives on the Grazi and Tsaritsin Railway in South East Russia.

Amongst the conflicting opinions entertained as to the utility of compounding in locomotives, the author, like many others, had his doubts on the subject in 1886. In order to satisfy himself on the question, he obtained the sanction of the Government for altering one locomotive by way of experiment according to his own plans. The altered goods engine No. 35 was put to work on 1st September, 1887; and after some modifications in the valve-gear, suggested by indicator diagrams taken in preliminary trials, it was finally completed, and the driver was allowed over a month's running to get fully acquainted with the handling in regular service. Comparative trials were then made of the compound against a non-compound with the same weight of train on the same days, the two trains being run one after the other with an hour's interval between, so as to expose them both to the same circumstances in regard to weather. It was proved without doubt that the compound burnt 22 per cent. less of the petroleum refuse used as fuel than the non-compound.

In consequence of this very favourable result the compounding of other locomotives was at once proceeded with. At the time of writing (December, 1889) there are already in daily use in the regular train service on this line twelve compound goods engines with six wheels coupled, and three compound passenger engines with four wheels coupled, all of which are doing very well indeed; and in the shops, in course of reconstruction, two passenger and four goods engines. It is intended to go on altering the rest of the locomotives to the compound plan as fast as the limited means in the railway works at Borisoglebsk will admit of this being done.

Economy of Compounding.—The fuel economy in the passenger engines the author believes cannot be less than 20 per cent. in the second or third notch, though there are not yet data enough for confirming this opinion with absolute certainty; it will be greater when the drivers manage the engines better. The mean economy in the twelve goods engines is now found to be 18½ per cent., which is a very good result, though less than what was got in the actual trial of the first one compounded. Including the three passenger engines therefore, the fuel economy in the compounded engines may now be safely taken at 18½ per cent. in comparison with ordinary locomotives. Last winter, 1888-89, was exceptionally severe, with from 55° to 65° Fahr. of frost; but the compounds ran equally well with the other engines, giving no inconvenience on account of the great cold.

Dimensions of Engines.—During the progress of these alterations, and of the author's observations on the working of the altered engines, several difficulties developed themselves, for which remedies had to be devised; those will no doubt interest all engineers concerned in the adoption of compound locomotives. In the accompanying illustrations, Figs. 1, 2, and 3, are shown a side elevation on the high pressure side, a transverse section through the smoke-box, and a sectional plan, of one of the altered six-wheel coupled 36-ton goods engines, of which the following are the main dimensions affecting the compounding:—Cylinders 18½in. and 25⅝in. diameter, and 24in. stroke; ratio of areas, 1·000 to 1·912. Slide-valves, maximum travel, 4¾in.; angle of advance of eccentrics, 20°; high-pressure valve, outside lap 0·81in., inside clearance 0·08in.; low-pressure valve, outside lap 0·67in., inside clearance *nil*. Stephenson link-motion. Receiver, capacity, 3·98 cubic feet; surface exposed to smoke-box heat, 11·52 square feet. Boiler pressure, 9 atm. = 135lb. per square inch above atmosphere. Six wheels, all coupled, 4ft. 3in. diameter. Adhesion weight, 36 tons. Tubes, number 151, outside diameter, 2⅛in.; length between tube-plates, 13ft. 10⅛in. Heating surface, tubes, 1164 square feet; fire box, 67 square feet; total, 1,231 square feet. Fire-grate area, 17 square feet, prior to burning petroleum; but no fire-grate is now used.

In Figs. 7 and 8, page 172, are shown sections of the two slide-valves. The diameter of the high-pressure cylinder is 18½in., and of the low-pressure 25⅝in., the piston areas being consequently 269 and 516 square inches, or in the ratio of about one to two. The original stroke of 24in. is retained unaltered, and the boiler pressure is 135lb. per square inch above the atmosphere. On first testing the engine with the original eccentrics, giving the valves a maximum travel of 4¾in., and having an angle of advance of 30°, it was found from the indicator diagrams that very excessive compression took place in the high-pressure cylinder, and too early a cut-off in both cylinders. The new eccentrics now used for all the compounded locomotives give the valves an increased travel of 4¾in., and have angles of advance of 20°. The indicator diagrams, Fig. 20, page 173, taken in forward gear since these alterations were made, show an improved distribution of steam, the engine giving out ample power in the third and fourth notches for the heaviest trains up the steepest gradients on the line, of 1 in 125; in fact, so far as the power of the engines is concerned, the compounds take their regular turns in the service, drawing the same number of trucks as the non-compounds, and keeping punctual time. The trial trains as well as the ordinary trains in summer consist of thirty loaded trucks of 16 tons each, or a total load of 480 tons exclusive of engine and tender. In these indicator diagrams 10 per cent. has been added to the mean pressure in each cylinder, in order to allow for the effect of the pipe connection from the cylinder to the indicator. All the engines have screw reversing-gear, enabling the driver to use any degree of expansion intermediate between the extreme limits of mid gear and full gear; and the four and five notches mentioned on the diagrams and in the appended Tables 1 to 8 are given merely for comparison with the ordinary nomenclature when a reversing lever and a sector with four and five notches are used. For the driver's guidance a corresponding notched indicator is added, which is shown double full size in Fig. 9 as fitted on the reversing gear for the passenger engines.

In Tables 5 and 6 are given the particulars of the working of the first compounded passenger engine No. 110; and in Fig. 19 are shown the corresponding indicator diagrams taken in forward gear, which are seen to be very good; the passenger engine indeed seems to work rather better than the goods.

Tractive Power.—An opinion prevails among engineers that the compounding of existing locomotives, when retaining the original boiler-pressure without augmentation and also retaining one of the original cylinders to form the high-pressure cylinder in the compound, must result in a considerable reduction in the tractive power of the compound as compared with the non-compound engine. In order to clear up this point, and ascertain fully what are the relative tractive powers of compound and non-compound locomotives, a series of comparative trials were made by the author during the summer of 1889 with both passenger and goods engines. A complete trial train of equal weight was made up for each passenger engine, the gross load being equal to its full adhesion; and similarly for each goods engine. Indicator diagrams were taken at each notch, at the slow speed of only ten miles an hour. At the same time a dynamometer was placed between the tender and the train, to show the actual tractive force exerted upon the train. The trials were all made up hill, from Borisoglebsk up to Gribanovka, a distance of eleven miles, with the maximum incline of 1 in 125 for the greater part of the way, and with frequent curves of 2,100ft. (32 chains) radius. In Fig. 18 is shown a profile of this portion of the line. The boiler pressure was the same in all cases, namely 9 atmospheres effective, or 135lb. per square inch above the atmosphere. The results are given in Table 7 and Figs. 19 and 22 for the passenger engines, compound and non-compound, both of which took trains of 344½ tons exclusive of engine; and in Table 8 and Figs. 20 and 23 for the goods engines, which took trains of 463 tons net.

In the compound passenger locomotive, as shown in Fig. 15, the tractive power undergoes the following diminution, as compared with the non-compound, in the five successive notches of the reversing lever from the earliest cut-off to full gear:—

1st notch	tractive power	42	per cent.	less in	compound.
2nd notch	,,	,,	28	,,	,,	,,
3rd notch	,,	,,	17	,,	,,	,,
4th notch	,,	,,	7	,,	,,	,,
5th notch (full gear)	,,	,,	5	,,	,,	,,

* Paper read by Mr. Thomas Urquhart, Locomotive Superintendent, Grazi and Tsaritsin Railway, South East Russia, before the Institution of Mechanical Engineers, on the 26th ult.

COMPOUND LOCOMOTIVES IN RUSSIA.

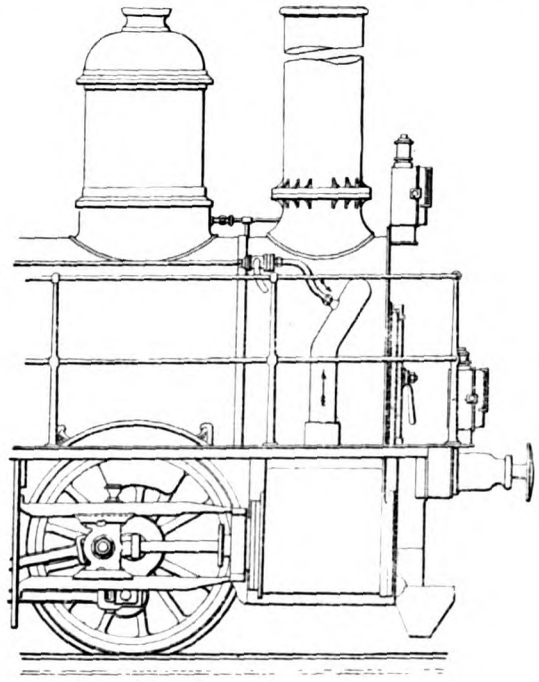


Fig. 1.

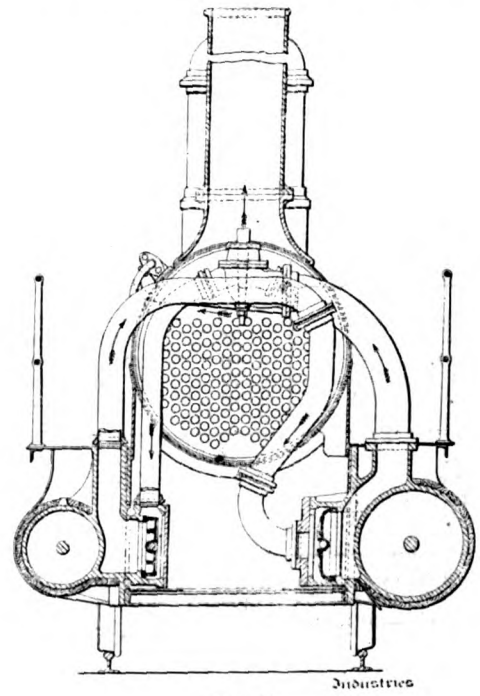


Fig. 2.

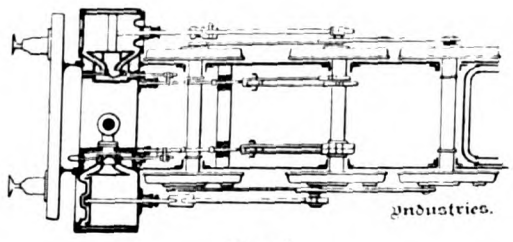


Fig. 3.

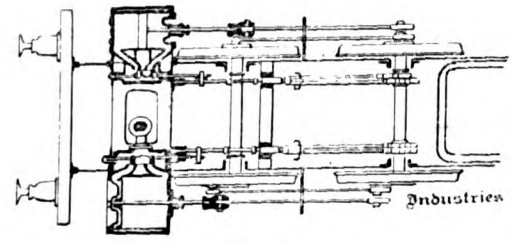


Fig. 4.

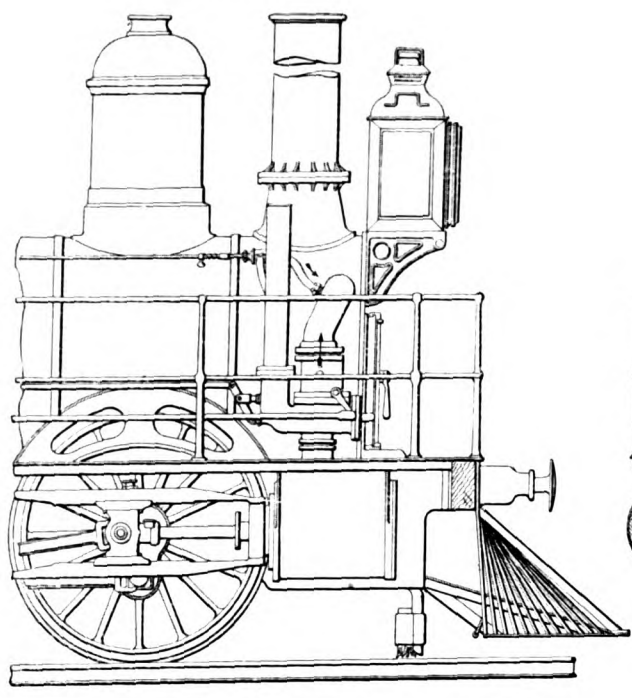


Fig. 5.

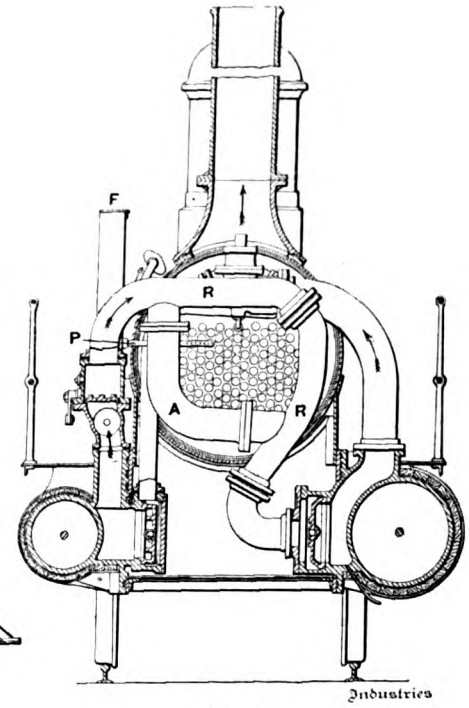


Fig. 6.

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COMPOUND LOCOMOTIVES IN RUSSIA.

TABLE I.

Mean Steam Pressures, and Temperatures of Steam, in Six-Wheel Coupled 36-ton Compound Goods Locomotive No. 35. High-pressure Crank leading in forward running.

See Indicator Diagrams, Fig. 20.

Cylinder.	Cut-off.		Steam Pressures, lbs. per Square Inch.					Temperatures of Steam.			
	No. of Notch.	† Percentage of Stroke.	Valve-Chest.	Mean Forward.	Mean Back.	Mean* Effective. D	D×1·1	Beginning of Stroke.	End of Expansion.	Utilised in Expansion.	Utilised in both Cylinders.
	No.	Per Cent.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Fahr.	Fahr.	Fahr.	Fahr.
High-pressure, right hand.	1	47	132·4	92	63	29	32	356°	293°	63°	—
	2	60	132·4	110	58	52	57	356°	311°	45°	—
	3	72	132·4	119	55	64	70	356°	324°	32°	—
	4	82	132·4	127	57	70	77	356°	333°	23°	—
Low-pressure, left hand.	1	49	47·1	27	7·1	19·9	22	295°	237°	58°	119°
	2	67	51·5	34	5·7	28·3	31	298°	257°	41°	99°
	3	79	52·9	41	4·3	36·7	40	300°	273°	27°	83°
	4	86	55·9	48	2·8	45·2	50	302°	284°	18°	72°

† The point of cut-off in percentage of stroke is given as marked from the valve setting.
* The mean effective pressure in column D is the difference between the mean forward and backward pressures; in column D × 1·1 it is increased by 10 per cent to allow for the throttling effect of the indicator pipe and connections.

TABLE II.

Power developed by Six-Wheel Coupled 36-ton Compound Goods Locomotive No. 35. High-pressure Crank leading in forward running.

Grade of Expansion. No. of Notch.	Speed of Train. Miles per Hour.	Driving Wheels. Revolutions per Minute.	Piston Speed. Feet per Minute.	Indicated Horse-Power.	Tractive Power.	Ratio of Tractive Power to Adhesion Weight.
No.	Miles.	Revs.	Feet.	I.H.P.	Tons.	[Per Cent. Ratio.
1	20	131	524	310	2·655	7·7 = 1 to 13
2	18	117	468	452	4·192	11·9 = 1 to 8·4
3	17	100	400	476	5·543	15·8 = 1 to 6·3
4	13	87	348	475	6·195	17·8 = 1 to 5·6

TABLE III.

Mean Steam Pressures, and Temperatures of Steam, in Six-Wheel Coupled 36-ton Compound Goods Locomotive No. 53. Low-pressure Crank leading in forward running.

See Indicator Diagrams, Fig. 21.

Cylinder.	Cut-off.		Steam Pressures, lbs. per Square Inch.					Temperatures of Steam.			
	No. of Notch.	† Percentage of Stroke.	Valve-Chest.	Mean Forward.	Mean Back.	Mean* Effective. D	D×1·1	Beginning of Stroke.	End of Expansion.	Utilised in Expansion.	Utilised in both Cylinders.
	No.	Per Cent.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Fahr.	Fahr.	Fahr.	Fahr.
High-pressure, left hand.	1	38	132·4	82	70	12	13	356°	288°	68°	—
	2	54	132·4	105	73	32	35	356°	309°	47°	—
	3	68	132·4	121	61	60	66	356°	322°	34°	—
	4	80	132·4	131	64	67	74	356°	345°	11°	—
Low-pressure, right hand.	1	38	55·88	24	11	13	14	302°	225°	77°	131°
	2	55	55·88	37	9	28	31	302°	248°	54°	108°
	3	68	55·88	43	4	39	43	302°	266°	36°	90°
	4	80	55·88	51	4	47	52	302°	286°	16°	70°

† The point of cut-off in percentage of stroke is given as marked from the valve setting.
* The mean effective pressure in column D is the difference between the mean forward and backward pressures; in column D × 1·1 it is increased by 10 per cent. to allow for the throttling effect of the indicator pipe and connections.

TABLE IV.

Power developed by Six-Wheel Coupled 36-ton Compound Goods Locomotive No. 53. Low-pressure Crank leading in forward running.

Grade of Expansion. No. of Notch.	Speed of Train. Miles per Hour.	Driving Wheels. Revolutions per Minute.	Piston Speed. Feet per Minute.	Indicated Horse-Power.	Tractive Power.	Ratio of Tractive Power to Adhesion Weight.
No.	Miles.	Revs.	Feet.	I.H.P.	Tons.	Per Cent. Ratio.
1	20	131	524	167	1·449	4·2 = 1 to 24
2	18	117	468	366	3·395	10·0 = 1 to 10
3	15	100	400	482	5·116	14·7 = 1 to 6·8
4	13	87	348	478	6·112	17·5 = 1 to 5·7

The high-pressure cylinder in this engine was worn out and had a crack in its body, and a liner was therefore put in, whereby the clear working diameter was reduced to 460 mm. = 18·11in.; whereas the first engine compounded, No. 35, with high-pressure crank leading, had its cylinder re-bored to 470mm. = 18·50in.

In the compound goods locomotive, as shown in Fig. 16, the diminution of tractive power as compared with the non-compound is as follows for the four notches:—

1st notch .....tractive power 27 per cent. less in compound.
2nd notch..... ,, ,, 17 ,, ,, ,,
3rd notch..... ,, ,, 10 ,, ,, ,,
4th notch (full gear) ,, ,, 5 ,, ,, ,,

Although the compounds thus show in full gear a diminution of 5 per cent., this difference from the non-compounds may for all practical purposes be neglected.

In Table 7 are given the indicated horse-power developed, and also the tractive force exerted by the passenger engines, compound and non-compound, each having an adhesion weight of 24 tons. At the third notch in the compound it will be seen there is a tractive force of 4·44 tons, equal to 18·5 per cent., or 1:5·4 of the adhesion weight, which is quite sufficient for all practical purposes. The maximum traction in the compound, at the fifth notch or full gear, reaches 5·17 tons, equal to 21·7 per cent., or 1:4·6, or more than one-fifth of the adhesion weight, which the author noticed was sufficient to slip the wheels on a perfectly dry rail. The increased tractive power shown in Table 7 over Table 6 is due both to the slower speed of only 10 miles an hour, and also to the cut-off being a little later, owing to wear of the valve-gear after longer running. The object of making these later trials in Tables 7 and 8 at the slower speed of 10 miles an hour, and at the full capacity of the locomotives, was to get fuller and clearer indicator diagrams than would be possible at higher speeds.

In the case of the goods locomotives, Table 8, having 36 tons adhesion weight, at the third notch in the compound a tractive power is attained of 5·56 tons, equal to 15·6 per cent., or 1:6·7; while at the fourth notch or full gear the maximum is reached of 6·42 tons, equal to 18·0 per cent., or 1:5·6 of the adhesion weight, which is quite sufficient for all practical purposes. Having fortunately been able to ascertain the foregoing facts from his own personal observations, the author will be very glad if they should be deemed sufficient to set at rest a question upon which a good deal of conjecture has hitherto existed.

In the calculation of the tractive power of the compound engines, the power of each cylinder is calculated separately by means of the formula:—Tractive power = 0·57 × boiler-pressure above atm. × (cyl. diam.)² × stroke ÷ (2 × diam. of driving wheels). The coefficient 57 per cent., which gives the mean effective pressure on the high-pressure piston in full gear, has to be replaced by a lower figure, deduced from indicator diagrams, when working more expansively; and for the low-pressure cylinder a still lower coefficient has of course to be taken.

Economy of Fuel and Repairs.—Table 11 shows the consumption of petroleum refuse, and the cost of engine and tender repairs, in six compound and six non-compound locomotives, one of each being a passenger engine and the other five goods; the results are those of five months' working in 1889, from April to August inclusive. The saving of fuel in the compounds is seen to have been 4·55lb. per mile, or 18·22 per cent. in the passenger engine, and a mean of 5·31lb. per mile, or 18·96 per cent., in the five goods engines, which together made 58,580 miles; in these five engines the saving ranged from a minimum of 14·75 to a maximum of 25·57 per cent. The saving in repairs was 49·2 per cent. in the passenger engine, and a mean of 28·8 per cent. in the goods. Naturally the whole of the saving in repairs must not be put down to the credit of the compounding alone, because all these compound engines had just passed through the shops and undergone a complete overhaul, so that they would reasonably require less repairs in running service than the old non-compound locomotives with which they are compared. None the less is the author of opinion, as the result of his own observations thus far, that the compounds will at all times require less repairs than the non-compounds, to the extent of probably at least 25 per cent., simply from the fact that the initial strains are not so high on the bearings and other mechanism in the compounds, and the force exerted by the pistons is continued upon the crank-pins for a greater distance during each stroke than in the non-compounds. Moreover, the friction of the slide-valves is much less in the compounds, because the back-pressure of about 60lb. per square inch under the high-pressure slide-valve tends to ease it off the face, while the low-pressure slide-valve is loaded to less than half the boiler pressure.

In Table 9, and graphically in Fig. 17, is shown the comparative consumption of petroleum refuse in compound and non-compound six-wheel coupled 36-ton goods engines doing equal work on the same section of line from 1st January to 31st October, 1889. During the first three months of severe winter the trains were much blocked by snow-drifts, causing the traffic to be very irregular; and as the compounds require just the same quantity of fuel as the non-compounds for keeping steam up while standing, they do not show so advantageously under such conditions as in long running service. The mean consumption per engine-mile for the ten months is seen to be 25·40lb. in the compounds and 30·65lb. in the non-compounds, showing a saving of 5·25lb. or 17·13 per cent. in the compounds. In conjunction with the mean saving of 18·96 per cent. shown in Table 11, the general average is roundly a saving of 18 per cent. for the whole of the ten months' working.

Slide-Valves.—The results of observation show that a very small difference in lap, outside or inside, amounts to a great deal in fuel consumption. The fuel sheets for all the compounds are every month carefully scrutinised, in order to see which particular engine burns least. Out of the twelve compound goods engines now running, No. 40, working between Tsaritsin and Archeda, has thus far proved the best from the commencement of its service in May, 1889, to the end of October; although over the shorter period covered by Table 11, No. 43, which began running in June, 1889, between Archeda and Filonoff, happens to show a little better. A longitudinal section of the two slide-valves of this engine No. 40 is shown in reduced size in Figs. 10 and 11; and particulars of their setting are given in Table 10. The full travel of the valves in each case is 4¾in., and the exact amounts of their lap are as follows:—High-pressure valve, outside lap 20mm. = 0·79in., inside clearance 1½mm. = 0·06in.; low-pressure valve, outside lap 15½mm. = 0·61in., inside lap 2mm. = 0·08in. A trial, however, is now being made of a low-pressure valve with an increased inside lap of 3mm. = 0·12in., with a view to increasing the compression in the low-pressure cylinder in order

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to take up the extra momentum due to the greater weight of the larger piston; and this difference in the inside lap is now being watched over a lengthened period of working, for determining its importance in accomplishing the desired object.

Relieved Slide-Valves.—For relieving the pressure of the slide-valves on their faces the author has adopted the plan shown in Fig. 12 for the high-pressure valve, placing over the back of the valve a fixed table or back-plate B, against which bear a couple of relieving rings R, let into annular grooves in the back of the valve, and pressed outwards against the plate by the steam getting under them through a small hole H made for the purpose. Any steam leaking through past the rings escapes through the tube T open to the atmosphere, whereby the valve is relieved from the steam pressure over the area enclosed within the two rings R. For the low-pressure valve the arrangement shown full size in Fig. 13 is adopted, consisting of a piston P in a cylinder of 6in. diameter, exposed to the steam pressure underneath and open to the atmosphere above, thus tending to lift the valve off its face by means of the connecting link L. This latter plan was tried on eight engines and did very well, but has been temporarily abandoned because it made so much noise when running without steam. In other respects, however, the author is so satisfied of its value that he intends to try it once more, and see if the above objection cannot be obviated. It will be seen that in neither of these plans for relieving the slide-valves are any springs used.

Sequence of Cranks.—The first four compounded engines turned out of the shops had their high-pressure crank leading and low-pressure following in forward running; and in Tables 1 and 2 are given the corresponding mean steam-pressures, and temperatures of steam, and power developed. In order to test the effect of the reverse sequence of cranks, one goods engine, No. 53, was altered to have the low-pressure crank leading and the high-pressure crank following in forward running; and in Tables 3 and 4 are given the corresponding particulars for comparison with Tables 1 and 2. From the indicator diagrams taken in forward gear with the latter arrangement, shown in Fig. 21, it will be noticed that inconvenient and very excessive compression takes place at the first notch in the high-pressure cylinder, so much so indeed that this notch is not used; but in all the other notches a good distribution takes place. In the low-pressure cylinder a much better distribution takes place at all notches compared with engines having the high-pressure crank leading; and this engine with the low-pressure crank leading, which has only recently been put to work, seems to develop more power and to burn less fuel than the others having the high-pressure crank leading. This is the first time, so far as the author is aware, that the sequence of cranks in compound locomotives has been taken into consideration. The receiver capacity is equal to that of the high-pressure cylinder; and all the dimensions are the same in both the above cases. Four goods engines now have the low-pressure crank leading, while all the passenger have the high-pressure leading.

The idea of making one engine by way of trial with the low-pressure crank leading in forward running originated in its being accidentally noticed that one of the other engines, compounded with the high-pressure crank leading in forward running, seemed to work better and to be more powerful, developing its full tractive force with an earlier cut-off and making steam with greater freedom, when running backwards with its train, in which case of course the low-pressure crank became the leading one. The line following generally the undulating contour of the plains, its profile has very long gradients of 1 in 125, thus demanding for long stretches at a time the full power of the engine, or say about the third notch out of four. The only objection the author now sees to the low-pressure crank leading is that it gives too much power in the large cylinder and too little in the small, thus putting the engine out of equilibrium; but this irregularity will in a great measure be obviated by having a receiver about half as large again as those now used on all the present compounds.

Air-inlet Valve.—When the first passenger compound was put into regular train service, it was noticed that, where an ordinary non-compound ran easily down hill with the regulator closed, the compound ran very stiff, and even required the regulator opening a little: thus proving that an increased internal resistance existed in the compound locomotive, which was traced to the large area of the low-pressure piston creating a strong vacuum in the receiver. This was overcome by placing on the receiver an air-inlet valve opening inwards, Fig. 14, for enabling the large piston to draw in air when required, as is invariably the case when the steam is shut off. Since the addition of this valve the engine runs down hill with even greater ease than a non-compound locomotive. As for the objection that such a valve cools the low-pressure cylinder, the author had to choose one of two inconveniences: either to keep steam on when running down hill, or to cool the cylinder. The latter proves the more profitable method, and is accordingly adopted.

Subsequently the author has arranged for mixing part of the hot smoke-box gases with the cold air, and admitting this mixture into the low-pressure cylinder at a temperature of from 120° to 180° Fahr.: this can easily be done without risk of injury to the valve-faces and piston-rings, because no solid particles from cinders or ashes exist in the smoke-box of these engines burning petroleum refuse. The plan adopted is shown in Fig. 6, and consists in placing upon the receiver R a short perforated pipe P of 2⅛in. bore, projecting into the smoke-box, the aggregate area of the perforations being double the area of the pipe. In order that the hot gases alone may not get into the cylinder and cause damage by their great heat, a couple of air holes are made in the flap-valve F which closes the top of the stand-pipe above the high-pressure valve-chest; the joint area of the two holes is about one-quarter that of the gas pipe P, so that the air and gas get mixed in the proportion of about one to four, which, as far as the author's experience goes, is quite sufficient for preventing over-heating. The results are very good; the cylinders no longer get cooled as they did before, and when the regulator is opened afresh less steam is condensed, or possibly none at all. The flap-valve F is closed by a light spring, and is at once blown wide open whenever the engine is made to work non-compound at starting.

Starting Valve.—The starting valve on the receiver, for admitting boiler steam direct to the low-pressure cylinder for starting, is worked by hand by the driver, and is not automatic in closing, its only merit being that it is exceedingly simple. In fact, these valves were already in stock, having formerly been used for steam-brakes on the locomotives. It cannot therefore be pretended that they present the same excellent features as the special automatic starting valves which have been introduced elsewhere and and have proved so efficient in working. In the author's locomotives retaining their original boilers it must be borne in mind that his whole attention was directed simply to obtaining from old engines compounded with 8½ to 9 atmospheres pressure the nearest and cheapest approach to modern compounds having 12 atmospheres pressure. As to any possibility of a wasteful expenditure of steam through abuse of the starting valve, this is sufficiently guarded against by the drivers being paid a premium for saving fuel; they are, as a rule, fully alive to their own interests, and never use the starting valve more than is absolutely necessary. In Figs. 5, 4, and 6 are shown a side elevation on the high-pressure side, a plan, and a transverse section through the smoke-box and cylinders, of a compounded passenger engine having a hand interchanging valve, in addition to the hand intercepting valve; the two together enable the engine to continue working non-compound for any length of time, instead of for only the first stroke at starting; and the interchanging valve, when the intercepting valve is either open or closed, serves also as an air-inlet valve for both cylinders in running down hill with the steam shut off. In Fig. 14 is shown the arrangement of these valves, which are indispensable for starting heavy trains without jerks.

Receiver.—The first compounded passenger locomotive had a receiver capacity equal to the volume of one stroke of the high-pressure piston; but in two recently compounded the receiver has been enlarged to 1·3 times that capacity, by the addition of

COMPOUND LOCOMOTIVES IN RUSSIA.

TABLE V.

Mean Steam Pressures, and Temperatures of Steam, in Compound Passenger Engine No. 110 with Six Wheels, four coupled. High-pressure Crank leading in forward running.

See Indicator Diagrams, Fig. 19.

Cylinder.	Cut-off.		Steam Pressures, lbs. per Square Inch.					Temperatures of Steam.			
	No. of Notch.	†Percentage of Stroke.	Valve-chest.	Mean Forward.	Mean Back.	Mean* Effective. D	Mean* Effective. D×1·1	Beginning of Stroke.	End of Expansion.	Utilised in Expansion.	Utilised in both Cylinders.
	No.	Per cent.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Fahr.	Fahr.	Fahr.	Fahr.
High-pressure, right hand.	1	30	132·4	8	57	31	34	356°	286°	70°	—
	2	50	132·4	110	55	55	60	356°	306°	50°	—
	3	70	132·4	125	54	71	78	356°	329°	27°	—
	4	80	132·4	132	53	79	87	356°	342°	14°	—
	5	87	132·4	135½	52	83½	92	356°	349°	7°	—
Low-pressure, left hand.	1	42	55·88	34	7·1	26·9	30	302°	243°	59°	113°
	2	60	56·61	43	4·3	38·7	43	303°	257°	46°	99°
	3	78	57·35	48	2·0	46·0	51	304°	273°	31°	83°
	4	86	57·79	53	1·0	52·0	57	305°	286°	19°	70°
	5	92	58·19	56	1·0	55·0	60½	306°	292°	14°	64°

† The point of cut-off in percentage of stroke is given as marked from the valve setting.
* The mean effective pressure in column D is the difference between the mean forward and backward pressures; in column D×1·1 it is increased by 10 per cent. to allow for the throttling effect of the indicator pipe and connections.

TABLE VI.

Power developed by Compound Passenger Engine No. 110 with Six Wheels, four coupled. High-pressure Crank leading in forward running.

Cylinders 17¼in. and 25¼in. diameter, 22in. stroke. Driving wheels 5ft. 3in. diameter. Adhesion weight 24 tons. Boiler pressure 135lb. per square inch above atmosphere.

Grade of Expansion. No. of Notch.	Speed of Train. Miles per Hour.	Driving Wheels. Revolutions per Minute.	Piston Speed. Feet per Minute.	Indicated Horse-power.	Tractive Power.	Ratio of Tractive Power to Adhesion Weight.
No.	Miles.	Revs.	Feet.	I.H.P.	Tons.	Per Cent. Ratio.
1	33	176	646	463	2·151	9·09 = 1 to 11
2	27	141	518	552	3·427	13·88 = 1 to 7·2
3	20	106	387	539	4·217	17·00 = 1 to 5·8
4	13	70	256	475	4·746	19·23 = 1 to 5·2
5	10	53	194	306	5·17	21·54 = 1 to 4·6

TABLE VII.

Power developed by Compound and Non-Compound Passenger Engines with Six Wheels, four coupled; with equal trains at equal speeds of 10 miles per hour.

Cylinders, compound 17¼in. and 25¼in. diameter; non-compound 17$\frac{15}{16}$in. diameter; 22in. stroke. Driving wheels 5ft. 3in. diameter. Adhesion weight 24 tons. Boiler pressure 135lb. per square inch above atmosphere. Revolutions 53 per minute. Piston speed 194ft. per minute. See Indicator Diagrams, Figs. 19 and 22.

Engine.	Grade of Expansion. No. of Notch.	Mean* Effective Steam-Pressure. Lbs. per Square Inch. Small Cylinder.	Mean* Effective Steam-Pressure. Lbs. per Square Inch. Large Cylinder.	Indicated Horse-power.	Tractive Power.	Ratio of Tractive Power to Adhesion Weight.
	No.	Lbs.	Lbs.	I.H.P.	Tons.	Per Cent. Ratio.
Compound No. 110.	1	35·2	30·5	139	2·35	9·8 = 1 to 10·2
	2	60·1	44·4	215	3·63	15·1 = 1 to 6·6
	3	79·3	51·6	263	4·44	18·5 = 1 to 5·4
	4	89·5	58·2	297	5·01	20·9 = 1 to 4·8
	5	92·0	60·5	306	5·17	21·5 = 1 to 4·6
Non-compound No. 115.	1	87·5		241	4·07	16·9 = 1 to 5·9
	2	108·2		298	5·04	21·0 = 1 to 4·8
	3	115·0		317	5·35	22·3 = 1 to 4·5
	4	116·3		321	5·42	22·6 = 1 to 4·4
	5	117·4		324	5·47	22·8 = 1 to 4·4

* The mean effective pressure in these columns is the difference between the mean forward and backward pressures, increased by 10 per cent. to allow for the throttling effect of the indicator pipe and connections.

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COMPOUND LOCOMOTIVES IN RUSSIA.

TABLE VIII.

Power developed by Compound and Non-Compound Six-Wheel coupled 36-ton Goods Locomotives, with equal trains at equal speeds of 10 miles per hour.

Cylinders, compound 18½in. and 25⅝in. diameter; non-compound 18½in. diameter; 24in. stroke. Wheels 4ft. 3in. diameter. Adhesion weight 36 tons. Boiler pressure 135lb. per square inch above atmosphere. Revolutions 65 per minute. Piston speed 260 feet per minute. See Indicator Diagrams, Figs. 20 and 23.

Engine.	Grade of Expansion. No. of Notch.	Mean* Effective Steam Pressure. Lbs. per Square Inch.		Indicated Horse-power.	Tractive Power.	Ratio of Tractive Power to Adhesion Weight.
		Small Cylinder.	Large Cylinder.			
	No.	Lbs.	Lbs.	I.H.P.	Tons.	Per Cent. Ratio.
Compound No. 35.	1	33	23	163	2·77	7·7 = 1 to 13·0
	2	58	32	253	4·29	11·9 = 1 to 8·4
	3	73	42	335	5·56	15·4 = 1 to 6·5
	4	79	52	379	6·42	17·8 = 1 to 5·6
Non-compound No. 63.	1	55		223	3·79	10·5 = 1 to 9·5
	2	75		304	5·17	14·4 = 1 to 7·0
	3	89		361	6·19	17·2 = 1 to 5·8
	4	98		398	6·78	18·8 = 1 to 5·3

* The mean effective pressure in these columns is the difference between the mean forward and backward pressures, increased by 10 per cent. to allow for the throttling effect of the indicator pipe and connections.

TABLE IX.

Comparative Consumption of Petroleum Refuse in 1889 in Compound and Non-Compound Six-Wheel Coupled 36-ton Goods Locomotives doing equal work on the same Section of the Grazi and Tsaritsin Railway.

See Diagram, Fig. 17.

1889.	Compounds.						Non-Compounds.					
	Mileage.				Petroleum Consumption.		Mileage.				Petroleum Consumption.	
	Average Number of Trucks in Train.	Total Train-miles.	Total Engine-miles.	Unremunerative Engine-miles.	Total.	Per Engine-mile.	Average Number of Trucks in Train.	Total Train-miles.	Total Engine-miles.	Unremunerative Engine-miles.	Total.	Per Engine-mile.
	No.*			Per Cent.	Tons.	Lbs.	No.*			Per Cent.	Tons.	Lbs.
January	21·52	9,138	10,225	10·62	144·46	31·65	22·16	9,237	10,872	15·03	174·76	36·01
February	21·36	6,165	7,949	22·44	100·12	28·21	21·48	6,196	8,089	23·40	124·11	34·37
March	21·21	6,561	7,822	16·10	101·06	28·94	20·81	6,184	7,303	15·33	115·09	35·30
April	22·82	7,491	9,398	20·27	96·07	22·90	24·79	8,170	9,791	16·56	125·68	28·75
May	25·69	16,634	18,305	9·13	195·02	23·86	24·83	16,109	18,273	11·84	229·93	28·18
June	24·61	15,741	17,873	11·92	177·62	22·26	24·76	16,304	18,818	13·36	234·56	27·92
July	25·69	13,929	15,817	11·93	162·10	22·96	26·03	13,849	15,397	10·05	195·39	28·43
August	26·01	15,566	17,940	13·23	178·22	22·26	25·35	15,009	18,177	17·42	216·74	26·71
September	25·60	19,186	22,174	13·48	254·33	25·69	25·32	21,513	24,790	13·22	321·83	29·08
October	24·25	22,085	26,007	15·08	292·93	25·23	24·01	23,924	26,868	10·95	380·85	31·75
November	—	—	—	—	—	—	—	—	—	—	—	—
December	—	—	—	—	—	—	—	—	—	—	—	—
Means and Totals ...	23·88	132,496	153,510	13·69	1,701·93	25·40	23·95	136,495	158,378	13·82	2,118·94	30·65

* Trucks each 16 tons gross weight.

TABLE X.

Setting of Slide-Valves in Forward Running with High-pressure Crank leading in Compound Goods Locomotive No. 40.

Stroke 24 inches. Full travel of each valve 4¾ inches.
High-pressure valve, outside lap 0·79 inch, inside clearance 0·06 inch.
Low-pressure valve, outside lap 0·61 inch, inside lap 0·08 inch.
See Sections of Valves in Figs. 10 and 11.

No. of Notch in Forward Gear.	High-pressure Cylinder, Right Hand.				Ligh-pressure Cylinder, Left Hand.			
	Lead.		Cut-off. Percentage of Stroke.		Lead.		Cut-off. Percentage of Stroke.	
	Front end.	Back end.	Front end.	Back end.	Front end.	Back end.	Front end.	Back end.
No.	Inch.	Inch.	Per Cent.	Per Cent.	Inch.	Inch.	Per Cent.	Per Cent.
1	0·31	0·30	40	36	0·49	0·49	50	46
2	0·29	0·28	55	52	0·47	0·47	66	61
3	0·25	0·24	69	64	0·43	0·43	77	71
4	0·20	0·19	80	76	0·39	0·39	84	80

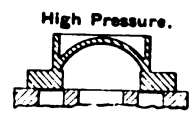


Fig. 7.

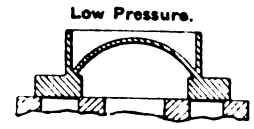


Fig. 8.

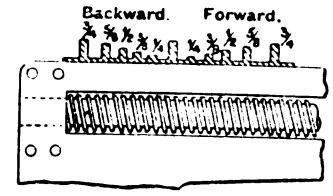


Fig. 9.

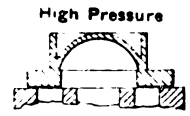


Fig. 10.

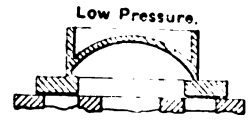


Fig. 11.

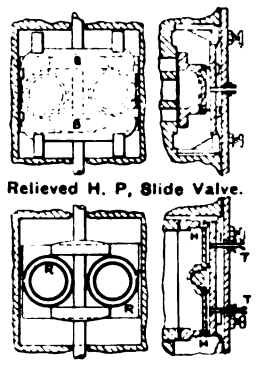


Fig. 12.

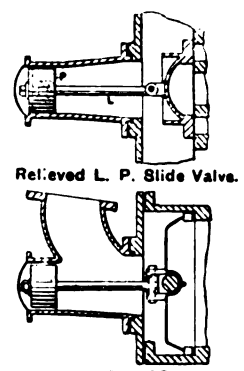


Fig. 13

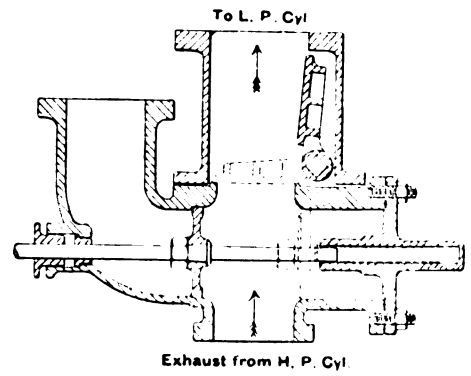


Fig. 14.

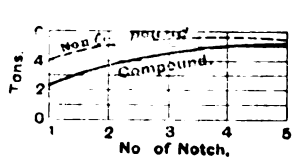


Fig. 15.

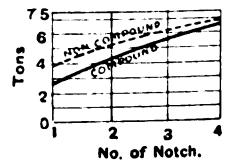


Fig. 16.

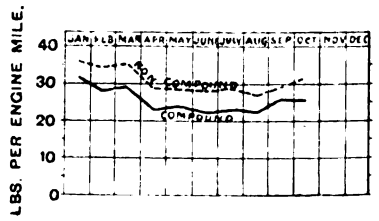


Fig. 17.

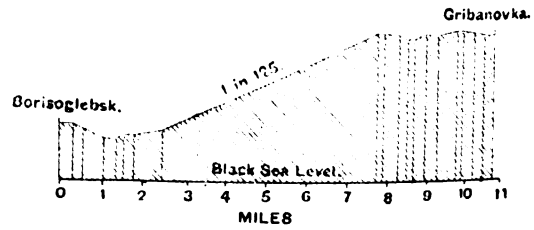


Fig. 18.

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COMPOUND LOCOMOTIVES IN RUSSIA.

TABLE XI.

Mileage, Consumption of Petroleum Refuse, and Cost of Engine and Tender Repairs in Compound and Non-compound Passenger and Goods Locomotives on the Grazi and Tsaritsin Railway during Five Summer Months, April to August inclusive, in 1889. Passenger Locomotives with Six Wheels, four Coupled. Goods Locomotives with Six Wheels, all Coupled.

Description and No. of Locomotives.		Mileage. Average Number of Trucks in Train.	Mileage. Total Truck-miles.	Mileage. Total Train-miles.	Mileage. Total Engine-miles.	Mileage. Unremunerative Engine-miles.	Petroleum Consumption. Total.	Petroleum Consumption. Per Train-mile.	Petroleum Consumption. Per Engine-mile.	Cost of Repairs. Total.	Cost of Repairs. Per Engine-mile.	Economy of Compounds. Fuel. Per Engine-mile.	Economy of Compounds. Fuel. Per Cent.	Economy of Compounds. Repairs. Per Cent.	No. of Locomotives.
PASSENGER.	No.	No.				Per Cent.	Tons.	lbs.	lbs.	£	Penny.	lbs.			No.
Compound	110	11·87	202,640	17,066	17,460	2·26	159·19	20·89	20·12	17·710	0·243	4·55	18·22	49·2	110
Non-compound	115	11·70	171,809	14,685	14,863	1·20	165·66	25·27	21·97	29·585	0·478	—	—	—	115
GOODS.															
Compound	35	27·39	351,698	12,847	14,195	9·50	145·09	25·29	22·90	22·196	0·376	4·88	17·57	48·8	35
	40	27·47	291,586	10,615	12,181	12·86	120·59	25·14	22·17	12·356	0·243	5·04	18·52	4·0	40
	43	27·78	145,171	5,224	6,388	18·22	60·23	25·82	21·13	4·585	0·170	7·26	25·57	24·1	43
	52	25·55	282,157	11,045	12,951	14·72	138·33	28·06	23·93	19·977	0·369	4·14	14·75	27·7	52
	58	24·43	271,974	11,132	12,865	13·47	130·14	26·19	23·09	31·756	0·500	5·21	18·41	39·2	58
Means and totals		26·52	1,342,586	50,863	58,580	13·75	591·38	26·16	22·64	90·870	0·350	5·31	18·96	28·8	—
Non-compounds	48	26·70	283,280	10,609	12,560	15·53	155·75	32·89	27·77	38·570	0·735	—	—	—	48
	34	26·81	184,463	6,880	8,363	17·73	101·61	33·08	27·21	8·802	0·253	—	—	—	34
	61	26·53	334,290	12,598	14,371	12·34	182·08	32·38	28·39	13·420	0·224	—	—	—	61
	60	30·31	238,763	7,878	10,768	26·84	134·92	38·37	28·07	23·857	0·510	—	—	—	60
	63	30·44	208,248	6,842	9,012	24·08	113·87	37·28	28·30	36·159	0·970	—	—	—	63
Means and totals		28·16	1,249,044	44,807	55,074	19·30	688·23	34·80	27·95	121·168	0·539	—	—	—	—

The boiler pressure in all these engines, both Compound and Non-compound, was 135lb. per square inch above the atmosphere.

The Trucks were each about 16 tons gross load.

In the three columns of Economy, the five Compound and five Non-compound goods engines are compared severally, according to their order of sequence:—Compound No. 35 with Non-compound No. 48, and so on to Compound No. 58 with Non-compound No. 63. The mean results show the comparison between the two groups collectively.

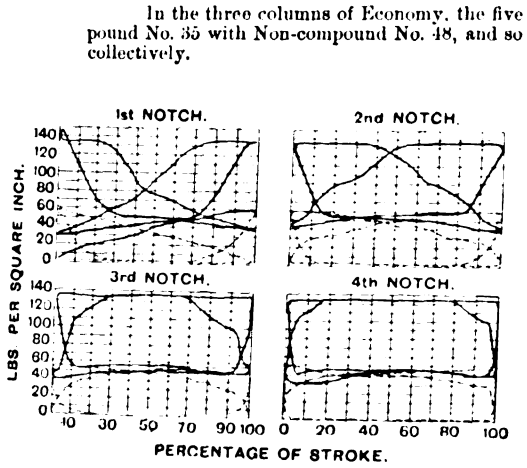


FIG. 19.

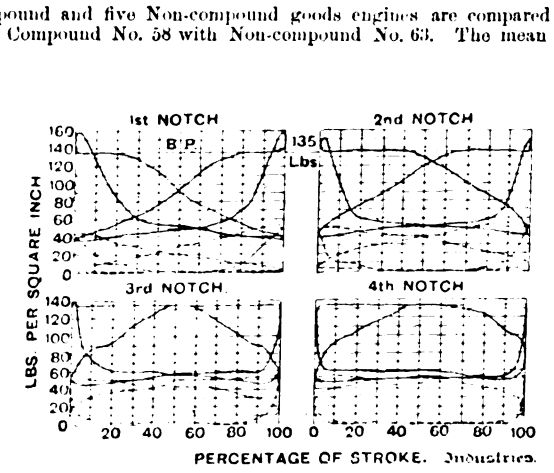


FIG. 20.

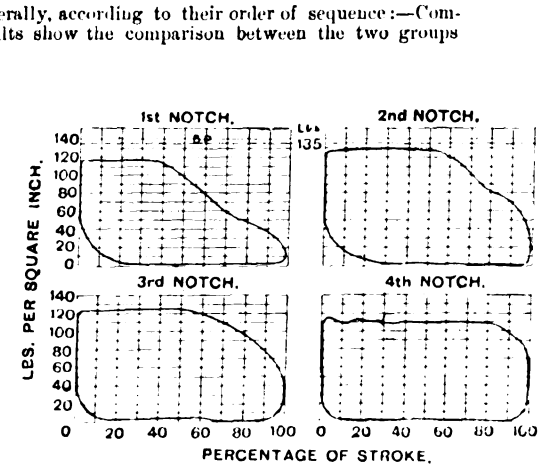


FIG. 22.

the pipe A in the smoke-box, as shown in Fig. 6. Both these engines have the high-pressure crank leading in forward running. The enlargement of the receiver is a step in the right direction, by more nearly equalising the power in the cylinders. There is less back-pressure in the high-pressure cylinder, and a greater quantity of steam in the receiver for charging the low-pressure cylinder; and although this steam is of slightly lower pressure, yet the diagrams from the low-pressure cylinder come out fuller. In other words, before the receiver capacity was increased it was found that the pressure in the low-pressure cylinder dropped at once on the piston starting at the beginning of its stroke; but with the enlarged receiver the pressure does not drop so fast.

In the compounded goods locomotive No. 28, recently put into service, with the low-pressure crank leading in forward running, the receiver has been further enlarged to 1·8 times the capacity of the high-pressure cylinder. The result is that not only is the pressure well kept up in the low-pressure cylinder from the beginning of the stroke, but also the influx of steam from the high-pressure cylinder takes place before the admission to the low-pressure cylinder is cut off at some notches of the valve-gear. Thus a pretty even pressure is obtained in the large cylinder, giving a good diagram for this cylinder, while at the same time, owing to the sequence of cranks, less resistance is offered to the exit of the steam from the high-pressure cylinder, except at the first notch or greatest expansion. From three months' performance, during September, October, and November, 1889, engine No. 28 seems to work very well; and for this result three reasons may be assigned. Firstly, the hangers to the link-motion are made ¼in. longer on the low-pressure side than on the high-pressure, causing a later cut off in the low-pressure cylinder than in the high-pressure. Secondly, the blast pipe is set 12in. lower down in the smoke box than in the other engines, keeping its nozzle at about the height usual in English engines, say about 8in. above the top row of tubes. Thirdly, the receiver as already stated is made 1·8 times the capacity of the small cylinder. Any one of these three points may have a useful effect upon the better

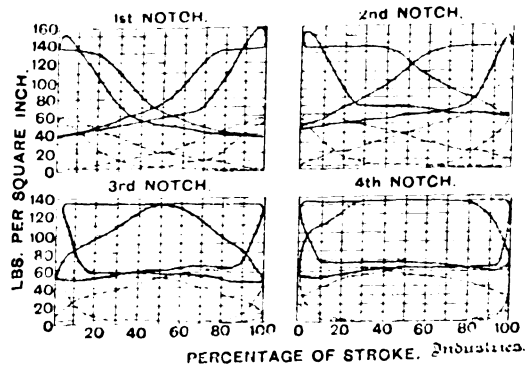


FIG. 21.

working of the engine; and the combination of all three together has undoubtedly the effect of saving a trifle more fuel; but to which of the three it would be right to assign the benefit it is impossible at present to say.

The results of the author's experience are such as to leave no doubt in his own mind that compound locomotives are the engines of the future in all countries. Plans are already in hand for compounding the eight wheel coupled 48-ton goods locomotives; and advantage will be taken of the alteration of these and other engines to substitute also the relieved slide-valves above described, so as to save the extra 5 or 6 horse-power at present absorbed by the friction of the slide-valves. The Government railway authorities have decided in future to order all new locomotives on the compound principle.

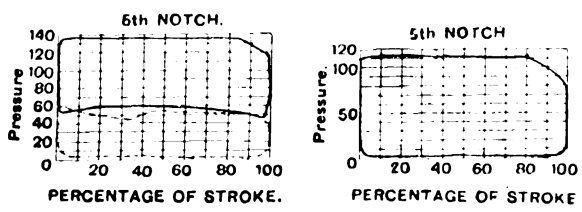


FIG. 22A. FIG. 23A.

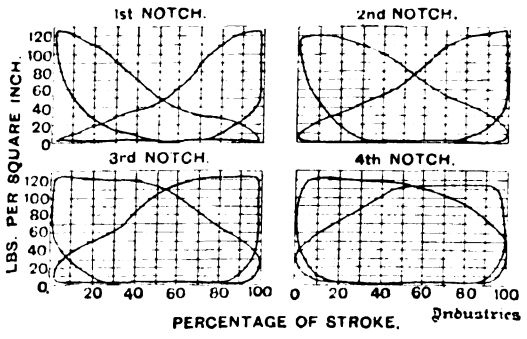


FIG. 23.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

(FOR LATEST TELEGRAPHIC DESPATCHES SEE PAGE 177.)

PARIS, 18th February, 1890.

IRON.—In their general aspect, the iron markets, as well of the capital as of the provinces, remain unchanged. Here in Paris the demand is slack, but prices are firm, at from £8 8s. to £8 15s. for bars and joists. Old rails are scarce at £4 12s. In the Haute-Marne the makers of wire cannot meet the demand, which is now exceptionally strong. The retrograde movement in the English markets, and the consequent retardation of business in those of Belgium, have somewhat shaken the confidence of buyers and checked a further rise. It is a commonly held opinion that prices have touched their highest point. The export trade seems to be steadily growing.

COAL PRODUCTION.—The *Journal Officiel* publishes the statistics of coal production in France in the year 1889 The total output was 24,588,880 tons, an increase of nearly two million tons relatively to 1888. The increase would have been fully half a million tons greater had not the strike occurred in the basin of the Pas-de-Calais. The production of the latter district amounted to 8,646,919 tons, and that of the Nord to 4,809,065 tons. Relatively to last year this is an increase of 9 per cent. for the former and 10 per cent. for the latter.

BERLIN, 17th February, 1890.

COAL AND COKE.—The falling off in the demand for house coal has relieved the tension which kept the Upper Silesian markets in an extremely sensitive state. The railways are now able to cope with the traffic, and deliveries are consequently made more promptly. This altered situation is, of course, favourable to the iron and steel industry, the production of which has been restricted of late by the want of fuel. Several of the new coke ovens constructed to save the tar and ammonia products will be ready for work in a few weeks. At the Falvahütte works several ovens on the Collins system are in course of construction. The imports of coal and coke into Germany in the year 1890 were as follows: Lignite (from Austria-Hungary), 5,650,966 tons; coke, 387,395 tons (from Belgium, 287,466 tons); coal, 4,573,209 tons (from England, 3,400,450 tons); briquettes, 51,769 tons (from Belgium, 35,201 tons). The exports were: Of lignite, 14,270 tons; of coke, 814,613 tons; of coal, 8,860,217 tons; and of briquettes, 93,385 tons. Of the coal exported, 3,128,079 tons were sent into Holland and 3,098,302 tons into Austria-Hungary. French and Austrian consumers purchased most of the coke exported.

IRON.—Though the current of trade has slackened considerably in the Rhenish-Westphalian markets, there is no retardation observable in those of Upper Silesia. The opinion, however, commonly held is that prices have touched their highest point. The Upper Silesian convention of rolled iron manufacturers has been prolonged for three years. In the Berlin market business is active, the demand for joists increasing as the spring approaches. The lowest tenders for the 6,300 tons of steel rails for the Berlin railway were received from the Gütehoffnungshütte at Oberhausen, and the Hösch Iron and Steel Works at Dortmund, whose prices were 165s. and 165s. 6d. respectively.

GERMAN IRON ABROAD.—The German export iron trade has suffered considerably from the effects of the high prices brought about by the syndicates of manufacturers in 1889. It is not possible, by reason of the changes made in the Customs Union, to compare the exports of last year with those of 1888; but it is certain that a serious shrinkage has taken place in the total trade. The exports in December amounted to 70,846 tons, exclusive of machinery, steam boilers, and ordnance, against 81,353 tons in November. The following is a classified account of the exports in the last month of the year and in the twelve months of 1889. Pig iron, 9,280 (156,434) tons; old iron and scrap, 1,740 (33,284) tons; half wrought iron and steel, 1,653 (20,847) tons; finished iron and steel (bars, angles, and plates), 18,042 (280,254) tons; wire, 10,386 (156,582) tons; wire nails, 3,686 (46,411) tons; rails, 9,386 (110,979) tons; other railway iron, 4,051 (52,185) tons; heavy castings, except ordnance, 1,793 (19,334) tons; other manufactured goods, except machinery, 10,829 (121,317) tons. Total, 70,846 (997,325) tons. The exports of wire to Great Britain in December amounted to 2,291 tons, making 33,575 tons for the year. The shipments of wire nails to Great Britain in the same periods amounted to 1,097 tons and 12,615 tons respectively. In the course of the year 10,338 tons of wire nails were shipped to Japan.

NEW RANGE-FINDER.—In military circles a new range-finder is spoken of as superior to anything of the kind previously in existence. Up to 7,000 yards it indicates distances with a degree of accuracy hitherto unapproached. The instrument, the readings of which are determined by geometrical methods, is the invention of Captain Erle, a staff officer of the German artillery.

SHIPBUILDING IN GERMANY.—The scheme which was under consideration by the Vulcan Shipbuilding Company, for the erection of a shipbuilding and repairing yard at Bremerhaven, has been abandoned on account of want of capital. A new shipyard is to be built on the Vistula. Owing to the site of the yard being very low, it is proposed to transport soil and earth to raise its level. A wire-rope railway will be employed to bring the earth from a neighbouring hill some hundreds of yards away.

VIENNA, 17th February, 1890.

THE COAL MARKET.—There is great activity in the Bohemian coal market. During the last few weeks the export to Bavaria has begun to revive. This export was at its maximum in 1888, when 572,929 tons were sent there. Ten per cent. of this quantity were consumed at Munich alone, whilst 40,000 tons went to Nuremberg. The greatest part of the export went to the Bavarian State railways for their own consumption. The Nordböhmische Kohlenwerks-Gesellschaft placed its shares last week on the Vienna Bourse, and they had a good sale. At the works of this company 1,400 hands are employed, and the daily production amounts to 2,700 tons; in January the works produced the total quantity of 70,350 tons, being nearly double the production of the same time in 1889. Last year's profit was 155,000fl. During the last twenty years the production has increased sixfold—viz., 1·6 millions to 9·2 millions. During the last year the greatest increase was at the Brux works, which in 1870 produced only 0·7 per cent. of the total quantity, whilst now it produces 27 per cent. of the coal quarried. The good quality of the coals and the excellent communication with the railways have caused this important increase.

THE IRON MARKET.—The animated traffic is being followed daily by increasing prices. In pig iron the demand is very much greater than the supply. Last week the Bohemian Ironworks raised the price of rolled steel plates by 10fl. per ton, and the Hungarian syndicate of rolling mills declared an increase of 5fl. per ton in the price of sheets. There is great activity in machine construction and in locomotive and waggon building. The Aussig-Teplitz railway has ordered 200 coal waggons with a capacity of 15,000kg.

ELECTRICAL ENGINEERING. Two more towns in Austria have decided on adopting the electric light for the purposes of illumination. At Carlsbad the town authorities have determined to spend 350,000 florins in the construction of a central station. At Brünn the matter is not as yet settled. The electric lighting installation at Cologne is to be supplied with long-distance cables on the Zipernowski-Deri-Blathy system, and with apparatus made by Messrs. Ganz, of Budapest.

BRUSSELS, 18th February, 1890.

THE COAL MARKET.—The tendency of the market towards a normal state of affairs continues at work, and at most of the collieries the stocks are being replenished. In the following table the imports and exports during the years 1888 and 1889 are compared with one another:—

Imports.

	1888.		1889.
Coal.....	1,033,169 tons	.....	1,002,194 tons.
Coke	27,461 „	.....	18,259 „
Briquettes ...	— „	.....	— „

Exports.

	1888.		1889.
Coal.....	4.141,908 tons	.....	4,257,694 tons.
Coke	1,060,754 „	.....	1,220.325 „
Briquettes ...	324,893 „	.....	316,439 „

The exports of coal have increased in all directions, with the exception of France, and the exports of coke have increased all round. During the week ending the 9th inst., 22,579 waggon loads of coal and coke were carried over the railways, as compared with 20,068 during the corresponding week of the previous year.

THE IRON MARKET.—The orders and demands are not quite so pressing in the iron market as they were a few days ago, but the current of business remains satisfactory, and there is no weakening in the scale of prices. The production of pig iron during the month of January amounted to 82,305 tons, as compared with 75,640 tons during the same month in 1889. The increase is entirely due to the improvement in the production of pig for making steel. The exports show that there is considerable progress in the iron and steel industries, and they have now risen to an unprecedented height. The exports of rolled iron have risen from 309,698 tons in 1888 to 332,987 tons in 1889, and of rolled steel from 87,936 tons in 1888 to 104,639 in 1889. The Couillet and Acoz Companies have obtained the order for 40,000 steel sleepers for the Congo Railway at the rate of 23·70fr. per 100 kilog.

THE GLASS TRADE.—At a meeting of the Glass Association on the 3rd inst. the formation of the syndicate for controlling the export of window glass to the United States was fully discussed, and a scheme drawn up for its establishment. A committee has been appointed to complete and extend the scheme and to draw up the statutes of the syndicate.

DÜSSELDORF, 18th February, 1890.

COAL.—The tone of business in the coal market is one of indecision. The prospect of a great strike of colliers in the North of England offers a set-off to the threatened general strike here in March, and tends to keep the market steady. The demand for house coal is rapidly falling off The merchants engaged in the export trade with Holland and Belgium resolved at the meeting held on the 13th inst. to make no alteration in prices. The consignments of Westphalian coal to Hamburg and its neighbourhood in the month of January amounted to 58,790 tons, against 61,350 tons in the same month of last year. The Hamburg trade proper shows an increase; the shrinkage is in the Altona to Kiel district. Relatively to January of last year, the price of coal delivered at Hamburg has risen 110 per cent., and that of coke 250 per cent. The tendency of the market is still upward for both Westphalian and English coal.

IRON.—The slower current of business in the iron market is not to be regarded as the beginning of a relapse, or as likely to be followed in any degree by weaker prices. The present level must be maintained so long as the raw materials of manufacture remain at the prices at which they are now quoted. As for coal, the tendency is toward higher rather than lower rates. Prices of pig iron remain steady. The market for finished iron and steel continues active, the demand being strong for bars, joists, and hoops. Makers of sheets have plenty of work in hand, sufficient for several months to come. At a meeting of the West Germany Sheet Makers' Syndicate, held at Siegen on the 12th inst., the convention was prolonged. Three hitherto outstanding firms joined the syndicate. The official list of prices made up for the 15th inst. is as follows:—Good merchant bars, 210s.; angles, 215s.; joists, 150s.; hoops, 215s.; ingot iron and Bessemer steel bars, 205s. to 210s.; boiler plates, 260s. to 265s.; common plate, 235s.; sheets, 255s.; rolled iron wire (nail quality), 195s.; wire nails, 220s.; rivets for boilers, bridge work, and ships' plates, 290s. a ton at works.

BELGIAN COMPETITION.—The industrial world of this region is much disturbed by the results of recent tenderings for railway rolling stock for the German State railways. The stock consisted of 3,170 goods waggons, to be delivered in a short space of time. The tenders of Belgian manufacturers were much below those of the German makers. For example, for 250 coal trucks provided with brakes, the lowest German offer was 2,430 marks per truck, while that of the Belgians was 2,280 marks, a difference of 150 marks. For 750 similar trucks without brakes, the lowest German tender was 1,840 marks per truck, a sum that was underbid by the Belgians in a like proportion. It will be seen that when the import duty is taken into account, the difference of price is large. Moreover, the Belgians offered to deliver in much less time than the Germans. As a consequence, important orders have been lost to German industry. But besides the present loss, a danger has been revealed which has given rise to grave anxiety.

LILLE, 18th February, 1890.

TEXTILE MANUFACTURES.—Business continues brisk in the market for linen goods. The turnover for the last week at Armentières was large, considerably above the average for this season, and the tendency is towards greater activity. The stocks in hand are about equal to those of last year. Provincial buyers are operating more largely. The Roubaix woollen goods trade presents no new features. The terminal wool market is reviving; the cause, however, must be sought among speculative dealings, for manufacturers are buying but sparingly. The reason alleged is that the February deliveries are defective in quality. Jute goods are in brisk demand.

FLAX AND YARNS.—Business in the flax market is scarcely so brisk as it was, and prices for home-grown produce have turned slightly in favour of buyers. A good deal of Russian flax has changed hands during the last week. There is a steady though not strong current of business in tows, the commoner sorts being offered plentifully. Buyers of yarns continue to restrict their dealings to what is strictly necessary. Prices are unchanged. Activity is still the characteristic feature of the jute market.

IRON.—The supply of coal having increased, the production of iron now proceeds without interruption. The market is very firm. For early delivery, bars and joists are sold at 160s. a ton; but for delivery later than March 31st, as much as 168s. has to be paid. This firmness is, however, due less to the activity of the market than to the high and still increasing cost of coal. Though our manufacturers are well provided with orders, they continue to push the foreign trade, and with considerable success, for export orders are coming in freely. There is a project under consideration for forming an export syndicate such as now exists for Algeria.

AMSTERDAM, 17th February, 1890.

ACCIDENTS IN FACTORIES.—The Government and a large number of factory owners have promised to exhibit in the coming Exhibition of appliances to minimise dangers to lives and limbs in factories, to be opened in Amsterdam in May. Many foreign companies and manufacturers have also announced their intention of exhibiting, and altogether this international show assumes much more important dimensions than was at first contemplated. The original guarantee fund is now considered inadequate. The committee asks for subscriptions to raise it by £1,000.

NEW LAND COMPANY AT AMSTERDAM.—The King has sanctioned the articles of association of the Transvaal Land Company, formed for the acquisition of lands in South Africa, particularly mineral lands in the Transvaal.

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The capital is 720,000 guilders (say £60,000). The company will also foster emigration of Hollanders to the South African Republic, for which same purpose the Dutch South African Association is now endeavouring to create an emigration fund, by whose means loans could be granted to intending emigrants, sufficient to defray their outfit and passage out, also their first expenses on arrival, and repayable out of the subsequent earnings. In a pamphlet, recently issued at Amsterdam by the secretary of the association, it is pointed out that, with the increased emigration of Englishmen and Germans to the Transvaal, it becomes necessary to strengthen the Dutch element there by a constant infusion of sturdy peasants and artisans from the Low Countries. The systematic exodus of Dutchmen to North America, Canada, and the Argentine Republic is deplored, because they become lost to the fatherland in course of time, whilst in South Africa they would contribute to maintain the old stock. The Transvaal Government should encourage immigration like the Argentine Republic, but, failing this support, the next best thing to do is to start an emigration fund. The secretary of the Dutch South African Association cannot contemplate any difficulty in the matter, for wages are high in the Transvaal, and, consequently, it would be easy for the emigrants to repay the grants made to them.

The Workmen's League.—The Workmen's League of Holland will hold its annual meeting in April at Amsterdam. Apart from several political questions various matters that interest the workmen will be brought forward for discussion. Among these are sanitary dwellings and their control by the State; the creation of strike funds for the support of workmen and their families whilst strikes or lock-outs are going on; the various methods by which slackness or absence of work can be remedied; an energetic support of the proposed labour inquiry by a Royal Commission, so as to make it as stringent as possible; the legislative settlement of employers' liability in cases of the incapacitating of workmen through accidents in factories, &c.

New Steam Ironclad Corvette for India.—The Royal Engineering Factory at Amsterdam is now building the steam ironclad corvette "Sumatra" for Government service in the Dutch East Indies. The vessel is to have electric light and fish torpedoes attached.

A Gigantic Scheme.—It is proposed to build a dam or embankment in the Y before Amsterdam, so as to form a means of communication with the other side, instead of a bridge. This embankment would have openings, with drawbridges, to let through ocean steamers and other passing vessels as required. The cost is estimated at more than £200,000; on the other hand, it is estimated that the municipal lands at the other side of the Y, opposite Amsterdam, would enormously increase in value for building purposes by this scheme, and a profit of no less than ten million guilders (say, £800,000) is anticipated after its completion.

English Coals in Holland.—With the exception of a few collieries in Limburg, Holland has no coal mines of her own. Her annual consumption is about 4,500,000 tons, and nearly the whole of this large total has to be imported from abroad. Prussia supplies by far the largest part thereof. In 1889 she exported into Holland 3,587,502 tons of coal, against Belgium 400,479 tons, and England 501,314 tons, but, whereas the imports from Belgium only increased 10,600 tons, those from Prussia fell off 388,202 tons, whilst the English imports of coal advanced by 210,314 tons, which shows a great increase on the total import in 1888, only 291,000 tons. The increased arrivals from England in 1889 were due to the strikes in Germany, and it is probable that the English imports into Holland during 1890 will again show a material advance upon 1889, as many Dutch manufacturers, foreseeing a rise in prices, have contracted forward deliveries in England, which have yet to arrive. These contracts are mostly at quotations much below the current ones, and so the Dutch consumers have been benefited; but, otherwise, the great rise in the coal prices has occasioned in Holland both inconvenience and losses. In many towns, the charge for gas has had to be raised. Thus in Utrecht, where the municipality has just contracted for the delivery of 40,000,000 hectolitres of coal at a minimum price of 94c., say 1s. 7d., the hectolitre, whilst the average price for the years 1885-1888 was only about 11d. per hectolitre.

COPENHAGEN, 15th February, 1890.

The Norwegian State Railways.—The total number of carriages on the Norwegian State railways is 3,627. Of these 3,032 are goods carriages, 419 are passenger carriages, and 176 are of various kinds. Some very large third-class carriages have just been received from the Kockum Engineering Works at Malmo, Sweden; they have a breadth of 2·9 metres, and length of 17·4 metres; they contain nine compartments each, with passage through, and one lavatory.

Wood Pulp Manufacture in Scandinavia.—The erection of new wood pulp manufactories continues, although the prospects cannot said to be particularly bright. Last year's production in Norway was a very large one, and this year's will of course be still larger. There will shortly be fifty-four wood pulp manufactories in work in Norway, against the fifty working last year, and their probable production has been put at about 250,000 tons. The export during last year was about 190,000 tons, which is again some 15,000 tons in excess of the production during the previous year. These figures refer to mechanically made wood pulp of chemical wood pulp the export has amounted to about 25,000 tons, of which rather more than half was wet wood pulp. This, too, is considerably above the export of this kind of wood pulp during 1888. Of manufactories for chemical wood pulp there were fifteen going at the end of 1889, eleven sulphite and four soda cellulose works. Their production is estimated at 30,000 tons sulphite (wet), and 9,000 tons soda cellulose (dry). The chemical wood pulp has not experienced such an unfavourable market during last year as has the mechanical, the former having maintained its price and commanded a satisfactory and ready sale. The value of the exported chemical wood pulp during 1889 has been put at approximately £200,000 f.o.b. Norwegian port. From a financial point of view the result has hardly been so satisfactory as one might expect, owing to the important rise in nearly all the requisite raw materials. For mechanical wood pulp, matters are, however, far more unsatisfactory, and prices, which have been gradually declining for the last twenty years, reached during the past year the unprecedented low figures of £2 2s. 6d. f.o.b. Hull. Attempts have been made to reduce and regulate the production during the present year of wood pulp in Scandinavia, as of iron in Sweden, but while Scandinavian farmers seem to have a happy knack of co-operating to mutual advantage this cannot be said to apply to the manufacturers, and however beneficial to all concerned an arrangement of this nature might prove, it is not very likely to come to anything. The value of the Norwegian export of mechanical wood pulp during 1889 has probably amounted to about £450,000. As is natural, the increasing production of wood pulp has given an impetus to the Scandinavian paper industry. In Sweden, as has already been mentioned in this paper, two or three large paper manufacturing companies have been formed of late, and in Norway some of those already in existence have been materially extended. The effect of these extensions will, no doubt, be apparent before long.

Land Reclamation in Denmark. Few kinds of large undertakings have perhaps, as a class, proved more risky than those based upon the laying dry or reclaiming of land, but nothing in this line has probably more utterly failed than the attempts of the Danish Land Company, afterwards the Nissum Fjord Company, in Denmark. Not only have these companies expended very large sums without any results, but the Danish Government has now undertaken to restore the whole thing to its *status quo*, the deposit of the English company being used for the necessary works. The Nissum Fjord has an area of some seven square miles, and was separated from the North Sea by a narrow ridge of cliffs: the depth of water is only small, although, of course, variable, and with a constant easterly wind portions are virtually laid dry. The concession passed into the first English company through one or two intermediate parties, and the work was at once commenced with energy; the weak ridge of cliffs was strengthened by dams and a sluice was erected at the entrance to the fjord. The building of a strong dam was commenced so as to isolate the northern and eastern portion of the bay, but the subsequent history of the undertaking became almost an uninterrupted chapter of accidents. The sea made its way hrough at various times, the large sluice was damaged before its completion, and the leading engineer, Mr. Earle, lost his life in a gallant attempt to save some countrymen from an English vessel stranded on the coast. The thing was, however, persevered with, and in 1870 a Danish engineer succeeded in completing a sluice, which transformed the Nissum Fjord to a sluice. In 1871 a corner with an area of some 5,000 acres was isolated by a dam, about two miles long, varying in height from 6ft. to 10ft. above daily water level, and covered for a distance of 6,000ft. with a shell of concrete up to 4ft. height. Heavy steam engines and pumping machinery were fixed, including a centrifugal pump of 6,000 barrels capacity per hour. The water would, however, not disappear. The concession expired in 1880, but was prolonged for a few years. The work was continued, absorbing a lot of money, but, finally, the whole thing collapsed in 1885, and, the concession expiring, the Danish Government became again proprietor of the Nissum Fjord, as it had been up to 1864. The machinery, &c., were sold for a song, and the dam, just referred to, for £50. A whole colony of labourers were thrown upon their own resources, and negotiations have been pending with the Government as to having the Nissum Fjord again transformed to what it was before the works began, on account of its fishing and marsh land. This will now be done, the deposit of the English company being used for the purpose—rather a melancholy winding up, after all.

MADRID, 17th February, 1890.

Madrid Gas Works.—Notwithstanding the tremendous price of 9s. per 1,000ft. being rigorously kept up, the increased sale has continued unchecked so far. As it is, the company have not had to supply gas to the theatres, otherwise they could not have met the demand. The electric light is now obligatory in the theatres. Should the further introduction of electric light not affect their present sale, it is supposed that they will be obliged to erect new works on some other site. It is the high price of coke that makes their business so good and safe. They derive very little advantage from their tar, and for the ammonia there seems to be no demand, notwithstanding that at the port of Valencia sulphate is imported to a large extent.

Silver Coining.—The Government of Spain has bought 30,000 kilogrammes of silver bar to turn into coins. The sellers have been the Marquis of Villamejor and the representatives of Rothschild's house. There is no real want of silver coins for circulation, and the idea of the Government in increasing the quantity is to gain a profit.

The Robla and Valmaseda Railway.—The Bill for this special coal-carrying line has passed in the Lower House, and has been sent to the Senate, where it is sure to pass shortly. Commercially this line of 220 kilometres, or 140 miles, is one of the most promising in the market.

Cost of Coals in Asturias.—As Spain is preparing to use native coals more freely than in past time, serious attention is now being given to all questions connected with the cost of obtaining and carrying fuel. Lately an engineer who is a good authority in the matter has given the cost on an average of the coals in the Mieres and Langreo districts at 8s. per ton, interest and depreciation of plant included, at pit's mouth. The northern coals though very good for some purposes, are not so well suited for steamers as those in the south, which, however, are much dearer to work.

NEW YORK, 8th February, 1890.

The Iron and Steel Markets.—The market is in a fairly satisfactory condition, although in such shape as to warrant much enthusiam. Prices of pig iron have been quite irregular, No. 1 foundry selling from $19·50 to $20·50 per ton, No. 2 at from $18·75 to $19·25, and grey forge at $17·50 to $18·00. The leading companies are all sold ahead, and all that is in the market is the product of small furnaces. There is a good deal of this iron offering, however, and during the week buyers have not found it difficult to obtain small lots at very low figures. In manufactured iron the market has not been very active, but prices are steady, and holders do not show much disposition to make concessions. Mills are generally well employed on old contracts, and new business is not as abundant as could be desired. In a few instances a slight shading has been done on plates and bars, but, as a rule, 1·59c. to 2c. per lb. for bars, and 2·35c. for plates and angles, have been the ruling quotations. Steel rails are steady at $35·50 to $36 at mill, but only small lots are taken at these figures. Prospects are said to be very encouraging, and a heavy demand is looked for in the near future. Billets are in a fair demand at about $38·50 per ton, with a restricted supply.

The Metal Markets.—The copper market is quiet, with little business doing. Prices are 14¼c. for Lake and 13c. to 13½c. per lb. for casting brands. The tin market is more active, a fair amount of business being done at improving prices. Straits, spot, is quoted at 20·90c. to 21·35c. per lb. Plates are in moderate demand, and prices are low. Lead is dull; few sales have been made, mostly at 3·82½ spot. There is nothing doing in spelter. Antimony is in active demand at $40 for Hallet's and $31 for Cookson's.

New Locomotive Shops.—The new locomotive shops which the Pennsylvania Railroad Company has been building, about one mile east of Altoona, are completed as far as the buildings are concerned. There is still about $500,000 worth of machinery to be put in. When in working order they will be capable of turning out 150 locomotives per year, and will employ 1,000 men. The old shops at Altoona will be used only for repairing purposes.

Material for Cruiser Machinery.—Contracts have been awarded for material for building the machinery of cruisers 7 and 8, to be built by the Government at New York and Norfolk, as follows: Wrought iron bolts, 7,500lb., to J. B. Morsell & Co., of New York, $561 75; pig iron, 100 tons, to D. S. Cook, of Wrightsville, Pa., $2,050; 200 tons steel plates for boiler shells, to the Linden Steel Company, of Pittsburgh, $30,912; and 40 tons steel rods, shapes, and forgings for boiler bracing, $11,332, 22,500lb. wrought iron nut blocks, $2,250, and 4,000lb. wrought iron washers, $480, to Greenlie, Watt, & Co., New York.

Important Railway Connection.—The Pennsylvania Railroad Company, which has for years been endeavouring to secure a more direct entrance to McKeesport, has accomplished its purpose at last by the purchase of the McKeesport and Bessemer Railroad. This line itself is only an insignificant one, and is to extend but a few miles from McKeesport to the manufacturing town of Bessemer, where connection will be had with the Pittsburgh, Virginia, and Charleston division of the Pennsylvania road. The line will be constructed forthwith by the purchasers, and will form an important link in the Pennsylvania system, as it will materially aid in the handling of the enormous freight traffic offered by the iron and steel plants along the Monongobela River.

The Master Builders.—The National Builders' Convention has been holding its session during the past week in St. Paul, Minn. The principal subjects taken up were on lien laws and an eight-hour day. On the subject of liens the laws in the various States are entirely different, so that while in many places they are just and fair, in others they are defective. The attempt was made to appoint a committee to either pick out the best law or formulate a satisfactory one, and urge it on the State Legislatures. The matter was finally tabled. In dealing with the eight-hour question, the executive committee took no action as to the advisability or otherwise of an eight-hour day, but recommended that labour be hired and compensated by the hour, allowing each locality to determine for itself the length of the working day.

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MESSRS. ARBEY'S TOOLS AT THE LATE PARIS EXHIBITION.

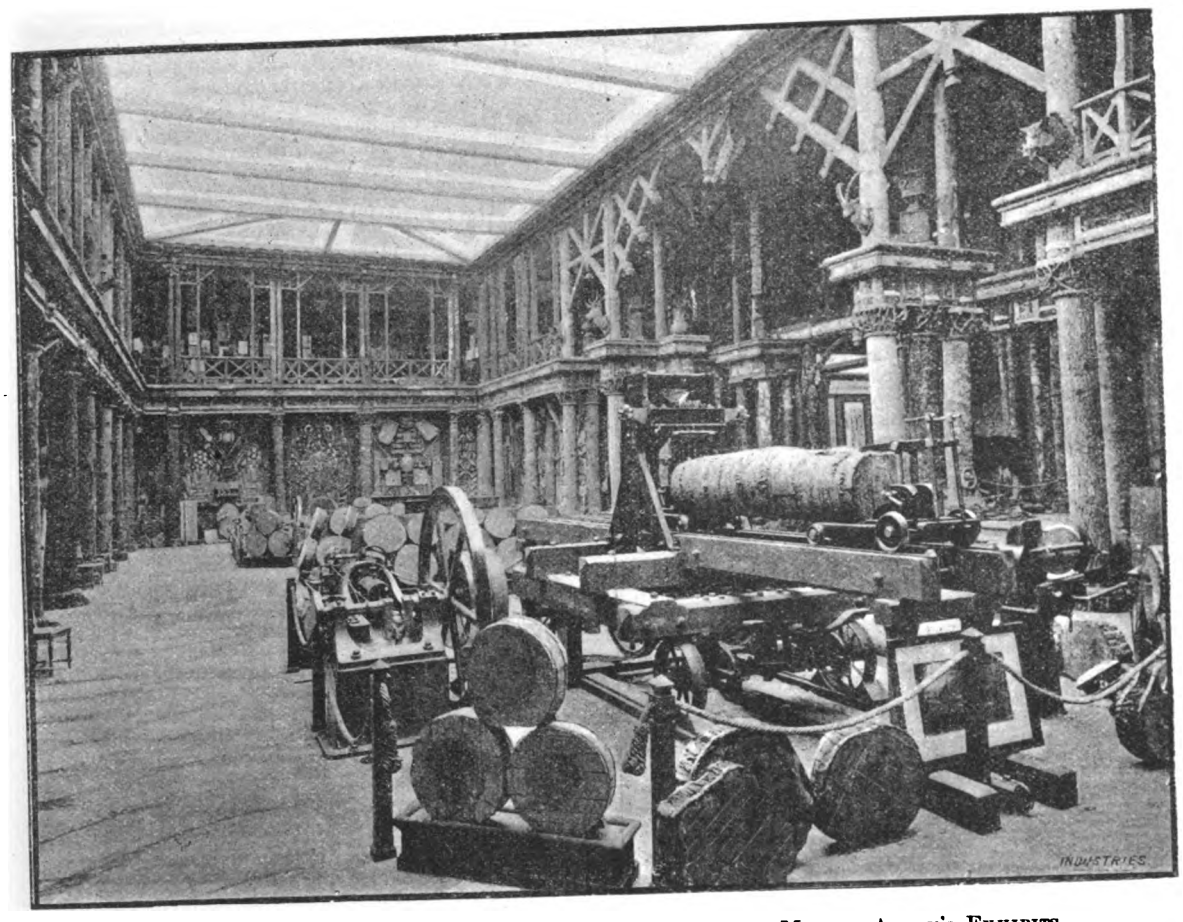


Fig 1.—The Pavilion of Woods and Forests, showing Messrs. Arbey's Exhibits.

MESSRS. ARBEY'S TOOLS AT THE LATE PARIS EXHIBITION.

Near the Trocadéro, and in the grounds, was a very artistic building erected by the Government Department of Woods and Forests, and containing a most interesting collection of woods and instruments used in forestry. This is shown in Fig. 1, above. There were three very instructive panoramas of forests and operations for maintaining them, as well as samples of the different woods, and the various articles made from each or the uses to which it may be put. In this pavilion Messrs. Arbey were invited by the Department to exhibit some of their special appliances for use in forests, and the interesting collection above mentioned was the result. The collection included a machine for sawing down trees, a machine for sawing logs in the forest or wood yard, a circular saw for use in the forest, and which may be drawn about by horses, and a log frame which may be moved from place to place by horses. Fig. 2, on page 180, shows the portable vertical log frame ready for working. When it is required to remove it to another place, two or four horses can be attached to the carriage, and it can be transported along the forest roads. About 5 h.p. are required to drive this frame. In many parts of France the owners of portable engines, which are kept busy driving agricultural machinery during the spring and summer, have nothing to do during the winter, and they take them about with these machines doing the kind of work for which they are adapted.

THE SOCIETY OF ENGINEERS.

The first ordinary meeting of the Society of Engineers for the present year was held on Monday evening, the 3rd inst., at the Town Hall, Westminster. Mr. Jonathan R. Baillie, the President for 1889, first occupied the chair, and presented the premiums of books awarded for papers read during his year of office, viz.:—The "President's Premium," to Mr. G. M. Lawford, for his paper on "Fireproof Floors"; the "Bessemer Premium," to Mr. Samuel Griffin, for his paper on "Modern Gas Engine Practice"; a "Society's Premium," to Mr. Henry Faija, for his paper on "Forced Filtration of Water through Concrete"; and to Mr. George R. Strachan, for his paper on "The Construction and Repair of Roads."

Mr. Baillie introduced the President for the present year (Mr. Henry Adams) to the meeting, and retired from the chair, receiving a hearty and unanimous vote of thanks for his services during the past year.

Mr. Adams then took the chair, and proceeded to deliver his inaugural address. After thanking the members for the honour they had conferred upon him in electing him to the presidential chair, he briefly alluded to the satisfactory position of the Society, which now numbers 417 members of all classes, and mentioned the loss by the death of Dr. Percy, and the addition of Earl Granville, Lord Armstrong, Lord Brassey, Sir Wm. Thomson, Mr. Wm. Anderson, and Mr. Benjamin Baker to the roll of honorary members. He commented on the principal points of the papers read during the session, and described the features of interest in the works visited by the members during the vacation, which included the East London Waterworks, the Sewage Outfall Precipitation Works at Crossness, the Central Station of the London Electric Supply Corporation, and the Foreign Cattle Market, Deptford. The President then referred to the progress of technical education, noticing particularly the work of the Science and Art Department, and that of the City and Guilds of London Institute, and incidentally gave some particulars of the City of London College, where he has been for 21 years the Professor of Engineering. Remarking that a wider field of enterprise than that contained within the shores of the United Kingdom was necessary for engineers, he gave statistics showing that about 30 per cent. of the English engineers were now practising abroad, and spoke of the advantages to be derived from the realisation of the idea of Imperial Federation. He then referred to the enormous strides being made in ocean navigation, and gave some particulars of the eight million tons of British shipping, with details of some of the recent performances. In connection with the Government expenditure on the increase of the Royal Navy, he said the contracts had been very fairly distributed over the great shipbuilding and marine engineering centres, and had given general satisfaction to those concerned. The extended use of mild steel and some of its disadvantages were noticed, and the President then passed on to a consideration of our fuel supply. He believed that the days of coal were surely numbered, and that it behoves us to seek other means of generating power and in the meantime to practise the greatest economy in the use of the mainstay of England's prosperity. Under the head of railways some figures were given, showing the vastness of the traffic upon them, and that, notwithstanding the rapidity of transit, according to the last statistics only one passenger was injured in 1½ millions, and not more than one in 80 millions was killed by causes beyond their own control. Particulars of present practice in compound locomotives were given, and the necessity for increasing the strength of the permanent way was stated. In connection with ordinary locomotives, Mr. Adams said he had recently made a public statement, which had been questioned, of the saving which one of the railway companies had obtained by the use of the "vortex" blast pipe, and he now appended a copy of the official statement, showing that by the alteration of 324 of the engines upon the London and South-Western Railway during the last four years, a saving of £48,461 had been effected. Several large bridges were described, the Forth Bridge, of course, occupying the place of honour, and references were made to many other engineering works and processes which have occupied public attention. In conclusion, attention was directed to the necessity for specialisation in the studies of engineers, the multifarious sub-divisions rendering it physically impossible for one man to thoroughly master more than one or two branches, and hence the necessity for the existence of such bodies as the Society of Engineers, where experience could be freely exchanged. A final exhortation to the members to wear out rather than rust out, brought to a close a very able and interesting address.

SHIPBUILDING NOTES.

The trial trip of the steel screw steamer "Malange" took place on the 5th inst. The "Malange" is built for the Mala Real Portuguese Company by Messrs Scott & Co., Greenock, and is fitted with a set of inverted direct-acting triple expansion engines, constructed for a working pressure of 160lb. to the square inch, and of 4,000 i.h.p. The cylinders are 31in., 50in., and 80in., with a stroke of 4ft. 6in. Her dimensions are: Length between perpendiculars, 350ft.; breadth, moulded, 42ft.; depth, 28ft. 6in.; gross tonnage, 3,543. She is fitted with two centrifugal circulating pumps with independent engines, supplied by Messrs. J. & H. Gwynne, of London. The electric light is fitted throughout the ship by Messrs. Parsons, Newcastle-on-Tyne.

On the 6th inst. Messrs. Russell & Co., Kingston Yard, Port Glasgow, launched a four-masted steel barque, named the "Strathgryfe." The vessel is built for Messrs. J. & W. Stewart, Greenock, and her dimensions are: Length, 270ft.; breadth, 42ft.; depth, 24ft. 6in.; net register, 2,200 tons.

The steel screw steamer of 4,000 tons, the "Palamcotta," was launched on the 6th inst. from the yard of Messrs. A. & I. Inglis, Pointhouse, Glasgow. The vessel was built for the British India Steam Navigation Company, London, and is intended for the Indian trade. She is provided with accommodation for first and second class passengers, and will be fitted with triple expansion engines of 3,000 h.p. She will also be supplied with electric light and hydraulic gear. Her dimensions are: Length, 360ft.; breadth, 42ft.; and depth, 29ft. 3in.

The steel screw steamer "Latona," built by Messrs. Russell & Co., Port Glasgow, was taken on her trial trip on the 8th inst. Her dimensions are: Length, 323ft.; beam, 42ft.; depth, 23ft. 6in. Two runs were made on the measured mile on the Clyde, and the speed obtained was 10¼ knots. The machinery worked very smoothly at 72 revolutions. The engines, which are by Messrs. Dunsmuir & Jackson, of Govan, have cylinders 24in., 39in., and 64in. diameter, with a stroke of 45in., and have been built under the superintendence of Messrs. Flannery & Blakiston, of Liverpool and London. The vessel is owned by Mr. G. M. Steeves, of Liverpool.

The "Normannia," a new Hamburg-American liner, was launched, on the 9th inst., from the Fairfield Shipbuilding and Engineering Yard at Govan. The launch was intended to have come off on Saturday, but it was found impossible owing to the dense fog which was over the river. The "Normannia" is provided with accommodation for 428 first-class, 170 second-class, and 700 steerage passengers. Her dimensions are: Length, 500ft.; breadth, 57ft. 6in.; depth, moulded, 33ft.; gross tonnage, 8,500 tons. She is guaranteed a speed of 19 knots, but there is every probability of her exceeding this. Twin screws have been adopted, as in most of the recent Atlantic liners, and her propelling machinery is designed to develop at least 14,000 i.h.p. The propelling bosses are of steel, and the blades of manganese bronze. Steam is supplied by nine double-ended steel boilers, each 16ft. by 18ft., and the shafting, which is made by Messrs. Jno. Brown & Co., Sheffield, is entirely of steel. She is fitted with triple-expansion engines, with cylinders 40in., 67in., and 106in. diameter respectively, with a stroke of 5ft. 6in.

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THE "Alfred Dumois," a steel screw steamer, was launched on the 11th inst. by Messrs. Blackwood & Gordon, Port Glasgow. The vessel has been built to the order of Mr. Jacob Christensen, Bergen, and is intended for the fruit trade between New York and the West India Islands. It is a remarkable fact that this trade, at one time largely in the hands of Scotch shipowners, has been for some time drifting into the hands of Scandinavian owners, till now they own the bulk of the tonnage engaged in the trade.

Notices of Meetings.

THE INSTITUTION OF ELECTRICAL ENGINEERS.—Thursday, February 27th, 8.0 p.m. Discussion on the following papers: "The Theory of Armature Reaction in Dynamos and Motors," by James Swinburne, and "Some Points in Dynamo and Motor Design," by W. B. Esson.

THE INSTITUTION OF CIVIL ENGINEERS.—Friday, February 21st, at 7.30 p.m. Students' meeting. Paper to be read: "Some Types of American Locomotives and their Construction," by C. N. Goodall, Stud.Inst.C.E. Tuesday, February 25th, at 8 p.m. Ordinary meeting. Discussion upon the papers by Messrs. Hart, Orange, and Turner, on the Shanghai, the Hong-Kong, and the Yokohama Water Works.

PRICES CURRENT, 19TH FEBRUARY, 1890.

Quotations at per ton, unless otherwise specified.

METALS.

Spelter: Ordinary	£23	15	0	to	£24	15	0
Copper: British Cakes and Ingots	56	0	0	„	57	0	0
„ Chili Bars, G.O.B.'s	47	15	0	„	48	2	6
„ Other sorts, G.M.B.'s (equal to Chili Bars)	47	15	0	„	48	2	6
„ Manufactured (strong)	64	0	0	„	.....		
Lead: Common Pig	13	15	0	„	14	0	0
„ English Sheet	14	5	0	„	14	10	0
Tin: Straits	91	5	0	„	91	12	6
„ Australian	91	0	0	„	91	10	0
„ English Ingots	97	0	0	„	.....		

Messrs. Carrick & Brockbank, Manchester, report as follows:—

COPPER: Since our report of the 12th the market for Chili bars has been irregular, and values are now higher. A better demand set in at the end of last week, and prices advanced from £46 17s. 6d. to £47 5s. on the 12th to £48 5s. to £48 12s. 6d. on the 17th, but have since receded, being quoted to-day £47 15s. to £48 2s. 6d. In manufactured the demand continues slack, and the official quotation is now £64 for strong copper.

TIN has been very variable during the week. On the 13th prices were £90 7s. 6d. to £90 15s. cash, advancing on the 17th to £92 to £92 10s. An easier feeling has, however, since prevailed, to-day's quotations being £91 5s. to £91 12s. 6d.

LEAD continues very flat, and prices are decidedly easier.

SPELTER is much stronger and in better demand, with every prospect of still higher prices, as stocks are small. The late depression was brought about by the reselling of stocks by weak holders. These lots having been worked off, the market has rallied, and the price is advancing daily.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £	s.	d.		Best. £	s.	d.	
Middlesbro' Bars	7	15	0	.....	8	5	0	f.o.t. wks.
„ Angles	7	10	0	.....	8	0	0	„
„ Plates	7	15	0	.....	8	5	0	„
Staffordshire Bars (cheaper makes)	9	0	0	.....	9	10	0	London.
„ Angles	9	0	0	.....	9	10	0	„
Crown Sheets	9	0	0	.....	9	10	0	„
„ Hoops	8	2	6	.....	8	12	6	„
"Siemens-Martin" Steel Boiler Plates	10	0	0					„
„ Ship and Girder	9	0	0					„

Market firm, but orders scarce.

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	78/6	..... 70/6

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

PIG IRON.

Middlesbro' Warrants, No. 3	53/6	Cash	
Scotch Warrants, m/n	53/4	„	
Hematite Warrants, m/n	70/6	„	

	No. 1.		No. 3.		
Coltness	75/6	.....	69/-	f.o.b.	Glasgow.
Gartsherrie	73/-	.....	67/-	„	„
Dalmellington	57/6	.....	57/-	„	Ardrossan.
Eglinton	54/6	.....	54/-	„	Glasgow.
Glengarnock	74/6	.....	66/6	„	Ardrossan.

CHEMICALS.

		£	s.	d.		£	s.	d.
Acid: Carbolic Crystals	lb.	0	0	10¾	to	0	1	0¼
„ „ Liquid	gal.	0	1	2	—	.....		
„ Citric	lb.	0	1	7	—	.....		
„ Oxalic	„	0	0	3½	—	.....		
„ Sulphuric	ton	1	10	0	—	.....		
„ Tartaric	lb.	0	1	4	—	.....		
Alum: Lump (powder 10/- ex.)	ton	4	17	6	—	.....		
Ammonia: Carbonate	lb.	0	0	3½	—	.....		
„ Muriate (Grey)	ton	22	5	0	—	.....		
„ „ (White)	„	26	0	0	—	.....		
„ Sulphate	„	11	17	6	—	.....		
„ Liquor	lb.	0	0	3½	—	.....		
Antimony	ton	.....			—	.....		
Bleaching Powder	„	5	7	6	—	.....		
Bisulphide of Carbon	„	13	10	0	—	.....		
Borax	„	30	0	0	—	.....		
Benzole (90 %)	gal.	0	4	0	—	.....		
„ (50/90 %)	„	0	3	1	—	.....		
Copper Sulphate	ton	27	0	0	—	.....		
Copperas	„	2	0	0	—	.....		
Kieserit	„	.....			—	.....		
Lead: Nitrate	„	22	10	0	—	.....		
„ White Sugar	„	24	0	0	—	.....		
„ Brown „	„	19	0	0	—	.....		
Potash: Bichromate	lb.	0	0	4	—	.....		
„ Caustic	ton	22	0	0	—	.....		
„ Carbonate	„	19	10	0	—	.....		
„ Chlorate	lb.	0	0	4½	—	.....		
„ Prussiate (Yellow)	„	0	0	10½	—	.....		
„ Sulphate (Basis 90 %)	ton	9	10	0	—	.....		
Precipitate: Red	lb.	0	3	1	—	.....		
„ White	„	0	3	2	—	.....		
Salts: Epsom { Bags	ton	3	0	0	—	.....		
Salts: Epsom { Casks	„	3	15	0	—	.....		
„ Glauber	„	1	10	0	—	.....		
Sulphur: Sublimed Flowers	„	9	0	0	—	.....		
„ Recovered	„	4	10	0	—	.....		
Soda: Ash	deg.	0	0	1¼	—	.....		
„ Caustic (White 70%)	ton	8	10	0	—	.....		
„ „ { „ 60%)	„	7	17	6	—	.....		
„ „ {Cream 60%)	„	7	5	0	—	.....		
„ Crystals	„	2	12	6	—	.....		
„ Bicarbonate	„	5	5	0	—	.....		
„ Hyposulphite	„	6	5	0	—	.....		
Solvent Naphtha	gal.	0	3	6	—	.....		
Tartar, Cream of	cwt.	5	12	6	—	.....		
Zinc Sulphate	ton	7	10	0	—	.....		

Messrs. S. W. Royse & Co., Manchester, report as follows:—

CHEMICALS: There have been few changes of note during the past week. Business in chemicals is, however, now quieter than it has been for some time, but prices remain fairly steady. The demand for caustic soda has slackened, and prices are easier. Bleaching powder has a good inquiry at steady figures. Soda ash still scarce, and the advance in soda crystals is maintained. Sulphate of ammonia has steadied, but not much business is passing. Other ammonia salts are in moderate request. Benzoles are easier. Carbolic acids still quiet. Solvent naphtha in demand. Makers of oxalic acid are busy, but prices remain low. There is less inquiry for green copperas. Sulphate of copper is very scarce on spot. Lead salts quiet, but steady.

OILS.

		£	s.	d.
Cocoanut: Cochin	per ton	26	0	0
„ Ceylon	„	23	10	0
Cottonseed	„	22	5	0
Cod	„	21	0	0
Lard	„	37	10	0
Linseed	„	22	0	0
Palm, Lagos	„	23	10	0
Rapeseed: English	„	35	0	0
Seal: Pale	„	26	10	0
„ Brown	„	22	0	0
Sperm	„	46	0	0
Whale	„	24	0	0
Turpentine	per cwt.	1	12	0
Coal	per gal.			
Petroleum (Refined)	„	0	0	5¾
„ Spirit	„			

FOREIGN TELEGRAPHIC ADVICES.

(From our own Correspondents.)

PARIS, Feb. 20.—*Iron.*—The tone of the iron market generally is weaker. Business here is very slack, and merchants find it hard to maintain the price of bars and joists at 172s. The markets of the provinces are still moderately strong in tone; but they have lost the buoyancy which characterised them a few weeks ago. Buyers hesitate. Sellers, however, having their order-books well filled, manifest no disposition to force the market.

Metals.—Business in the metal market continues to shrink. Consumers of copper are buying but little, and no rigging of the market will frighten them into dealing beyond the needs of the moment. Prices are weak. The markets for tin, lead, and zinc exhibit the same features which characterised them a week ago. The declining tendency is, however, but feebly marked.

BERLIN, Feb. 20.—*Bourse.*—The last week has been a period of fluctuations in the market for industrial securities. Among investors, however, sellers are still more numerous than buyers, the threatened strike of colliers having shaken confidence. Shares in iron and steel companies maintain their position in the market, but colliery shares are lower.

Iron.—Though business in the iron market is not particularly brisk just now, sellers have not hesitated to advance their rates. The minimum price for Upper Silesian bars is 205s., but dealings are recorded several shillings higher. There is a better demand for joists and sheets.

Metals.—Business in the metal market is quieter, and prices have further declined. Mansfeld refined copper, £59 10s. to £60; English brands, £57 to £59. Tin has receded a point: Banca, £102 to £104. Lead is tending in favour of buyers: Clausthol refined, £16 to £16 10s. Spelter, too, has receded slightly: Silesian, W.H. brand, £26 10s. Antimony regulus firmer, at £79 to £82 English.

BRESLAU, Feb. 20.—*Coal.*—The prices of coal at the fiscal collieries have been advanced 1s. to 1s. 4d. a ton. As a reduction is usually made on March 1st for the summer months, this advance is significant. The supply of coal for metallurgical purposes is increasing.

Iron. The market is active all round. The blast furnaces are now producing more abundantly, thanks to a better supply of coal. The price of grey No. 1a pig remains at from 85s. to 90s. Boiler and common plates are in strong demand, the former at 250s. to 260s., the latter at 230s. Sheets are quoted 265s. The minimum for bars has again been raised.

Metals.—There are no signs of weakness in the metal market here. Spelter remains unchanged in price. The production is large, but barely sufficient to meet the demand. There are no stocks. Lead maintains its price firmly.

DÜSSELDORF, Feb. 20.—*Coal.*—No change worthy of note has occurred in the market for coal within the last few days. The recent advance is readily paid. Iron masters are now getting a more abundant supply. Coking coal from 14s. to 16s. at pits. Blast-furnace coke from 29s. to 31s. at the ovens. Briquettes are in strong demand at from 16s. to 18s.

Iron.—Business in pig iron is somewhat slack, but prices have lost none of their firmness. Spiegel pig, ordinary, 103s.; Rhenish-Westphalian forge, 93s.; Siegen forge, 94s.; white steel pig, 93s.; foundry, No. 1, 102s.; Thomas, 80s. to 82s.; Bessemer, 95s. to 96s. The market for finished iron and steel is less animated generally, but common plates and sheets are in strong demand. Prices are unchanged.

CHARLEROI, Feb. 20.—*Iron.*—The recent relapse in the English market has knocked out most of the life from the market here. To-day, however, matters look a little more cheerful. Buyers are not, perhaps, dealing more freely, but they are inquiring more earnestly. Prices are firm. Bars, No. 2, are quoted 152s.; joists, 144s.; angles, No. 3, 152s.; plates, No. 2, 220s.

Glass.—The proposed syndicate for the sale of window glass in the markets of the United States of America is on the point of being established, all the difficulties which hindered its formation having, it is said, been removed.

GHENT, Feb. 20. *Flax and Yarns.*—The supply of home-grown flax is large and the demand moderately brisk. Prices unchanged. Large dealings are taking place in Russian flax at lower prices. There is a fairly active demand for yarns; but sellers have to make concessions in the case of large orders. The high prices asked for cotton yarns restrict business within very narrow limits.

PREVENTION OF FIRE.—An invention for the prevention of fire in cotton cargoes is attracting some attention. Jute packing is objected to on two grounds. It is woven loose, and therefore does not completely cover the cotton bale; and, besides being of an inflammable nature, it is rendered easily combustible on account of oil being used in its preparation. Mr. Samuel Quilliam, Liverpool, has patented an invention which it is claimed obviates the two difficulties referred to. Mr. Quilliam's improvement, it is said, gives a non-inflammable close woven bagging, which can be produced at a little over the cost of the bagging now in use.

AN IMPROVEMENT IN SLIDE VALVES. Mr. Lyon, of Messrs. Gourlay & Co., Dundee, has patented a new arrangement of slide valve in connection with marine engines, with the object of getting rid of the difficulty of cushioning the low-pressure piston. The arrangement is thus described:—"The exhaust ports are so arranged that during the period of release the communication with the condenser is closed and opened to the heater. The steam, which would in ordinary circumstances rush to the condenser, is therefore trapped and utilised to cushion the piston and to heat the feed water." It is claimed that besides making the engine work more smoothly this arrangement effects a saving in fuel of about 7½ per cent.

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HOME INDUSTRIES.

LONDON 20TH FEBRUARY, 1890.

THE MONEY MARKET.—In the earlier part of the week a strong impression prevailed, chiefly in Stock Exchange circles, where the change would be welcome, that the Bank directors would lower the official rate to 5 per cent. The belief was fostered by the purchase of gold by the Bank on Monday and by arrivals of sovereigns from Paris later on. But neither cause was sufficient to justify the assumption, for purchases of bullion do not affect the relations between liabilities and reserve, and the arrival of gold from Paris was proof that the high rate was achieving what it was intended to do. The money market set no store on the rumours of a reduction in the official minimum, and rates for loans and discounts have remained firm. The stock markets are still listless. The slight improvement in the monetary position has told in favour of Consols, and the investment of dividend money has given a fillip to substantial railway stocks. Still, home railways have been dull, speculative purchases of Chathams and Metropolitans being the most marked feature. American railways have been hardly looked at, though the long-talked-of funding of the stocks of the Pacific lines has been used as an argument for purchases. Canadian lines are neglected, and Mexican Railway stocks, though a rise in silver has stiffened quotations, are out of favour. In the foreign department business is restricted, Turkish stocks alone showing consistent vitality. Nitrate securities, after a feeble rally, have relapsed, and mining quotations are tending downwards.

COMPANIES.—The following companies have been registered since our last report:—The Summervale Mill Co., Ld., with a capital of £22,500; The Hull Enamelled Slate and Marble Co., Ld., with a capital of £8,000; The Hargher Clough Room and Power Co., Ld., with a capital of £15,000; The Patent Rivet Co., with a capital of £60,000, to carry on business at Smethwick; Pearce & Co. (Cardiff), Ld., with a capital of £35,000, to carry on the business of brewers; The Lane-Fox Electrical Co., Ld., with a capital of £100,000; The Golden Valley Mines, Ld., with a capital of £60,000, to acquire mines in the Barberton De Haap Goldfields, Transvaal; The Fareham Electric Light Co., Ld., with a capital of £5,000; The Button Machine Manufacturing Co., Ld., with a capital of £25,000, to acquire a certain patent for button machines; The Heavitree Brewery, Ld., with a capital of £65,000; The Iron Minerals Syndicate, Ld., with a capital of £10,000, to carry on the business of proprietors of mines, &c.; The South Wales Whitworth Mineral Estates, Ld., with a capital of £50,000, to carry on the business of colliery proprietors; The Bradford Manufacturing Co., Ld., with a capital of £41,000, to carry on the business of combers, doublers, spinners, &c.; The African Prospecting Syndicate, Ld., with a capital of £100,000, to acquire claims, &c., in Africa; The Hollingreave Manufacturing Co., Ld., with a capital of £5,000, to carry on business of cotton manufacturers; The Sheriff Hill Colliery Co., Ld., with a capital of £30,000; The Leeswood Spelter Co., Ld., with a capital of £5,000.

COPPER.—James Lewis & Son report that the "stocks of copper continue steadily to decrease, the reductionin the past fortnight being 1,978 tons. Realisations of good merchantable copper falling due, bought by Scotch and other speculators three months previously, combined with the large number of warrants available from the sale in January of 4,000 tons Chile bars by one of the French holders and the dearness of money, caused the market, in sympathy with a further fall of 4s. per ton in pig iron warrants (making the total fall in rather less than a month over 20 per cent.), to give way, and sales of cash G.M.B. were made from £48 15s. on the 3rd inst. to £46 15s. on the 11th the fall on this day being 22s. 6d. per ton. With less pressure to sell and more desire to buy, values advanced on the 13th and 14th inst. from £46 17s. 6d. to £47 17s. 6d. for cash and from £47 5s. to £48 10s. for three months' prompt. On the 17th the market was irregular, but good business was done at £48 12s. 6d. to £48 2s. 6d. for cash, and £48 17s. 6d. to £48 12s. 6d. for prompt, closing with buyers at the latter figures. A considerable portion of the warrants put on the market by the French bankers have now been absorbed by consumers, and in view of the sharp fall in values caused by the sale of a large quantity at one time, they will doubtless act with more caution in future."

GAS AND ELECTRICITY.—At the half-yearly meeting of the Gas Light and Coke Company, held recently, the Chairman, Colonel Makins, M.P., stated that he did not think the house owners of London, who were mostly leaseholders, would go to the great expense of an installation of the electric light when they could get gas without that expense. This attitude of Colonel Makins is exceedingly similar to that of stage coach owners and posting house proprietors in the days when railways were in their infancy. The general public, they said, were not likely to give up the safe and pleasant four-in-hand to risk life and limb on the iron road.

THE SPHINCTER GRIP ARMOURED HOSE.—The Sphincter Grip Armoured Hose Company, Limited, 9, Moorfields, E.C., have been awarded a bronze medal (being the highest award given for hose exhibit) for their patent sphincter grip hose, at the Brighton and Hove International Exhibition. No other armoured hose has, we understand, secured an exhibition award. Awards have been made at the Paris Exhibition, 1889, the Birmingham Electrical and Industrial Exhibition, and the American Exhibition, London, 1889. The company have added five new patented improvements to their machinery since they first placed this hose on the markets. The hose is in extensive use at the various Departments of Her Majesty's Government, the Continental and Colonial Governments, railway, steamship, and dock companies, &c.

ARTIFICIAL STONE.—The Indurated Stone Company, Limited, are removing their offices from 13, Victoria Street, Westminster, to their works in the Glengall Road, Millwall. The company are very busy manufacturing artificial paving stones and sewer pipes. They are extending their works, having taken in a large piece of ground, upon which they propose erecting a galvanised iron shed and improved machinery for the manufacture of their specialties.

SANITARY ENGINEERING.—Messrs. Baird, Thompson, & Co., ventilating, sanitary, heating, and lighting engineers, of London and Glasgow, have opened new showrooms at 165, Queen Victoria Street, E.C. Alterations are being made to St. John's Church, Carlisle, and the ventilation improved. Baird, Thompson, & Co.'s new and improved self-acting exhaust ventilator has been adopted for the extraction of the vitiated air, and their latest improved form of air-inlet "panel ventilator" is used for the introduction of the fresh air without draughts.

NEW TELEMETRICAL THEODOLITE.—Mr. W. F. Stanley has introduced a new patent theodolite possessing many noteworthy improvements. A tribrach stage is employed instead of four parallel screws, which permits the instrument being used on a wall without the legs, and prevents all possibility of straining the centre. The instrument has a mechanical stage for shifting the centre with exactness over the desired spot. The telescope supports and the centre are in one casting, and the size of the bearing on the centre has been increased. Instead of webs, which are a constant anxiety to the engineer or surveyor, platinum-iridium points are substituted. These neither rust nor break, and allow of any dust being brushed off with a camel hair pencil without interfering with the adjustment. The eye-piece is also fitted with two vertical adjustable points for measuring distances. A long trough needle is supplied with each instrument in place of the usual small circular compass. The head of the tripod is of an improved form, giving greater rigidity.

MANCHESTER, 20TH FEBRUARY, 1890.

THE LIMITED LIABILITY ACTS.—A conference of representatives of Northern Chambers of Commerce was held on the 14th inst. in Manchester, at which resolutions embodying the proposed amendments to the Companies Acts were adopted. The amendments suggested were as follows:—First, that two registrations of every company should be made, one provisional and one complete; second, that before complete registration 75 per cent. of the nominal capital should be subscribed and allotted; third, that 10 per cent. should be paid on application and 10 per cent. on allotment; fourth, that the nominal capital of any industrial company shall not be less than the value of the fixed and working plant; fifth, that before allotment a meeting of applicants should be convened, which may appoint a committee of five, exclusive of the promoters or other interested persons. The committee is to have the power of examining all documents and contracts, present or proposed, between the vendors and the proposed company; sixth, that a copy of the memorandum of association, the names, addresses and occupations of the promoters or provisional directors, and the names and descriptions of all persons entitled to any commission, brokerage or agency charges and the amount of these, should be included in every prospectus; seventh, that the balance-sheet of every company shall state the annual rate of depreciation which has been charged and be accompanied with a detailed statement of all items added to the capital account since the preceding balance-sheet. Power is given to penalise auditors who do not certify the deduction of the depreciation, and a similar power is given with regard to the signing of balance-sheets by directors. Sir W. H. Houldsworth, M.P., and Mr. Isaac Hoyle, M.P., were empowered to draft a Bill upon these lines.

BRUNNER, MOND, & CO., LIMITED.—The half-yearly report of the directors of this company shows that a profit of £120,640 had been made, out of which a dividend of 7 per cent. per annum on the preference and 30 per cent. on the ordinary shares is proposed to be paid. In addition to this £2,500 was written off patents account, £20,000 placed to a suspense account to provide for remodelling a part of the plant, £6,500 written off the lands account, and a balance of £13,806 carried forward.

PACKING OF SURAT COTTON.—The Liverpool Cotton Association have adopted two new bye-laws with reference to Indian cotton. The first provides that this class of cotton is not to be considered merchants' shipment unless it has been sampled and examined by the European firm shipping it. The second empowers either buyer or seller to remove a hoop and to take samples from both sides and the middle of the bale, in equal quantities, in order to test the condition of the packing. Samples for sale or arbitration are to be drawn only from the fair side. The examination is not to invalidate any subsequent claims for false packing.

AMERICAN LIFTS.—At the annual dinner of the Manchester Association of Engineers the Mayor announced that the Corporation of this city had resolved to put an American lift into the Victoria Buildings, and twitted English engineers with not being able to compete with Americans. The statement was received with dissenting cries, and the President subsequently said that if English firms were fairly treated they were quite able to construct lifts equal to those of American make.

AIR PROPELLER TESTING.—The Blackman Air Propeller Company at their Manchester stores have fitted up a simple contrivance by which they can ascertain the relative merits of any make of propeller. It consists of a short length of tube of large diameter with both ends open. Attached to each end are light frames containing suitable bearings for a shaft extending the full length of the tube, and fitted with a shank at each end, on to which the propellers can be firmly fixed. Sliding freely upon the shaft and fitting the tube is a diaphragm, dividing the tube into two parts. When the propellers are fixed the shaft is driven by a strap from a gas engine, and as one of the propellers is the opposite hand to the other, air is forced into the tube from each end. The relative efficiencies of the different makes is determined by the position the diaphragm assumes in the tube. If the powers are equal it remains midway; if not, it is forced to one end. We saw several types tested against the Blackman, and in every case the diaphragm was forced to the end of the tube furthest from the latter. By means of a gas meter of suitable construction the actual consumption of gas by the engine with each propeller when running can be gauged, but we did not see this point actually tested.

THE LINEN AND JUTE TRADES.—Manufacturers across the border and in the North of Ireland continue well engaged on orders placed some time ago and on new contracts, but producers in the North of England are not so busy as could be wished, power looms not being fully engaged, while the old hand-loom industry seems to be dying out altogether. Brazilian and Portuguese troubles have affected business somewhat, but not to a sufficient extent to have any perceptible influence upon the commerce of the country generally. Firms engaged in the shipment of drills to South America of course find trade slower owing to the political disturbances there, and the sensationally high rates of exchange have borne very heavily upon importers in South America, with the result that remittances are being purposely delayed until they can be made without so much loss. Scotch makes of bleached fringed tray cloths have met with a good inquiry, and the business in these elegantly designed fabrics promises well for the future. Fancy check hollands in greater widths than usual, suitable for pinafores and dresses, are much more in favour now with the public, to judge from the orders placed by the wholesale distributors here, and manufacturers would do well to note this fact. Stair linen damasks and crumb-cloths are not in such demand as formerly, and the old huck towel trade is a decaying one. The fancy jute trade is unchanged. Plain varieties move off steadily, and there is a good all round demand for linen threads.

GLASGOW, 20TH FEBRUARY, 1890.

SHIPBUILDING.—Orders continue to be scarce, almost none of any consequence having been booked by any of the Clyde shipbuilders for about three weeks. This lull is probably due to the falling away of freights, especially homewards. The increased cost of material and labour, and the large amount of work on the stocks in the yards, have combined to produce this depression. Freights for sailing ships have suffered a drawback as well as steam freights, and thus there is little encouragement at the moment to place new orders.

ENGINEERING.—The well-known engineering firm of Messrs. P. & W. Maclellan has been formed into a limited liability company. P. & W. Maclellan, Limited, will be the new style of the firm. The capital will amount to £300,000 in £10 shares, 16,000 of these being 6 per cent. cumulative preference shares and 15,000 ordinary stock. The preference shares are to be entitled to receive half the balance of profit after 6 per cent. has been paid on the ordinary stock. £150,000 is also offered in 5 per cent. first mortgage debentures, the interest being guaranteed by the Mortgage Insurance Corporation (Limited). The prospectus states that the business was established in 1811, that the number of employés is 2,000, and that the annual turnover is about a million sterling. It is also stated that there is enough work on hand to keep the existing powers of production going for a year. The purchase price, including land, buildings, plant, goodwill, patent rights, &c., is to be £350,000. Messrs. Turquand, Youngs, & Co. report that the average annual profits for the past five years were more than sufficient to pay 5 per cent. on the amount issued as debenture stock, together with 6 per cent. on both preference and ordinary shares. The list opens to-day (Thursday) and closes to-morrow (Friday).—Mr. Alexander Aitchison, engineer of the Steel Company of Scotland, has gone to a similar appointment at Messrs. Palmer & Co.'s works at Jarrow-on-Tyne.

PIG IRON.—Although the pig iron market is still labouring under the weight of large quantities of high-priced contracts coming due every day till the end of this month, confidence has been to a great extent restored by seeing even the heaviest settlements going on day by day without any trouble. The greatly increased cost of production seems to make 52s. a safe enough basis of operation, and some good buying has been done on the strength of it. Cleveland and hematite have been affected even more than Scotch by the prospective scarcity and demand of coke. This week the market was strong, and in the early part of

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the week had reached a point which marked an advance of about 3s. on Scotch, 4s. on Middlesbrough, and 5s. on hematite above the lowest points touched during the late depression.

(From our own Correspondents.)

LIVERPOOL, 19th February, 1890.

Liverpool Overhead Railway.—Considerable progress has been made in the construction of this railway. The foundations of a hundred piers have been laid at the north end and work has commenced at the south end. The columns and girders are being constructed, and in a short time the contractor hopes to be able to erect them at the rate of two spans of 50ft. per day. The equipment of the line would be of the lightest kind, and would resemble more an overhead tram-line than a railway. The motive power is to be electricity, but on account of the rapid strides of this science, the particular form of motor will not be decided upon until the last moment. The specified time for completion of the line is two years, and there is every prospect of the work being then completed.

The Dinsmore Gas Company.—At the annual meeting of the shareholders of this company, held on Monday, it was stated that, although there had been considerable delay in the operations, the directors were quite satisfied as to the ultimate success of the process. Satisfactory reports had been received from Mr. Newbigging and from Professor Foster, and the process was in operation at twelve gas companies or corporation works. Mr. Carr, gas engineer, Widnes, stated that the process had effected an annual saving of £1,700, and that the illuminating power had been increased from 19 to 20 candles. Mr. Pritchard, of the Huyton Gas Works, stated that by adopting the process the illuminating power had been increased 20 per cent.

New American Steam Line.—It is announced that Mr. Ingalls, President of the Chesapeake and Ohio Railroad, has been granted a charter by the Virginia Legislature for the establishment of a line of steamships between New York and Liverpool, and that the ships are to be built in England.

Live Stock and Fresh Meat Imports.—During the past week 1,107 cattle and 12,023 quarters of beef were landed in Liverpool, showing a decrease of 13 cattle and 3,102 quarters of beef from the amounts of the previous week.

SHEFFIELD, 19th February, 1890.

Coal and Coke.—House coal is not selling very briskly just now owing to the mild weather; its average price is from 12s. to 15s. per ton, according to quantity. Coke of all classes is in excellent demand. The hard North of England coke is in great request for steel melting purposes, while the smaller varieties used for stoves and smithies find a steady and increased sale.

Iron and Steel.—The iron market has assumed a firmer tone. Local manufacturers report a good volume of business. Merchant bars in standard sizes of treble best quality are still imported to a large extent. Further large orders for armour plates have been received by Messrs. Cammell & Co. and Messrs. John Brown & Co. The former firm will supply plates to the "Hood," building at Chatham Dockyard; the "Royal Sovereign," building at Portsmouth; the "Royal Oak," building by Messrs. Laird Brothers, Birkenhead; and the "Ramillies," building by Messrs. J. & G. Thomson, Glasgow. Messrs. John Brown & Co. are to supply armour for the "Repulse" and "Renown," building at Pembroke Dockyard; also the "Resolution" and "Revenge," which are to be constructed by Messrs. Palmer's Shipbuilding Company, Jarrow-on-Tyne. It is expected that this work will occupy the above firms for about two years. Messrs. Vickers, Sons, & Co., Limited, of the River Don Works, have secured a large contract for the thinner all-steel armour plates up to 4in.

LEICESTER, 19th February, 1890.

Wool Spinning and Yarn Trades.—No great variations are apparent in the local wool market. The tone remains cheerful and healthy. There is a large consumption and stocks are generally low. The business done is for present wants. Spinners are busy. Though the new orders booked are light, there are enough on the books to keep the mills going for some time to come.

Hosiery Trade.—For the time of the year a good trade is being done. There are some very good Government contracts for the army and navy now on hand, and they will give much employment for some time to come.

Boot and Shoe Trade.—Business in this industry still flourishes. All the houses are working up to their full capacity, and several of the largest are working overtime.

SWANSEA, 19th February, 1890.

Tinplates.—Several tinplate works have already temporarily stopped, as they cannot pay the price of steel bars and manufacture plates without a positive loss. On the completion of the balance of unexecuted orders several other makers mean to adopt a similar course. Notwithstanding this unsatisfactory immediate outlook, every confidence is retained in the future of the trade, and capital continues to flow into this industry. The Port-Talbot Tinplate Company has been registered, with a capital of £35,000 in £35 shares, and the Cardonnel Tinplate Company, with a capital of £20,000 in £50 shares. The tender of Mr. A. George, of Neath, for the erection of the Baglan Bay Tinplate Works has been accepted. So enormously has the traffic in tinplates increased that the executive committee of the Swansea Harbour Trust recommend laying down additional sidings at the Prince of Wales' Dock at a cost of £1,600. We quote Bessemer bars, £7 15s., and Siemens, £8 2s. 6d.; tinplates, Bessemer cokes, 16s. 6d., Siemens coke finish, 17s. 6d. per box, common sizes.

Companies and Dividends.—The two great railway companies interested in this district—viz., the Great Western and the London and North-Western—have both declared dividends at the rate of 8 per cent. per annum for the past half-year. This leaves room to hope that the Great Western Railway will be mindful of its interests in Swansea, where the shipments of coal have been diminished by 20,000 tons in one month owing to the war of rates waged by the railways converging on Cardiff. Colliery proprietors have notified purchasers that they cannot in future ship coals at Swansea except at an advance of 6d., and in one case of 1s., per ton on ruling prices. The Rhondda and Swansea Bay Railway, the completion of which has been entrusted to Messrs. Lucas & Aird, who undertake to finish their work about the middle of May, will help to restore this lost trade, especially as its mineral traffic continues to increase on the section of the line already open, and in view of the fact that the junction with the Taff Vale Railway has been effected. The directors have been able to recommend a dividend at the rate of 5 per cent. on the preference capital, and 2 per cent. on the ordinary shares. The shareholders in the Brittany Steamship Company, Limited, who have received 26 per cent. for the year, are to be congratulated, and not less so those of the Bristol and South Wales Railway Wagon Company, who receive 10 per cent., after having had a similar dividend for the last twenty years. The South Wales Engineering Works and Ship Repairing Company have also paid 10 per cent. for the year.

BARROW-IN-FURNESS, 19th February, 1890.

Iron.—A better tone is imparted to the hematite pig iron trade this week by reason of the improvement which has just taken place in warrants. The latter have advanced during the week to the extent of 3s. per ton, and are now quoted at 67s. 6d.; but makers are still asking 82s. for mixed numbers of Bessemer net f.o.b. The result is that little new business has been done during the week. Makers are very busy, and are full of orders for many months to come.

Steel.—There is a quieter tone in the steel trade consequent on the expectations of reduced prices. There is a good inquiry for steel rails, but not any disposition to place orders. A large inquiry is also experienced for steel shipbuilding material. The tinplate trade is quieter, and the demand is less.

The Foreign Ore Trade.—Owing to the scarcity which has arisen in the supply of native hematite ore, large importations are now being made of Spanish ore from Bilbao, Carthagena, and elsewhere, and this has consequently imparted considerable activity to the shipping trade of the North-West Coast. Spanish ore is quoted at from 16s. 6d. to 17s. 6d. per ton delivered, and prices are buoyant. Advices from Bilbao say the supply of ore is not equal to a maintenance of the present rate of exportation.

A Successful Mining Company.—The Hodbarrow Mining Company is at present engaged in the building of a sea-wall or embankment in the Duddon estuary, with a view to keeping the water out of the workings of their hematite mines, which are the richest in the world. The cost of this embankment will be from £170,000 to £200,000.

Shipping.—The shipping returns for the West Coast ports for the past week show an improvement on 1889. The amount of pig iron and steel shipped during the week represented 21,939 tons, compared with 16,614 tons in the corresponding week of last year, being an increase of 5,325 tons. The total shipments to date, however, show a falling off as compared with last year.

MIDDLESBROUGH, 19th February, 1890.

Pig Iron.—There was a large attendance at the weekly market held on 'Change yesterday, and there was a good deal of business done. Buyers are eager to be supplied in the prospect of a busy spring. Prices advanced slowly but steadily. The quotation now is 55s. to 55s. 3d. per ton for prompt delivery of No. 3 G.M.B., and 55s. 6d. per ton for delivery over the next two months. Makers, however, still hold out for 60s. and upwards, and will not part with grey forge under 57s. per ton, as they have the most of it on their hands. Warrants are 55s. 1d. cash buyers and 55s. 3d. buyers. Everything denotes a steady rise, and as yet there is no attempt at speculation. The stock in Connal's store on Monday, the 17th inst., was 181,264 tons, against 182,523 tons on the previous Monday.

Shipments of Pig Iron.—The dead season is gradually coming to an end, and shipments are beginning to increase. The outlook in this direction is very promising indeed, except as regards Scotland. The shipments for the present month, up to the 17th inst., were 28,914 tons, as against 23,173 tons over the similar period last month, and 27,938 tons over the same time in February last year. Germany and Holland are taking more, as well as other foreign countries. There is, indeed, every indication of increased shipments as the spring advances.

Manufactured Iron and Steel.—In the finished iron trade there is no change, but this is not likely to continue if pig iron goes on advancing. There are more inquiries and greater desire to have orders placed. Iron ship-plates are at £7 10s., angles, £7 5s., bars, £7 10s. per ton f.o.t. less 2½ per cent.; steel ship-plates, £8 10s., angles, £8 5s., rails, £6 12s. 6d., sleepers, £7 10s. per ton, less the usual discount.

Coal and Coke.—The threatened strike is causing some uneasiness, and there is good reason for such amongst the blast furnace owners, who could not go on for long. There is a feeling, however, that all will come right. The threat has had its effect in stiffening prices and pressure for delivery. All kinds of coal are in brisk demand except households, which are somewhat dull from the mildness of the season. Coke maintains its price at 27s. to 27s. 6d. delivered.

NEWCASTLE, 19th February, 1890.

Steel and Iron Trades.—In these industries there is considerable uncertainty just now, the impending labour troubles in the coal trade and the marked falling off of orders in the shipbuilding trade being among the chief disturbing elements. The works, however, are generally kept busily going, the briskness in both the iron and steel departments of the Palmer's Shipbuilding and Iron Company's works at Jarrow being particularly noticeable. This firm, though being themselves among the largest consumers in the country, are still, owing to their unique resources, able to supply a good proportion of the material used by the other shipbuilding, boiler building, and bridge building firms in the district.

Shipwrights' Wages.—The shipwrights employed in the various shipbuilding yards on the Tyne have given the employers notice that they require an advance of 3s. per week in the wages rate, to commence on March 13th. A meeting of the employers will shortly be held, to consider and decide upon the application.

Engineering.—Messrs. Ernest Scott, Close Works, Newcastle, have received orders for some forty pumps, of the Admiralty type, for use on board the new cruisers now in course of construction at the principal shipbuilding yards on the Tyne and other rivers. They have also several orders for the Priestman oil engine. In their electrical department exceptional activity exists, the manufacture of dynamos and arc lamps of various sizes being carried on on an extensive scale. Among the principal installations in hand may be mentioned the lighting of a large steamer intended for employment in the frozen meat trade. The firm have also an order for the complete installation of a frozen meat store in the Argentine, and are about to send out a staff of skilled workmen to fit up the plant.

The Coal Trade.—The somewhat strained relations now existing between employers and employed are causing some anxiety in commercial circles as to the future course of affairs. The shipments of coal and coke at Tyne Dock for the week ending February 15th amounted to 103,129 tons, being a decrease as compared with the shipments for the corresponding week last year of 834 tons.

Chemicals.—The chemical trade of Tyneside is affected by a dread of labour difficulties interfering with the output of manufacturers. The workmen of Messrs. Tennant & Parts, who demanded an advance of wages, and who were refused any increase in the amount of their remuneration, have now suggested that their case be referred to arbitration. The employers have agreed to submit their case to the arbitrament of a local solicitor. The alkali makers of the district have now formed an association for the purpose of resisting what they consider to be unreasonable demands on the part of the workmen.

BELFAST, 19th February, 1890.

Dock Labourers' Strike.—This strike still continues—at least in name—and the work of discharging vessels is being done by means of non-society men without any interference from the men on strike. Several of the latter have started work again, and it is thought that the strike cannot last much longer, and that the power of the Union is almost completely broken.

Boiler Making.—Several large orders are now in hand for land boilers. Two very large boilers have just been completed by Messrs. Victor Coates & Co. for the Hilden Thread Factory. Much more work of this sort might be done in this district if makers were a little more enterprising.

Shipbuilding.—The stocks still continue full, but orders are not coming forward as they were some time ago. Workmen are now becoming more plentiful, and are working steadily. Ship carpenters have been granted an increase of 1s. per week. Several large vessels are ready for launching, and others are in an advanced state of completion.

Linen Trade.—The markets continue very slack, and the turnover is very small. Contracts are running out, and as they do so buyers find less difficulty in making purchases to suit their ideas. The stock of warp lines is very small, and prices are firm. Tows also maintain their old values. Manufacturers of special makes of cloth hold good contracts at fair prices.

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MESSRS. ARBEY'S TOOLS AT THE LATE PARIS EXHIBITION.

(For description see page 176.)

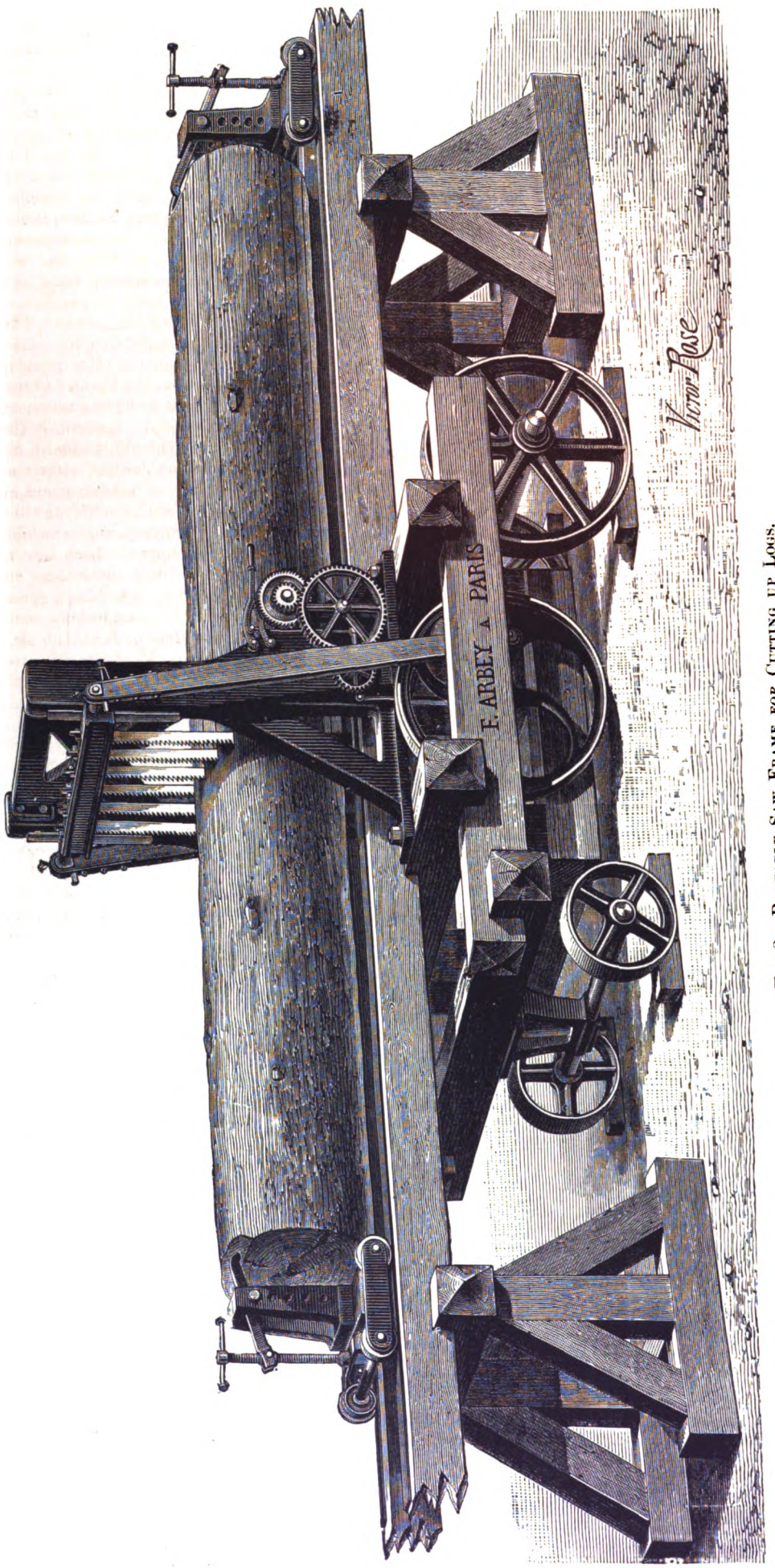
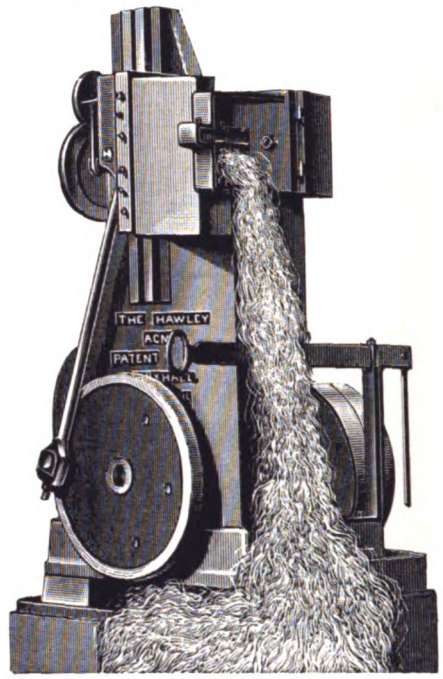


FIG. 2.—PORTABLE SAW FRAME FOR CUTTING UP LOGS.

MACHINE FOR MAKING WOOD WOOL.

MESSRS. JOSEPH M. WEBSTER, Derby Works, Carruthers Street, Vauxhall Road, Liverpool, are now placing on the market the Hawley "Acme" wood wool machine, which is illustrated below. The use of wood wool is coming rapidly into favour among manufacturers of glass cutlery, confectionery, &c., for packing purposes on account of its cleanliness and non-hygroscopic



properties, but its adoption is hindered, among other things, by its comparatively high price. The Hawley machine is intended to reduce the price, for it is of such a size and design that every manufacturer can have one working on his premises, and can thus turn out his own wood wool. Very little attention is required by the machine, and all the parts are easily renewable. Timber of any convenient length can be cut, and waste pieces can also be utilised.

THE NEW RULES FOR LIFE-SAVING APPLIANCES.

THE strictures which have been freely passed in certain shipping circles on the rules drawn out by the Board of Trade, based upon the "Merchant Shipping (Life-Saving Appliances) Act, 1888," are finding complete justification from the general attitude of shipowners and builders towards them, as well as from the fact of the Board of Trade having postponed the date on which the rules are to come into force. Messrs. Russell & Co., the well-known shipbuilders of Port Glasgow, wrote some little time ago to the local Board of Trade surveyors asking a few pertinent questions as to the precise bearing of the Act in a given case, to which they have received the polite but not very satisfying reply:—"For an explanation of the rules I am instructed to inform you that you should refer to the rules, and the local surveyor will see that they are carried out." Messrs. Russell & Co. are not the only firms, having at least ordinary business intelligence, who have been knocking at the door of the Board of Trade for enlightenment, only to be met with the polite request, "Refer to the rules"! Now the rules are, as we have already heard them characterised, a perfect "pigs-in-clover" puzzle. Readers honestly applying themselves to the task of comprehending their bearing in any given case are not long so engaged before they are compelled to give up in despair. The system of cross-reference adopted in framing the rules, while perhaps securing brevity, has imparted an element of confusion and uncertainty which might well have been avoided. The text of the measure has to be fished out piece-meal from amongst a plethora of "clauses," "divisions," and alphabetically distinguished paragraphs, until, after weary and painstaking efforts at tracking the full meaning from page to page and clause to clause, it, will-o'-the-wisp like, finally eludes the grasp. The operation of the Act has been postponed from the 31st of March to the 30th of June next. The Board of Trade could not exercise its latent energies to better purpose, between now and that date, than in modifying the present rules in *substance*, so as to more equitably meet the cases in which they at present bear so hardly, or at least in *form*, so as to be more intelligible to the reader, whose abilities find worthier scope than solving needless word-puzzles.

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As we go to press early with certain of our advertisement pages, all Alterations to Standing Advertisements should reach the Publisher not later than 2 o'clock on Wednesday afternoon in each week.

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

Contents.

	PAGE
On the Compounding of Locomotives Burning Petroleum Refuse in Russia (*Illus.*)	169
Foreign Industries (Corres.)	174-175
Messrs. Arbey's Tools at the late Paris Exhibition (*Illus.*)	176
The Society of Engineers	176
Shipbuilding Notes	176
Notices of Meetings	177
Prices Current	177
Foreign Telegraphic Advices (Corres.)	177
Home Industries (Corres.)	178-179
Machine for Making Wood Wool (*Illus.*)	180
The New Rules for Life-Saving Appliances	180
The Present Standard of Light	181
The Templeton Mill Disaster	182
The Chamber of Shipping	182
A Discovery of Coal in Kent	182
The Royal Meteorological Society	182
Letters to the Editor:—	
The Manchester Ship Canal	183
William Murdoch	183
Silicon in Iron and Steel	183
The Institution of Civil Engineers	183
Brick Pressing Machine (*Illus.*)	185
Boult's "Tricord" Light Adjuster (*Illus.*)	185
The Heating of Conductors by Electric Currents (*Illus.*)	185
The Society of Chemical Industry	186
The Future Supply of India-rubber	187
The Lead in the Water Supply of the Northern Towns	187
Notes	188
"Industries" Patent Record:—	
Applications and Acceptances	189-190
Illustrated Abridgments	190-192

To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

We cannot undertake to return manuscripts or drawings, and must request correspondents to keep copies.

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Industries:

FRIDAY, 21ST FEBRUARY, 1890.

THE PRESENT STANDARD OF LIGHT.

THE last quarterly report of Professor Williamson, the Chief Gas Examiner for the metropolitan area, brings to the notice of the London County Council many points of interest concerning the quality of the London gas during the last few months, and this again brings home to the guardians of the public the unsatisfactory nature of the present official methods for ensuring an adequate lighting of our large towns by the gas companies. At the present time, when electric lighting is making such rapid progress, the controlling authorities will soon have to adopt some method for ascertaining the illuminating power and efficiency of the lighting of the new rival to gas, and it cannot be too strongly urged upon those who have the interest of the public in their keeping to take steps towards introducing into Parliament a Bill which will deal with the question on such a broad basis that the competing systems shall be judged by a uniform and definite standard of light. For many years those engaged in the determination of the illuminating power of coal-gas have been unanimous in condemning the "Parliamentary candle" as unreliable at all times, and frequently official tests made with this standard are known to be worthless by the controlling authority, and yet, because the conditions as defined by law and the Gas Referees appointed by the Board of Trade have been complied with, the unoffending gas company is compelled to suffer the ignominy of a police-court prosecution and to pay the forfeiture laid down by law. Mr. Dibdin, the chemist to the London County Council, in a public discussion which followed the reading of a paper on the "Standards of Light," and while referring to the present mode of determining the illuminating power by candles in closed photometers, described the process as one which oftentimes necessitated the committal of "a nightly fraud" on the part of the gas examiners. Notwithstanding such a strong statement on the part of the scientific representative of the controlling authority, the late Board and the present County Council are still enforcing the present Acts. It is to be regretted that such lethargy in high places should thus retard progress in this direction, and we are not surprised that the Chief Gas Examiner, to whom all disputes between the gas company and the controlling authority are first brought, should express himself strongly on this subject. In a report on the appeals of the Gas Light and Coke Company against the official returns at two of the testing stations last year, Professor Williamson says: "The official system of photometry, like all such experimental operations, has been gradually undergoing improvement, but there is still one serious defect in it, namely, the standard of light. Sperm candles such as are ordered to be used by the gas examiners are officially known to differ from one another to the extent of at least ten per cent. of their illuminating power, so that one standard candle might show gas to have an illuminating power of 15·2, while another shows 16·8 as the illuminating power of the same gas." Still more recently the gas examiners have pointed out in a memorial to the County Council the same difficulty in the satisfactory working of the present Act of Parliament. They say: "It has long been recognised, and is now generally acknowledged, that of all standards of light, the standard at present adopted, namely, sperm candles, is the most unsatisfactory. So great are the discrepancies which may, and frequently do, arise from the use of this standard, that three successive tests of the same gas may vary by more than 1·5 candles, or 10 per cent., of the whole illuminating power. The Gas Referees themselves recognise that such a variation may arise from the inadequacy of the standard," and they proceed to urge that the County Council should take the necessary steps to have a more accurate unit of measurement adopted. Apparently the Gas Referees wish to adhere to the old standard, as they have not taken as a body any distinct steps towards altering the present system of measurement, but have contented themselves with modifying the style of photometer and the conditions under which the standard candles should be burnt. Last year we drew attention to some of these alterations (see *Industries*, Vol. VII., page 163), which as a general result have had the effect of considerably complicating the methods of procedure and at the same time afford the gas companies loopholes of escape if the gas examiners should depart from any of these refinements and directions in even an unimportant particular. The result of these so-called improvements on the method of manipulating candles has, however, been very unfortunate. For instance, those who are not under the London County Council, and who believe in the old standard, have now two standards to appeal to. The Gas Referees have, indeed, tried to remedy the evil, by prescribing an additional test to be taken after a further interval of one hour in those cases in which the return falls below the Parliamentary limit, but we should have thought that Professor Tyndall would have been able to persuade his two colleagues to refrain from insisting on such a useless expenditure of energy. We do not wish to urge the adoption of any particular fad or hobby, but when it is admitted by every photometrist that there are at least some half-dozen new standards which are undoubtedly superior to the "candle," the Gas Referees are not prescribing the mode to be adopted for testing in a satisfactory manner when they waste their time in patching up a system which is now acknowledged to be effete and exploded, instead of using their official position to advocate the adoption of a modern and better method. Professor Vernon Harcourt, as is well known, has in his individual capacity devised a new standard of light, and has shown, at the British Association and elsewhere, that it is capable of giving better and more trustworthy results than the candle. It would seem, therefore, that Professor Harcourt's colleagues either do not think highly of his Pentane standard or else are quite satisfied with the existing system. We hope the Board of Trade will ask the Gas Referees to furnish them with a report on their work, which will give them an opportunity of letting the public know their official views on this matter. We should not be surprised if a question should be asked in Parliament on this subject, in connection with the low returns of illuminating power which have been made by the official examiners at two of the testing stations of the South Metropolitan Gas Company during the recent period of strike among their employés. We hope that the subject will then be fully discussed, and that steps will be taken to amend the Act, so that the determination of illuminating power shall at last be placed on some approach to a satisfactory basis.

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Electric lighting is developing so rapidly that electrical engineers will soon need a definite standard of light. Though the light of glowlamps is spoken of as so many candles, candles are never used in the determination. In London the Methven screen, or more recently the pentane standard, is employed. Electric lighting, being a new and interesting industry, has attracted the attention of a great many unpractical and purely scientific men; and they have brought out the square centimetre of solidifying platinum as a light unit. Gas companies and practical gas analysts have no leaning towards square centimetres or solidifying platinum, and such a proposal cannot but cause confusion. The British Association Committee has defined the candle in terms of the platinum standard; but unfortunately the matter, from a commercial and legal point of view, is none of the British Association's business. Whether the vague standard candle remains, or the definite pentane lamp comes into use, the practical standard will not be made to fit the platinum unit; but if the new standard does not come out the exact fraction of the platinum standard, it is the British Association unit that will have to alter, not the new standard. What is wanted is, not a definition of unit light that has the appearance of having something to do with the C.G.S. system, but a legally and accurately defined standard whose exact value can always be reproduced. In electric light work there is no definition of light, apart from the standard. A standard flame, if transparent, gives equal light in all directions; an incandescent carbon does not. What, then, is meant by the light of an incandescent lamp? The mean of the intensities in all directions should be taken. This last is a small matter, however, in comparison. What is wanted is that when a gas company has to supply sixteen-candle gas, and its profits depend on whether it gives sixteen-candle or fifteen-candle, the public should be able to claim sixteen-candle gas on the one hand and the company should not be obliged to supply seventeen-candle gas on the other. As we have already said, there is now no reason whatever why a company supplying proper gas should be reported by an analyst—who knows his results, though legally right, are actually wrong—and fined, merely because the authorities are too lethargic to adopt a standard which has been carefully prepared for them and laid ready to hand.

THE TEMPLETON MILL DISASTER.

The report of the Commissioners, Colonel Malcolm R.E., and Mr. W. W. Robertson, appointed by the Secretary for Scotland to inquire into the cause of the fall of Messrs. Templeton & Co.'s mill at Greenhead, Glasgow, a few months ago, has just been published, and, as it treats of matters of great interest to all engaged in large industries which require buildings of considerable height, a few of its chief points may be noted.

The Commissioners do not bring any serious charges against those who were connected with the construction, although they point out with great force, what struck us at the time the evidence was given, that there ought to have been more direct co-operation between the architect who designed the shell of the building and the engineers who were responsible for the arrangement of its interior and the constructions immediately depending on the machinery. In the case of the mill under consideration, there seems to have been no approach to collaboration, and all communications between the architect and the engineers were not direct, but passed almost entirely through Messrs. Templeton. The drawings were issued to the skilled workmen signed by the engineers, and there is some conflict of evidence as to how far they had been approved, or in some cases even seen, by the architect. These drawings gave details of the iron columns, beams, stanchions, &c.; and of course should all have been designed with reference not only to their special relation to the machinery, but also their more general relation to the walls and the structure generally. This matter, we think, brings out a weak point in the training of architects. They are taught to make a fine picture on paper, but questions of stability or strength are seldom considered. Every architect who takes up the department of mill work should be sufficient of an engineer, not only to design the walls, but to make out complete drawings from the sketches of the mill engineer, and the two should be jointly responsible for the plans.

The materials and workmanship of the buildings were of excellent quality, and the Commissioners are of opinion that no shortcoming in this respect can be held as having contributed to the accident. Neither do they think that the scaffold on the outside of the front wall, and the steam crane on the top tier of joisting, had anything at least directly to do with it. Even with the front wall, in which the architect departed from the original plans, they fail to find any fault, as they say that it exceeded the dimensions required by the Metropolitan Building Act, and, moreover, it was strongly supported by the joists.

The Commissioners differ from the opinions given by the witnesses as to the cause of the accident, and they find it in the back wall, which they consider the weakest part of the structure. Although this was not exposed directly to the force of the wind, it was subject to a large though unascertainable wind pressure, due to the openings in the front wall, and the absence of a roof, as well as to a considerable thrust transmitted from the front wall by the four tiers of joists which crossed the building. Against these forces the wall had nothing to oppose but its own lateral stability, which was not great, its thickness being less than that of the front wall, and somewhat under the requirements of the Metropolitan Building Act. Moreover, it was supported on lintels and stanchions, and had no connection, except at the two ends, with any other structure which could stiffen or support it. The Commissioners show that the wind, acting on this wall, would, by a series of gusts, not only play havoc with it, but also bring down the front wall. We need not enter into the details of their reasoning, but we may say that it seems sound, and at least gives one of the most probable causes of the accident.

The lessons to be learnt from the disaster are that it ought to be remembered that ordinary walls, when unsupported, have small lateral stability, and especially so when, instead of rising from solid foundations, they are carried on iron beams and columns, and that a building which may be strong enough and stable enough when completed, may require to have special precautions taken during its construction. In the present case some additional temporary strength should have been given both by transverse bracing of the building at intervals and by diagonal bracing of the floors. Moreover, the wall should have been thicker. Another lesson is that the engineer and the architect should co-operate in their work, and be jointly responsible for the plans, and that both should have a sufficient knowledge of each other's business to enable them to turn out a design which may be a harmonious unity, and not merely an architectural shell with a mechanical interior having little relation to the shell in the matter of construction.

THE CHAMBER OF SHIPPING.

The proceedings at the annual meeting of the Chamber of Shipping, which was held in London last week, showed that the association is in a vigorous condition; and it is certain, as was expressed by the retiring President, that the future of British shipping will, in a great measure, rest with the Chamber, if it remains united and strong, and the consciousness of this should ever be present in the minds of the members and give weight to the deliberations of the Chamber. Mr. Dunlop further said that the Chamber was likely to have, if it cared for it, an important part in the settlement of some of the questions that are agitating the wage-earning classes in this country and abroad, and he hoped that it would be instrumental in reconciling the differences between employers and employed as they affect shipping.

During the past year we have discussed more or less the various subjects which came before the Chamber, and, as they are likely to attract attention during the present year, we will only notice them very shortly at present. The question of light dues is still unsettled, and Sir Michael Hicks-Beach, who was present at the meeting, offered a Royal Commission for the investigation of the subject. Sir Michael also alluded to the Tonnage Measurement Act, and hoped that, whatever might be their feelings towards him in the earlier stages of the measure, they were not now absolutely hostile. The shipping interest had been so well able to take care of itself that various provisions had been inserted which had been of material advantage to that great industry. He alluded to the Maritime Conference which had been recently held at Washington, the results of which, he believed, would be of great importance to our mercantile marine. On the subject of collisions its discussions had been especially valuable, although he would have preferred that more definite conclusions had been come to on some matters, such, for instance, as an international load line. He was strongly of opinion that in all attempts at legislation the shipowners should be consulted, as he was sure that the great majority of them were anxious to do all in their power to safeguard the interests of the life and property committed to their charge.

Among the other subjects discussed by the Chamber were the penalties for smuggling, which fell heavily on shipowners, a compulsory load line, supply of seamen, and strikes. Mr. Edward Martin, on behalf of the Clyde Shipowners' Association, moved that the number of representatives from the various ports on the Committee of Lloyd's Register should be increased, and, notwithstanding the opposition of the Chairman of Lloyd's Committee, the motion was agreed to. It seems only right that this proposal should be carried out, and we trust that, when it has been conceded, those who are appointed will attend the meetings of the Committee, for it is said that at present the members who represent the outports are generally conspicuous by their absence. We intend during the year to note the points of the programme of the Chamber which come up for discussion in Parliament or otherwise, so that our readers may know what progress is being made.

A DISCOVERY OF COAL IN KENT.

For several years Sir Edward Watkin has been making experimental borings in the south of Kent for the purpose of discovering the beds of coal which his geological advisers tell him must exist there. The borings hitherto have proved fruitless, but Mr. Brady, the engineer-in-chief to the South Eastern-Railway, has now reported a successful issue of the experiments. His report says:—

"Coal was reached on Saturday last, the 15th inst., at 1,180ft. below the surface. It came up mixed with clay and reduced almost to powder by the boring tools. A small quantity of clean bright coal found in the clay was tested by burning and proved to be of good bituminous character. The seam was struck after passing through 20ft. of clays, grits, and blackish shales belonging to the coal measures, which at this point lie close under the lias, there being only a few intervening beds of sand, limestone, and black clay separating them. The correspondence of the deposits with those found in the Somersetshire coalfield is thus pretty close, the difference consisting in the absence of the red marl at the Shakespeare boring. The lines of bedding in the shale are distinctly horizontal. This is an indication that the coal measures will probably be found at a reasonable depth along the South-Eastern Railway to the westward. I beg to hand you herewith two specimens of the clay containing coal, one taken at 1,180ft. and the other at 1,182ft. I also enclose a specimen of clean coal taken to-day at 1,183ft. 6in. from the surface."

THE ROYAL METEOROLOGICAL SOCIETY.

The usual monthly meeting of this Society was held on Wednesday evening, the 19th inst., at the Institution of Civil Engineers. The first paper read was by the Hon. Ralph Abercromby, and entitled "Observations on the motion of dust, as illustrative of the circulation of the atmosphere, and of the development of certain cloud forms." The general conclusion was that, when the air is in more or less rapid motion from cyclone or other causes, small eddies of various kinds form themselves, and that they develop the different sorts of gusts, showers, squalls, and whirl-winds.

Then followed a paper on "Cloud Nomenclature," by Capt. D. Wilson-Barker. The author proposes a simple division of cloud forms under two heads—viz., Cumulus and Stratus—and recommends that a more elaborate and complete division should be made of these two types.

The last paper read was on "An Optical Feature of the Lightning Flash," by E. S. Bruce, M.A. It has been stated in the Report of the Thunderstorm Committee of the Royal Meteorological Society that there is not the slightest evidence in the photographs of lightning flashes of the angular zigzag or forked forms commonly seen in pictures. The author, however, believes that this is an optical reality, as the clouds on which the projection of the flash is cast are often of the cumulus type, which afford an angular surface.

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Letters to the Editor.

THE MANCHESTER SHIP CANAL.

To the Editor of "Industries."

Sir,—Although I look on with a friendly eye at the progress now being made with the Manchester Ship Canal, still my mind is disturbed with some feelings of doubt.

The report of the Consultative Committee is pleasing, but the question, to my mind, is whether it is correct. Concerning the railway deviations, for example, it would be interesting to know how much of this work is actually done, and, at the average rate of progress for the last twelve months, how many years they will take to complete? With regard to the stone pitching of the bank, considered at the rate for the last six months, is it possible to complete this in ten years from the present date? Further, now that the expected supply of stone has failed, where is the stone to come from? Some very positive statements are being passed round on these points, and the statements are rather different to those given by the above-named Committee. The actual figures would please many besides the writer, who is one of the thousands interested in the scheme.

Yours, &c.,
Inquirer.

Warrington, February 18th, 1890.

WILLIAM MURDOCH.

To the Editor of "Industries."

Sir,—In reply to Mr. Alex. Murdoch's letter in your issue of the 31st January, several items of interest referring to Mr. Murdoch are to be found in the recently published autobiography of Richard Tangye. Mr. Tangye says "that it was at Redruth where Mr. Murdoch invented gas lighting and astonished the miners by carrying a lantern supplied by coal gas from a bladder which he carried under his arm. It was also at Redruth where he constructed the first locomotive made in England."

In 1889 Mr. Tangye and his brother had a granite slab placed in the wall of Murdoch's house, having the following inscription: "William Murdoch lived in this house 1782-1798; made the first locomotive here, and tested it in 1784; invented gas lighting and used it in this house 1792."

Yours, &c.,
C. J. W.

Manchester, February 19th, 1890.

SILICON IN IRON AND STEEL.

To the Editor of "Industries."

Sir,—In looking over the recent valuable contributions of Mr. Turner and others on the alloys of silicon and iron, it has occurred to me that a few remarks based on some years' experience in iron founding and steel casting may not be out of place, and may possibly prove interesting to some of your readers. For some time the silicon alloys of iron containing also carbon, and which may be termed the triple alloys of silicon, iron, and carbon," have been the subject of careful study, and have afforded a mine of information, of which practical founders and ironworkers have not been slow to avail themselves.

A proportion of the data given, and conclusions derived therefrom, may be said to be merely historical, long familiar to experts and specialists, but not as a rule to the average body of ironworkers, who in consequence paid little attention to the previous work of some metallurgists—prominently Mr. Riley—showing the marked influence of silicon on the physical properties of both steel and iron when alloyed with silicon. It, however, goes without saying that as regards the general results of recent investigations on silicon cast iron alloys, there can be no question that the methods of mixture, which previously were merely empirical, have been placed on a sound scientific basis; the ironfounder can now work with confidence, in accordance with specified reactions, and much that was before obscure, or even unexplained, has been rendered clear.

Briefly, silicon now ranks with carbon as a necessary constituent of both crude iron and steel, not as before, "according to generally received opinion," as an element to be avoided, but, on the contrary, to be used in accordance with certain known requirements and under well-understood conditions. It has been shown that silicon expels carbon from iron, thus rendering the metal grey or graphitic—or, in other words, carbon is less soluble in iron than silicon. The former is precipitated, and remains simply intermixed with iron. The graphitic carbon may be mechanically separated, as proved by Mr. Snelus.

It must not, however, be forgotten that temperature plays an important part in determining the greyness, or technically the No., of cast iron. A graphitic iron may be produced with a comparatively low percentage of silicon by slow cooling. Thus, a very grey pig iron may be produced from the same materials, and without altering the furnace burthen, which, if quickly cooled, would be little better than common grey forged pig iron. So marked are the results of cooling, that even in the same pig bed several varieties of grey iron may be obtained, and to obtain a good graphitic pig slow uniform cooling must be practised and quenching with water avoided. The initial temperature of casting and subsequent cooling are factors which should be considered, but which recent investigators appear to have rather ignored, very possibly deeming that the new method, based on the relative solubility of silicon and carbon in iron, stood on its own merits, regarding the older well-known methods of slow cooling, &c., as being outside the limit of their investigations.

It is, however, submitted that the initial temperature of casting and the subsequent rate of cooling must of necessity play a part in the final results, whatever may be the percentage of silicon. It may therefore be premature to say that a sufficient percentage of silicon only suffices for the formation of graphitic iron, and that the rate of cooling, &c., is unimportant. Molten metal slowly cooled—or, in other words, solidified—rejects, like water when frozen, foreign substances previously held in solution. A relative rejection, corresponding to the rate of cooling and the relative solubility of the various elements presumably held in solution in the fluid state, may occur. Graphite may be mechanically separated from iron, and it is certainly curious that the mere presence of a body simply intermixed with iron should modify its physical properties, as it undoubtedly does.

Dr. Percy states that the simple intermixture of a foreign body with a metal may not always influence its malleability, and states that the malleability of an ingot of copper was not affected although it contained 22 per cent. of tungsten, the whole of which, he was certain, was present in a state of mechanical suspension. It is difficult to understand how the presence of such a large quantity of merely intermixed tungsten did not affect the malleability of the ingot; sensible particles of copper must thus have been kept apart from each other, and in consequence malleability or coherence of the pure metal deteriorated.

We, however, know that suitable bodies may be mechanically intermixed, which when afterwards subjected to heat or pressure, or even left to themselves, adhere closely together. Instances are so numerous and simple that quotation is scarcely needed. These may, however, be roughly divided into two groups—viz., (1) those in which a body of high fusion point is mixed with another fusing at a lower temperature: the mere application of a heat roughly corresponding to the latter must, it is evident, bind both together, forming on cooling a solid coherent mass of some strength, and which whilst hot might even be malleable; (2) intermixed bodies in which under proper conditions *quasi* chemical combination takes place.

May we assume that in degree the same reasoning may be applicable to iron? It is known that certain elements, when present in iron, modify its properties; can we go further and regard crude iron—(1) as an intimate mixture of two or more bodies, or (2) bodies in *quasi* chemical combination, which, under certain conditions, may be suitable for a given purpose, but which, under others, may not. Something may be gained by regarding iron as a mechanical mixture of one or more bodies? It does not, however, follow that recognised chemical combinations with iron do not play a part; these should not be ignored, but regarded as affording additional aid in explaining certain phenomena of everyday occurrence in the iron manufacture, and which certainly have not as yet been satisfactorily explained.

In rolling wrought iron bars a better weld is obtained when the mass or pile is well intermixed with a fluid cinder or slag. This has been explained as being due to the protection of the iron from superficial oxidation by the slag. Thus clean surfaces of iron are brought in contact, and therefore perfectly welded together.

But the theory does not always account for the behaviour of certain qualities of iron under similar conditions; for instance (even with considerable care and with the aid of slag), steel and wrought iron cannot well be welded together, but the interposition of a moderately thin plate of a softer or intermediate quality of steel greatly facilitates the welding together of the total mass. Here we have an instance of an intermediate body assisting the union of iron of dissimilar chemical composition, one containing little or no carbon, the other a steel containing as much as half per cent. carbon, and even sometimes more, and of different fusion point. Further, we may have any number of thin plates, or even particles of varying composition, symmetrically arranged forming, on being heated and rolled, a coherent mass of metal.

According to Professor Akerman, mechanical work, and especially hardening in the usual manner, causes a more intimate union between carbon and iron, which union may be relaxed in a greater or less degree by reheating and subsequently slowly cooling. Professor Akerman also deems it probable that carbon is present in iron in three forms—viz., first, as carbon in combination; second, graphite; and lastly, in the intermediate condition, changing from combined carbon to graphite, or *vice versa*; thus furnishing a key to the changes which iron may undergo under varied conditions of heating, cooling, and mechanical work. Granting this, have we not here a clear instance of either a mechanical mixture of iron and carbon or what may be termed *quasi* chemical combination, and it seems probable that this intermediate or cement condition of carbon determines the adhesive power of the unit molecular mass, and therefore its physical properties, ductility, tensile strength, &c., in accordance with variations in heating, cooling, and mechanical work.

It is not, however, certain that this intermediate condition of carbon is always present in iron; indeed it has been asserted that carbon cannot be said to exist in this form at all. On the whole it is probable that the above suggestions are of little use except as affording material for further investigation and discussion.

Mr. R. Hadfield, going a step further, has endeavoured to form alloys of iron and silicon only, rightly assuming that the physical properties imparted to iron by silicon alone were masked in the presence of a sensible quantity of carbon. He does not appear to have succeeded in producing a pure alloy of iron and silicon, but by using a pig iron high in silicon and correspondingly low in carbon—"ferro-silicon"—he has, however, succeeded in producing what, "in contradistinction to a carbon," may be termed a silicon steel. This alloy is not, in his opinion, equal to ordinary carbon steel. Silicon cannot take the place of carbon; the latter has always the advantage of being more easily applied and of producing a material more suited to the requirements of the steel worker. It is proved that silicon, unlike carbon, does not confer on iron the properties of becoming hardened when water-quenched. The writer, however, does not consider that Mr. Hadfield has, "strictly speaking," produced a pure silicon steel.

According to the analyses given, the samples contain carbon from ·25 per cent. down to ·01, the latter containing 7·23 silicon. Such percentages of carbon as ·14 per cent. or ·18 per cent., with respectively ·24 and ·79 per cent. silicon, are quantities of carbon quite likely to modify the properties of silicon steel; quantities of carbon equal to $\frac{1}{10}$ or even less modify the quality of steel, and steel containing ·14 per cent. carbon is materially softer than an ·18 per cent. carbon steel of ordinary make with traces of silicon.

The non-hardening of silicon steel by water-quenching can hardly be termed a disadvantage; for certain purposes it is evident that a material not susceptible to changes would undoubtedly be useful. It is suggested that we have yet to learn what would be the properties of silicon steel with carbon reduced to the level of a technical impurity such as sulphur or phosphorus—*e.g.*, a silicon steel with, say, not more than ·05 carbon, preferably less, and about a quarter per cent. silicon—or a metal in which practically silicon altogether replaces carbon. Steel manufacturers are quite cognisant of the fact that ordinary rail steel, or even the softer varieties, containing a notable proportion of silicon, can be easily rolled or otherwise manipulated. The writer can quote many instances in which a steel containing ·25 per cent. and even more of silicon worked even better than the ordinary metal, but, as a rule, yielding a brittle hard steel. Rails, however, containing silicon have been approved; further, rails with 1-10th per cent. silicon, even up to 2-10ths, have been demanded as being superior to ordinary rail steel. It may indeed be said, it is probable, that good steel is never quite free from silicon, and some metallurgists assert that no steel can be said to be absolutely free from this element.

In some localities, however, the presence of any appreciable quantity of silicon seems inadmissible, the chemical composition as regards carbon, &c., corresponding to that of other makers and differing only as regards silicon. No reason can be assigned for the discrepancy; yet in the writer's experience this has repeatedly occurred; it may, however, be due to unnoticed modifications in casting, heating, and rolling. On the whole, it seems to have been fairly well established that good rail steels always contain at least distinct traces of silicon, and that up to a certain limit of silicon, not as yet strictly defined or known, improved results are obtained.

As an instance of how long-standing ideas may be modified, or even altogether discarded, we may take the positive assertion that the silicon in ordinary spiegeleisen should not exceed 1 per cent., and that spiegel containing more could not be used without deteriorating the quality of the steel. Now, the writer, many years ago, under pressure of circumstances, and much against his will, was compelled to use spiegel containing, to him, the fatal quantity of 3 per cent. silicon. The resultant steel worked well and bore the usual tests; analysis gave the usual amount of silicon—viz., from ·02 to ·04 per cent. It was, however, noted that on pouring the silicious spiegel into the blown metal the white flame shooting out from the converter—due to the reaction of carbon on the dissolved oxygen (or, query oxide of iron) in the blown metal—was very feeble; the metal also did not boil to the same extent. At the time it was inferred that silicon was *preferentially* oxidised, thus saving carbon, and henceforth a moderate quantity of silicon in spiegel was not objected to. On another occasion only about half the usual quantity of spiegel could be obtained for the cast, and the weight was made up by adding No. 1 grey hematite pig iron. The steel worked as usual, and was considered even better than some casts of steel made the same day in the ordinary manner. I need not say all these reactions have since been worked out, and therefore need no further comment here.

Yours, &c.,
Metallurgist.

South Wales, 19th February, 1890.

THE INSTITUTION OF CIVIL ENGINEERS.

At the twelfth ordinary meeting of the Session, on Tuesday, the 18th inst., the President, Sir John Coode, K.C.M.G., being in the chair, three papers were read on Water Works in China and Japan.

I. The Shanghai Water Works, by Mr. J. W. Hart, M.Inst.C.E.

The Shanghai Water Works were the first water works constructed either in China or in Japan. The city of Shanghai, the chief commercial centre of North China, consisted of foreign settlements and a native city, the population of the former, English, American, and French, being 170,000 in 1885, and of the latter, by estimation, from 100,000 to 150,000. It was situated on the west side of the River Hwang-Poo; the country was flat and of alluvial formation. The necessity for an efficient water service had been recognised for twenty years previous to 1880, when the author was invited to investigate the question again, and to prepare plans and estimates, which were accepted; and a concession was granted by the municipality to construct the works. To secure a constant supply of water the author constructed, in a central position, within the English settlement, a water tower, to contain a reserve of 150,000 gallons at an elevation of 103½ft. above the main. To obtain a foundation on the unstable water-logged soil, the author discarded the use of piles, and, after trial experiments, particulars of which were given, adopted a concrete foundation 5ft. thick, and founded upon 2½ft. of rough rubble, the area being 68½ft. by 65ft., and the total weight to be supported 3,725 tons, or 1,847lb. per square foot, being only a little more than 51·25 per cent. of the load applied in testing the ground. When the work was completed, it was found that the steady, accumulative weight of materials used (2,735 tons) had caused an even settlement of 2½in. The superstructure for supporting the tank was exclusively of iron, octagonal in form, 52½ft. in diameter. The tank was 50ft. in diameter by 12¼ft. deep, and contained 670 tons of water. The roof, covered with corrugated galvanised iron, closely resembled the construction of an umbrella when open. The centre tube was 6ft. in diameter and 82½ft. long. One 20in. pumping main had been laid between the water tower and the pumping-station 3 miles lower down the river, and provision had been made for a duplicate main. The mains were connected with the tower by a breeches-pipe communicating with the centre tube. The arrangements for the admission and egress of the water by valves were described. The water left the tower through meters, and was registered every day at noon, and the quantity compared with that

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delivered from the pumping station. In front of the water tower, a 20in. by-pass main connected the inlet and outlet branches of the pumping and service mains, so that the water could be delivered direct through the settlements. When the tank had been filled with water the total subsidence of the foundation was found to be 2½in. The total cost of the water-tower, exclusive of land, was £11,849. The Yang-Tsze-Poo works and pumping station were on the banks of the river Hwang-Poo, below the shipping and harbour limits, but within the area of the Anglo-American settlements. The site had the advantage of being down the river, below the native city, foreign settlements, and shipping, and at the intake-well the risk of contamination of the water from these sources and from the creeks was avoided. The sewage from the settlements and native city, and the impurities from the shipping and from the creeks, were carried into the upper reaches of the river by the flood-tide. The valves of the intake-well were so placed that when opened they could not admit water until one hour after the flood-tide had set in; therefore the water entered the settling-reservoirs nearly at the top of flood-tide, when it was in its purest state; but the river was always in a turbid condition. There were two settling-reservoirs, with an exposed water surface of 75,000 square feet, collectively; each reservoir was 250ft. by 150ft. by 13½ft. deep, with a total capacity of 6,130,312 gallons. The walls were constructed of concrete on the foreshore of the river, in one continuous slab for the entire circumference. The intake-well was a cast iron cylinder 6ft. in diameter, and was placed in the river 25ft. beyond low-water mark. The inlet valves were bolted inside the cylinder, and had strainers outside; they were 2ft. above low-water mark. The total cost of the settling-reservoirs (exclusive of the cost of land) was £11,058, being £1,804 per million gallons capacity. The service-tank for feeding the filter-beds was 220ft. by 92ft. by 8½ft. deep, and contained 996,000 gallons of water. The walls were of brick; the floor was of concrete 12in. thick, laid on 12in. of rough rubble. The tank was divided into three compartments, communicating by equalising-valves, so that the sediment could be flushed out of any one compartment while the others were in use. There were four filter-beds at present, having a total surface of 4,266·5 square yards, and each bed was designed to filter 30,000 gallons of water per hour. They were all 120ft. by 80ft. by 9½ft. with 5½ft. of filtering materials. The floors were of concrete 12in. thick, laid on 12in. of rubble. The only particular in which the construction of the beds differed from the ordinary plan was the application of a special supply valve for feeding the filters with water, so as to ensure a uniform head, which might be varied at pleasure. The average rate of percolation had been 540 gallons of water per square yard per twenty-fours hour, and the average duty of each filter 9,000,000 gallons before it required cleaning. The clear-water covered service-reservoir had a capacity of 840,000 gallons. It was 120ft. by 80ft. by 14ft. deep. Provision was made for diverting the water from the filter to the main pumping well direct, and for shutting off the reservoir should it become necessary to do so. The main building was 180ft. long, 61ft. wide, and 20ft. high; it contained the engine-house, valve- and gauge-room, and an office. Under the same roof were the boiler-house, stores, and workshop. In consequence of the faulty character of the ground, the chimney for the main boilers, which was 103ft. high, was built on a foundation block of concrete 20ft. by 50ft. by 4ft. thick. The total weight on the foundation was 571 tons, equal to 3,201·5lb. per square foot. There were two sets of horizontal compound pumping engines, each designed to deliver into the water tower 75,000 gallons per hour; and two sets of duplicate centrifugal pumping engines raised the water from the settling-reservoirs to the high-level service tank. There was also, within a few feet of the settling-reservoirs, another independent engine and boiler-house for a second set of centrifugal pumping engines. Here there was a deposit well and steam engine for facilitating the clearing of the settling-reservoirs of sediment. The cost of the Yang-Tsze-Poo pumping station, inclusive of culverts, by-passes, and valve wells, but exclusive of the cost of land, had been: Service tank, £1,913, or £192 1s. 6d. per 1,000 gallons capacity; filter-beds, £6,056, or £1 8s. 5d. per square yard of area; service reservoir, £2,938, or £349 15s. per 1,000 gallons capacity; main building, £2,567; and chimney for boilers, £798. Sluice valves were placed on the pumping main between the Yang-Tsze-Poo Works and the water tower, at an average distance of 500 yards apart. The mains extended to all the roads and streets in the settlements and suburbs: their size varied from 18in. in diameter, on leaving the town, to 5in. in the public roads and streets; in passages, courtyards, and alleys, the largest size was 3in. in diameter, and the smallest 1½in.; aqueduct mains were 20½in. in diameter. Four hundred and fifty hydrant posts were placed in the roads and streets, and there were numerous private fire-valves. All house fittings were supplied and laid by the company. Tin-lined lead service piping for domestic supply, was the only class used. None but screw-down draw-traps were allowed, and every service pipe was provided with a stop-valve immediately inside the building it supplied, while another was placed in the street, at the boundary of the consumer's property, and was under the control of the waterworks company only. Duplicate 12in. meters recorded all the water passing into the French settlement. The water supplied to the American settlement was registered by a set of 8in. duplicate meters; and there was a similar set at the boundary of the English settlement, where the main crossed the Defence Creek for supplying the suburbs. All the main pipes, service pipes, and sluice valves were coated with Dr. A. Smith's preservative solution, applied at a temperature of 600° Fahr. The cost of laying the pumping and the distributing mains, inclusive of all charges, per pipe of 12ft., varied from 19s. for a main 20in. in diameter to 7s. for a pipe of 5in. diameter. The total length of mains and service pipes was nearly 39 miles, and their weight 5,460 tons. One advantage of the water works was the great reduction in fire insurance premiums, the direct aggregate annual saving to merchants and property owners being not less than £90,000 to £100,000. Formerly a limited supply of filtered water was delivered in carts to the houses of customers by a small local company, at rates varying from 6s. 6d. to 13s. per 1,000 gallons; whereas, from the date of starting to December, 1887, the company's receipts for 2,447 million gallons of water, delivered to the community on the constant service system, were at an average rate of 5·7d. per 1,000 gallons. The Shanghai Water Works Company was registered with a capital of £100,000, subsequently increased to £120,000, and a further augmentation to £145,000 would be necessary. This expenditure would amount to 17s. per head, exclusive of the native city and of the population afloat. The works were commenced in August, 1881, and were inaugurated for public service in July, 1883.

II.—The Tytam Water Works, Hong-Kong, by Mr. Jas. Orange, Assoc.M.Inst.C.E.

The works described in this paper were originally projected in 1873 by Mr. J. M. Price, the Surveyor-General of the Colony, but actual operations were not commenced until the beginning of 1883. The works were divided under four headings, namely, the formation of a storage reservoir at Tytam, by the construction of a concrete dam, together with by-wash, &c.; the boring and completing a conduit tunnel through the Tytam range of hills; the construction of a masonry conduit; and the construction of filter-beds and a service-reservoir. The storage reservoir was situated in the Tytam valley, five miles from the city of Victoria; the height of the surface of the water above the sea was about 500ft., the drainage area was about 700 acres, and the area of the reservoir 27 acres, which latter contained about 310 million gallons. The dam was constructed of Portland cement concrete, of different proportions. There was an inner and an outer facing of granite, and the mass of the dam had granite stones embedded in the concrete, the water-tightness of the work depending upon the thin skin of rich cement concrete next to the inner face. A valve well, with five inlets into the reservoir, was constructed, and was divided into wet and dry compartments by a cast iron midfeather, so that the valves, &c., were easily examined. A scour pipe was fixed at the bottom of the dam communicating with the reservoir. The dam was 120ft. high, and contained about 66,000 cubic yards of materials. The by-wash was built away from the dam, and led to a separate valley; it had 100ft. clear waterway, over which a road bridge was built. The greatest observed depth of water over the by-wash had been 4ft. The total cost of the reservoir works was about £99,000. The water was conveyed to the tunnel inlet by cast iron pipes. The tunnel was 2,428 yards long, and about 7ft. 6in. square. Almost the entire length was through very close and hard granite. The boring was effected by 3in. machine drills, actuated by compressed air; the explosive principally used being dynamite. The work, after a preliminary training by European miners, was carried out entirely by Chinese labour, and occupied four years. A description was given of the method of alignment, which proved successful, the two headings meeting to ⅛ of an inch, while the difference of level was 0·08ft. Inlets and outlets were built at the respective ends of the tunnel, and were in finely worked granite with a considerable amount of details in the mouldings, &c. The cost of boring the tunnel was £48,269, equal to £19 17s. 7d. per lineal yard. The outside works raised the total cost to £53,950. About 62,000lb. of dynamite, 16,000 coils of fuse, and 5,400 tons of coal were used. From the tunnel outlet the water passed to the conduit, which wound, for a distance of over three miles along the mountain sides, to the site of the service-reservoir above the town of Victoria. The conduit was 3ft. wide and 2ft. 6in. high, and was built with a concrete bottom, brick sides, and granite cover stones, the sides and bottom being rendered with cement. Owing to the numerous ravines and gullies, there were about 100 bridges and culverts. The principal works were aqueducts of twenty-one spans of 20ft. arches, and double or 36ft. spans; there was also one heavy cutting through a hill spur 95ft. in depth. A small service-reservoir, containing about a million and a half gallons, was constructed midway of the conduit length. The principal quantities of work were about 30,000 cubic yards of excavation, 15,000 cubic yards of masonry and walling, and 1,200 cubic yards of concrete, the total cost being £34,700. The conduit delivered the water to the filter-beds and service-reservoir. The site for these latter works was extremely irregular. The filter-beds were constructed half in cutting and half by wall and bank, the cutting being 60ft. deep, and the wall up to 24ft. in height. There were six beds, each bed averaging 541 square yards. The filtering material was gravel and sea-sand washed. The service-reservoir, which contained about six million gallons of water, was constructed across a ravine, three sides being in cutting, and one side a wall and bank 62ft. in height; the depth of the reservoir was 30ft. The stream was taken under the reservoir in a culvert 16ft. wide. All the walls were made of local lime concrete, a facing of stone being used for the sides of the walls exposed. The principal quantities of this work were about 96,000 cubic yards of excavation, 11,000 cubic yards of walling and stonework, and 16,000 cubic yards of concrete; the cost was £22,761. The total cost of the works described was £209,579, taking an assumed value of the Mexican dollar of 3s. 4d. All local payments were in dollars. The consulting engineer for the reservoir and tunnel works was Sir Robert Rawlinson, K.C.B., Vice-President Inst.C.E.; the engineer-in-chief was the Surveyor-General of the Colony, Mr. John Macneil Price; and the author was resident engineer, and prepared the designs for the conduit, filter-beds, and service-reservoir, and all the working drawings.

III.—The Construction of the Yokohama Water Works, by Mr. J. H. T. Turner, B.Sc., Assoc.M.Inst.C.E.

The works for the water supply of Yokohama were completed in October, 1887. This was the first undertaking of the kind in Japan. Its inception was largely due to the recognition by the Japanese Government of the close relation subsisting between the use of polluted water and the development of choleraic epidemics at Yokohama. The principal original features of the works were that they were constructed in a country subject to earthquakes, and to meet the peculiar requirements of a Japanese population. The source of supply was the River Sagami, which was tapped at a point about 28 miles distant from Yokohama. The water was raised from the river by steam-pumps, and was delivered into a depositing tank built on the mountain side. It passed from this tank through a gauge-plate into the aqueduct, and flowed by gravitation to the town. The upper portion of the aqueduct was composed of alternate lengths of 18in. cast iron main pipe and masonry conduit, constructed along the precipitous rock wall of the Sagami cañon. The hydraulic gradient of the first 18 miles of the aqueduct was 6ft. per mile, and of the last 9 miles, 14ft. per mile, the diameter of the main-pipe being reduced to 15½in. Lead joints were employed everywhere except at the river crossings, where flange joints were adopted. The main-pipe delivered the water to the filter-beds and service-reservoir, which were situated at Yokohama, about one mile from the centre of the town. The filter-beds were three in number, two being ordinarily in use together; they were built of concrete. The filtering material consisted, essentially of a depth of 2ft. 6in. of sharp sand, supported in the usual way upon gravel, and underlaid by brick drains. The service-reservoir was a concrete structure, the walls being faced with brickwork. The depth of water was 18ft. Both the reservoir and the filter-beds, and all wells and tanks, were built upon, and entirely surrounded by, good puddle up to the water-line—a feature of construction to which the water-tightness of all these structures was doubtless largely due, and which might be regarded as almost essential in earthquake countries. A system of by-passes permitted of the water being delivered direct to the town, without passing through either the reservoir or the filter-beds, if it was necessary to do so at any time. The distribution in the town was effected by a ramification of 4in. and 8in. pipes branching off an 18in. main pipe from the service-reservoir. The service was constant. Stand-pipes were largely used for the supply of the native portion of the town, and lead service pipes were introduced into the houses of the foreign settlement. Fire hydrants were provided in large numbers throughout the town. The entire town was placed under the control of the waste-water meter system for preventing waste of water. Water was sold by measure to manufactories and shipping, the town being rated for all domestic supply.

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BRICK PRESSING MACHINE.

Mr. William Johnson, Castleton Foundry, Armley Road, Leeds, has lately brought out a special machine for pressing sand-faced bricks. After the bricks have been formed in any ordinary way they are rolled in sand and placed in the special machine referred to and illustrated herewith. Five moulds are fitted on a table, which is given an intermittent revolving motion by means of a pawl and ratchet disc. The sides of the moulds are hinged at the bottom, and they are caused to swing round these hinges by runners and inclined planes. In this way the moulds are opened for the reception of the brick and closed to grip it for pressing. The moulds are open when the table is stationary, and during this time the bricks are placed within them. The table then moves on, and brings one of the moulds and its bricks into position under a vertical presser which is worked by steam power. After this operation the mould passes on, and is opened again to allow the brick to be taken out. The result is that the sand is pressed evenly all over the surface of the brick.

BOULT'S "TRICORD" LIGHT ADJUSTER.

The accompanying illustrations—Figs. 1 and 2—show an ingenious arrangement for adjusting a light, which has been designed by Mr. W. S. Boult, Assoc.M.Inst.C.E., of Liverpool, and which can be used with advantage for many purposes, for the light can be tilted to any position, and still be self-supporting. A small brass boss, with three radial arms, is screwed on to an ordinary lamp-

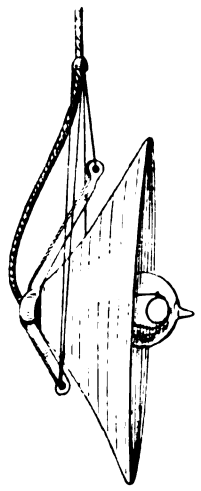


Fig. 1.

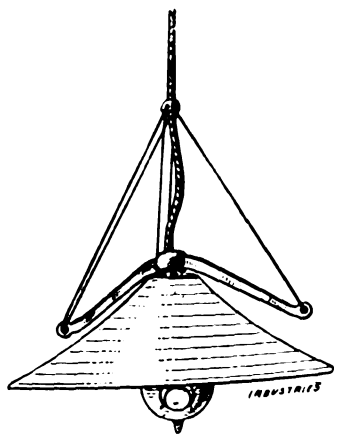


Fig. 2.

holder, and takes the place of the usual cord-grip; a little brass basin-shaped block is supported in a convenient position on the hanging conducting wires by an internal india-rubber washer, the block and radiating arms being connected by an endless silk cord. The cords and arms adjust themselves to the different positions accurately, and the whole arrangement is very neat and effective.

THE PHYSICS OF ELECTRIC LAMPS.

On Friday evening last Dr. J. A. Fleming gave a lecture at the Royal Institution on "The Physics of Electric Lamps," of which we give a short summary as follows:—

In an incandescent lamp the carbon filament, which is enclosed in a very perfect vacuum, will only stand a certain amount of current being passed through it, the limiting current being represented by the expenditure of 360 foot-pounds per second per square inch of cross section, or by a temperature in the filament equal to the melting point of platinum. After this current and temperature have been exceeded, the filament disintegrates, and carbon molecules are gradually dislodged and become deposited on the sides of the surrounding glass globe. The theory is that these carbon molecules are shot off in straight lines, and carry with them a negative electrostatic charge whose potential is equal to that of the negative electrode of the filament.

The reason for supposing that the particles are shot off in straight lines is two-fold. In the first place it has been noticed that when one particular point of the loop of the carbon filament has had too high a resistance, owing to faulty construction, the resulting spray of carbon molecules has been projected all over the interior of the glass globe, with the exception of one narrow space. This space has been found to be, as it were, the shadow on the globe of the perfect limb of the filament, with respect to the faulty point of high resistance in the other limb. It would thus appear that the perfect limb stood in the way of a spray of molecules which moved in straight lines.

Another reason for supposing that the molecules are projected in straight lines may be deduced from the phenomenon known as the "Edison effect." This phenomenon is obtained by interposing a metal plate or other conductor between the two limbs of the filament, and not in connection with either, and by raising the strength of current to the limit mentioned above. It will then be found, by testing with a galvanometer, that the potential of the metal plate is equal to that of the negative electrode. This effect is explained by supposing that the carbon molecules leaving the filament are charged with negative electricity, and, striking against the metal plate, raise it to a potential equal to that of the negative electrode. If a non-conducting shield is interposed between the negative loop of the filament and the metal plate, no such effect is observed, nor is there any such effect if the metal plate is arranged in such a way that the path between the filament and the plate is not a straight line. Therefore it is probable that the carbon molecules are projected in straight lines from the negative loop, and are charged with negative electricity.

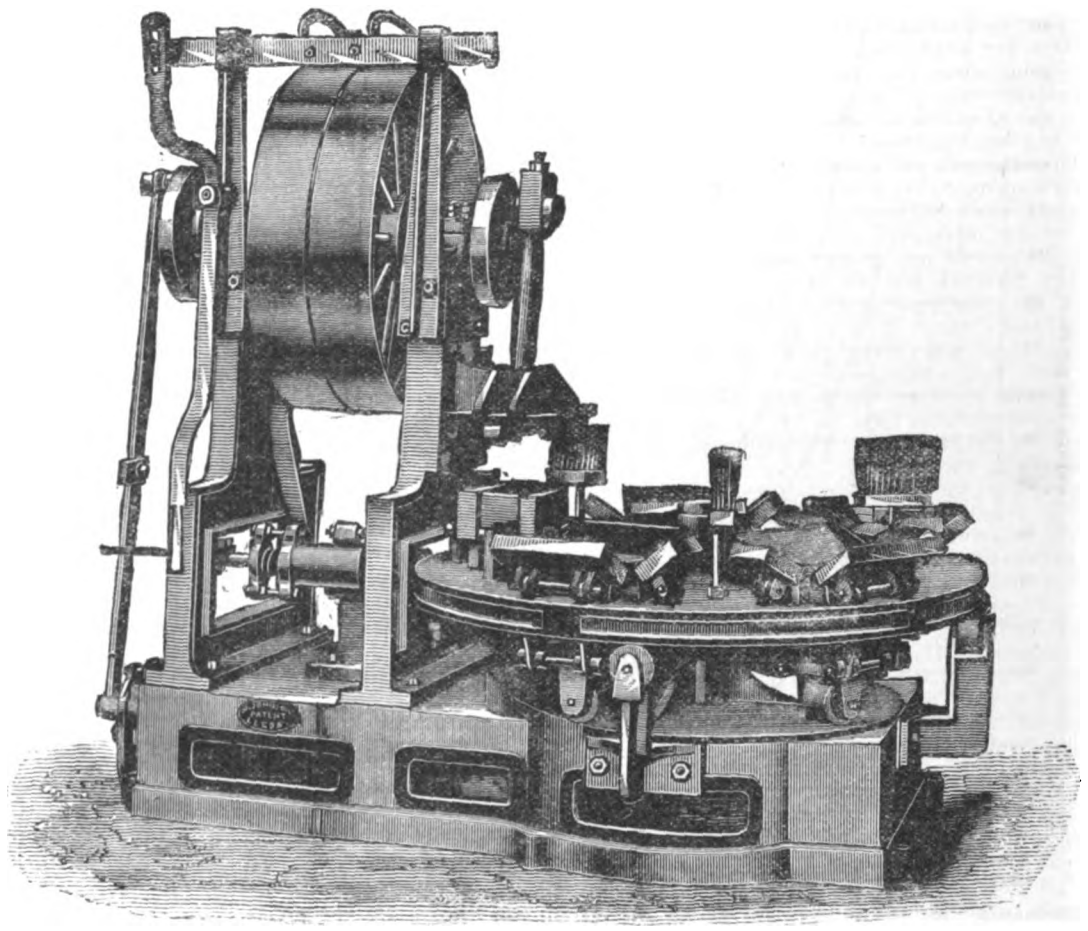
Then comes the consideration as to how the molecules obtain their negative charge. When the molecules are dislodged they become inductively charged by the electrostatic field, and their positive electricity becomes discharged at once by the red hot carbon, according to Guthrie's well-known principle. It also follows from these experiments that the potential in the greater part of the filament is equal to that of the negative electrode.

Dr. Fleming then proceeded to discuss the similar phenomena in an arc lamp. By feeling about with a thin pointed conductor through the space between the two carbon poles, it has been discovered that the potential of the arc is for the greater part of its length equal to that of the negative carbon, and that the rise of potential is very sudden at a point extremely close to the positive carbon. It is also known that carbon molecules are projected from the negative limb, and it is supposed that the spray thus formed, acting in a similar manner to that of a sand blast, produces the hollow crater in the positive carbon. The temperature of the arc is greatest just in the hollow crater of the positive carbon, and this may be due to the bombardment of the projected carbon molecules.

Dr. Fleming also mentioned that his assistant, Mr. Bate, had discovered that the "Edison effect" could be obtained in the ordinary atmosphere as well as in a vacuum, although in that case the effect was only instantaneous owing to the carbon filament being so soon destroyed.

BRICK PRESSING MACHINE.

Constructed by Mr. William Johnson, Castleton Foundry, near Leeds.



THE HEATING OF CONDUCTORS BY ELECTRIC CURRENTS.

By Alex. P. Trotter.

The sizes of cables used for electric lighting are usually governed by the necessity for maintaining a uniform difference of potential between the mains and the lamps. Under some circumstances, generally when the distance between the mains and the lamps is very short, the required fall of pressure cannot be obtained without the use of correspondingly small conductors, and therefore a high density of current.

The Board of Trade has abandoned the rule which limited the density for currents up to 10 amperes to 2,000 amperes per square inch, and 1,000 amperes per square inch for heavier currents, and by the regulations recently published have prescribed a temperature limit.

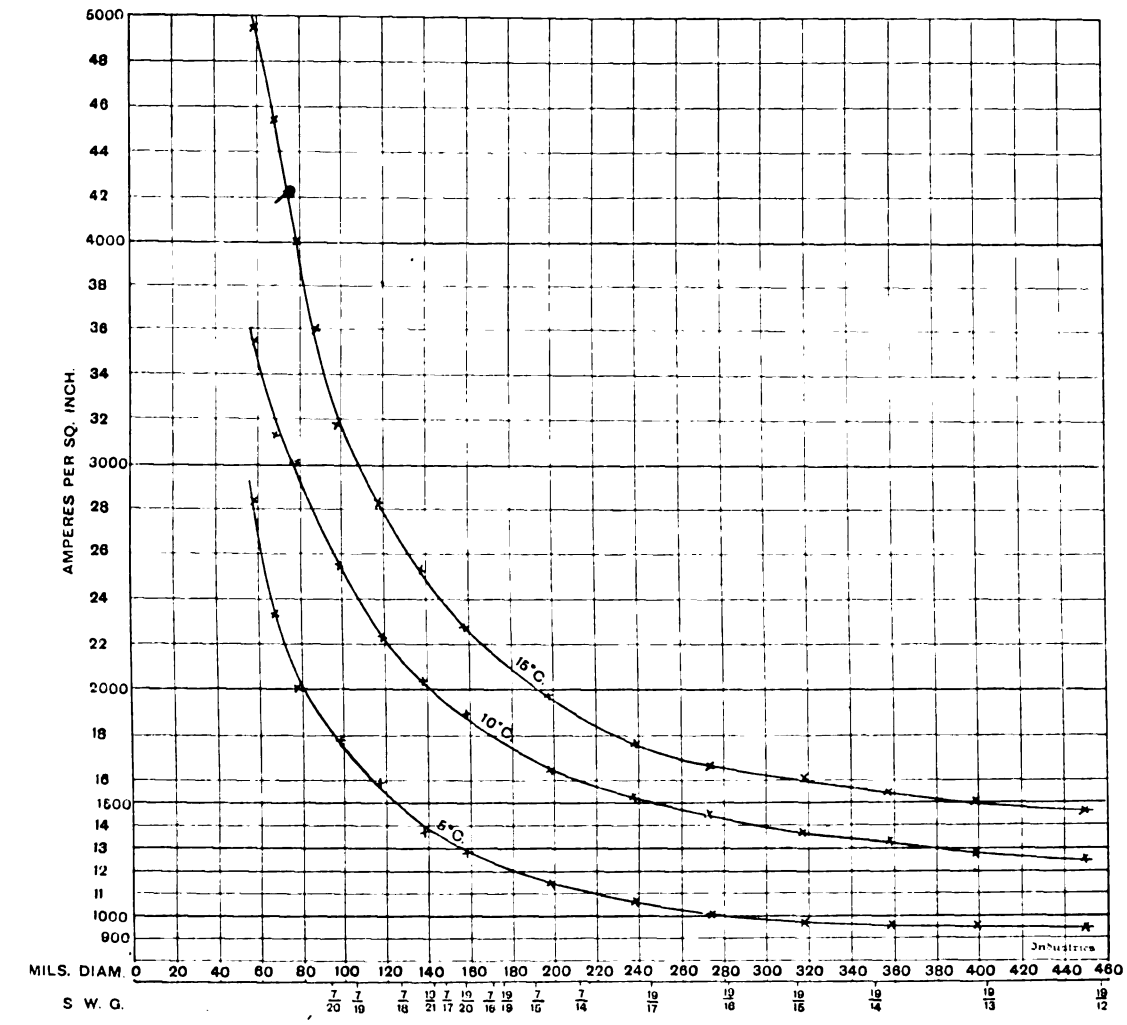
"The maximum working current in any conductor . . . . shall not be sufficient . . . . in any case to raise the temperature to a greater extent than 30° of Fahrenheit's thermometer." It becomes therefore important to know what size of cable may in practice be used to carry a given current, when for any reason the Board of Trade regulation has to be observed, instead of the resistance of the conductor.

The paper contributed to the Society of Telegraph Engineers and Electricians in March, 1884, by Professor G. Forbes, treated the subject of heating of conductors, from a mathematical point of view, in a most exhaustive manner, and his results have recently been confirmed experimentally by Mr. A. E. Kennelly in a report read before the Edison Convention in America. The most useful portion of Mr. Kennelly's tests relates to wires covered with wooden casing under the ordinary conditions of house lighting. The wires are said to have had "the usual thickness of insulating covering." The results are given, partly as tables, and partly as curves. These may be compared with the curves contributed by the present writer to the discussion on Professor Forbes paper.

One of Mr. Kennelly's curves gives the currents which

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HEATING OF ELECTRIC CONDUCTORS.



will raise wires of different diameters 15° C. This is near enough to the Board of Trade limit, and gives more than one degree margin. The author states that it is difficult to find any simple algebraic law, but suggests $560\ d^{\frac{3}{2}}$ where d is the diameter in inches, as a formula for the "current whose double raised the temperature 40° C."

Professor Forbes showed that with a simple suspended wire the heating is inversely as the sectional area, that is, the diameter squared, and the cooling is as the surface, that is, as the diameter; the temperature, therefore, is as the diameter $^{\frac{3}{2}}$, or $\sqrt[3]{\text{diameter}^2}$. But Mr. Kennelly admits that the conditions of an insulated wire in a wooden casing are of a very complex nature, and it is not surprising that the suggested formula does not fit the curve at all well. Since a wire of 0·1in. diameter is heated 15° C. by a current of 25 amperes, we may draw curves of $d^{1\cdot3} \times 25$, $d^{1\cdot4} \times 25$, $d^{1\cdot5} \times 25$, and plot the 15° C. curve among them, and it will be found that none of them fit the observed curve, which evidently is not of a power function of the diameter. Up to 0·34in. diameter the empirical formula $1000\frac{\pi}{4}d^2 + 156\ d$ fits the curve very closely.

Assuming that the solid wires, which appear to have been used, behave like the stranded cables which are used in practice, we may take from Mr. Kennelly's curve the following table, giving the sizes as stranded cables instead of the diameters of solid wires:—

S.W.G.	Amperes.	Amperes per sq. in.	B.W.G.	Amperes.
7/22	18	4,090	7/22	18
7/21	21	3,720	7/21	20
7/20	24	3,900	7/20	22
7/19	27	3,050	7/19	28
7/18	34	2,700	7/18	35
19/21	38	2,500	19/21	38
7/17	41	2,420	16/20	42
19/20	45	2,300	7/17	44
7/16	50	2,200	7/16	50
19/19	52	2,140	19/19	55
7/15	58	2,010	7/15	58
19/18	66	1,890	19/18	67
7/14	67	1,900	7/14	70
7/13	82	1,760	7/13	85
19/17	83	1,750	19/18	87
19/16	103	1,650	19/16	105
19/15	126	1,600	19/15	124
19/14	150	1,550	19/14	158
19/13	190	1,500	19/13	200

The striking feature of this table is the high density which is permissible under the new regulations; indeed, for a No. 18 wire a current of 11 amperes, at a density of 5,850 amperes per square inch, may, according to Mr. Kennelly, be used without raising the temperature more than 15° C. if covered with insulation and a wood casing.

The above curves show the relation between the density and the diameter of conductors in casing, for use of 5° C., 10° C., and 15° C. above the surrounding air. The readings for small wires appear to be somewhat irregular, but any small variation in the original curves, from which these were calculated, would appear very much exaggerated.

THE SOCIETY OF CHEMICAL INDUSTRY.

LIVERPOOL SECTION.

At the meeting held on the 15th ult. Mr. Douglas Herman exhibited and described a tower condenser made entirely of glass. The principle adopted is to divide the vertical height of the tower into sections of two or three feet, so arranged that each section shall carry the entire weight of packing material contained within it without pressing on the portion of the tower below it. A dangerous pressure in the lower parts of the tower is thus avoided, and the tower may be built to any height that is considered desirable. The sections consist of glass pipes with an upper external and a lower internal flange; the upper flange, resting on suitable supports, carries the whole weight of the pipe and its contents. The pipes taper slightly so that they can be fitted one into the other, the joint being made good by means of a suitable cement. A grid, consisting of pieces of slightly curved glass, $\frac{3}{4}$in. thick and $1\frac{1}{2}$in. deep, resting on the lower internal flange, carries the packing material, these grids being placed at right angles to one another in the successive pipes, so that the centre of distribution of the liquid is changed as it passes from one pipe to the next. The packing material may consist of glass of a twisted irregular form, and will weigh, with the supporting grid, about 1 cwt. per pipe; coke can also be used. Individual pipes, if damaged, can be removed and another substituted without interfering with the rest of the tower. The pipes are made about $\frac{3}{4}$in. thick, and in point of price will compare favourably with earthenware pipes doing the same amount of work. Mr. Herman pointed out that his tower satisfied one of the conditions insisted on by Dr. Hurter in his paper on the "Condensation of Hydrochloric Acid"—viz., that of providing ample cooling surface in that part of the apparatus in which the gas comes in contact with the condensing liquid. The pipes shown had a capacity of about three cubic feet and a surface area of over nine cubic feet. In this respect they appeared superior to earthenware.

At a later meeting held on the 5th inst. a paper was read by Dr. G. Schack Sommer, on "Home-grown Sugar for Great Britain and Ireland." The author pointed out that the popular impression had hitherto been that the climate of Great Britain and Ireland was too cold and too damp for the successful cultivation of beet, but he had no hesitation in saying that practical experience had proved the entire fallacy of this idea. In support of this statement, evidence given before a Select Committee of the House of Commons, by Mr. James Duncan and by Dr. Martineau, was quoted. Dr. Schack Sommer's experiments on the growth of beet had been made on farms at Wavertree (near Liverpool), and at Ballymitty, County Wexford, Ireland. Four kinds of seeds obtained from Dr. Scheibler, of Berlin, were used. As to the soil and manure required, wet and swampy ground was unsuitable; a loose clay with a well-drained bottom was what was wanted. A good artificial manure was one containing one part of nitrogen to two parts of phosphoric acid as superphosphate. In Germany as much as £6 per acre was spent for manuring. Stable manure was very efficient, but ought not to be used on the land within nine months of planting the beetroot seed. Lime was often of great advantage to the soil, but an addition of potassium salts had not proved remunerative. The proportion wanted was from 200lb. to 300lb. nitrate and from 400lb. to 600lb. superphosphate, or 400lb. to 500lb. Peru guano and 200lb. to 300lb. superphosphate per acre. The soil had to be ploughed up deeply—to a depth of 12in. to 15in. The percentage of sugar found varied from 14·2 per cent. to 18·2 per cent., a result comparing most favourably even with the beet grown in Germany, where an artificial method of cultivation had been in vogue for some time past. A small proportion of invert sugar was also found in the juice from the roots, due probably to the comparative poorness of the soil in which the beet was grown. At the Wavertree farm 42 tons 19 cwt. of beet were obtained per statute acre. Evidence was quoted by Dr. Schack Sommer to the effect that beet is by no means an exhausting crop; on the contrary, if planted with a due regard to rotation, it is not only a paying crop in itself, but it increases the fertility of the ground for wheat and other cereals. It is not possible to plant beet profitably oftener than once every fourth year. As regards the financial aspect of the question, the profit to the farmer, per acre, was set down at £5 15s. 6d. as a minimum—due allowance being made for the value of the beetroot pulp as a food for cattle, for which it is well adapted. Provided, then, that the necessary means were at hand for the manufacture of the sugar from the beet in this country, there was no doubt that the industry would prove commercially successful. At the same time the reader of the paper referred to the disadvantage under which this country suffered in respect to the home production of sugar, owing to the bounty system prevalent on the Continent. An interesting discussion followed, to which Dr. Schack Sommer replied.

A paper was also read, by Dr. S. G. Rawson, on a "New Form of Sprengel Pump, and on Apparatus connected therewith." The author described two new forms of pumps which he had constructed. One of these was a much simplified form of the ordinary apparatus, but equally efficient; the other more complex, but possessing several important advantages.

GLASGOW AND SCOTTISH SECTION.

On the 4th inst. Dr. J. B. Readman read the first part of a contribution on the "Manufacture of Phosphorus," and Mr. G. H. Gemmell a paper on "Moisture in Pulp."

Dr. Readman gave the results of his experiments under the heads of "Preparation of Phosphoric Acid," "The Concentration of the Acid," "Phosphorus Retorts and Furnaces," "Distillation," "Condensation, Refining, and Packing." His process differed much from that described in the text-books, which led to several of the members saying that they did not think that many of the statements made in these text-books were founded on facts. He afterwards gave the results of analysis, showing the small amount of phosphorus in boxes of ordinary matches of various makes, the quantity in all the matches in each box varying from half a grain to $2\frac{1}{2}$ grains.

Mr. Gemmell, in his paper, pointed out that straw or

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wood pulp, as imported from Germany and Norway, contained a high percentage of water, varying from 40 per cent. to 50 per cent., but that the price of the material was based upon the amount of air-dried substance present. In the paper trade some pulp manufacturers sold their material on the basis that it contained 12 per cent. of moisture when air-dry, but paper makers did not generally allow more than 9 per cent. He had made a few experiments with a view of ascertaining what amount of moisture should be allowed, and the result of these was that 10 per cent. was about the mark. It was of interest to know this, for disputes often arose between buyer and seller over this question.

THE FUTURE SUPPLY OF INDIA-RUBBER.

Recent political proceedings in Brazil have brought into prominence the subject of our india-rubber imports, on which depends the success of one of our important industries. A failure in the supply of Pará rubber, whether caused by recklessly dealing with laws of exportation or natural laws in the forest, would fall heavily on many of our public and private interests. Hence it will be of interest to refer to what our authorities have been doing by way of providing against any such contingency. Considering that india-rubber comes next after sugar and coffee on the list of Brazilian exports, it appears strange that till recently so little attention was given to the way in which the substance was collected. The work was left to ignorant natives, and they destroyed millions of trees either by cutting them down or by their injudicious system of tapping. Latterly, however, the province of Amazonas has passed laws to regulate the season for tapping the trees, and has awarded premiums to encourage the planting of new forests.

Some twenty years ago the importance of the question of the future supply of rubber was recognised by our Government, and Mr. James Collins, of Edinburgh, was instructed by the India Office to draw up a report concerning the rubber trees of America, and to ascertain whether they could be grown in India. The results of his investigations were published in 1872. In 1875 Mr. Robert Cross, of Liverpool, in concert with Mr. C. R. Markham, of Assam, went to Panama to collect seeds and cuttings of the Central American rubber tree (Castilloa). He was also sent by the India Office in the following year to Pará to collect information about the Pará (Hevea) and Ceara (Manihot) trees, which produce the best rubber. The descriptions given in his official report show that he met with formidable difficulties in the course of his undertakings, but he succeeded in his main object. The seeds and cuttings which he obtained were duly sown and planted at Kew, and in due time dispersed over various botanical gardens in India and the Colonies. As trees, they are now flourishing at Madras, Calcutta, and Zanzibar, also in Burmah and Ceylon. The great superiority of the Pará rubber (Hevea) over all other kinds has ensured for it the most attention, but, notably in Assam and Northern India, its cultivation has been very much of a failure, though not equally so in Burmah and Ceylon. It requires an equable moist climate without extremes of temperature. The Castilloa tree was reported a few years ago to be doing well in Burliar and other places in Southern India. Some attempts have been made to grow the West African tree (Landolphia) in India. It is a hardy shrub, but takes up a good deal of room, and the quality of its products leads to some doubt whether it would pay for cultivation. From the botanical point of view we append a short list of plants producing india-rubber.

Nat. Order.	Genus.	Species.	Locality.
Euphorbiaceæ	Hevea	H. Braziliensis	Pará
	Manihot	M. Glaziovii	Ceara
Artocarpaceæ	Castilloa	C. Elastica	Central America, West Indies
	Ficus	F. Elastica	Assam, Rangoon, Java
Apocynaceæ	Hancornia	H. Speciosa	Pernambuco
	Urceola	U. Elastica	Borneo
	Vahea	V. Gummifera	Madagascar
	Landolphia	Various	West Africa, Mozambique

The above trees are to be met with in a broad zone parallel to the equator, where there is an isotherm of 70° F. Rubber is found as a milky fluid in the laticiferous vessels in the middle layer of the bark. It is coagulated by one of various methods, which include smoking over a wood fire, as in Brazil, or adding alum or a dilute acid, or by pouring the milky substance into hot water. The milk is very rarely met with in England, but we recently examined a good sample from Pará, and the proportion of rubber found in it—namely, 32 per cent.—was found to agree closely with earlier analyses by Adriani and Faraday. Before bottling the milk it is necessary to add some ammonia to prevent spontaneous coagulation. The most substance comes from the lower limbs of the Pará tree, which grows to great dimensions, and may be tapped at ten years' growth, but does not for twenty years reach its maturity.

From trees as they grow in untended nature, we may turn to some of the results that have been obtained from those that have been acclimatised. A report in 1881, from Dr. King, of the Calcutta Botanical Gardens, stated that the Ceara tree was the only one that promised good results, while the Pará and the Madagascar had utterly failed. This experience has been confirmed by Sir John Kirk, Consul at Zanzibar, who, in one of his official reports in 1882, said that the Ceara (Manihot) plants grew very well even in the worst soil, that they needed no attention, and that they commenced to yield rubber in five years, though not in a way to be remunerative. Nevertheless, the attempt to acclimatise American plants in Africa is an interesting one, and we cannot help wishing it an improved success, as manufacturers would be glad to receive clean rubber from Africa in place of the dirty resinous product of the Landolphias so generally imported into this country. In October, 1882, Dr. Trimen, of the Ceylon Botanical Gardens at Peradenya, sent to Kew a sample of the Central American rubber (Castilloa) produced from a cutting sent from Kew in 1876. This was examined by an expert, and reported to be of good quality, only deficient in tensile strength, owing perhaps to the immaturity of the tree from which it was taken. Colonial rubber is often being received at Kew, and submitted for examination, showing that this branch of economic botany is far from being neglected. Of Pará rubber from a Kew cutting, grown at Mergui, the first sample was received last season at Kew, and through the courtesy of Mr. Morris, the subdirector, we got a piece for examination. As in the above case, it was found wanting in tensile strength, and fell short of the best qualities of ordinary smoked Pará. The question is, whether the excess of its viscous over its fibrous constituents will be corrected in future tappings. It is not only in acclimatising foreign trees in India that work has been done, but, acting on Mr. Collins' report, the India Office have caused denuded districts to be replanted with the indigenous "Ficus elastica." Already in 1870 there was a plantation of these trees at Chardnar, in the district of Darrang, which covered a space of eighty square miles. This particular area has since been annually increased, and there has been planting in other districts besides. We may feel assured that the wanton destruction of rubber trees has practically ceased, and that the importance of securing an adequate supply of rubber for our future needs is fully recognised.

The financial side of the question can hardly be discussed till more reliable data have come to hand, but they are hardly likely to prove that undertakings in forestry bring any immediate or very early return. Dr. Trimen, for his part, feels confident that produce from Ceara trees will furnish an important item of revenue to Ceylon. It must be added that, in view of the competition in the case, other interested parties are not so sanguine of commercial success as he is.

THE LEAD IN THE WATER SUPPLY OF THE NORTHERN TOWNS.

The numerous cases of lead poisoning which have recently been recorded in the West Riding of Yorkshire, and in others of the Northern towns supplied with moorland waters, have at last induced the Water Committee of the Sheffield Town Council to undertake a thorough investigation as to the action of these soft moorland waters on leaden service pipes and cisterns, with a view to remedying this evil. At Mirfield, during the last twelvemonths, the medical officer of health has reported upwards of forty cases of lead poisoning, and Dr. Herbert, of Whitby, in a recent paper communicated to the Yorkshire branch of the Society of Medical Officers of Health, pointed out that most if not all of the towns supplied with moorland waters had suffered to an alarming extent. When such important towns as Sheffield, Bradford, Huddersfield, Rochdale, Keighley, Darwen, and Pudsey are all more or less affected by this evil, it appears to be a subject of such vital importance to the community, that we are surprised that the town councils have not combined together with the object of solving the difficulty. It seems somewhat unfair that Sheffield should alone undertake the investigation, and that the other towns should then reap the benefit of its labours. A combination of the whole of the infected district would naturally be able to engage in experiments of a larger magnitude and employ the best advice at a less cost per town than would otherwise be possible. Mr. Allen, of Sheffield, who is the analyst to the borough and also to the West Riding, has for some time been engaged on this problem, and has pointed out that the acidity of the water appears to have an important influence in increasing its solvent action for lead. At Sheffield the acid water only acts on the pipes, and the same fact has been observed at Huddersfield and Bradford. Many chemists have also pointed out that when lead is alternately in contact with air and water it is rapidly attacked, and the water is then found to contain appreciable quantities of lead. This is no doubt due to the oxygen of the air, as when the lead is always in contact with water only, whether under pressure or not, there is scarcely any action on the metal. It has also been found that many waters containing an appreciable quantity of free carbonic acid act upon lead, and that when such water is boiled, so as to drive off this excess of carbonic acid, the water then no longer acts on lead. Muller has also shown that distilled water, quite free from carbonic acid, but containing dissolved oxygen, has no action on lead, but on exposure to the air it absorbs acid and begins to attack the metal. The presence of chlorides, nitrates, organic matter, and ammonia in water do not influence its behaviour towards lead; while waters containing lime compounds, or carbonate of soda, have a marked action on the metal, although apparently in this instance the compound of lead formed is not soluble in the water, but remains as a protecting crust on the interior of the pipe. Carnelley and Frew have similarly pointed out that the corrosion of lead pipes by water is increased by the presence of air, and that sand, calcium carbonate, old mortar, calcium silicate, and a mixture of sand and calcium carbonate have a great protective action. The marked influence of sand in protecting lead from corrosion was also pointed out in the report of Crookes, Odling, and Tidy, on the action of water on lead, made to the Water Committee of the Corporation of Huddersfield in 1886, and Carnelley and Frew attribute this action to the formation of calcium silicate, as this body, or old mortar, is found by them to be more effective than limestone and sand, either separate or mixed. The theory of the borough analyst at Huddersfield was that sulphuric acid in the water caused it to act upon the lead pipes. At Leeds, where also the water supply is drawn from the moors, there have been no cases of lead poisoning. Here, however, the water, after passing through a large reservoir, is sent through iron pipes to the Wentwood filter beds, where, it is stated, its susceptibility to absorb lead is removed, or, at any rate, considerably reduced. Dr. Sinclair White, the former Medical Officer of Health for Sheffield, agrees with Mr. Allen that the solvent action is due to the presence of a certain amount of free acid of organic origin in the water supply from the high level, while others contend it is due to the absence of silica in the water. It will be seen from the above *résumé* of the opinion of experts on this much debated question that there are still conflicting views on the cause, or causes, of lead pollution. It is, however, worthy of notice that in Germany cases of lead poisoning from the water supply of the large towns are almost unknown, and that this is attributed to the fact that they are all supplied with water on the continuous system, and, therefore, there is no chance of the pipes becoming filled with air, as in England, where the intermittent water supply is common. Prof. Bunté, some time ago, pointed out that, although this might be the true explanation, it must be borne in mind that most of the German towns derive their water supply from waters which contain an appreciable amount of solid residue, and are therefore possibly not comparable with the soft moorland waters of our Northern districts. Last year Professor Percy Frankland contributed to the *Journal of the Society of Chemical Industry* a valuable contribution to this discussion, and as a result of his investigation he concludes that the activity of water towards lead may, according to its composition, be either increased or diminished by increased pressure. In those waters which contained oxygen an increase of pressure diminishes the activity of the water, while with waters containing carbonic acid no material alteration in the lead-absorbing power is noticed. Professor Frankland also has shown that, by very slow filtration through extremely divided flint, a small proportion of silica is dissolved, and that the water after such filtration has less action on lead. This statement is true both in the case of distilled water and all other soft potable waters examined by him, so that there seems a strong ground for generally adopting this method of filtration. Another important fact which has been brought out by this investigation is the reduction of the activity of a soft water by the addition of small proportions of carbonate of soda, which lends support to the acid theory of Mr. Allen and others, as the treatment with carbonate of soda would neutralise the acid. Sodium silicate might also possibly be found a convenient remedial agent to employ, as, by its use, not only would the acid present in the waters be neutralised, but silica would be added, and it would thus have a two-fold

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retarding action. The Town Council of Sheffield were prepared some months ago to adopt the suggestion of Crookes, Odling, and Tidy that their water should be filtered through beds of limestone and sand, and were prepared to spend £100,000 on the experiment. Dr. Tidy attributed the action of limestone to the silica in it, but, as Mr. Allen has pointed out, it would be necessary to dissolve such an amount of limestone as would render the water intensely hard in order to get the half-grain of silica per gallon which Dr. Tidy has fixed as necessary to prevent the action on the lead pipes. The Sheffield Town Council have, however, still delayed action in the matter, and at their meeting last month appointed Professor Dewar and their consulting engineer, Mr. Hawksley, to assist their water engineer, Mr. Eaton, in an inquiry on "the tendencies, causes, and remedies of the Redmires water to take up lead," and we shall read their decision with interest, especially if in their report they are able to state that they have exhaustively examined into the merits and demerits of the various proposals which we have seen exist for the solution of this interesting problem. Possibly the problem may be solved in some such simple way as that adopted with success at Bradford, where they have mixed the soft acid water with their hard water supply, which has thus produced a water which is not only neutral, but has not yet caused any symptoms of lead poisoning.

Notes.

WOODEN VILLAS FOR SOUTH AMERICA.

A CARGO of villas has recentiy been despatched from Gothenburg, in Sweden, to Buenos Ayres. They were manufactured at the famous Ligna Works, and filled fifty railway waggons. This building of portable houses is becoming quite an important industry, both in Sweden and Norway. The villas are handsome, useful, and very cheap, and they have already found buyers in a number of different countries.

THE SAFETY OF THE ELECTRIC LIGHT.

THE *North American Review* having published articles from Edison and Westinghouse, who may be regarded as somewhat biassed authorities, now gives a paper by Sir William Thomson, who may be said to step in as a sort of impartial umpire. He says that with proper precautions the electric light is safe. Major Flood Page also writes a long letter to the *Times* in the same strain. The scare about the danger of the electric light seems to be dying out now; and, on the whole, it may have done some good, though it was carried a great deal too far. Reasonable care is wanted; and our Board of Trade and insurance rules ought to prevent any more bad work.

THE SKILLED LABOUR MARKET.

DURING the past month the labour market has been in a very disturbed condition, and the number of new strikes recorded has reached a high figure. In November the total was 92; in December, 57; but during January the number rose to 85, some of them being of considerable importance and affecting a large number of workers. In the cotton trade there were 15 stoppages in this way; in the coal trade, 10; among dock and wharf labourers, 10; in the woollen trade, 8; in the linen trade, 4; in shipbuilding, 5; in engineering, 4; and in brass hollow ware and wire-drawing, 6, in which 6,000 to 7,000 workers were involved. The remainder were among miscellaneous trades, such as brickmakers, bacon-curers, locksmiths, &c. In spite of these elements of disturbance, however, the societies representing the chief skilled trades sending in monthly statements make reports of a highly satisfactory character. In almost every case an improvement is to be noted on the figures of the previous month. In the few instances where an increase in the number of unemployed is to be observed, the change is so slight that in the aggregate the total increase is but 93; while, on the other hand, the decrease of the number of members out of work is so marked that the total is 673, a net reduction on the month of 580. In all, 21 societies have reported. These have a total membership of 211,855, of which 3,044 are out of employment, as against 3,624 for the previous month, and 7,397 for the corresponding month of last year. The proportion per cent. is this month 1·44, while for the month before it was 1·75, in the corresponding month of ast year 3·1, and in the February of 1888 7·8. In the shipbuilding trade the percentage of unemployed has only n one previous year been less—that is, in 1882, although since then the number of men engaged in this industry has increased by at least 20 per cent. Not one in each hundred of the men in this trade is out of work at present, the correct proportion being about 9 per 1,000. Almost equally prosperous are all the branches of the engineering trade, which has not been so well employed since 1873. Despite the earliness of the season, the building trades are showing signs of improvement. In the steel, iron, and coal industries work is plentiful. The textile trades are moderately employed, but are stationary. The printing and book trades are also fairly busy. A general summary of the remarks made in the reports shows that 14 societies report their trades as "very good," three as "good," and four as "moderate."

EXHIBITION OF MINING AND METALLURGY.

IN our London letter some weeks ago, we mentioned briefly that a proposal was on foot to hold this year, in London, an Exhibition of Mining and Metallurgy. Matters have now progressed so far that particulars are available. It will be opened early in July at the Crystal Palace, and continue for three months; entries are to be made by the 15th of March at the offices, 18, Finch Lane, E.C. The list of persons connected with the enterprise contains the names of many prominent men connected with the mining and metallurgical industries, and we understand that the support promised from the Colonies and from abroad is considerable. The subjects embraced in the scope of the Exhibition include machinery in motion, mining plant of all kinds, the manufacture of iron, steel, zinc, copper, and alloys, the petroleum industry, salt mining, the nitrate and phosphate industries, electricity in its application to mining and metallurgy, and sundry minor sections. It is somewhat to be regretted that the site of the Exhibition is so far out of town, for the Crystal Palace is not the most convenient site for business men.

THE GLASGOW CHAMBER OF COMMERCE AND THE PROPOSED FORTH AND CLYDE CANAL.

IN a recent note we mentioned that the Government had declined to undertake any financial responsibility in connection with the proposed Forth and Clyde Canal, and we pointed out that at present the schemes must be discussed on their commercial merits. The Glasgow Chamber of Commerce has dealt with the matter in a very summary manner. In reply to a communication from the Edinburgh Chamber of Commerce respecting the proposed canal, and from the Belfast Chamber desiring to be informed of the views of the Chamber respecting it, after a discussion of the matter, it was unanimously agreed that the Glasgow Chamber could not support the memorial of the Edinburgh Chamber, believing that the proposed canal was unnecessary, and that, financially, it would not be successful. Before discussing this decision we will wait till further information is published about both of the proposed routes, but it must be evident that the decisions of the Government and of the Glasgow Chamber of Commerce reduce the probabilities of either of the schemes being carried out to a very considerable degree, and therefore make it absolutely necessary for their promoters to bring forward the strongest possible evidence in their support.

TELEGRAPHS IN CHINA.

THE progress of telegraphs in China during the past few years has been very great, and it shows that as soon as the Government of the country is satisfied that any Western art or science is required by the people, or at least can be introduced without causing any upturning of social or industrial arrangements, and, especially when it adds to the defence of the country, it sets about its introduction with great vigour. For thirty years the Chinese were aware of the advantages which foreigners derived from the employment of telegraphy, but they did not think that the conditions of the country required it, and it was not until 1877 that a start was made by the Great Northern Telegraph Company. The campaign of 1880 in Kuldja showed the necessity of a speedier means of transmitting news to the army, and the same thing was demonstrated in the troubles with France in Tonquin. Since these dates great extensions have taken place, and now we learn that the Chinese telegraph system adjoins that of the French in Tonquin and that of the Russians at Kiachta, and that in a few months the junction will be complete. While the military uses of the telegraph have always been kept prominently in view, it has also become of great importance for commercial and general purposes and all the latest important information is now sent from Europe to China, so that the telegraph is likely to be a very important factor in the awakening of China.

A FEDERATION OF COAL OWNERS.

A POWERFUL federation of coal owners has been arranged, which is intended to include all the coal districts in England except those of South Wales, and of Northumberland and Durham, where at present sliding scales exist for the regulation of wages. It is proposed to raise in connection with the federation a large fund in order to resist, in case of emergency, what the employers consider unfair demands on the part of the miners, either in regard to wages or the restriction of output. It is said that the feeling of the coal owners is strongly that the demand for an eight hours' day from bank to bank must be resisted to the utmost, not alone in the interests of the owners themselves. It would mean, as a rule, only six hours' actual work per day, and the coal owners contend that this would result in a reduction in the total output of the country of not less than thirty million tons per annum, and an increase of the price of coal to the consumer by something like 5s. per ton. If this be so, it is a very serious matter, and we trust that no hasty steps will be taken by either party, but that the questwill be fully considered in all its bearings.

TECHNICAL SCHOOL AT GARTSHERRIE.

THE Scotch Technical Education Act has now been in existence for more than two years, and up to the present time its effect has been null. Now, however, the Old Monkland School Board has obtained the necessary permission from all the authorities mentioned in the Act, and arrangements have been made for the erection of a new science and art school at Gartsherrie. It is intended chiefly for evening classes, for the benefit of those engaged in work during the day, although certain day classes will also be held. The work of the school as hitherto conducted in other buildings seems to be carried on strictly in accordance with the requirements of the Science and Art Department, and the new buildings are being arranged to suit these. They will include several class rooms, mechanical and architectural drawing rooms, a chemical and a mechanical laboratory, with the necessary smaller rooms for preparation and administration. The work done in the school has hitherto depended largely on the support of the employers of labour in the neighbourhood, and has been very successful. Whether that success will continue when it has become a formal piece of official administration is a point on which many have doubts. If Technical Education Acts only lead to the separation of the interest of the employers from the schools they will confer a very doubtful advantage.

BASIC STEEL IN 1889.

THE official statistics of the Thomas-Gilchrist steel industry have just been completed for the twelve months ending December 31st, 1889, and show that the total make of steel and ingot iron from phosphoric pig during this period amounts to 2,274,552 tons. This is an increase of 321,318 tons over 1888, and brings the total production of basic steel to the enormous amount of 10,845,000 tons. Last year's make by the basic process includes 1,764,639 tons of ingot iron, containing less than ·17 per cent. of carbon. The following table gives the statistics for the various steel producing countries during the year:—

	1889. Total Make.		1889. Ingot Iron.
1. England	493,919	...	348,828
2. Germany and Austria	1,481,642	...	1,185,323
3. France	222,393	...	159,271
4. Belgium and other countries	76,599	...	71,217
Totals	2,274,552		2,276,476

	1888. Total Make.		1888. Ingot Iron.
1. England	408,594	...	276,476
2. Germany and Austria	1,276,070	...	1,026,033
3. France	222,333	...	158,223
4. Belgium and other countries	46,237	...	32,300
Totals	1,953,234	...	1,493,032

From last year's total of 2,274,552 tons there was produced an amount of slag estimated at 700,000 tons, and containing about 36 per cent. of phosphate of lime. The greater portion of this slag has already been disposed of as a fertiliser and for cement making.

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Patent Record.

(Compiled from "The Illustrated Official Journal (Patents).")

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

3rd February, 1890.

1785. Hannaford, C. E. ..... Weighing machine.
1797. McGregor, W. ..... Roofs.
1803. Appert, L. ..... Apparatus for moulding glass. (29th August, 1889.)
1806. Conley & Lancaster ... Apparatus for making steel.
1814. Preston, Marshall, & Cotton ..... Lathes.
1817. Jobson, A. ..... Boiler furnaces.
1820. Gurney, H. ..... Kiln for burning bricks.
1821. Phillips & Lewis ..... Application of copper to ships, &c.
1824. Messenger, T. ..... Ratchet gear.
1827. Barnes, S. K. ..... Furnace flues.

4th February, 1890.

1837. McGovern, B. ..... Waggon wheels.
1840. Vanorman, O. ..... Car axles. (31st August, 1889.)
1846. Clegg, Clegg, & Townend ..... Looms.
1847. Meredith, O. ..... Tubes for steam boilers.
1856. Wilkinson, R. T. ..... Railway rails.
1858. Arnold & Arnold ..... Boilers.
1862. Scott & Davis ..... Machines for covering wire.
1863. Wilson, J. ..... Wire rope machine.
1864. Booth, J. ..... Machines for pile fabrics.
1870. Reinecker, J. E. ..... Steam hammers.
1871. Fleshman, B. F. ..... Combined running gear and steering apparatus.
1875. Lightfoot, T. B. ..... Refrigerating machinery (*Linde*).
1877. Riedler, A. ..... Compressing air.
1882. Stubley, C. H. ..... Sifting apparatus.
1888. Totten, R. C. ..... Castings.
1890. Maxon, Coleman, & Boyer ..... Drive chains.
1892. Wheeler, N. ..... Sewing machines.
1893. Berrenberg, A. ..... Air pumps.
1901. Brown, I. ..... Permanent way.
1904. Cole & Waller ..... Steam engines.

5th February, 1890.

1907. Bingham, G. C. ..... Machine tool for making milling cutters.
1911. Marks, G. C. ..... Tubular shafting (*Ogilvy*).
1916. Lindsay & Lindsay ..... Looms.
1919. Ellison, J. B. ..... Apparatus for gassing yarn.
1921. Gibbs, C. ..... Condensing steam in brewing coppers.
1927. Pope & Pope ..... Self-acting feed for materials, grain, or minerals.
1932. Hood, G. C. ..... Lowering and detaching boats.
1937. Kirk, J. H. ..... Looms.
1942. Rodewald, F. A. ..... Boats' tillers.
1943. Abel, C. D. ..... Oil engines (*Gas Motoren Fabrik Deutz*).
1948. Deacon & Driffield ... Apparatus for separating liquids from solids.
1955. Ross, J. ..... Breechloading small arms.
1958. Robinson, M. H. ..... Steam valves.

6th February, 1890.

1961. Batchelor, J. G. H. ..... Boiler tubes.
1968. Booth & Beaumont ..... Machinery for condensing fibres.
1970. Sellars, G. ..... Pressure filters.
1973. Gäbel, R. ..... Cutting tool for lathes, &c.
1976. Steel, A. ..... Lubricators.
1991. Lamb, H. ..... Thrust blocks for propeller shafts.
1997. Price, Sen., & Valentine Machinery for cleaning flues.
2001. Statham, F. T. ..... Root cutting machines.
2003. Jensen, P. ..... Machines for forming articles from wood pulp (*Christensen*).
2004. Jensen, P. ..... Pit saws (*Blom*).
2006. Taylor, F. ..... Ploughs (*Taylor*).

7th February, 1890.

2010. Bacon, W. R. ..... Wire stitching machines.
2014. Sayer, W. ..... Air propellers.
2021. Dearden & Dearden ... Machinery for sawing stone.
2024. Curtis, J. ..... Looms (*Stancliffe*).
2038. Steele, T. ..... Railway couplings.
2040. Dick & Jones ..... Metal plates, tubes, or bodies adapted to facilitate the absorption and transmission of heat or cold.
2041. Rütgers, G. ..... Attaching rails to sleepers.
2043. Stevenson & Little ..... Drying machines.
2044. Kohn, O. ..... Rotary engines.
2045. Newton, A. V. ..... Firearms (*Nobel*).
2050. Haddan, H. J. ..... Rotary engines (*Dow*).
2053. Stephens & Stephens ... Machinery for drilling rock.
2055. Mills, B. J. B. ..... Apparatus for heating liquid and gaseous bodies (*Scigle-Goujon*).

8th February, 1890.

2062. Dyer, S. ..... Spinning frames.
2063. Holecek, A. ..... Water-tube boilers.
2064. Davies, C. A. ..... Boilers for manufacture of paper-pulp (*Kellner*).
2066. Schofield, Haslam, & Hargreaves ..... Looms.
2069. Muter, D. D. (on behalf of The Carlton Press, Ld.) ..... Printing machine.
2070. Sahlström & Hill ..... Furnaces for burning liquid fuel.
2072. Hardaker, W. ..... Jacquard machines.
2081. Dracup, C. H. ..... Jacquard mechanism for looms.
2085. Hay, A. ..... Fireproof doors.
2086. Hearth, Hearth, & Willis ..... Circular knitting machines.
2088. Hearth, Hearth, & Willis ..... Straight bar knitting frames.
2089. Thompson, W. P. ..... Tanks for storing petroleum (*Vaillant*).
2093. Stevenson, A. ..... Sieving machines.
2094. Haddan, R. ..... Air pump (*Desir*).
2096. Reid, Fisher, & Parkinson ..... Jacquard machines.
2105. Nobes & Jackson ..... Signalling on railways.
2106. Neher & Frey ..... Magazine gun. (24th July, 1889.)
2109. Wade & Cherry ..... Motor pump.

ELECTRICITY.

3rd February, 1890.

1784. Garrett, T. A. ..... Production of ozone by electricity.

4th February, 1890.

1867. McMullen, J. A. ..... Electrical conduits.
1878. Williams, J. B. ..... Insulating compounds.
1897. Farrig, E. ..... Electrical insulating composition.

5th February, 1890.

1939. Bougault, M. H. L. ..... Electric temperature alarm.

6th February, 1890.

1987. Wohle, S. ..... Electro-plating metals with aluminium.

7th February, 1890.

2056. Lebenberg, S. ..... Telephone receivers.

8th February, 1890.

2080. Chamberlain, J. C. ..... Storage batteries. (10th July, 1889.)
2091. Thompson, W. P. ..... Secondary batteries (*Gibson Electric Company of Europe*).
2108. Whitmore & Akester ... Switches for controlling electromotors.

CHEMISTRY.

3rd February, 1890.

1794. Pfeiffer, C. ..... Extraction of gold and silver.
1808. Imray, O. ..... Colouring matter (*Society of Chemical Industry in Basle*).
1811. Holliday, R. ..... Colouring matters.
1812. Holliday, R. ..... Dyeing wool.
1813. Holliday, R. ..... Dyeing textile fibres.
1816. Ewens, G. W. ..... Purifying sewage, &c.
1828. Willcox, B. ..... Colouring matters (*Farbenfabriken vormals Friedrich Bayer & Co.*).

4th February, 1890.

1842. Mayer & Lorrain ..... Recovery of float gold.
1848. Davis, A. R. ..... Distillation of ammonia liquors.
1874. Imray, J. ..... Colouring matters (*La Societe Anonyme des Matières Colorantes et produits Chimiques de St. Denis & Chapuis*).

5th February, 1890.

1913. Thompson, W. P. ..... Utilisation of scrap tin (*Carez*).
1914. Spence & Spence ..... Alum.
1946. Wright, J. ..... Purifying water.
1951. Maxim, H. S. ..... Explosives.

6th February, 1890.

1962. Bang, A. ..... Yellow dyestuffs (*Dahl & Co.*).
1964. Kibble, W. O. ..... Sulphuretted hydrogen.
2002. Shenton, G. ..... Aluminium (*Berg*).

7th February, 1890.

2057. Campion, A. J. ..... Smelting tin ores.

MISCELLANEOUS.

4th February, 1890.

1900. Drexler & Drexler ... Roof coverings.

5th February, 1890.

1933. Hood, G. C. ..... Scattering oil to calm the sea.
1934. Fifield, C. ..... Paving and building stone.
1947. Wilson, G. ..... Fire escape.

7th February, 1890.

2048. Rubin, E. ..... Bullets.

8th February, 1890.

2076. Horton, A. ..... Instrument for indicating vertical positions in ships.
2077. Barlow, E. S. ..... Water and gas pipes.
2107. Casebrook & Perry ..... Fire escapes.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form, of such opposition.

Year 1888.

17565. Rietsche & Kaiser.

1889.

9. Holloway.
1984. Hearsey.
2093. Julius Fredrick Moore Pollock & George Henry Collins.
2956. Fitch.
3192. Morton.
3213. Ayrton & Perry.
3526. Salamon.
3753. Row.
4112. Owens.
4432. Ingle.
4561. Thompson (*Delatour*).
4645. Parr (*Haake*).
4670. Sturgess, Brown, Brown, & Brown.
4847. Williams.
4914. Bland (*Parcy*).
4990. McGregor.
5090. Shaw & Christiansen.
5225. Dormer.
5288. Manoschek & Manoschek.
5341. Gabet.
5428. Eckardt.
5500. Watson.
5569. Hartley.
5615. Timmis.
5629. Hoyle & Hoyle.
5644. Shouler.
5662. Barlow.
5678. Wood & Hoyle.
5699. Wich.
5703. Kirkman.
5724. Auchinachie.
5727. Leigh (*Mayer*).
5755. Halpin & Timmis.
5779. Kynaston & Sutherland.
5789. Davies & Tourtel.
5807. Arnold.
5846. Watkinson & Dodd.
5852. Hack & Plaistowe.
5862. Deards.
5891. Fagan & Moorhouse.
5909. Bryan.
5920. Raymond.
5962. Del' Guerra.
5992. Rhodes.
6020. Hardingham (*Halsey*).
6021. Shepard.
6040. Crompton & Horrocks.
6058. Weston.
6131. Fox & Blass.
6257. McAinsh.
6411. Hille.
6910. Naumann.
7138. Fitch (*Drummond*).
7506. Timmis.
8462. Cave.
8683. Lake (*Goldsmith & Wright*).
10286. Rogers & Wharry.
11327. Dutto.
11588. Caufor & Hendricks.
13049. Turnpenney.
13221. Brown.
13368. Mock.
13718. Clark (*La Société en participation Bourbouze et Cie.*).
15745. Wilcox.
16809. Brittain.
17660. Keats.
17947. Olsen.
18018. Boult (*Rics & Henderson*).
18493. Lake (*Fiske*).
19641. Rorke.
19711. Biber, Matejka, & Bocek.
19944. Ranft.
20109. Boult (*Personne*).
20261. Stitzel, Weinedel, Reutlinger, Schwartz, Egelhoff, & Kreiger.
20371. Wellner.
20515. Steffen.
20629. Nicoll.
20758. Floyd.
20810. Willcox (*Koyl*).
20836. Stromeyer.
20874. Waterman.
20880. Dougherty.
20894. Stevenson.
20911. Woolf.
20931. Vos (*Weed*).
20956. Williams.
20966. Lake (*The Gould Rolling Machine Company*).
20973. Baker.
20978. Browning.
464. Howcroft.
2001. Lake (*Johnston*).
2116. Bradshaw.
2287. Strauss.
2633. Smallman.
2738. Enright.
2968. Pierce.
3197. Schwartz.
3520. Bonicard & Benoit.
3600. Hayes & Hayes.
3862. Harrington.
4191. Comings.
4504. Rose.
4594. Pridmore, Wakelin, & Johnson.
4701. Daw.
4783. Walker (*Isaacs*).
4853. Anderson.
4962. Allin.
5026. Rees.
5205. Doulton & Leech.
5277. Vogelgesang & Bonn
5298. Thorne.
5322. Murday.
5344. Greening.
5450. Mugford.
5543. Mosely.
5595. Roberts.
5619. Garside.
5637. Hamilton.
5651. Mackintire.
5664. Ninschke.
5684. Gradwell & Baker.
5701. White.
5707. Fleiss.
5725. Hiscocks.
5751. Case & Allcard.
5757. Heys (*Pinon & Guérin*).
5785. Johnson (*Heyden*).
5787. Rowland.
5795. Baker.
5809. King.
5851. Rowland.
5859. Sneath.
5864. Schurr.
5900. Pegg.
5916. Barr.
5955. Lancaster.
5974. Hawks (*Brady*).
6010. Mills (*The Wise Mining and Milling Company*).
6022. Hill.
6044. Foster & Foster.
6083. Mathieu & Morfaux.
6140. Green.
6311. Smith.
6600. Rees-Philipps.
7012. Lake (*Hollander & Vinken*).
7848. Howlin.
8596. Chapman.
9009. Boult (*Anderson*).
9671. Clay.
11228. Bowring & Newcomb.
11362. Houghton.
12289. Carter (*Rhodes*).
13118. Clark (*Babbitt*).
13224. Ringaud.
13670. Dudley.
14506. Barber.
15161. Swyer.
15601. Landolt.
16190. Grimshaw.
16994. Lilwall.
17826. Russell.
17962. Macintyre
18032. Love.
18487. Lake (*Fiske*).
19134. Randall.
19691. Freeworth.
19797. Clark (*Ladd*).
19900. Thompson (*Smead*).
20096. Verdam.
20232. Leigh (*De Laval*).
20269. Haddan (*Ewert & Mehling*).
20275. Overgaard.
20333. Lewinsohn.
20512. Clark (*Barclay*).
20614. Douglas & Donald.
20722. Fell (*The American Ammonia Manufacturing Company*).
20839. Mussen.
20875. Elliot.
20883. Spencer & Ralston.
20908. Mason, Warren, & Warren.
20936. Pinagel.
20962. Lake (*Thomson & Lemp*).
20971. Imray (*The Electric Exercising Machine Company*).
20986. Lake (*Cornell*).

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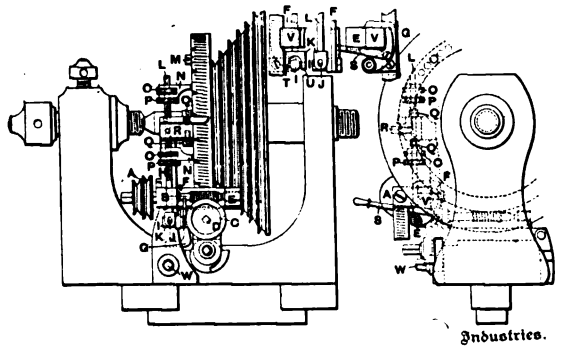
1890.

33. Pickhardt.
86. Hall.
143. Carette.
177. Johnson.
193. Tuer.
198. Eglin.
214. Canet.
238. Edwards.
257. Halladay.
266. Brock & Romero.
272. Haddan (*Williams*).
290. Pirnie.
296. Groth & Constantine.
302. Lake (*Alexander*).
307. Imray (*Martin*).
346. Bryden & Stansfield.
354. Olpherts.
364. Lake (*Ellebye*).
56. Robinson.
87. Hart.
172. Finley.
184. King, Stuart, & Christie.
206. Gronwald & Oehlmann.
246. Crowe.
258. Halladay.
276. Boult (*McArthur*).
285. Canet. (8th June, 1889.)
293. Lake (*Chase*).
297. Baltzley.
303. Lake (*Alexander*).
319. Grimshaw.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

Lathes.—*J. J. Holzapfel & G. W. Budd, London.*—A silent driving appliance and automatic stop are here described for use upon lathes and other machines. In the illustrations Fig. 1 gives a side elevation, and Fig. 2 an end elevation of a lathe head with the appliance attached. A large worm-wheel is fixed to the lathe mandril and geared to the tangent screw or worm D. The screw D has fixed to its shank the second worm-wheel C, in which gears the tangent screw B driven by the V pulleys A. The pulleys A are driven by a band from an overhead motion, and cause the mandril of the lathe to rotate slowly. For automatically stopping the revolution of the mandril a sliding rod L is constructed provided with adjustable stops N. A pin M in the worm-wheel on the mandril strikes the stops N in its revolution and causes the rod L to slide in its bearing and throw the screw B out of gear from the worm-wheel C. The action of the rod L in throwing the screw B out of gear is more clearly shown in Figs. 3, 4, and 5. The screw B is held down in gear with the worm-wheel C by a hook F pivoted upon the spindle I. On the spindle I rests the saddle-piece K, which is attached to the end of the rod L. When the rod L is depressed the part T presses on a pin in the

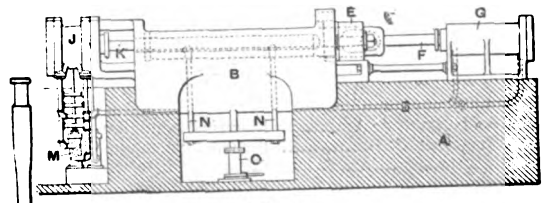


spindle I and causes the latter to rotate and move the hook F off the supporting frame of the screw B. The screw B thus rises from the action of a spring fixed beneath it, and the rotation of the mandril is stopped. If the rod L is raised by M coming into contact with the other stop, the spindle I is rotated by the part U of the saddle K as may be seen from the illustrations, and similar actions take place to those already described. The appliance is attached to the lathe head by a screw W, so that it can be easily and quickly removed. Claims: (1) The construction of an apparatus for giving a slow and regular movement to the spindle or mandril of a lathe arranged substantially as above described, so that the motion in either direction of the mandril's rotation can be arrested either automatically or by hand, independently of any movement that may be occurring in any other part of the lathe, and which apparatus is removable at will in manner above described; (2) the construction of an apparatus for giving a slow and regular movement to the spindle, mandril shaft, or screw of machines other than lathes arranged substantially as above described, so that the motion in either direction of the rotation of the spindle, mandril shaft, or screw can be arrested either automatically or by hand, and which apparatus is removable at will in manner above described.—No. 2136. February 6th, 1889. 8*d*.

Sand Blast Apparatus.—*J. E. Mathewson, Sheffield.*—The improvements described in this invention refer to recovery or separating of sand from the blasts of air in sand blast machinery after the sand has operated upon the work. The principle involved is the same as that described by the inventor in a previous patent, No. 2456, 1887, for removing the priming from steam. The steam in its course is given a whirling motion by passing through a helical passage, and the water is thrown off by centrifugal force. In the present case the sand-laden air is led to and through a helical passage, and receives a similar whirling motion, causing the sand to fly through perforations in the cylinder which surrounds the helical discharge aperture. A second cylinder surrounds the perforated one, and collects the thrown-off sand, which is in a dry state and ready to be used again. Claims: (1) Drawing or forcing air laden with solid particles through a helix into a slotted or perforated cylinder, whereby a whirling motion is communicated to the air, and the solid particles are discharged tangentially through the slots in the cylinder; (2) the means as herein described for separating or recovering sand and other solid particles from blasts or currents of air charged with such particles; (3) an apparatus for separating solid particles from currents of air, the combination with a helix and perforated cylinder of an outer concentric casing provided with radial baffle plates, and with or without exhauster or fan.—No. 4032. March 7th, 1889. 8*d*.

Bearing for Shafts and Crank Pins.—*S. Z. de Ferranti, London.*—The main object of the invention is to ensure the crank shaft of an engine resting equally in its bearings throughout the whole length. To effect this the bottom block of the bearing is curved on its underside to the form of part of a cylinder which has its longitudinal axis at right angles to the axis of the shaft and in the same horizontal plane. The curved underside of the block rests in a correspondingly curved seat formed for it on the upper side of a base plate. The base plate is flat on its under side and capable of swivelling in a horizontal plane. With a bearing such as described it will be seen that the bearing surface for the shaft may assume any position. To prevent the parts of the bearing heating, passages are formed in them for the circulation of water. The bearing block of a connecting rod is made to swivel in the same manner as that described. Ten claims are made for the block described and modifications.—No. 1902. February 2nd, 1889. 11*d*.

Manufacture of Railway Axles.—*H. Aiken, Homestead, Pennsylvania, U.S.A.*—This machine is designed to form the entire axle in one operation. The axle is formed from a blank piece of shaft, which is heated and placed between powerful dies closed by hydraulic pressure. The dies are of the shape of the finished axle, and are closed by wedge pieces worked by the hydraulic power. In the illustrations, Fig. 1 is an elevation of



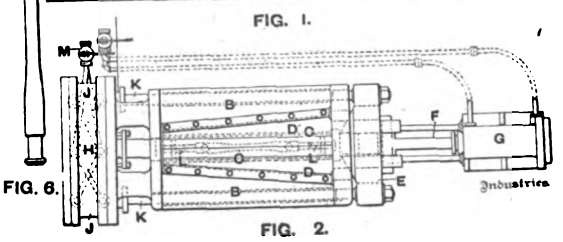
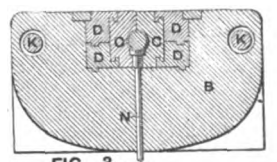
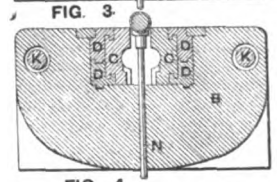
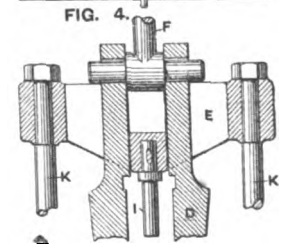


FIG. 2.

the apparatus, Fig. 2 a plan, Figs. 3 and 4 sections upon the body B. Fig. 5 a section upon the part E, and Fig. 6 a finished axle. The appliance is mounted upon a suitable foundation A. It consists of a strong iron body B, in which are inserted the dies C and the wedges D for closing the dies. The wedges and dies are grooved (see Figs. 3 and 4) to ensure the latter opening when the former are withdrawn. The wedge pieces D are connected by shanks to the crosshead E, to which is also connected the piston rod F of the hydraulic cylinder G. At the opposite end of the body B is another and larger hydraulic power cylinder H, which actuates a plunger L at that end of the dies. Two other smaller cylinders J are placed upon each side of the cylinder H, and have their pistons connected by rods K to the crosshead E. To the crosshead E is attached a second plunger L. Valve



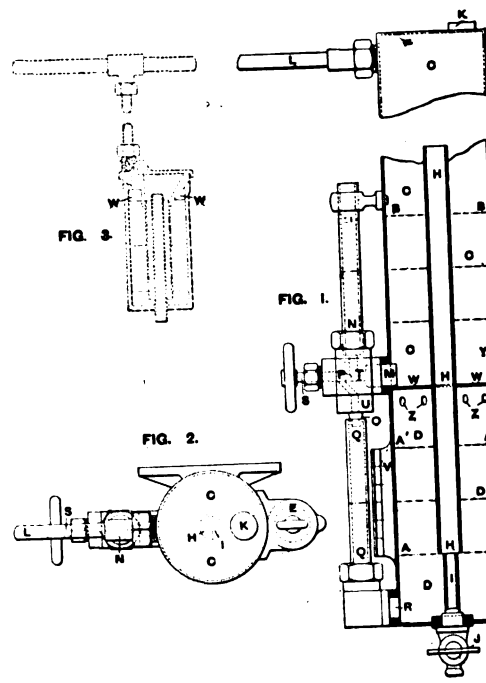




mechanism M controls the supply of water to the cylinders. Rods N, worked by hydraulic power in the cylinder O, discharges the finished axles from the dies. The method of proceeding is as follows:—A blank piece of round bar iron, rather smaller in diameter and longer than the required axle, is heated and placed between the dies C. Fluid pressure is now admitted to the cylinder G, and the wedges thus forced in, causing the dies to close and firmly grip the blank. Next fluid pressure is admitted to the cylinders H and J, thereby forcing the plungers L inward, upsetting the ends of the blank, and finishing axle. The plungers are then retracted, and the axle discharged by the rods N. Nine claims are made for the machine above described.—No. 9287. June 4th, 1889. 8*d*.

Bobbins for Spinning, &c.—*W. R. Sidebottom, Stockport.*—In this specification a method is described for imparting rotary motion to bobbins or tubes used in certain cotton spinning and doubling machines. The bottom part of the bobbin or tube is made parallel and cylindrical to drop into a cup or socket fitted to surround the lower part of the spindle. The top of the bobbin or tube is provided with a small hole to fit loosely the top of the spindle, and so keep the tube in an upright position. The cylindrical part of the tube that fits the cup upon the spindle may be made to taper upwards a little in order to fit it more tightly. The rotation of the spindle causes the tube to be forced into contact with the cup on the spindle, so that rotary motion is imparted to the tube or bobbin. This invention enables bobbins or tubes provided with "heads" being employed in ring-spinning and ring-doubling machinery, the cups upon the spindle ensuring the bobbins a uniform height and vertical position on the spindles. Claim: The hereinbefore described method of maintaining loose bobbins or tubes in position upon and imparting rotary motion to them by means of the spindles of machines for spinning and doubling cotton and other fibrous materials, which method consists in so forming the bobbins or tubes and the spindles that when such a bobbin or tube is placed in position upon such a spindle and such spindle is rotated, the bobbin or tube will be forced into contact with a part upon the spindle, and have rotary motion imparted to it, and be kept in position upon the spindle by the rotation of such spindle.—No. 2112. February 6th, 1889. 8*d*.

Lubricating Apparatus.—*S. Banner, Sunderland.*—In a previous patent, No. 18943 of 1888, the inventor describes a method and apparatus for lubricating surfaces by the use of air pressure. In the present invention improvements are made in that part of the appliance which supplies the air and indicates the action of the feed. In Fig. 1 is shown a sectional elevation of the appliance in broken connection with a lubricator, Fig. 3. Fig. 2 is a plan of the appliance. The vessel is divided into two compartments C and D. At the top of C is the outlet L for conducting air to the lubricators, and an opening K for filling the chambers. At the back of the vessel is fixed the air-pump E, which is operated by the spring G and by the motion communicated through the cord F from an oscillating part of the machine. The pump communicates with the top chamber by a small aperture Y. On the front of the vessel are gauge glasses N and Q, which communicate with the top and bottom chambers by the ports M and R, and to each other through the valve P. Behind the gauge glass Q is a scale to indicate the depth of



liquid which is in the chamber D. The chambers also communicate by a pipe H, and the lower one is provided with a valve I, by which liquid can be removed from the chamber to the depth indicated by the line A, A. The apparatus is worked as follows: The top chamber is filled with oil to the level B B, the height assumed to correspond with the level of oil in the lubricators. The bottom chamber is filled to the height A A. The pump is now started and air is forced into the top chamber, where it has two means of escape, one through the supply-pipe L to the lubricators, and the other down the pipe H through the chamber A, and out of the vents Z. At the same time oil is allowed to drop through the valve P under pressure due to the head of liquid in C into the glass Q and chamber A. The height of oil is thus gradually raised in the chamber A, and the air has a resistance now in escaping through the pipe H equal to the pressure due to the increased height. This resistance to the escape of air causes the air in the chamber C to exert upon the surface of the oil a pressure that compensates the diminished head, and so the oil flows through the valve P under a constant pressure and indicates the action of the lubricators by the scale and glass Q. The compensating action is communicated to the lubricators through the pipe L. Four claims are made.—No. 1554. January 29th, 1889. 8*d*.

Stamps for Crushing Ores.—*P. J. Ogle, London.*—In practice a gravitation stamp cannot be driven above a certain speed, for if driven faster the impetus imparted to the stamp by the cam would cause it to rise above its path, and so prevent it completing its downward stroke before the cam is in the position to again raise it. To enable the stamps to be driven faster, they are provided, according to this invention, with an elastic buffer or spring, which opposes the tendency of the stamps to rise, and gives more force to its downward stroke. A simple form of this invention is a coiled spring surrounding the stem of the stamp above a tappet fixed to the stem; as the stamp is raised, the tappet compresses the spring, and so retards the upward movement of the stamp. Claims: (1) In an ore-crushing mill the employment of buffers

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for preventing the stamps from rising above their normal height, whereby such stamps can be driven at a greater speed than heretofore; (2) the application to an ore-crushing mill of buffers arranged as described; (3) the manufacture and use of stamp mills having elastic buffers arranged as described.—No. 1619. January 29th, 1889. 6*d*.

Expansion Gear.—*H. Kühne, London.* (*W. R. Proell, Dresden, Germany.*)—The improvements refer to that form of expansion gear in which steam is admitted by two slide valves, one working on the back of the other. In this invention the main slide valve is of the usual form, excepting that the admission ports at the outer face of the slide valve have the shape of arcs. The second slide valve, or expansion plate, is a circular disc, having on its back a stud whose axis coincides with the axis of the disc. To the stud of the expansion plate is fitted a lever, which is oscillated by a suitable eccentric upon the engine shaft. The disc is given by this oscillating lever a movement that causes it to alternately open and close the arc-shaped admission ports of the main slide valve. The motion of the disc being in an arc, its outer edge is subjected to more friction than the inner edge, and, as the disc is free to revolve upon its axis, it assumes different positions whilst at work, and so grinds itself straight and tight on the back of the main slide valve. Claims: (1) In expansion gear for steam engines the combination with a main valve having in it arc-shaped admission ports of a circular plate or disc free to turn on its centre, and connected with an expansion eccentric or equivalent device as described; and (2) and (3) the arrangement and combination of parts as described and illustrated in the specification.—No. 3475. February 27th, 1889. 6*d*.

Machines for Knitted Pile Fabrics.—*J. Booth, Halifax.*—This invention consists of the application of a series of hooks and circular cutters to straight-bar knitting machines for the purpose of severing the pile loops as they are formed. By the application of this invention to machines hitherto only available for the manufacture of knitted looped fabrics, such pile fabrics as plush seals and the like may be produced. The illustrations show Fig. 1, a sectional end elevation of a straight-bar knitting machine with the appliance attached; Fig. 2, a front elevation of the same; Fig. 3, a front elevation, with part in section; and Fig. 4, details of the machine. A are the hooks and B the circular cutters, employed in combination with the guides

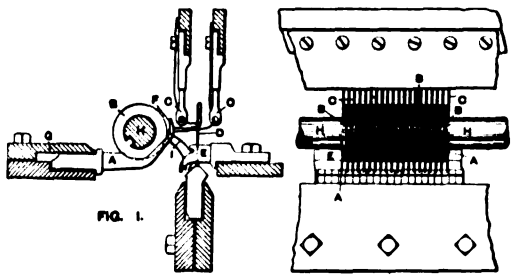

FIG. 1.

FIG. 3.

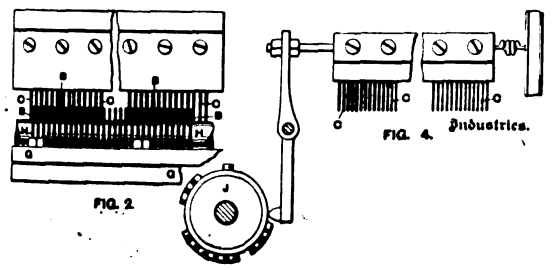
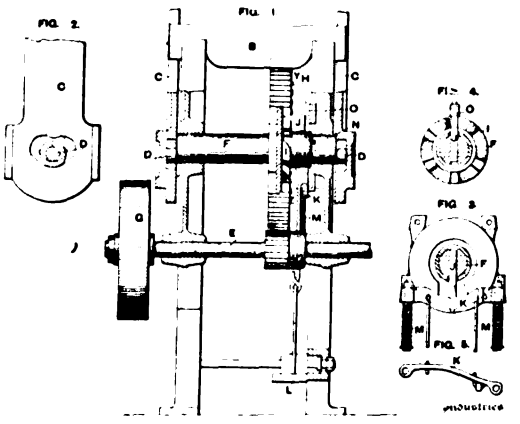

FIG. 2.

FIG. 4.

C, the needles D, and the sinkers E of an ordinary machine. The points F of the hooks are free, but the shanks are secured in bars of spelter or lead, and clamped in a continuous manner between the plates G. The hooks are arranged in pairs, and between each pair is a circular cutter B, which is secured to a shaft H. As the pile loops I are formed, they are passed over the points of pairs of the hooks A by the guides C, which receive a lateral motion from the peg wheel J, Fig. 4. The loops collect upon the hooks A until those first made slide down and come into contact with the knives B and are severed. By this arrangement a number of the loops are always upon the hooks, which ensures the effectual tying in and securing of the pile loops. Claim: The improvements in machines for knitting and cutting pile fabrics, wherein are employed revolving circular cutters or circular knives, working between cranked hooks or stems, such as illustrated, in combination with the needle, sinkers, and guides of a straight-bar knitting machine as described.—No. 2872. February 19th, 1889. 8*d*.

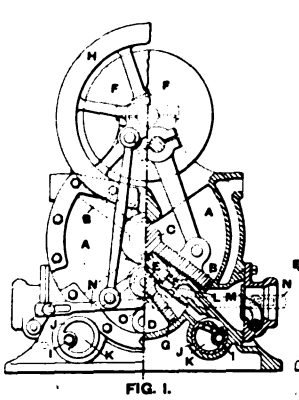
Carding the Backs of Cords, &c.—*J. Brindle, Manchester; R. L. Reade, Sale; J. Taylor, Sale; and J. M. Moulson, Manchester.*—The object of this invention is to effect the carding or perching of the backs of woven fabrics, such as cords, fustians, &c., in the loom and during the process of manufacture. To accomplish this a sliding bar, or preferably a roller, is mounted at the front portion of the loom underneath or behind the cloth. The roller or sliding bar is covered with carding material and has motion given to it by suitable gearing connected to the ordinary working parts of the loom, such that the bar has a reciprocating motion or the roller a rotary motion. In the case of the sliding bar the card is pressed to the cloth when moving in one direction only, but in the case of the roller the card may be pressed thereto continuously or intermittently, as found most desirable. Claims: (1) The employment in a loom during the operation of the weaving of a roller clothed with wire card and mounted underneath the woven fabric, at or near the front breast beam of the loom or other convenient point, and giving, by means of suitable gearing with the working parts of the loom, an intermittent or continuous motion to such card clothed roller, for the purpose of perching the back of the fabric; (2) the employment in a loom during the operation of weaving of an oscillating or reciprocating bar, clothed with wire fabric and mounted underneath the woven fabric at or near the front breast beam of the loom, or other convenient point, and giving, by means of suitable gearing with the working parts of the loom, reciprocating motion to such card clothed bar, for the purpose of perching the back of the fibre.—No. 2878. February 19th, 1889. 6*d*.

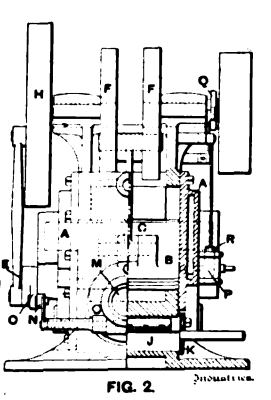
Heeling Machines.—*T. Peberdy, W. Earp, & T. H. Parr, Leicester.*—The machines referred to are employed for building heels and attaching them to the boots and shoes. The invention consists of improvements in the gear for raising the bed upon which the building and attaching stands are placed, and in the method of starting and controlling the machine by an automatic clutch arrangement. In Fig. 1 is shown a side elevation of the machine partly in section. The building and attaching stands (not shown) are placed upon the bed plate B, which are supported by the guides C. In the guides C work the studs D of an eccentric shaft F, so that by the revolution of F the table B is raised and lowered. Upon the shaft F is a loose gear wheel H, which is geared to the driving belt pulley G as shown. When working the machine, the driving wheel is kept running, and revolves the wheel H upon its shaft F. To put the bed-plate in motion for a length of time sufficient to complete one operation, a clutch arrangement is devised for coupling the shaft F to the wheel H. Details of the clutch are shown in Figs. 3 and 4, of which 3 is a section upon the line Y Z, Fig. 1. The clutch is constituted by a ratchet face I, into which engages a catch J pinned in a slot in the shaft F. The catch J is normally held away from the face I by a guide bar K, which is controlled by a foot lever L and springs M. By


FIG. 1.

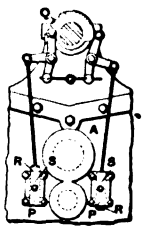
pressing the foot lever, the guide K is lowered and permits the catch J to be pushed forward by the spring N into the clutch I. The shaft then revolves with the wheel H, and the roller O attached to the catch J keeps the latter in contact with the face I by rolling upon an annular plate. During this revolution of the shaft F, however, the foot lever has been released and the guide guide bar K assumed its original position, so that as the shaft completes its revolution the roller O passes behind the guide K and withdraws the catch from the face I. The slots for the eccentric studs in the slide C are shaped as shown in Fig. 2 to make the bed-plate rest whilst the pegs are being driven into the heel. Claims: (1) In a heeling machine the combination with a clutch such as I of a lever such as J mounted in the shaft which carries the clutch and adapted to be engaged with the clutch by a cam-bar such as K substantially as and operating in the manner and for the purpose herein described and illustrated in the accompanying drawings; (2) in a heeling machine the combination in the vertical slides C of a groove or slot shaped or adapted to cause the block and die to remain compressing the heel during the ascent of the plunger substantially as described; (3) the improved machine constructed, arranged, and operating substantially as and for the purpose herein described and illustrated in the accompanying drawings.—No. 1889. January 12th, 1889. 8*d*.

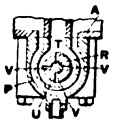
Gas Engines.—*W. E. Crist, Brooklyn, & H. C. Covert, New York, U.S.A.*—The engine is constructed with a double oscillating piston and separate compression chamber, and explodes a charge of gas each stroke. In the illustrations, Fig. 1 is a side elevation of the engine, half in section; Fig. 2 an end elevation, half in

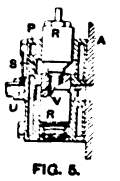

FIG. 1.

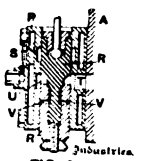

FIG. 2.

section; and Figs. 3, 4, 5, and 6 show an improved igniting chamber. A are the chambers in which the double piston B oscillates upon the centre C. Below the chambers A is the compression chamber D, in which oscillates a piston G upon its centre E. The piston B is connected to the crank discs F, and the piston G to a pin in the fly-wheel H of the engine. The chambers A communicate by the valves L to the compression chambers, and by the valves M to the exhaust. The chamber D communicates to the valves J, which supply the gaseous explosive. In the valves J the gas is supplied by the tube I and the air by the larger space K. The cycle of the engine is as follows:—The fly-wheel is revolved, and the piston G sucks in the gaseous compound from the valve J. Upon the return stroke of the piston G the charge is compressed and passed through the valve L into the chamber A, where it is immediately exploded. The piston B makes its outstroke under the force of the exploded charge, and upon its return exhausts the charge through the valve M, which is operated by a lever N attached to the crank O. The cycle of operations is the same upon each side of the engine, the explosion upon one side taking place at the time the other is exhausting. The pistons B and G, when in motion, move towards and away from each other, but the piston B commences its out-stroke a little before the piston G completes its compression stroke to facilitate the opening of the spring valve L to admit


FIG. 3.


FIG. 4.


FIG. 5.


FIG. 6.

the charge to the chamber A. The igniters P are placed at the back of the engine, and operated by a cam Q fixed to the crank shaft, as shown in Fig. 3. The igniter is composed of a double piston R, which puts the flame vent S in and out of communica- with the firing port T, as shown in Figs. 5 and 6. In Fig. 5 communication is shown made through the annular space U and the vent holes V. In Fig. 6 the communication is shown broken, the piston R having been lowered by the action of the cam Q. Six claims are made for this form of gas engine and the igniter.—No. 20249. December 17th, 1889. 8*d*.

ELECTRICITY.

Bases for Electrical Instruments.—*F. L. Rawson, London.*—The bases are composed of a composition formed of about six parts by measure, of Portland cement with one part of plaster of Paris, treated in the following manner:—The plaster of Paris and Portland cement are mixed with sufficient water to form a paste suitable for moulding. In some cases a small proportion of sand may be added, not more than two parts. The paste is moulded in a mould to the desired shape, and such metal parts as are required are bedded in it. When the material has set it is removed from the mould and slowly dried for several days. The moulded article may be further hardened by immersing it in a solution consisting of equal parts of silicate of soda and water. When the moulded article is sufficiently dry and hard it is heated to about 220° F. and plunged in a bath of liquefied ozokerit or paraffin wax, or material which is the heavy oil or residue of paraffin. In making boxes or tanks which cannot be conveniently immersed in a bath of molten material the following method is adopted:—A closed vessel is placed in the moulded box, leaving sufficient space around it to receive the impregnating substance. This vessel is then charged with steam, and the impregnating material becoming liquefied is allowed to soak through the moulded article. Claims: (1) The method of preparing bases and other insulating parts of electrical apparatus by moulding them of a mixture of Portland cement and plaster of Paris, drying the moulded articles, heating them, and impregnating them with heavy oil; (2) bases and other insulating parts of electrical apparatus consisting mostly of Portland cement and plaster of Paris moulded to shape and impregnated with heavy oil or analogous material.—No. 2176. February 7th, 1889. 6*d*.

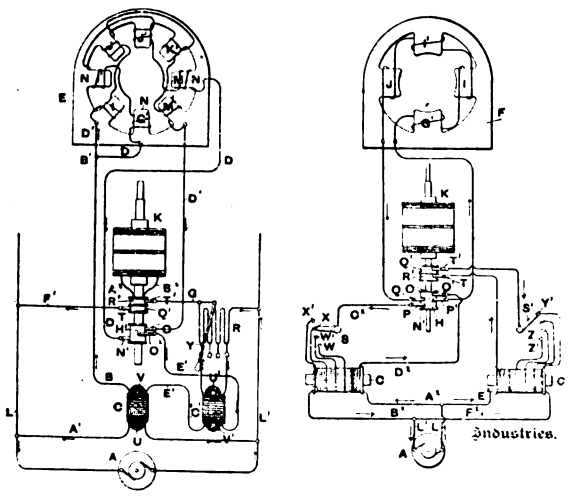
Measuring Electric Currents.—*W. H. Dines, Esher, & L. W. Gatward, Hitchin.*—The recording mechanism of this measuring appliance is driven by a flow of water, and the flow is regulated by the electric current passing through the machine. A small tipping cistern is balanced upon knife edges, and constructed with a long discharging pipe. The mouth of the discharging pipe is over another small vessel, which automatically tilts and discharges its contents as it becomes filled. This small vessel is connected to the recording mechanism so as to indicate the number of times it becomes filled or the quantity of water discharged. The tipping cistern has attached to it the core of a solenoid, whose weight holds the vessel normally such that the mouth of its discharge pipe is at the same level as the water within the cistern. The water in the tipping cistern is supplied from a main cistern and kept at a constant height. When a current is passed through the solenoid its core is lifted, and depresses the end of the tipping cistern discharge pipe so that water flows into the measuring vessel at a rate depending on the current. The deflection given to the tipping cistern discharge pipe is proportional to the square of the current, and the rate of efflux of the liquid is theoretically proportionate to the square root of the pressure or head, hence the registration of the instrument can be accurately judged. For alternate currents the solenoid would be replaced by suitable controlling coils. Claim: The principle by which the flow of electricity is measured by the rate of efflux of a liquid, the pressure or head causing that efflux being made to depend upon the strength of the current.—No. 656. January 14th, 1889. 6*d*.

Electrically Driving Vehicles.—*P. B. Elwell, Deauville, France, & J. K. Starley, Coventry.*—Improvements are claimed in the method of applying electromotors to wheels for driving vehicles such as railway carriages, tramcars, &c. It is designed to enable such wheels to be driven independently of each other, so that one wheel of a pair may run faster than the other in

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travelling round corners or curves. Instead of mounting the electromotor so that only the field magnets or only the armature revolves, both are caused to revolve in opposite directions, and the armature is applied to one wheel and the field magnets to the other. The method of mounting these parts to the driving wheels is as follows:—At the outer end of the armature spindle is mounted a crank or eccentric carrying an externally toothed wheel held by a spring or lever from revolving upon its own centre. The toothed wheel engages in an internally toothed wheel firmly attached to the axle of one driving wheel in such a manner that upon the crank revolving the inner or externally toothed wheel is carried round the inner periphery of the internally toothed wheel, imparting to it a powerful, but slow motion. On the outer end of the field magnet spindle is also mounted a crank or eccentric; but in order to obtain a reversed motion, it carries the internally geared wheel, and the externally geared wheel is attached to the driving wheel. Claims: (1) In electrically driven vehicles the application to the wheels of such vehicles of a motor in which the impulse between the armature and field magnet (or magnets) forms a perfect differential motion; (2) in electrically driven vehicles, the use of internally and externally toothed gearing in combination with cranks or eccentrics, and springs or levers, as and for the purposes described; (3) in electrically driven vehicles the general arrangement of motor and gearing as described.—No. 2567. February 13th, 1889. 8*d.*

Electric Motors.—*W. P. Thompson, Liverpool.* (*The Westinghouse Electric Company, Pittsburgh, U.S.A.*)—The class of motors referred to is that operated by alternating electric currents, and the object of the invention is to construct a motor that will readily start from rest. The magnetisation of the field magnet is carried to a very high point of saturation at the commencement and gradually decreased as the motor increases its speed. In the accompanying illustrations Fig. 1 gives a general organisation of circuits and apparatus for carrying out the invention and Fig. 2 a second application of the same. In Fig. 1 A is the source of electric supply from which conductors L and L^1 lead to the commutator Q^1 R^1 of the armature K. A conductor A^1 leads from the conductors L L^1, and includes the primary coil of a converter C whose secondary coil is connected by B to the field magnets E of the motor, and the conductor B is divided at B^1, each branch passing round alternate poles of the magnet and afterwards connected to the brushes N^1 O of a commutator H^1. A brush O^2 applied to the commutator H^1 makes alternate contact with the plates X against which the brushes N^1 O rest. This brush O^2 is connected to the secondary coil of the converter C^1 and thence to the remaining terminal of the secondary coil of C. It will thus be seen that the secondary circuits of the converters C and C^1



are completed alternately through the conductors D D^1, thus causing the poles of the armature to be alternately vitalised. The primary circuit of the converter C^1 is connected in a shunt upon a resistance R which is included in a conductor G leading from L^1 to a contact brush T^1. A second contact brush T is connected up to L. The rings of the armature Q^1 R^1 are connected up to the armature coils. When the machine is started the resistance R is included in shunt upon the converter C^1, so that the maximum difference of potential is applied to the primary coil of the converter. The secondary current thus induced is combined with that being produced by the converter C, and serves to magnetise the field magnet E to a high degree of saturation. The armature is meanwhile supplied with currents through F1 and G. As the rotation of the armature increases in rapidity the resistance may be gradually cut out, and so diminish the difference of potential at the terminals of the primary coil and its magnetising effect upon the field magnet. When the resistance R has been completely short-circuited the converter has no further effect, and the converter C then operates alone to maintain the magnetic field at its proper value.—Eleven claims are made.—No. 3272. February 23rd, 1889. 8d.

Testing Electric Conductors.—*W. Lowrie & C. J. Hall, London.*—The conductors are tested for insulation whilst in use by an apparatus which indicates their conduction by light or the absence of light. The appliance employed consists of a vacuum discharge tube, usually known as Geissler's tubes, enclosed in a small box. The tube is connected to terminals upon the outside of the box, and the box provided with an aperture to observe the effects of the tests upon the tube. In testing a high potential conductor one of the vacuum tube electrodes is connected to one pole of the conductor, whilst the other tube electrode is connected to earth. If the insulation of that portion of the conductor is bad the characteristic glow of the vacuum tube is wanting, because earth connection is made at the extremities of the testing circuit. On the other hand, if the insulation is good the glow of the tube is present, because current is discharging through the vacuum tube to earth. Both poles of the conductor should be tested to see which is the faulty side of the cable. A standard vacuum tube can be used with the first, illuminated by other sources of electricity to enable comparisons to be made. In the case of currents of low potential an induction coil and a make and break apparatus is connected with one of the poles to be tested and put to earth, whilst the vacuum discharge tube is placed on the secondary circuit. The result is that if there is a leak on the portion of the conductor under test no light is given upon the pole, because earth is made at both extremities of the tube. But if light is given it follows that the insulation of the opposite conductor is more or less bad because the inducing current which discharges (by induction) through the vacuum tube must pass through the imperfect portion of the conductor to earth. Seven claims are made.—No. 1166. January 22nd, 1889. 8*d.*

CHEMISTRY.

Treatment of Ores.—*E. B. Parnell, London.*—By treating the ores according to this process they become softened to such an extent as to enable rolls and such machines to complete the disintegration in place of the heavy stamps usually employed. The quartz or other ore is first heated to a fair red heat in a suitable furnace, and then immersed in its heated state in water. The result is that the ore becomes so softened that it can be crushed with great ease. A form of apparatus that may be employed to heat the ore consists of a horizontal tube, through which the ore is propelled by a helical revolving screw mounted upon a hollow shaft. Into this tube, through perforations in the hollow shaft, is drawn air which has been previously heated by any suitable furnace. At the time the ore reaches the end of the tube it becomes sufficiently heated by the air, and is discharged into a tank of water. The ore is next raised by an elevator to a second tube, which is similarly constructed to the first, and has passed through it the air proceeding from the first, for the purpose of drying the ore. The ore is delivered from the last tube into the hopper of the rolling or other machine. Instead of discharging the ore from the first tube into a tank of water as above described, the ore may be discharged on to an endless band, which would carry the ore under a shower of water and into a suitably constructed drying oven before finally dropping it into the hopper of the rolling mill. Six claims are made for the treatment of ore as described and the apparatus employed in the process.—No. 2,931. February 19th, 1889. 8*d.*

A Substitute for India-rubber.—*S. Kenyon, Warrington.*—The substitute consists essentially of a preparation of oxidised linseed oil, such as the skins and refuse of boiled oil. In carrying out the invention oxidised linseed oil is mixed with a liquid in which it will dissolve or with which it will combine when heated. The solvent material preferably used is the distillate produced in the manufacture of varnish from gums or gum resins, although varnish foots, pine oil, or thick pine grease, resin, resinous oil, or a mixture of two or more of these or other similar substances will also act as solvents when heated. The varnish distillate or other solvent is placed in a pan or still heated by steam or otherwise, and the skins of boiled oil or oxidised oil added and mixed well together (or they may be mixed prior to being placed in the pan). The proportion of the solvent to the oxidised oil will altogether depend on the consistency of the product desired. To make the product of about the consistency of raw india-rubber one part of the varnish distillate to three parts of the boiled oil skins is used, but to produce a substance of a thick treacly consistence equal parts of each. The mixture in the pan is then heated to about the temperature of boiling oil, say 350° to 450° F., and maintained at that heat for a considerable time until all the hard or oxidised masses of the oil are dissolved in or thoroughly incorporated or combined with the varnish distillate or other solvent used (say from twelve to twenty-four hours). Claims: (1) A substance applicable as a substitute for india-rubber, also for waterproofing and for other purposes, prepared from the skins of boiled oil or oxidised linseed oil dissolved in varnish distillate or other solvent; (2) the process of manufacturing or producing a solid or semi-solid or viscous soluble substance from the refuse skins of boiled oil or oxidised linseed oil which consists in mixing the skins or oil with varnish distillate, varnish foots, pine oil, resin or resinous oils, and boiling the mass at a high temperature in a suitable pan or still until the two are thoroughly combined.—No. 4477. March 14th, 1889. 4*d.*

Explosive Compounds.—*H. S. Maxim, Crayford, Kent.*—In the manufacture of explosive compounds, according to the present invention, dissolved gun-cotton or pyroxyline is mixed with nitro-glycerine, nitro-gelatine, or similar material, and with oil, preferably castor oil. The inventor has discovered that the addition of castor oil, or other suitable oil, to compounds of dissolved gun-cotton and nitro-glycerine, nitro-gelatine, or the like, increases the toughness of the product and modifies the explosive properties thereof, whilst greatly diminishing its liability to deterioration by exposure to the atmosphere. Castor oil is preferably employed, because it is soluble by means of the solvents which are employed for dissolving the gun-cotton and nitro-glycerine or nitro-gelatine. The improved explosive compound is advantageously manufactured as follows:—First dissolve gun-cotton or tri-nitro-cellulose in acetone, ethylic acetate, or a similar solvent, either in a liquid state or in the form of vapour, until the said gun-cotton is brought to a sufficiently thin consistency, and then add to the dissolved gun-cotton the nitro-glycerine or nitro-gelatine, and after that the castor oil, and thoroughly incorporate these substances. Or the castor oil may be dissolved in a portion of the acetone, or other solvent, before the solvent is added to the gun-cotton. When the mixture is sufficiently dissolved, it is subjected to pressure in a cylinder, and so forced out through small holes in the form of threads or strips, which may be cut into small pieces as already explained by us in these columns (Vol. VII., page 508) in a description of a previous invention, No. 16213 of 1888. Claims: (1) An explosive compound consisting essentially of gun-cotton or pyroxyline mixed with nitro-glycerine, nitro-gelatine, or similar material, and with castor oil or other suitable oil; (2) the manufacture of an explosive compound by first dissolving gun-cotton by means of acetone or other solvent and then incorporating with the dissolved gun-cotton, nitro-glycerine, nitro-gelatine, or similar material, and castor oil or other suitable oil; (3) the manufacture of an explosive compound by dissolving first castor oil or other suitable oil and then gun-cotton by means of acetone or other solvent, and incorporating therewith nitro-glycerine, nitro-gelatine, or similar material; (4) the manufacture of an explosive compound by first mixing nitro-glycerine, nitro-gelatine, or similar material, and castor oil or other suitable oil, with a small quantity of acetone or similar solvent, treating dried gun-cotton with this mixture in a rotary cylinder or chamber, and then subjecting the product, in a cylinder or chamber from which air is exhausted, to the action of vaporised acetone or other solvent, and then to pressure.—No. 4477. March 4th, 1889. 6*d.*

Dyeing and Printing Fibres.—*B. Willcox, London.* (*F. Bayer & Co., Elberfeld, Germany.*)—This invention relates to an improved process for fixing colouring matter, such as the azo-dyestuffs, which possess the property of directly dyeing unmordanted cotton in an alkaline bath, and which are known in the trade as substantive colouring matters, on or in the animal or vegetable fibres to which they are applied in the processes of dyeing and printing. The said substantive colouring matters possess the property of forming with the salts of the earthy and of the heavy metals lakes which in part are very permanent. By boiling in a solution of a metallic salt goods which have been dyed or printed in the usual way, the metal becomes fixed by the colouring matter in the form of a fixed lake. The results obtained naturally vary according to the nature of the metallic salt and colouring matter employed. Zinc is found to be best suited for use in dyeing wool and silk, as it has no influence whatever on the colour, and forms lakes which perfectly resist the action of boiling water and better resist fulling or milling than do the original colours. The zinc can be employed in the form of sulphate of zinc or white vitriol. Woollen goods dyed in the usual way, with deltapurpurine for example, are boiled for a few minutes with a quantity of white vitriol corresponding to the dye employed. The zinc is then completely taken up from the bath. The wool so treated is now faster to fulling or milling, and can be acted on with boiling water without suffering in the least. The dyestuffs are preferably employed in printing with an addition of neutral thickening paste. Claims: (1) The process of boiling animal fibres dyed or printed with any substantive cotton colouring matters such as those hereinbefore mentioned, with a solution of zinc salts, especialy white vitriol; (2) the process for dyeing and printing with substantive cotton colouring matters, by boiling animal and vegetable fibres (which are dyed or printed with such colouring matters) with a solution of copper salts, and especially with blue vitriol; (3) the process for dyeing and printing with those substantive cotton colouring matters which result from the combination of the tetrazo compounds of the diamines such as those hereinbefore named with (*a*) two molecules of salicylic acid or cresol-carboxylic acid, or with (*b*) one molecule of salicylic acid or cresol-carboxylic acid, and then with another molecule of any amine, phenol, or their sulpho or carbo acids, the said process consisting in printing the dyestuff in neutral thickening in the presence of a chromium salt, or in treating animal or vegetable fibres dyed or printed therewith with a solution of a chromium salt.—No. 3,934. March 6th, 1889. 6*d.*

Colouring Matters.—*B. Willcox, London.* (*F. Bayer & Co., Elberfeld, Germany.*)—This invention relates to the manufacture of new acid green dyestuffs. The inventors have discovered the general rule that in the case of the tetra-alkylised product of the diamido-triphenyl-methane series (which are green dyestuffs), the colouring power increases as the molecular weight is decreased. The improved process may be stated as consisting in condensing benzaldehyde or nitrobenzaldehyde with two different tertiary amines in the presence of a dehydrating agent, then converting the unsymmetrical substituted diamido-triphenyl-methane derivatives thus obtained into leuco-sulpho acids by means of sulphonating agents, such as concentrated sulphuric acid, fuming acid, or sulphuric mono-chlorhydrine, the resulting unsymmetrical substituted diamido-triphenyl-methane sulpho acid being then converted into the green dyestuff by an oxidising process. By sulphonating the bases produced by the new process and oxidising the resulting sulpho acids, valuable new dyestuff sulpho acids can be obtained, of which the trimethyl benzyl-diamido-triphenyl-methane derivative and the unsymmetrical dimethyl-dibenzyl-diamido-triphenyl-methane derivative are the most important products. Claims: (1) A process for the production of unsymmetrical substituted diamido-triphenyl-methane derivatives consisting in condensing benzaldehyde or meta-nitrobenzaldehyde with a mixture of two different tertiary amines in the presence of a dehydrating agent substantially as hereinbefore described; (2) the process for converting the unsymmetrical substituted diamido-triphenyl-methane derivative referred to in the preceding claiming clause into leuco sulpho acids by treating with sulphuric acid, fuming acid, or monochlorhydrine; (3) the process for converting the unsymmetrical substituted diamidotriphenyl-methane-sulpho acids obtained according to the process of the second claiming clause into green colouring matters or dyestuffs by oxidising the same; (4) as new articles of manufacture the products obtained by the means hereinbefore described and claimed by the preceding several claiming clauses.—No. 1046. January 19th, 1889. 6*d.*

Silicon Bronze.—*G. E. Vaughan, London.* (*L. Weiller, Angoulême, France.*)—In alloys of copper containing silicon or sodium improvements are made according to this invention in their tenacity and ductility by the addition of zinc or spelter. The new alloys are formed by bringing those of copper containing silicon or sodium to a state of fusion and then adding the zinc or spelter in quantities varying as the resulting alloy is required to approach the nature of brass or bronze. Three claims are made.—No. 18,211. December 13th, 1888. 6*d.*

Copies of the British specifications may be obtained on application to H. Reader Lack, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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THE "LUKIN" LATHE.

THE Britannia Company, Colchester, have recently brought out a new lathe, which we illustrate herewith. The fast headstock is made with a steel traversing mandril which runs in hardened steel collars, and is fitted with six screw guides or "formers" of different pitches. The guides work in a segment plate, which is adjustable in and out of gear by means of an eccentric motion. A plain sleeve is used in place of the screw "former" when plain turning is to be done. When screw cutting is only temporarily interrupted, a simple device is provided to avoid taking off and putting on the screw guide and sleeve. The cone pulley is made of gun-metal, with three or four speeds, and its front is fitted with a division plate having three or more circles of holes. A driver, chuck, and face plate are fitted. The loose head or poppet is fitted with a steel tubular mandril, coned at the front end for the centre, and screwed at the back end and fitted with a left hand square thread traversing screw. A plain hand rest and tee-fittings for wood and metal are fitted.

TRAINING FOR TRADES AND CRAFTS.

BY HENRY DYER, C.E., M.A.

(*Continued from page* 147.)

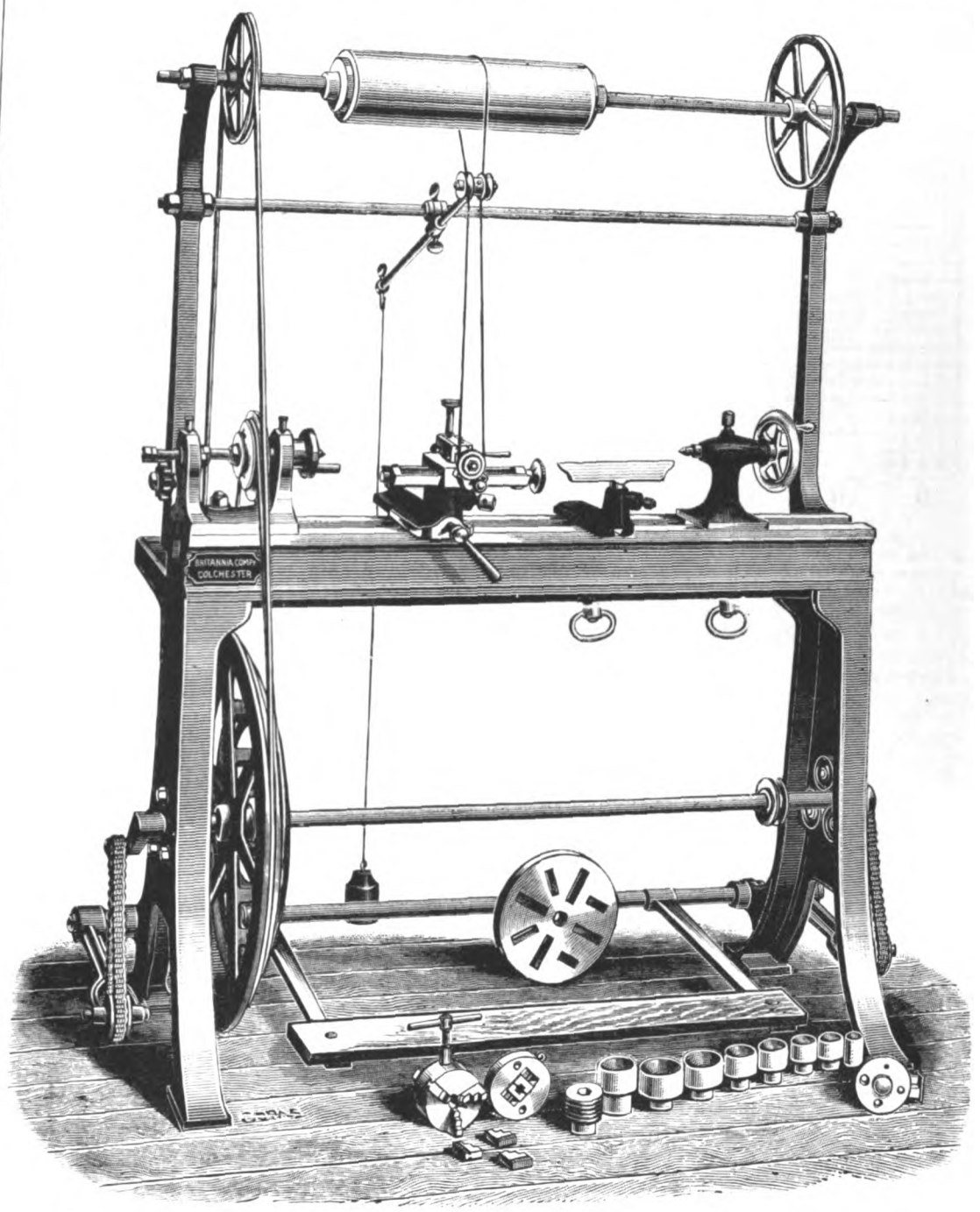
II.

THE great majority of boys of the working classes leave the elementary day schools when they are about thirteen years of age, and those of the middle classes leave the secondary schools when they are about sixteen. At the earliest of these ages it is quite absurd to expect them to have acquired much in the way of technical education, nor indeed should it be attempted. The moral nature should be trained, not by the dry inculcation of theological dogmas, but chiefly by the example and direct teaching of the masters, for the permanent influence of a teacher depends not so much on what he teaches as on what he is. If all our teachers were men of wide culture and with high ideals of the duties of citizenship, we should have less of that narrow selfish spirit in the world which is at the root of a great many of the difficulties with which we are now confronted. If we wish our boys to become manly men and good citizens, we must be careful to appoint manly men for their teachers, and not merely learned pedants or skilled artificers, whose minds are very often narrower than those of the boys they undertake to educate, many of whom enter school or college with enthusiastic ideas of what they would like to do in this world, and who leave it narrow-minded scholars. Moreover, it must be distinctly remembered that, "if education is to be a prevailing power, it must be something which the auctioneer's hammer cannot fix the value of, something that the highest bidder cannot buy, a gain in the man himself. The auctioneer's view will never command the hearts and lives of the young."* This may seem a digression, but as a matter of fact it is the foundation of the whole matter. All history, especially the history of the industrial cities of the middle ages, shows us that an ounce of manly pride and enthusiasm has always been worth a pound of technical skill. At the present day in every department of education, and especially in that part of it which is usually called technical, there is too great a tendency to magnify the machinery, and to ignore the spirit. If we wish our country to retain its position among the foremost countries of the world, we must recognise that neither technical skill nor scientific knowledge will avail much, unless they are combined with breadth of economic and political vision, and with depth of social feeling on the part of its citizens. If the whole aim of the present movement were the production of men who were adepts at putting on pins' heads, or of fashioning the hundredth part of a machine or manufactured product, it would be impossible for those who really thought about the matter to feel much enthusiasm for it. That the spiritual is the parent and first cause of the practical is very often forgotten by those who pride themselves on being practical. Moreover, there are higher interests which are very often neglected, and Ruskin has well said: "The great cry that rises from all our manufacturing cities, fiercer than their furnace blast, is all in very deed for this, that we manufacture everything there except men; we bleach cotton, and strengthen steel, and refine sugar, and shape pottery, but to brighten, to strengthen, to refine, or to form a single living spirit, never enters into our estimate of advantages. And all the evil to which that cry is urging our myriads can be

* Thring: "Theory and Practice of Teaching," page 79.

THE "LUKIN" LATHE.

CONSTRUCTED BY THE BRITANNIA COMPANY, ENGINEERS, COLCHESTER.



met only in one way; not by teaching or preaching, for to teach them is but to show them their misery, and to preach to them, if we do nothing more than preach, is to mock at it. It can be met only by a right undertaking on the part of all classes, of what kinds of labour are good for men, raising them and making them happy, by a determined sacrifice of such convenience, or beauty, or cheapness as is to be got only by the degradation of the workmen, and by equally determined demand for the products and results of healthy and ennobling labour."

The first necessity for the improvement of the training of those who intend to follow trades and crafts is a loftier ideal of the functions of elementary education, and chiefly in its human and ethical aspects. At the same time, the minds of the pupils should be trained to correct habits of thought, and in quickness and accuracy of perception, and their eyes and hands in those exercises which are necessary to make the instruction real. These latter should be more of the nature of laboratory work than of workshop routine—that is to say, they should all have an educative purpose, and not be mere pieces of training in manipulative dexterity. Of course a good deal of dexterity would naturally be the result of this kind of training, but it ought to be of such a nature that it would be of use in whatever trade or profession the pupils might ultimately adopt, but all attempts to convert the school into a workshop should be firmly resisted.

The actual workshop or manufactory is the proper place for trades or crafts to be learned, and if the selfish, commercial spirit which now everywhere prevails had not been allowed to warp our ideas of duty we would not have heard the cry for the necessity for improved technical education. Both the masters and the men have been to blame. The masters have used apprentices simply because their labour was cheaper than that of men, some being so unscrupulous as to have the greater part of their work done by them. The men, on the other hand, have been concerned chiefly in the keeping up of wages, and have done little or nothing to maintain the standard of workmanship. The ordinary apprentice is placed in a workshop and allowed to pick up his trade as best he can. For some time he runs messages and does odd jobs until he is able to use his tools, and gradually he makes his way to the more difficult pieces of work, wasting much time and a considerable amount of material in the process, for of real instruction there is little or none. What little he gets is by the generosity of the workmen, and it must be admitted that if he shows any attractive qualities he generally finds some one to take him by the hand. He thus acquires a certain amount of manual skill through the dull routine of his daily work, but as a rule he grows up an uninstructed man and an indifferent workman. When he has finished the years of his apprenticeship he becomes a member of his trade union, and then he claims to be paid at least as well as the majority of his fellow men. This is no exaggerated picture, as I can vouch for it from personal observation, especially in the larger industries connected with wood and iron, and it is supported by all who have had any experience of the matter. For instance, the following is

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SENDING PICTURES BY TELEGRAPH.

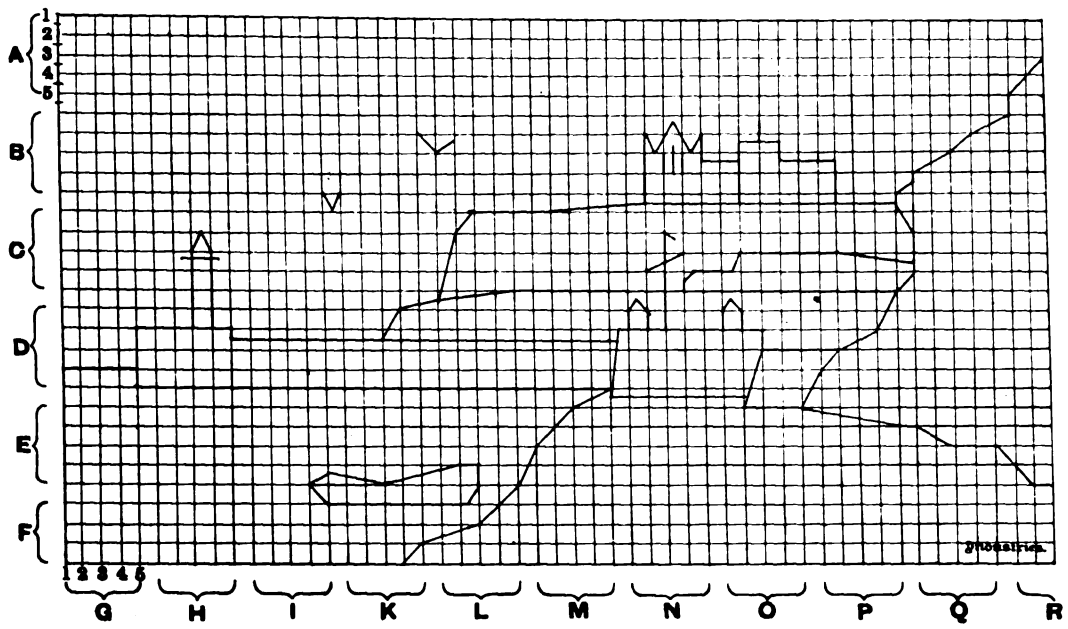


FIG. 1.—CHART FOR LOCATING THE POSITION OF LEADING POINTS IN PICTURE.

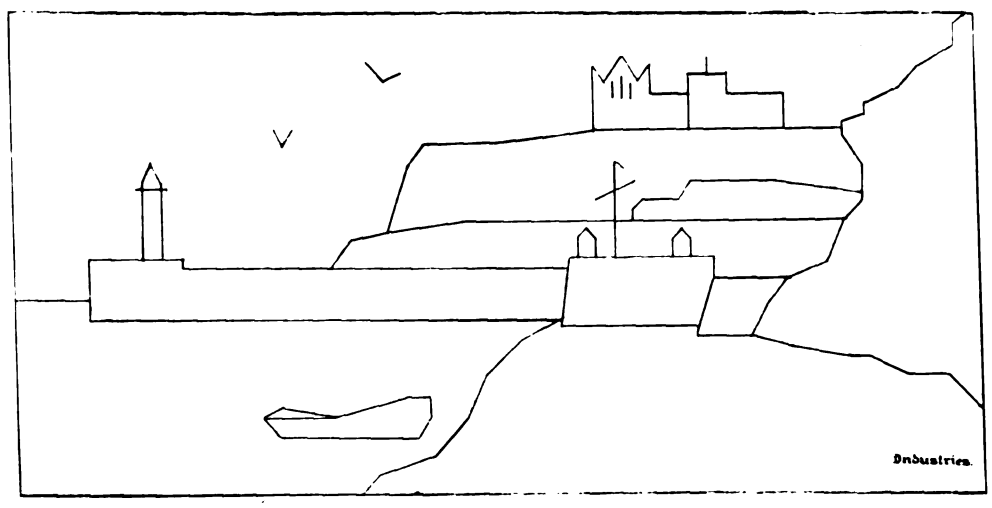


FIG. 2.—ROUGH OUTLINE OF SKETCH TAKEN FROM CHART.

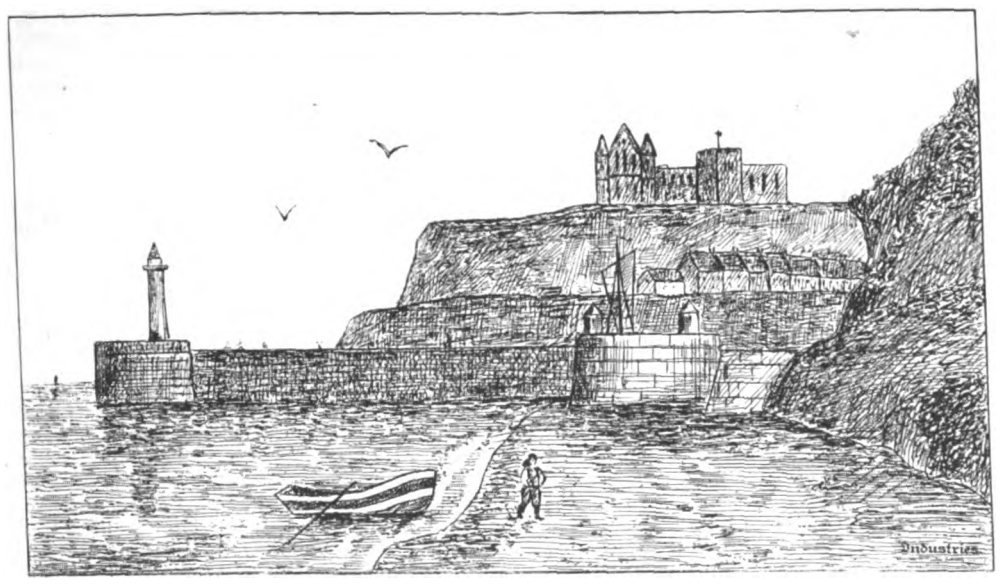


FIG. 3.—COMPLETED PICTURE SHADED IN ACCORDANCE WITH MESSAGE.

from a report by a working mechanical engineer:—"In England at the present time as soon as a boy is sent to learn a trade all mental instruction is discontinued. He conceives he has only to learn to work, and in this he is very much encouraged both at home and in the factory—at home by the indifference of his parents, in the factory by the indifference of master and foreman. In fact he is looked upon as a nuisance and in the way for the first year or two; he is set to do the most trifling jobs, and discipline is often so loose that he becomes a confirmed skulking sloven, his powers of mischief being the only faculties that evince development. The reason for work being done in a particular way is rarely put before him, and it is only when he is grown to almost man's estate that he begins to be regarded as of any value. The foreman, perhaps, notices what branch he shows most aptitude for—vice, bench, or lathe—and to this he is put and kept for the remaining term of his apprenticeship. By these means he becomes, perhaps, a fair turner or fitter, but rarely both. The neglect of mental training during his apprenticeship is so absolute that he is a worse scholar by far than when he left school. The habits of the most recent years of his life are not easily shaken off. Hence, even when he begins to be aware of his deficiencies, he is rarely to be found attending a science school. He lives and works—it may be steadily and soberly—but at the best like a mere machine. In many cases he does not know how to make the simplest calculation in relation to his work."* Moreover, it is well known that "The ever-increasing competition in production has led to the employment in many trades of children to do work of a mechanical kind requiring little skill; but whilst thus employed these young people have little opportunity of learning those parts of their trade in which skill and special knowledge are needed; and when they are grown up and seek higher wages they are dismissed to make room for other children. Numbers of young men are thus thrown upon the labour market, competent to do nothing more than children's work and to earn children's wages, and knowing no trade to which they can apply their hands."† It is thus quite evident that while in the industrial development production has been largely improved the producers have been very much neglected.

It has been frequently stated in recent years that the system of apprenticeship is practically dead, or at least is quite unsuited to the conditions of the present times. In the trades connected with engineering, apprenticeship is certainly not dead, although, like many other things, it may have lost much of its reality. The trades unions have always insisted upon it so far as they can, and so have the masters, at least in the matter of wages. What we want is not a new-fangled system of schools, which would become an intolerable burden to the community, but rather an improvement and extension of those we have, coupled with a higher sense of duty on the part of the employers and employed to those who are fitting themselves to become tradesmen. If we had proper systems of elementary and secondary education, the great majority of those engaged in trades and crafts could get all they required in properly organised evening classes during the time they were serving their apprenticeship. No one should be considered a journeyman until he has reached the age of twenty-one, however long he may have been in the workshops, although those who had been at least five years should be ranked as improvers and receive wages in proportion to their skill as workmen. A minimum of at least three years in the workshops should be required of all who were admitted as journeymen. Arrangements would thus be made which would suit the convenience of boys leaving both the elementary and the secondary schools, the latter of whom would be able to make more rapid progress than the younger boys, not only on account of their greater age, but also because of their better preliminary training.

The present Science and Art Classes, which are now so common throughout the country, would, if their methods were improved, be sufficient to meet the wants of the great majority of the apprentices, but in some cases it might be necessary to institute special classes, and these should be supported by, and be under the supervision of, the trades and crafts. At present this is done by the plumbers, coachbuilders, printers, and others, with the most marked advantages to all.

Those who were able to take advantage of the day classes of a Technical College or University would get all they required in the way of theory in these classes, but such as intended to follow the practice of the work should be expected to serve at least three years in an actual workshop or manufactory. Although trade schools are not likely to make much progress in this country, still a limited number of them would be found useful. There are a great many young men who do not propose to become tradesmen who would find it an advantage to be able to freely use the ordinary tools for wood and iron; others cannot decide what work they would like to follow, and a year or two in such a school enables them to find out their special aptitudes. Then, again, work is so subdivided in manufactories that it is very difficult to obtain a practical knowledge of anything outside the departments in which they may have been engaged, and a short time in a trades school would be of use to them in gaining a little experience in the other departments. Such schools, however, should be either self-supporting, or be kept up by those directly interested in the trades, for if once started and supported by the public rates, they would go on increasing till we had them for every trade in the country, and the tendency would be to transfer many of the functions of the workshop to them, and the whole system would break down through its complexity.

That apprenticeship, supplemented by evening classes for the theoretical parts of the work, is the proper training for tradesmen and craftsmen, is the opinion held by

* "Artisan Reports on the Paris Universal Exhibition of 1878," published by the Society of Arts, page 274.
† Magnus: "Industrial Education."

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all who are well qualified to judge of the matter. It was strongly insisted upon, for instance, by Sir Benjamin Browne, at the last meeting of the British Association, and he mentioned the practice of the firm with which he is connected (R. & W. Hawthorn, Leslie, & Co.) as having given good results. He said that instead of starting new classes the partners decided to pay the fees of every apprentice who attended any evening class approved by the firm. He also advised that, when possible, apprentices should have opportunities of attending day classes for six or eight months when they were just out of their apprenticeship. In our present social and industrial organisation, the element of personal responsibility is gradually being dissolved, and in the training of apprentices it has almost disappeared. If employers of labour would look upon technical schools and colleges as arrangements which had been rendered necessary by our present rather complicated system of civilisation, and give them their material and moral support, and encourage their apprentices to take advantage of them, the problem of technical education would be solved.

(To be continued.)

SENDING PICTURES BY TELEGRAPH.

Mr. H. Rickinson, of 13, Wellington Street, Islington, London, N., is the inventor of a system of transmitting sketches by telegraph. The advantages of such a method of communication lie in its applicability in time of war to telegraphing the position of an enemy, &c. It would also be useful in tracking a criminal, for his portrait could be transmitted rapidly from place to place. The method of working will be understood from the illustrations on page 194 and the above table. The original sketch is divided up into squares by means of ordinates and abscissæ, and each square is identified by the letters which are ranged along the sides of the chart. Each of these squares is again divided into five parts, which are identified by the numbers 1, 2, 3, 4, and 5, and each such part is divided into two, and half the part is denoted by the letter j. Any point in the picture thus has two co-ordinates, as in analytical geometry, and these co-ordinates are communicated by telegraph. A broken line is, of course, identified by a number of points taken along it. When the sketch has been reproduced by joining the points constituting the lines, the details may be filled in by the aid of the descriptive words added. The diagrams and table of the telegraphic message so fully explain the method that further comment is unnecessary. It may be of interest to add that the scene depicted in the specimen illustration is a view from Whitby Harbour.

THE STRAIGHTENING OF CHIMNEY SHAFTS.

By C. Molyneux and J. M. Wood, A.M.Inst.C.E.

The deviation of a chimney shaft from the vertical is often to be traced to the settlement or giving way of the foundation in consequence of too great a load being placed upon it. In some cases it is due to the rapid rate at which the chimney has been built, whereby the mortar in the joints is unable to carry the superincumbent weight; or the chimney may have been canted from the vertical by the force of the wind whilst the mortar is still soft and yielding. There are also cases recorded in which one side of a chimney was exposed to a continuous period of wet weather, which kept the mortar soft and allowed the shaft to settle on one side.

The work of straightening a shaft is a work of considerable difficulty, besides entailing serious risks; in fact, it must be looked upon as a bold piece of engineering, and one in which the utmost caution should be used. All the conditions under which the chimney was built should be known before any work of this character is undertaken; and it will often be found advisable rather to rebuild a shaft than to attempt to straighten it. Under no circumstances should an attempt be made to restore the structure to the vertical position, by sawing out the joints, or removing courses of brickwork—*i.e.*, "cutting back," as it is technically called—unless the shell of the stalk is built solid as a whole, in one material, and is absolutely homogeneous, the brickwork or masonry being of the highest character throughout. Many existing *brick* chimneys have been successfully cut back in the hands of skilful and cautious men; but, on the other hand, many have received fatal cuts, and have either fallen under the operation or a short time afterwards, among which may be mentioned the noted Newlands Mill chimney. The cutting back of *stone* shafts is seldom attempted, there being only a few successful cases recorded. When it has been decided to straighten a chimney, the aid of a specialist or professional "chimney doctor" should be called in: for his experience and staff of workmen, &c., are essential to the successful treatment of the case.

The first operation is to determine exactly how much the shaft deviates from the vertical, and from this a careful calculation is to be made to find the necessary gap or depth of the cut. The cut should be of a wedge shape with a maximum opening at the outer circumference tapering away to nothing at the centre. Allowance has to be made for settlement, so that the chimney shall not afterwards incline in the opposite direction. When the deviation is considerable, it is usual to make several cuts—*i.e.*, at several joints; but in no case should they be close together. If the shaft deviates, as a whole, from settlement of the foundation, the cut is made as low as possible. It must be borne in mind that when once a chimney has been partly cut or sawn through, its stability depends entirely upon its own weight, all cohesion at the bed joint being destroyed; it is, therefore, advisable to keep the cuts as low down as is practicable. When a brick chimney is of considerable diameter the method sometimes adopted is to cut out either one or two courses of bricks half-way round the chimney on the side opposite to that towards which the chimney leans, and replace the same by a thinner course of brick or hard stone of wedge-shape form. In executing this operation the brickwork is cut out in segments of, say, about 2ft., and is replaced by a thinner course. The first incision is made directly opposite to the direction in which the shaft leans; the next incision is made to the right or left, and so on alternately until one half of the chimney has been cut through. As this work proceeds wedges are driven in to keep the cut open. The cutting out can be carried out from both the inside and outside at the same time by the aid of long chisels. As soon as the cut has been made half way round, and the wedges slackened, a loud report is almost invariably heard, which is caused by the breaking of the rest of the joint. The chimney begins to move, and by slight oscillations slowly settles down on the thinner inserted course. A large shaft in Prussia, 331ft. in height, was successfully cut back by this method.

The usual plan, however, now adopted is to make an incision boldly into the shaft, as above described, and insert, as the brickwork is cut away, strong steel screw-jacks, whose function is to support the superincumbent mass above as the masonry in the cut is removed. These jacks are from 7in. to 10in. in length; above and below them are placed strong wrought iron plates to distribute the load and obtain a good bearing. When the cut has been completed, and the jacks all inserted at their proper places, the next operation is to gradually and uniformly unscrew them, till the shaft has nearly regained its vertical position. The space between the jacks, and finally that occupied by them, is filled in with solid brickwork. It is usual to commence making good the cut before the chimney has quite returned to the vertical position, otherwise the slight settlement of the new work will bring the chimney in the opposite direction.

The Townsend Shaft, Glasgow, was straightened by sawing out the brick joints from the inside; no less than 12 cuts were made in the shaft, the first at a height of 41ft., and the last 326ft. from the ground line. Before this operation, the shaft was stated to be 7ft. 9in. out of the vertical: it came back in a slightly oscillating manner, and the men could tell when it was returning by the saws tightening. (See Bancroft, "On Chimneys.") A few years ago a very massive chimney, 100ft. in height, at the Royal Arsenal Gas Works, was successfully straightened. The foundation settled, and the shaft inclined 3ft. 6in. out of the vertical. Notwithstanding that calculations were made which showed that it could remain more than 3ft. out of the perpendicular without over-reaching the limit of safety, it was deemed advisable to cut it back, and this was accordingly done.

In conclusion, it may not be unnecessary to warn proprietors of chimney shafts against unscrupulous practitioners claiming to be "chimney doctors," but who are quacks and incompetent men, and yet always ready to undertake any sort of work of this description.

SENDING PICTURES BY TELEGRAPH.

TABLE OF TELEGRAPHIC MESSAGE CONNECTED WITH CHART ON PAGE 194.

A3R3—A5R1—B1R1—B2Q4—B4Q1—B4jQ1—B5P5—B5jP5—C2Q1—C4Q1—C5P5—D2P4—D3P2 E1O5—E2P5 E2Q1—E3Q3—E3Q5—E5R2—E5R3	Foreground cliff.
D3P2—D3O3—E1O2—E1O5	Stone ramparts (circular).
D3O3—D2O3—D2M5j—D5jM5—D5jO2	Watch houses (circular).
D2N1—D1N1—C5jN1j D1N2—D2N2	Flag staff.
D2O1—D1O1—C5jO1j—D1O2—D2O2	Stone pier.
D2N3—C2N3—C2jN3j	Light house.
C4N2—C3N4	Horizon.
D2jM5j—D2jH5—D2H5—D2G5—D5G5—D5M5	Water line.
D2H3—C3H3—C2H3j—C3H4—D2H4	Boat.
C3jH2j—C3jH4j	Distant cliff.
D4G5—D4G1	Abbey.
D5M5—E1M3—E3M1—E5L5—F2L3—F4K5 F5K4	Windows.
E5K3—E4jI5—E5I4 E5K3 E4L2—E4L3—E5L3—F1L2j—F1I5—E5I4	Church.
B5jP5—B5jN2—C1M2—C1L3—C2L2—C5jL1—D1K4—D2jK3	Lower ledge.
B5jN2—B2N2—B3N2j—B1jN3j—B3N4j—B2N5—B3jN5—B3jO2	Old houses.
B4N3—B3N3... B4N3j—B2jN3j B4N4—B3N4...	Seagull.
B5jO2—B2jO2—B2jO4 B3jO4—B3jP2—B5jP2 B2jO3—B1jO3	
C5P5—C5L5—D1K4—D2jK3	
C5N4 C4jN4 C4N4j C4O1j C3O2 C3P2—C3jQ1	
B2K5 B3L1—B2jL2	

THE DISCOVERY OF COAL IN KENT.

It is now upwards of thirty years since Godwin Austen first pointed out the close connection which exists between the Rhenish and Belgian coal beds, and those in the midland and northern counties of England. Last week we alluded to the success which has attended the efforts of Sir Edward Watkin in this direction, which fully confirm the predictions of geologists on the presence of coal in the south of England. It is gratifying to find, not only that the predictions of the geologists have been fully borne out, but that the two or three years' work under the direction of Mr. Francis Brady, the engineer-in-chief to the South-Eastern and Tunnel Companies, should bear fruit so soon. It is, of course, too early to predict the commercial value of the discovery, but there certainly seems good grounds for believing that a genuine coal field of unknown extent has been reached in the Dover boring, and that there is no obstacle to working these deposits. The seam was struck after passing through 20ft. of clay, grits, and blackish shales, which undoubtedly belong to the coal measures, and resemble very closely the sequence which is observed in the Somersetshire coal fields. The comparative low depth of 1,180ft. at which the find was made is due to these coal measures being separated by only a few feet of intervening beds of sand, limestone, and black clay, and there being no new red marl at the Shakespeare boring. The lines of bedding in the shale are distinctly horizontal, and thus contribute to the ease with which the deposits may in future be worked. It is exceedingly interesting to note that the locality in which the coal has been found, and the absence of any considerable depth of overlying strata, coincides with the predictions of Godwin Austen and other geologists. In the paper already alluded to, he shows that the influence of the old axis of flexure on the distribution of the oolitic and cretaceous groups favours the presumption that there are no very thick series of overlying strata interposed between the coal measure series and the present surface. He placed the position of the hidden coal measures as occupying a line on the north of the Weald denudation, and conforming generally to the direction of the valley of the Thames.

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IMPROVED REDUCING VALVE.

CONSTRUCTED BY MESSRS. WILLIAM REID & CO., LONDON.

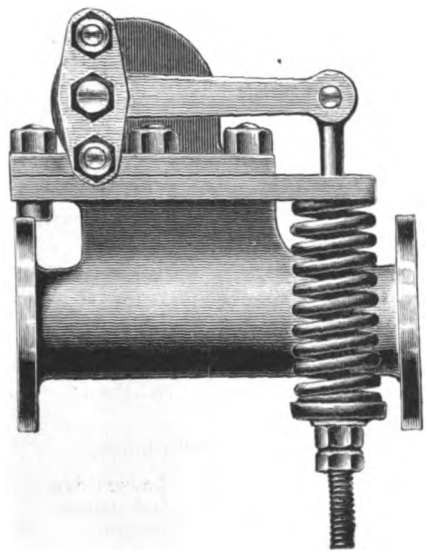


FIG. 1.—FRONT ELEVATION.

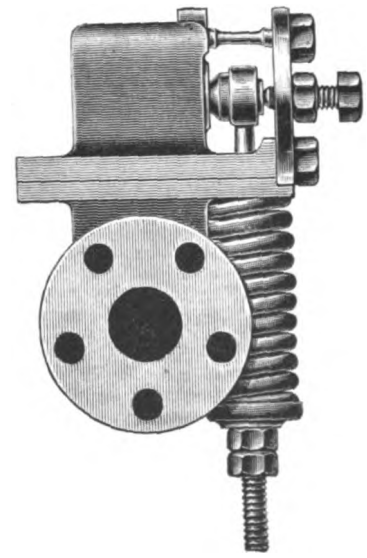


FIG. 2.—END ELEVATION.

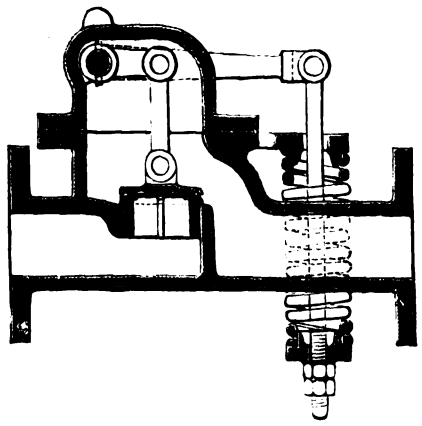


FIG. 3.—LONGITUDINAL SECTION.

There seems also reason to believe that a lower stage of coal deposits also exists somewhat west of the Boulonnais district and of equal value, which in England may occur on a line coincident with the northern chalk escarpment of the Weald denudation. Subsequent to these remarkable predictions of Godwin Austen on "The possible extension of the coal measures beneath the south-eastern part of England," the sinking of several deep wells gave geologists a further insight into the distribution of palæozoic rocks in the London area, since Devonian rocks were found immediately beneath the cretaceous group in London and near Cheshunt, and Upper Silurian shales below the gault at Ware. The British Association boring in 1872 at Battle had to be abandoned at a depth of 1,998ft. in the Oxford clay owing to the smallness of the bore. But later the coal measures were touched in Calais at 1,032ft. and at Burford, in Oxfordshire, at a depth of 1,184ft., identical, in fact, with that of last week's triumph at Dover. Characteristic coal plants were found at both of these places, but as no coal was obtained the borings were abandoned. Although coal was not found at Calais, it is worked beneath the chalk of the north of France in the Valenciennes coal field, which is known to extend 80 miles west of Valenciennes, by Douay, Bethune, and St. Omer.

In 1877 the sinking of a well at Messrs. Meux & Co.'s brewery in the Tottenham Court Road to 1,140ft. revealed Upper Devonian rocks, and this, coupled with the finding of Silurian rocks at Ware, clearly pointed to the absence of the carboniferous series in the whole of the London district immediately north of the Thames. Since 1877 several deep wells have been sunk in the London basin, the deepest of which, at Richmond, reached the trias rocks, while at Harwich lower carboniferous beds and no coal measures were found. Mr. Whittaker, in reviewing the addition to our knowledge from these further sinkings, in a paper on the deep-seated geology of the London basin, read before the Geological Society in 1886, says: "As to the question of finding coal measures along the valley of the Thames, it seems to me that a hopeful answer is possible, or at least that a negative cannot be given, for we know not what may be hidden under the Jurassic and possibly Triassic beds that have been found, and as Upper Devonian and Lower Carboniferous rocks have already been found, it would be strange if the Upper Carboniferous had been wholly swept off." He also states that from topographical considerations, and nearness to tracts where older rocks are known to occur, Dover is well placed, as it is at no very great distance from the outcrop of the carboniferous rocks of Northern France. He further points out that it is clearly of importance to begin any fresh work at as low a level as possible, and adds: "Here, again, Dover is a good site, the lower part of the town being little above the level of the sea. The progress, therefore, of a deep boring at Dover should be watched with much interest."

Prof. Prestwich, in the discussion which followed the reading of the paper, also expressed his strong opinion that somewhere in the district between the Thames, near Chatham, and Harwich, was the spot where the coal measures might most probably be found, basing his argument from the analogy of the succession of strata between Boulogne and the Palæozoic rocks of the Boulonnais and that between the Battle boring, Chatham and Harwich. Recently at the Dover convict prison a boring for water was carried down to a considerable depth, but it had to be abandoned from the want of success in finding water. It reached a depth of 931ft., and passed through the chalk, gault, lower greensand, and Wealden deposits. The Channel Tunnel boring at St. Margaret's Bay is situated 2½ miles to the E.N.E. of the prison boring, and, we believe, passed through the same sequence of beds in the earlier days of the enterprise.

We shall await with much interest further details of the progress of the work, especially with regard to the thickness of the bed reached and the occurrence of lower-lying series. In the report of Saturday, the 15th inst., it will be seen that coal was first found in clay at 1,180ft. from the surface, but that at 1,183ft. 6in. the clay entirely disappeared and the coal recovered was clean and bright, and when tested by burning was found to possess a good bituminous character.

It is less than a month ago that we drew attention in our leader (*Industries*, Vol. VIII., page 61) to Mr. Hall's conclusions as to the duration of our coal supply, which show that we cannot safely calculate on our coal fields lasting more than 200 years at the most. There seems, however, from this discovery in Kent, and from the opinions held by geologists, which we have attempted to review, that there is a possibility of a considerable extension of our supplies of coal, which will necessarily prolong the time of England's independence in this respect.

RADIAL DRILLING MACHINE.

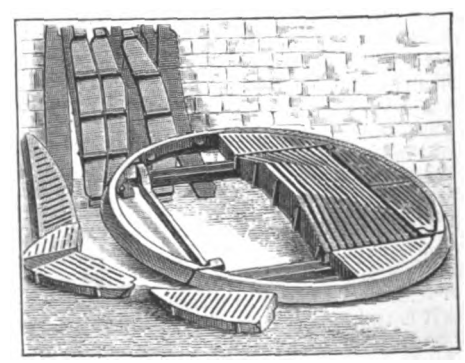
THE machine we show on the opposite page is a balanced spindle 6ft. radial drilling machine. The engravings show clearly the principal features of the machine and their arrangement, and indicate the adaptability of the machine to a wide range of work. The height of the column is 9ft. 1in., which includes the floor table, which is 6in. in height. The elevating screw, in its highest position, is 12ft. The greatest distance from the bed B to the centre of the spindle is 64in., with 13in. additional clearance in the throat D. The traverse of the head on the arm is 50in., while the arm itself radiates in a half-circle. The distance from the spindle in its highest position to the floor table is 74in., and it may be lowered to 19in. The arm has a vertical adjustment of 40in., and is raised and lowered by power. The head is moved on the arm by mechanism, so arranged with gears and rack that the operator can move it quickly, having the advantage of being over his work instead of using the screw at the end of the arm. The steel spindle is 2¼in. in diameter, has a traverse of 15in., and is driven by a 3¾in. belt on a cone having four changes—15½, 12½, 10⅞, and 9⅛in. diameter. The arm can be turned to any degree, as it swivels on a graduated shoe A, which is planed on tracks on the vertical bed B, on which it has a bearing of 29in. secured by four large bolts. The utility of having the shoe planed on the tracks is manifest when the operator desires to throw the arm over and drill in a horizontal position, as he can raise and lower the arm to accommodate the drill and counter-bore and yet retain its exact position with the work. The quick return and feed act the same in all positions. The great distance between the bearings on the vertical bed B obviates the necessity of tightening and loosening the grip bolts on surface drilling, thereby saving a large percentage of time over the ordinary radial drill. The portable table C is 27in. long, 23in. wide, and stands 24in. high. When necessary it can be readily detached and large work placed on the floor table, the extreme dimensions of which are 127in. long and 58in. wide. This table is provided with five planed slots. All the shafts are steel, and the bearings long and large. All the slides are scraped to fit. A speed of the counter-shaft of 190 drives the spindle on quickest speed 190, and on slowest with back gears nineteen revolutions per minute. The balance-weight runs on planed grooves and requires no adjustment in the positions shown. The shipping weight of the machine is 10,500lb. This and the patented 16in. and 26in. stroke traverse head shapers are specialties built by William H. Warren, of Worcester, Mass. We are indebted to our contemporary, *The Iron Age*, for the illustrations.

IMPROVED REDUCING VALVE.

WE illustrate above an improved reducing valve which is now being placed on the market by Messrs. William Reid & Co., 45, Fenchurch Street, London, E.C. It will be seen that there is no packing required and no so-called automatic parts to get out of order. The valve can be fitted easily in the engine-room, as it occupies but little space, and, as will be seen from the illustrations, its construction is extremely simple.

IMPROVED GRATE FOR VERTICAL BOILERS.

THE new form of grate which we illustrate below has been invented and is being manufactured by Mr. N. Downing, Clarence Foundry, Stockton-on-Tees. It will be seen from the figure that the central part of the grate is raised; thus there is very little fire in the middle, and

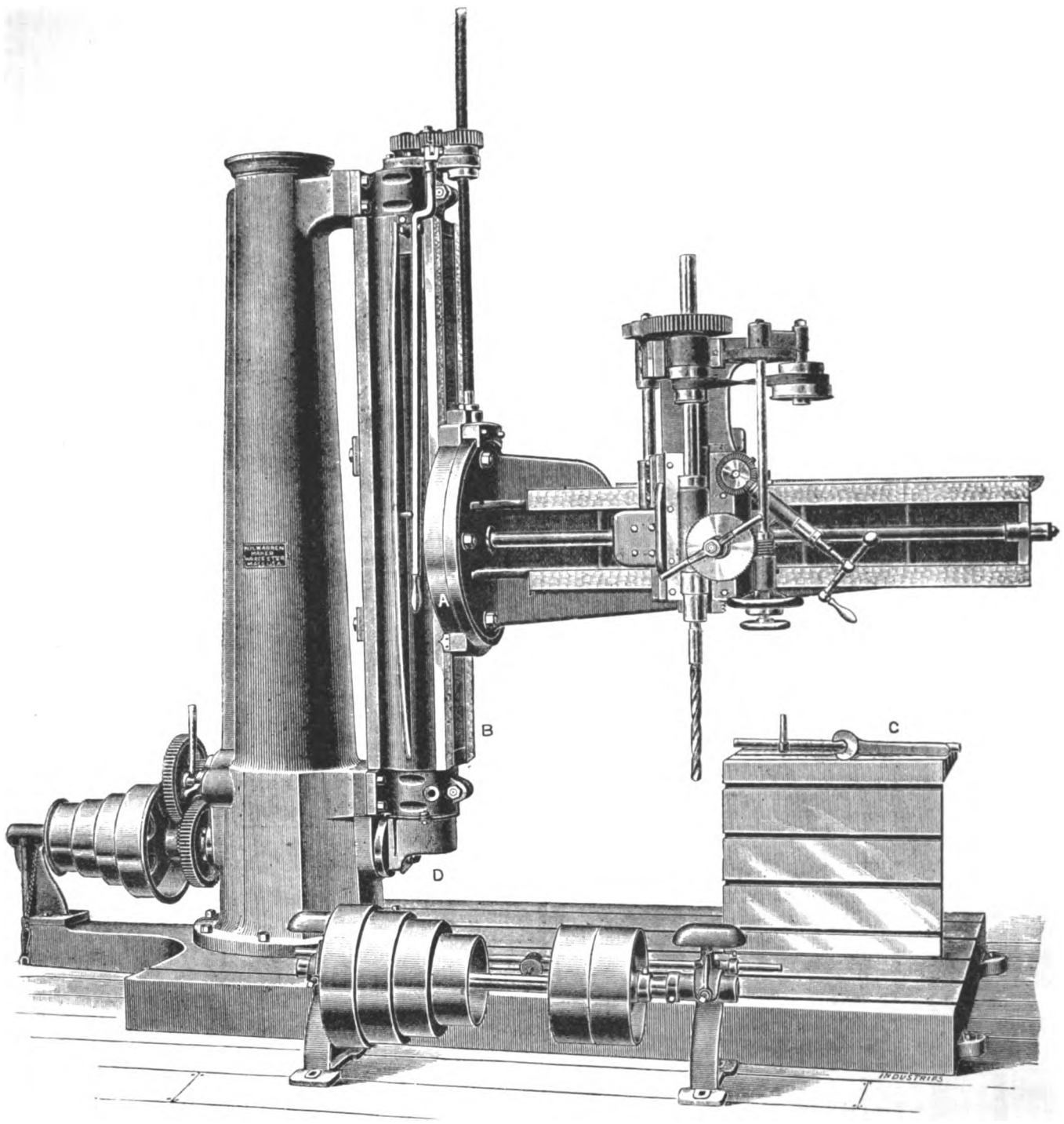


the air can thus pass through more freely and mix with the unconsumed gases as they come off from the outer layers of fuel, which are thicker. The inventor claims that the fuel is more thoroughly consumed, and that an economy of fuel is the result. The grate is made in segments, in the way indicated in the illustration, and if one part wears out before the rest, it can be easily replaced.

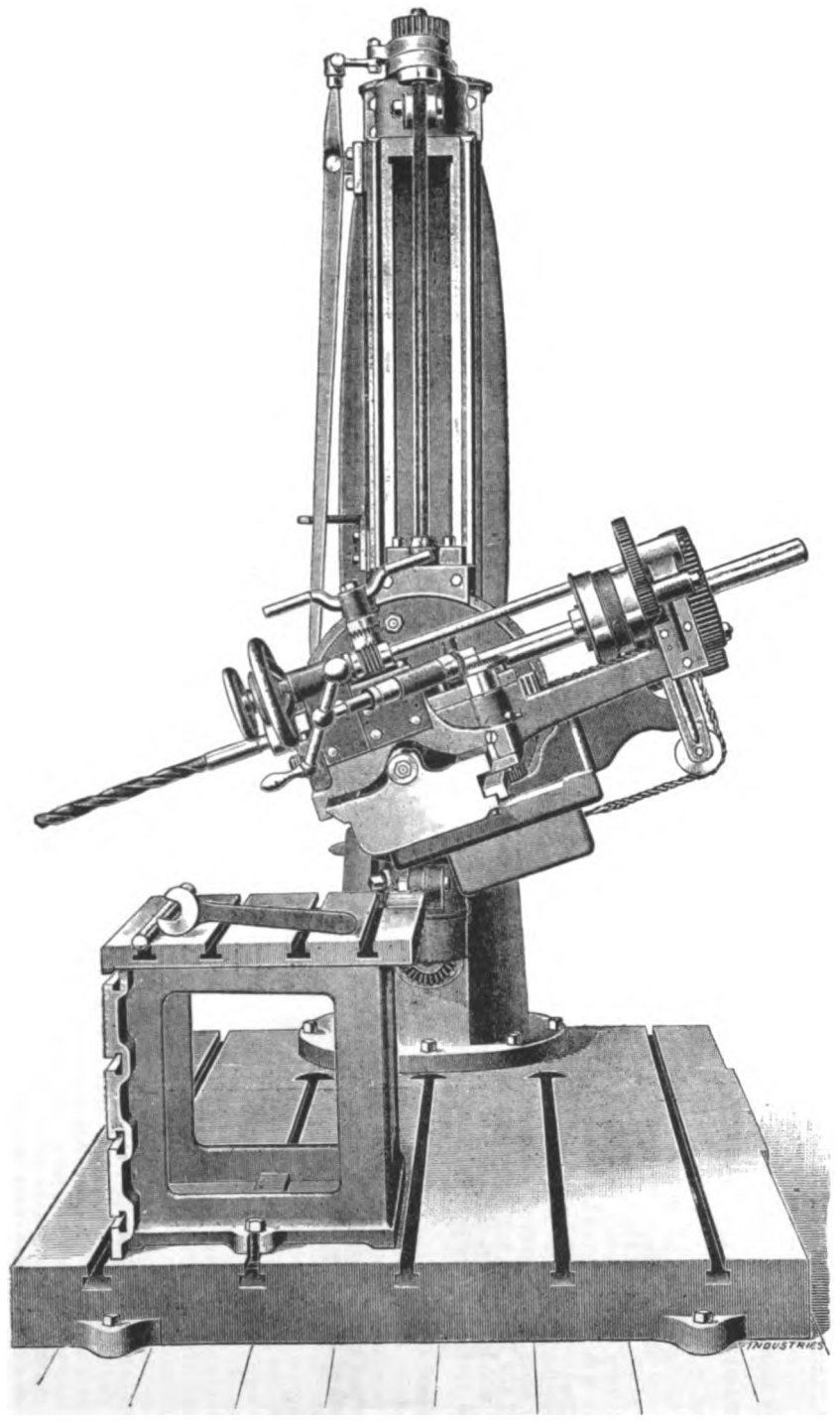
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RADIAL DRILLING MACHINE.

CONSTRUCTED BY MR. W. H. WARREN, ENGINEER AND MACHINIST, WORCESTER, MASSACHUSETTS, U.S.A.



SIDE VIEW SHOWING DRILLING SPINDLE VERTICAL.



FRONT VIEW SHOWING DRILLING SPINDLE INCLINED.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

(FOR LATEST TELEGRAPHIC DESPATCHES SEE PAGE 201.)

PARIS, 25TH FEBRUARY, 1890.

COAL.—The market for coal continues active and buoyant in spite of the high prices prevailing. Coal which a year ago could be purchased at Rouen for 13s. a ton now sells at 27s. to 28s. There is no prospect of lower rates. The miners seem disposed to demand still higher wages. There is much efferverscence among the colliers of the St. Etienne basin. Some 2,000 have turned out on strike on some trivial pretext. It is feared that this disturbance may bring about a general strike in the locality. The miners of the North are now receiving a high rate of wages, with which, however, they do not seem to be content. The cost of production is being everywhere increased.

THE FOREIGN COAL TRADE.—The shrinkage in the imports of foreign coal is continued into the year 1890. The quantity received for consumption in the country in January amounted to 580,999 tons, against 587,012 tons in the same month of 1889. The falling off is pretty equally distributed over the trade with England, Belgium, and Germany. As a set off to the shrinkage there was a considerable increase in the purchases of foreign coke, 72,799 tons against 67,078 tons. This increase was wholly in the trade with Belgium, the German imports having fallen off heavily. The exports of French coal in the month of January amounted to 85,740 tons against 63,399 tons in 1889 and 26,375 tons in 1888.

IRON.—There is but little doing in the Paris market, and though merchants have issued circulars announcing a further rise, they find it difficult to obtain last week's prices. Business continues active in the Haute-Marne, where one manufacturer has put up his price for bars to 168s. The pig iron market of the Meurthe-et-Moselle shows some symptoms of weakness. It is reported that a large iron and steel works is about to be established at Longwy, in which Belgian and French capitalists will take part. Founders are getting more busy again. Business seems to be steadily reviving in the Ardennes. The weakness which appeared in the markets for finished iron and steel in some places at the beginning of the week has disappeared.

OSIER CULTURE.—The Société d'Agriculture of Montreuil-sur-Mer has addressed a petition to the Minister of Agriculture praying for the imposition of an import duty of 3·75fr. per hundred kilogrammes on peeled osiers, and one of 1·50fr. on the unprepared bundles. It appears from this petition that foreign competition is fast destroying the formerly important industry of osier growing in the valleys of the Caniche, the Lys, and the Aa. The imports of osiers last year amounted to 79 tons against 53 tons in 1888 and 18 tons in 1887.

PRODUCTION OF IRON IN 1889.—The official statistics of the production of iron and steel in the year 1889 have just been published. From these we learn that the make of pig of all sorts amounted to 1,722,480 tons, of which quantity 940,719 tons were produced in the Meurthe-et-Moselle. The production of finished iron amounted to 793,358 tons, and that of steel of all sorts to 529,021 tons. This is a considerable increase for all classes on the production of the previous year.

TELEPHONES IN PARIS.—The Minister of Posts and Telegraphs has decided to erect a large telephone exchange in the centre of Paris. There will be accommodation for 30,000 subscribers. This should cause a great improvement in the telephone service.

ELECTRIC LIGHT ON IRONCLADS.—The ironclad "La Hoche" has an electric light installation which is worthy of notice. There are six projectors, which are fitted with arc lamps of 70 amperes, 14 incandescent lamps of 50 c.p., 23 incandescent lamps of 32 c.p., and 350 of 10 c.p. The voltage of the current is 65. The motive power is supplied by compound engines by Messrs. Breguet, the speed being 350 revolutions per minute, and the current is generated by four Desroziers dynamos.

BERLIN, 24TH FEBRUARY, 1890.

BRESLAU INTERNATIONAL MACHINERY FAIR.—The twenty-seventh international machinery fair will this year be held at Breslau on the 9th, 10th, and 11th of June next. The necessary space has already been obtained and a large number of allotments made. Dutiable goods will be admitted and returned free if unsold. Also for such goods the railway authorities have offered to forego all charges for the return journey, provided they be sent back within four weeks of the close of the fair. Judging from the applications for space in this important international market, the meeting will be this year an exceptionally good one.

BRESLAU STRAW HAT MANUFACTURE.—Breslau is, after Dresden, the most important centre of the straw hat and bonnet trade of Germany. Breslau, indeed, takes the first place for quality of manufacture and taste in design. The number of persons employed—chiefly women and girls—in this industry is about 2,000, and the mean value of the annual production about two million marks. Besides the straw goods ladies' felt hats are manufactured to the value of about one million marks annually. The export trade in straw hats is rapidly growing. The number exported in 1889 amounted to 2,861,153 for untrimmed, and to 549,192 for trimmed goods. More than half the former were sold to French customers.

JUTE FACTORY.—A share company, with a working capital of one million marks, has been formed at Bremen, to take over and work the jute spinning and weaving factories of the firm of Vogt, Wex, & Co., at Delmenhorst. The company will be known as the "Hanseatische Jute-Spinnerei und Weberei."

LINEN YARNS.—The linen yarn market grows more active. From Trautenau we learn that buyers are dealing freely. Prices are very firm. At Bielefeld, too, the market is strong, the demand having freshened a little of late.

THE SMALL ARMS INDUSTRY.—Great activity prevails in all the small arms factories, both Government and private. The Oberndorff works in Wurtemburg are busy on an order, recently received from the Turkish Government, for 400,000 Mauser rifles and 40,000 carbines. Upwards of 115,000 rifles have already been delivered in Constantinople.

COAL IN BERLIN.—The coal and coke consumption of Berlin in 1889 amounted to 1,319,957 tons. Besides this there were consumed 678,902 tons of lignite. The use of lignite is rapidly increasing. By far the greater portion of the Berlin coal supply is derived from Upper Silesia. A small quantity of Westphalian and English coal finds its way to the capital.

PAPER PRICES. At a meeting of the Silesian paper makers the other day it was decided to advance prices 10 per cent.

PAPER EXPORTS.—The exports of German-made paper in 1889 amounted to 299,456 cwt. of wrapping and packing paper, 558,010 cwt. of printing, writing, and drawing paper, and 50,700 cwt. of wall paper. The quantities shipped to Great Britain were 109,302 cwt. of the first, 134,134 cwt. of the second, and 1,908 cwt. of the third.

LARGE GUNS.—Some time ago M. Krupp, of Essen, received an order for twenty large guns from the Spanish Government. These guns are to be used for defence at various seaports in Spain, and they each weigh about 50 tons, the bore being 30 centimetres. Five of them are now being shipped at Hamburg, where they arrived by rail from Essen. Great satisfaction has been expressed by the representatives of the Spanish Government.

PAPER PULLEYS.—The company which carry on the works of Klein, Schanzlin, & Co. are now selling pulleys which are made by hydraulic pressure from paper pulp. They claim that their frictional grip is greater than that of cast iron pulleys. Thus, the tension of the belt may be reduced, and consequently the vibration of the machinery.

VIENNA, 24TH FEBRUARY, 1890.

THE COAL MARKET.—There is no change to be noted in the coal market. The business is very animated, and prices are firm, with a tendency to advance.

THE IRON MARKET.—The animated business in all branches of the market is being followed by a raising of the prices, not only as regards pig iron, but also as regards manufactured iron of all kinds. The opinion prevails, however, that this haste to raise the prices will cause the prices to become rather uncertain. Machine manufactories are very busy, and their inability to accept orders is retarding some other enterprises. Some home capitalists are making the most of this good state of things by erecting a new machine shop near to Brünn.

ELECTRICAL ENGINEERING.—The adoption of the electric light in Austria is proceeding apace. The Empress's villa at Lainz has been lighted in this manner for three years or so, the installation having been put in by B. Egger & Co., and in a short time the summer residence of the Emperor at Iselil is to be lit in the same way. The watering places are following each other's examples in providing public installations, and in a short time all the more important ones will be lit electrically. At Carlsbad the central station will be supplied with alternate current dynamos by Hilbert, of Nürnberg. At Brünn it is probable that a fourth installation will be erected shortly. Most of the electrical firms will be represented at the forthcoming Agricultural Exhibition at Vienna. Messrs. Siemens & Halske have established a cable manufactory at Vienna. This makes the tenth large cable works in Austria-Hungary. A company is about to start a works near Gastein for the manufacture of aluminium by the same process as that used at Neuhaus in Switzerland. The steam tram company and the electric tram company at Vienna have amalgamated; by this means Vienna will possess the longest electric tram-line in Europe.

BRUSSELS, 25TH FEBRUARY, 1890.

THE COAL MARKET.—The position of the coal market remains good. There is a great deal of anxiety as to the height of the prices for coke, and there seems to be no likelihood of any abatement or fall. Several producers have sold the whole of their coke, for the whole of the year, at a price of 35fr. Coking coal is quoted at about 20-23fr., and it is quite as scarce as the coke itself. The directors of the collieries in Belgium are petitioning the Minister of Railways to maintain the special tariffs for the transport of fuel.

THE IRON MARKET.—New orders are rare at present. The position of the market will probably not alter for ten days or so, when it will be necessary to commence work on a good many contracts; then the buyers will come up more readily, unable to hold off any longer. The basis price of merchant irons remains fixed at 18fr., but many rolling mills are demanding more. Sheets are firm at 22fr., and makers of girders demand 17fr. to 18fr. Pig iron is rare, and maintains its high price.

GLASS WORKS.—The construction of the syndicate for controlling the export of window-glass to the United States is being actively carried out. The committee for considering the subject has met several times, and will soon be in a position to place a definite scheme before the meeting of glass makers. The price of window-glass remains stationary.

THE BELGIAN SOCIETY OF ENGINEERS. The Society of Belgian Engineers has just devoted two sittings to the study and discussion of the various systems of transmission of energy and to the consideration of the methods of distribution of electric light and motive power in towns. M. Anspach made a comparison between hydraulic transmission and high and low tension electric currents. He favoured the high tension (2 000 volts) system, and pointed out that the cost of distributing was much lower than by the low voltage. The dangers of high tension were, in his opinion, much exaggerated. One advantage of the high tension was that the central station could be at a distance from the distributing area, while the central station for the low tension current had to be near at hand in the middle of the town. M. Anspach did not think much of M. van Rysselberghe's hydraulic system and turbines. M. Bede combated the opinions of M. Anspach with regard to the high tension system, and M. van Rysselberghe defended his hydraulic transmission. At the second sitting of the society M. Bede explained the Popp system of transmission of energy by compressed air. The advantages would be seen in the fact that the air could not only be used for driving electric light generators, but also for ventilating and cooling purposes. M. van Rysselberghe's system had the disadvantage that nothing useful could be done with the water after it had been used.

DÜSSELDORF, 25TH FEBRUARY, 1890.

COAL.—Notwithstanding the anxiety felt respecting the attitude of the working miners—whose threat to strike early in March to enforce a claim for a 50 per cent. rise in wages is, thanks largely to the action of the English miners, likely to be carried into effect—the coal market is steady. Production has now reached its maximum. The quantity sent away daily from the Westphalian pits averages about 10,500 ten-ton truck loads. This is not only as much as the pits can turn out, but as much as the railways can deal with. The official statistics of the coal industry in 1889 show that, practically, the whole of the great increase in prices in that year has gone into the pockets of the middlemen.

A COLLIERY OWNERS' DEFENCE ASSOCIATION.—The frequency and gravity of the strikes which have of late occurred in the coal-mining districts have forced home on the colliery proprietors the necessity of combination. An association is now being formed here which will be a beginning in this direction. The principal rules of this association are to the following effect:—The contracting parties undertake to guarantee one another from loss in the case of a strike occurring in the pit of any member of the association. Before an indemnity be paid, however, the council of the association must declare the action of the men unjust, and, further, the number of men out on strike must be at least one-third of the total number employed. The amount of the indemnity is to be determined by the council. The guarantee fund is to be about one and a quarter million marks (some £62,000). Each colliery company is to contribute to this fund proportionately to the number of tons of coal it produces annually. This counter movement among the employers of labour, if taken up generally, as it is expected to be, will have important consequences to the industry of this country, and indeed of all countries.

IRON.—The iron market has developed no new feature in the week last past. In tone, however, it is somewhat firmer since the recovery in the English markets. Relatively to the past, business is quiet, particularly in crude iron, which is now much less largely dealt in. Prices remain firm, however, but the buoyancy of the market, which was so striking a feature a few weeks ago, is gone. There is a strong and steady current of business in finished iron and steel. At the meeting of the West of Germany Common Plate Makers' Association, held at Cologne on the 21st inst., it was agreed that the existing situation is, for the plate trade, exceptionally good, and the near prospect encouraging. No alteration was made in prices, which stand as follows:—Iron boiler plates, 260s.; common plates, 235s.; steel boiler plates, 225s.; and common plates, 210s. per ton.

ASSOCIATION OF IRON GALVANISERS.—A well-attended meeting of iron galvanisers was held a week ago at Cologne with a view to the formation of an association or syndicate for regulating the prices of galvanised sheets. A committee of six was appointed to draw up rules to be submitted to the next meeting called for March 10th.

LILLE, 25TH FEBRUARY, 1890.

IRON.—The iron market has an appearance of strength, but it is said that iron in quantities of considerable importance may be bought a few shillings below the official quotations. Certainly orders are not coming in so freely as formerly. The Government statistics of production in 1889 give as the output of the Nord 216,714 (1,722,480)

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tons of pig iron, 310,494 (793,358) tons of finished iron, and 67,230 (529,021) tons of steel. The quantities in parentheses are the totals for the whole country.

TEXTILE MANUFACTURES.—The market for linen goods is scarcely so active as it was last week, but some falling off is usual at this season of the year. The great Paris houses are buying less. In part compensation, however, inquiries from the provinces are more numerous. Prices are well maintained. The quantity of linen piece goods sent away from Armentières in 1889 amounted to 323,286 cwt., an average of 26,940 cwt. per month. Business in the woollen goods trade of Roubaix is falling off, the summer purchases having been for the most part completed. Manufacturers are already turning their attention to the next winter season, and are getting their new patterns ready.

FLAX AND YARNS.—The last few days have been a period of great activity in the market for raw flax. Large transactions have taken place in Russian produce for forward delivery at prices favourable to buyers. Home-grown flax has been freely offered for sale, and prices are in consequence a little weaker. The demand is brisk. Yellow Courtrai has been largely dealt in. The market is quiet for tows. Business is not very active for yarns, yet the sales effected are said to be sufficient to absorb the whole of the production. The finer numbers are most sought after. The market is active for jute yarns.

AMSTERDAM, 24TH FEBRUARY, 1890.

THE PETROLEUM TRADE AT ROTTERDAM.—The Communal Council of Rotterdam has sanctioned the agreement proposed by the communal authorities for the transfer of a tract of river bank near Charlois, under Rotterdam, to the German-American Petroleum Company at Bremen, who will virtually represent the interests of the Standard Oil Company of the United States. The lease is for fifteen years, from the 1st of April next, and will be renewable for ten years at the option of the lessee as soon as it expires. The town will get sixpence per square metre per annum, the area of the land being 5½ hectares, but the town authorities are to expend some £6,000 in constructing an embankment, with landing places, &c., along the front of what will virtually become the petroleum depôt of Rotterdam. The contract has not been sanctioned without some opposition, several members of the Communal Council complaining that the terms are too low compared with those demanded for the same purposes at Antwerp, and others protesting against the right of the lessee to store naphtha and turpentine at Charlois. These objections were overruled.

SAFETY ON RAILWAYS.—A Dutch engineer is applying for patent rights throughout Europe and in the United States, for a new system of preventing railway accidents which he claims to have discovered.

PRESS MESSAGES TO THE DUTCH EAST INDIES.—The Dutch and the Dutch-Indian Governments have agreed with the Eastern Extension Telegraph Company to introduce press cablegrams between Holland and her East Indian possessions at a special reduced rate.

"COCOA-NUT BUTTER."—Much attention is now being paid to the new product called "cocoa-nut butter," prepared from the fat contained in the cocoa-nut and from other vegetable fats. This "butter" is said to be richer and more palatable even than many margarines of low grade. Nethertheless, "butter" is a misnomer, as the new product is not intended for competition with dairy butter, but exclusively for cooking purposes. At present it is not manufactured in Holland at all, but only at Mannheim, where the invention of Dr. Schlemk, at Ludwigshafen, is worked by a private factory, which in 1889 turned out about one thousand kilogrammes of "cocoa-nut butter" a day, the market value thereof being about one shilling and twopence a kilogramme. But a factory upon a somewhat larger scale is at present in course of erection at Amsterdam, and the promoters of the Dutch Vegetable Butter Company believe that their article has great possibilities in the near future. They point out that the islands of the Dutch East Indies contain an inexhaustible supply of cocoa-nut palms, and that the nuts can be obtained in great quantities at a merely nominal price. These nuts are certainly valuable, because they contain not only a large amount of fat, but are enclosed in a fibrous substance, which resembles jute, and can be manufactured into yarn. The Dutch Company will, therefore, produce and bring to market two entirely distinct articles of commerce, yet coming from the same fruit—viz., "cocoa-nut butter" and cocoa-nut yarn, the latter already known in England for some time, as it is manufactured in British India.

A DUTCH PHONOGRAPH COMPANY.—There is in course of formation a Dutch Phonograph Company, which is to take over and work the Edison patents in Holland. It is intended by the promoters, who are well-known engineers in Amsterdam, to bring the phonograph within the reach of all by means of low sale prices, and by hiring them out at a moderate rental. Competent agents will be appointed in the leading cities, who will be charged with the periodical inspection of phonographs sold or let, and from whom purchasers and hirers will be able to obtain every information.

GERMAN-DUTCH RAILWAY GOODS TARIFFS.—At an important meeting of railway managers, both German and Dutch, held at Düsseldorf, it was resolved to lower the transit rates for goods considerably, as from May 1st, both viâ Belgium and viâ Dutch routes.

COPENHAGEN, 22ND FEBRUARY, 1890.

TIMBER IN SWEDEN.—Some important sales of forests have recently taken place in Sweden, where there appears to be a tendency at present to bring large tracts of forest under the same proprietorship. The Meyer Company at Karlshamn has of late bought very extensively in Vestbo, Unnaryd, &c.; not long ago they paid away on one day 500,000kr. to various sellers of forest. At Falun the right of cutting for four lots of the Orsa forest was sold at 424,150kr., which was about 25,000kr. above the reserve put upon them.

PROJECTED CANALS.—An extension of the old Stens canal at Jonsborg, Norway, which was built in the beginning of last century, has been decided upon by the Jonsborg Corporation. The projected canal is to have a depth of 21ft., and to take a straight line from Trälen to the Obe Bay. The cost has been calculated at 355,000kr., of which it is proposed that the State shall pay one-third, and the Jonsborg Corporation the rest. A large canal is under contemplation so as to establish a connection between the Lake of Venern, Sweden, and the Kattegat, as well as with the towns of Venersborg and Uddevalla. The Venern is the largest lake in Sweden, and has hitherto only been connected with the Kattegat through the Trollhättan, with its celebrated falls. The canal is 8·16 kilometres long, 2·97 metres deep, and 1·9 metres broad. It has sixteen sluices. The new canal would be 25 kilometres long and have a depth of 7 metres. It is intended to accommodate vessels up to 3,000 tons, and the canal, if carried out, will no doubt prove of great advantage to the numerous iron works in the interior of Sweden. An annual traffic of some 100,000 tons of iron is looked upon as likely to pass through the canal, and it will also prove of importance to the timber traffic. Apart from this, it will, of course, greatly facilitate the general traffic between Venern and the Kattegat. There is a good feeling for the canal being constructed, and there seems to be fair prospects of the plan being realised.

PROPOSED LAW FOR WORKMEN.—Measures for benefiting and protecting the working man are at present under consideration, and an important Government Bill has just been introduced in the Norwegian Parliament. The measure deals with all kinds of manufactories, but not with the workshops of the artisans proper. The regulations of the measure refer to the following questions: (1) Safety and sanitary measures, &c.; (2) rules for the protection of labourers by restrictions in the ordinary freedom of contract between employers and the employed; (3) regulations for control and inspection; (4) regulations for punishments, &c. Of these various regulations the following may be worth mentioning. In order to ensure the men's safety in case of fires, all manufactories, &c., shall have the necessary number of staircases and exits, and where circumstances require it there shall be special safety arrangements. On all manufactories' chimneys above 2 metres high, and on all larger manufactories, there shall be lightning conductors. Regulations are further given with regard to appliances of safety against danger from machinery in motion, &c., and to prevent the evil effect of injurious steam, dust, &c., and about the proper ventilation, lighting, warming, and cleaning of the premises. It is left with the Government to frame rules for inspections of boilers, &c. At every place of working the men shall be able to get their food warmed and accommodation for the hands to have their food in a warm room when the weather makes this necessary. It is left with the Government to give special regulations with reference to manufactories, &c., especially injurious to health, and to give orders about the men not being allowed to take their meals or spend their off-time in such places. As to children being employed, the lowest age has been placed at twelve years, and children between twelve and fourteen years only be used on a doctor's certificate that they are suitable for such work; nor must the hours be more than 6½ hours per day. The children shall have at least half-an-hour's rest not later than 4½ hours after commencing work, and all night work is prohibited for children. Nor must their work interfere with their attending school. Children must not be employed on underground mining work nor at any dangerous occupation. Lads between fourteen and eighteen years must not work more than ten hours a day and not between the hours of nine p.m. and six a.m.

MADRID, 24TH FEBRUARY, 1890.

THE BELMEZ COAL COMPANY.—The news coming from England that a company, with £140,000 capital, has been formed in London to work some coal mines in the Belmez district, has come as a surprise to every one. There are great doubts as to the success of coal mining in that district by a company which is not powerful enough to make a railway to a shipping port on the Guadalquiver. At the present rate of carriage there is nothing to be done but a very small retail business, whilst with a special railway line for conveying coals the Gibraltar market might be supplied from the Belmez district.

SHIPBUILDING YARD AT CADIZ.—It is reported that a shipbuilding yard and docks are being commenced at Cadiz, but its prospects of completion are rather vague.

IRON AND ENGINEERING INDUSTRIES.—Representatives of all the iron works and engineering firms have met at Madrid to discuss what course they ought to take in connection with the Parliamentary inquiry going on respecting the treaties and modifications in the Custom House tariffs. So far, the advantage has been altogether on the side of the iron smelters and rolling mills, as whilst the duty on pig iron and bars, as well as on steel, has been from 20 to 35 per cent., engines, boilers, and machinery in general have only paid a nominal duty. The question now is for the parties to agree on proposals to the Government which can be supported by the iron and steel makers and by the engineering trades. It is evident that pig iron and bar iron will be much lighter taxed, whilst the duty on machinery, railway rails, and rolling stock will be rigidly imposed, although it may not be a heavy one. We may look in future to see many more boilers, steam engines, and locomotives made in the country, and English firms with specialties which are sold freely in Spain will do well to be prepared to establish branch works in the North of Spain, especially the makers of Knap and of Babcock and Wilcox boilers.

SECONDARY RAILWAYS.—The Bill pending at the Cortes for an extended system of secondary railway lines, with interest guaranteed by the Government at the rate of 5 per cent., has been withdrawn by the new Minister of Public Works. It is the third project which has suffered this fate.

NEW YORK, 15TH FEBRUARY, 1890.

THE COAL MARKET.—There is little improvement in the anthracite trade. The production has increased slightly, and the prices are not likely to be lowered any further. The output for January was 300,000 tons less than for the corresponding month during any of the past five years. This restriction, besides being expensive to everybody connected with the trade, has had no favourable effect. A feeling is growing that something more decisive must be done. It is believed that a public association should be formed and the supply regulated and adjusted to the demand. The leading companies are agreeable to a concentrated action as far as the trade of the present year is concerned. The demand for bituminous coal is large and the movement of coke is above the average.

GLASS.—The members of the American Window Glass Importers' Association met in Springfield, Mass., on the 5th inst., and advanced the price of window glass 5 per cent. for the next five days, at the end of which time a new price list was issued and the prices advanced by 10 per cent. The demand for glass is quite remarkable. The formation of all the glass manufacturers in Pittsburg into a joint stock company is now in progress, and when this is completed all the window glass made in this country will be under the control of three large firms.

AN EDGE TOOL SYNDICATE.—At a meeting in Pittsburg on the 5th inst. the American Axe and Edge Tool Company was formed. The new corporation comprises all the axe and edge tool companies in the country. It purchased the plants outright, and will operate them under the management of their former owners. The capital stock of the new company is $4,000,000. The company will have its chief office in Pittsburg, and will have the control of 10,000 men. The object of the combination, according to the officials, is not to advance the prices, but to economise production by being enabled to purchase raw material cheaper.

A NEW STEEL BRIDGE.—The Canada Atlantic Railroad steel bridge over the St. Lawrence at Coteau Landing has been completed, and freight trains have made the initial trips. It has occupied ten months and ten days in completion. There are seventeen fixed spans, one of 139ft., two of 175ft., ten of 217ft., and four of 223ft. each, while the swing bridge covers 355ft. over the main channel.

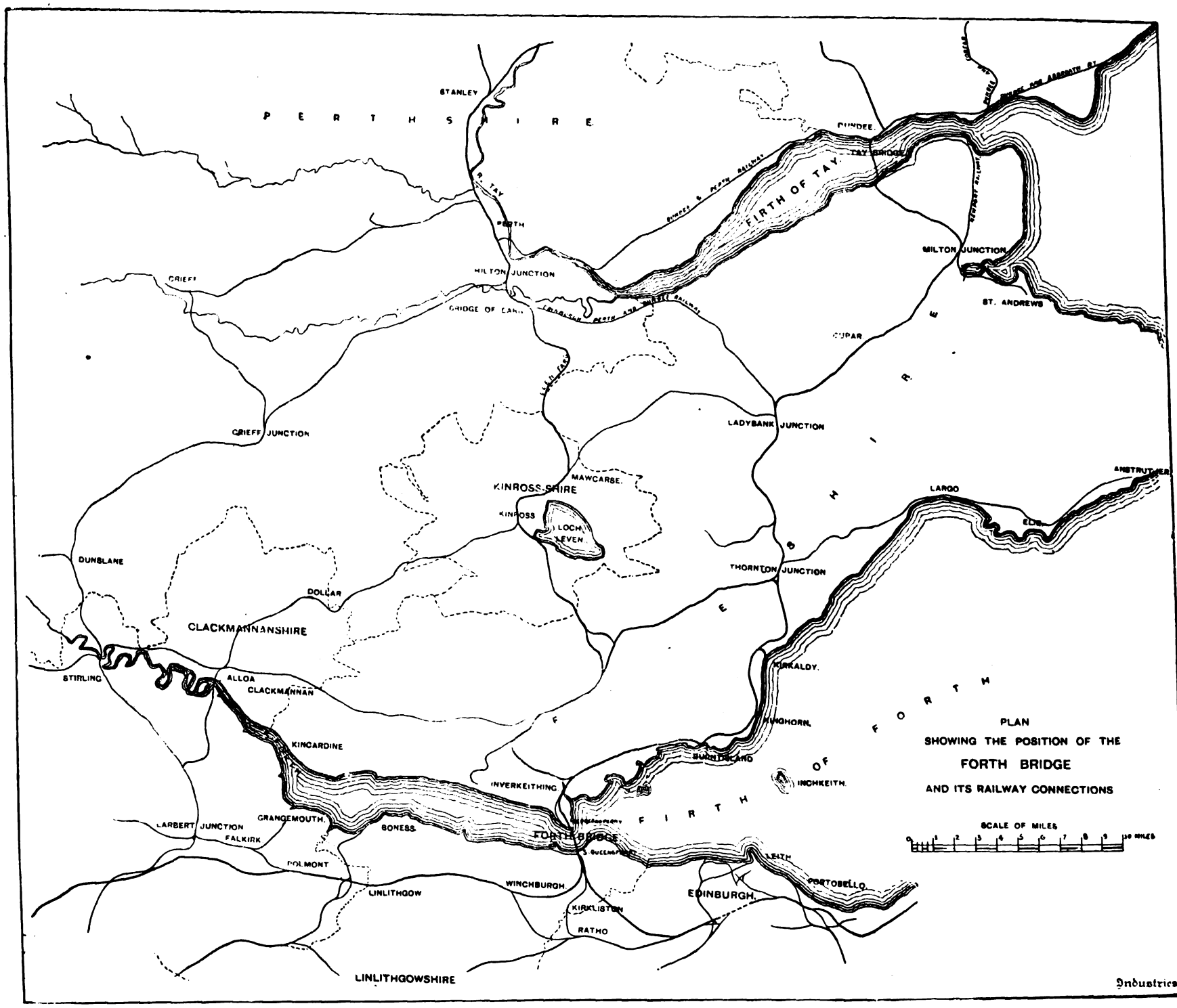
A HARBOUR OF REFUGE.—Congressman O'Neill has presented a memorial from the Philadelphia Board of Trade, the Commercial Exchange, the Maritime Exchange, the Captains' and Vessel Owners' Association, and other commercial bodies of Philadelphia, asking for the appointment of a Board of Engineers for the purpose of making a survey and report on the construction of a harbour of refuge for deep draught vessels at the mouth of Delaware Bay. This is a question which vitally concerns the maritime interests, as the Delaware breakwater is totally inadequate for a safe harbour, as may be imagined from the numerous wrecks occurring there in the past few years. It is intended to press this matter.

NATIONAL BOARD OF TRADE.—The National Board of Trade Council has lately been holding its annual meeting in New York. The demand for a national bankruptcy law has been considered, and will be urged upon Congress, as well as the necessity for an Act to subsidise the American shipping interest for the extension of our commerce. The improvements of rivers and harbours was also considered, and it is expected that the council will appear before the Congressional Committees in order to urge their passage.

THE CHESAPEAKE AND OHIO CANAL.—The only bid for the purchase or rental of the Chesapeake and Ohio Canal was opened at Annapolis on the 5th inst. It was made by a new corporation called the Washington and Cumberland Railroad. The capital stock of this company is $2,000,000, and the line of the road is to extend from Cumberland to Washington, a distance of 240 miles, parallel with the Baltimore and Ohio Road from the coalfields to tidewater. The company proposes a lease of ninety-nine years, renewable for ever, and a railroad to be constructed on the bed or towpath of the canal. The cash value of the plan is 1¼ million dollars. The Governor of the State urged the acceptance of the bid. This canal has already cost the State of Maryland over 21 million dollars.

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THE FORTH BRIDGE.



MAP OF THE ENVIRONS OF THE BRIDGE.

THE OPENING OF THE FORTH BRIDGE.

THE opening of the Forth Bridge will take place on Tuesday next, the 4th March. The occasion might be characterised fairly as a national function. H.R.H. the Prince of Wales will perform the ceremony, and will be accompanied by H.R.H. the Duke of Edinburgh and Prince George of Wales. A large number of members of both Houses of Parliament, including several members of the Cabinet, are expected to be present. H.M.S. "Devastation" will provide a guard of honour. His Royal Highness will arrive at Dalmeny House on Monday, and will be entertained to a banquet by Lord Rosebery. A special train conveying the invited guests will leave Waverley Station, Edinburgh, at 10.45 on Tuesday morning, and will arrive at 11.15 at Forth Bridge Station, where the Prince and his party will join the train. The train will cross the bridge to North Queensferry, and will proceed to Inverkeithing. Returning to North Queensferry, the party will embark on board the steamer "John Stirling" in order to have a view of the bridge from the river. They will disembark at North Queensferry, and will rejoin the train. On the arrival of the train at the centre of the connecting girder of the south span the Prince will alight, and will fix the last rivet. At the end of the south span, where it joins the approach viaduct, the bridge will be declared open. Luncheon will then be served in the Model Room of the Bridge works.

We have on so many previous occasions illustrated the structure of the bridge, and in our FORTH BRIDGE SPECIAL NUMBER, just published, have dealt with it so amply, that its characteristic features must be perfectly familiar to all our readers. We have, therefore, on the occasion of the opening, reproduced representative portraits of the men who have built it. Our single-page supplements show some of the Directors of the Forth Bridge Railway Company; Sir John Fowler, K.C.M.G., and Mr. B. Baker, F.R.S., the engineers of the bridge; and Mr. William Arrol, the principal contractor. On our four-page supplement we show Mr. Joseph Phillips, one of the partners of the firm of Messrs. Tancred, Arrol, & Co., a number of members of the engineers' staff, and a number of members of the contractors' staff, together with three representatives of firms of contractors who have supplied material for the erection of the bridge—viz., Mr. James Riley, of the Steel Company of Scotland, Glasgow; Mr. J. H. Ziegler, of the Clyde Rivet Company, Glasgow, and Mr. J. Fyfe, granite merchant, Aberdeen. It has been impossible for us to include, as we should have wished to have done, in this representation many more of those who have taken a prominent part in the labour connected with the erection of the bridge.

Above we give an outline map of the neighbourhood of the Forth Bridge, showing the railway systems which will be benefited by its construction.

On page 204 we show a number of designs for the bridge. Those in Figs. 1, 2, and 3 were drawn up in 1810; that in Figs. 4 and 5 is Sir Thomas Bouch's design, which was given up after the fall of the Tay Bridge in 1879; that in Figs. 6 and 7 was the preliminary design of the present engineers; and that in Figs. 8 and 9 is that of the present structure.

ANOTHER PROPOSED THAMES TUNNEL.—A number of public bodies and private firms petitioned the London County Council, on Tuesday last, asking them to favour some scheme for the construction of a tunnel under the Thames at Millwall. The proposition was discussed at some length, for it was felt that the means of communication between the north and south sides of the river at the East End of London were ridiculously inadequate. Other methods of communication were suggested by some of the County Councillors. The consideration of the subject was adjourned for a short time, in order to allow the members to inspect the locality.

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Notices of Meetings.

SOCIETY OF ENGINEERS.—Monday, March 3rd. Paper on "The Application of Water Pressure to Machine Tools and Appliances," by Mr. Ralph Hart Tweddell, M.Inst.C.E.

INSTITUTE OF MARINE ENGINEERS.—Tuesday, March 4th, at 7.30 p.m. Paper on "Friction of Screw Propelling Engines," by Mr. W. J. N. Brett.

INSTITUTION OF CIVIL ENGINEERS.—Ordinary meeting, Tuesday, March 4th, at 8 p.m. Papers to be read: "The Hawksbury Bridge, New South Wales," by C. O. Burge, M.Inst.C.E.; "The Erection of the Dufferin Bridge over the Ganges at Benares," by F. T. G. Walton, C.I.E., M.Inst.C.E.; "The New Blackfriars Bridge on the London, Chatham, and Dover Railway," by G. E. W. Cruttwell, M.Inst.C.E. Students' meeting, Friday, March 7th, at 7.30 p.m. Paper to be read: "Telephonic Switching," by C. H. Wordingham, A.K.C., Stud.Inst.C.E.

PHYSICAL SOCIETY.—Friday, March 7th. On "Bertrand's Refractometer," by Professor S. P. Thompson.

ROYAL INSTITUTION OF GREAT BRITAIN.—Friday, March 7th, at 9 p.m. Francis Gotch, Esq., Hon. M.A. Oxon, B.A., B.Sc., on "Electrical Relations of the Brain and Spinal Cord."

PRICES CURRENT, 26TH FEBRUARY, 1890.

Quotations at per ton, unless otherwise specified.

PIG IRON.

Middlesbro' Warrants, No. 3	52/-	Cash
Scotch Warrants, m/n	53/4	"
Hematite Warrants, m/n	63/5	"

	No. 1.		No. 3.		
Coltness	75/6	.....	69/-	f.o.b.	Glasgow.
Gartsherrie	73/-	.....	67/-	"	"
Dalmellington	57/6	.....	57/-	"	Ardrossan.
Eglinton	54/6	.....	54/-	"	Glasgow.
Glengarnock	74/6	.....	67/-	"	Ardrossan.

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	78/-	70/-

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	7 15 0	.....	8 5 0	f.o.t. wks.
" Angles	7 10 0	.....	8 0 0	"
" Plates	7 15 0	.....	8 5 0	"
Staffordshire Bars (cheaper makes)	9 0 0	.....	9 10 0	London.
" Angles	9 0 0	.....	9 10 0	"
Crown Sheets	9 0 0	.....	9 10 0	"
" Hoops	8 2 6	.....	8 12 6	"
"Siemens-Martin" Steel Boiler Plates	10 0 0			"
" Ship and Girder	9 0 0			"

Market weak, with a downward tendency.

METALS.

Spelter: Ordinary	£23	10	0	to	£24	0	0
Copper: British Cakes and Ingots	55	0	0	"	56	0	0
" Chili Bars, G.O.B.'s	47	0	0	"	47	7	6
" Other sorts, G.M.B.'s (equal to Chili Bars)	47	0	0	"	47	7	6
" Manufactured (strong)	63	0	0	"	.....		
Lead: Common Pig	13	15	0	"	14	0	0
" English Sheet	14	5	0	"	14	10	0
Tin: Straits	89	17	6	"	90	5	0
" Australian	89	17	6	"	90	7	6
" English Ingots	95	10	0	"	.....		

Messrs. Carrick & Brockbank, Manchester, report as follows:—

COPPER: There has been a very irregular market in Chili bars during the past week. Although stocks are reported as steadily decreasing, the prices quoted on the 19th—viz., £47 15s. to £48 2s. 6d.—have not been maintained, values having given way in sympathy with the relapse in the pig iron market, and owing to the absence of speculative buying. On the 21st prices dropped as low as £46 10s. to £47, but there is now a somewhat steadier feeling at improving prices, quotations to-day being £47 to £47 7s. 6d. Manufactured is easier at £63 sheets, £67 bottoms.

TIN: A very small business has taken place in tin, and prices are weaker. Heavy arrivals, and absence of demand, have brought values down. To-day's quotations are £89 17s. 6d. to £90 5s., with quiet business.

LEAD: A better feeling prevailed in lead towards the end of last week, owing principally to purchases on German account. Quotations for foreign on the 20th were £13 10s. to £13 15s., but prices to-day are somewhat easier—viz., £13 to £13 5s.

SPELTER has fluctuated in price, and is still unsettled. The demand is small and irregular, but the stocks are small, and the price on the Continent is higher than in England. Galvanisers are very slack, and this makes the market very flat, so that prices are unsettled.

CHEMICALS.

		£	s.	d.		£	s.	d.
Acid: Carbolic Crystals	lb.	0	0	10½	to	0	1	0¼
" " Liquid	gal.	0	1	2	—	.....		
" Citric	lb.	0	1	7	—	.....		
" Oxalic	"	0	0	3¼	—	.....		
" Sulphuric	ton	1	10	0	—	.....		
" Tartaric	lb.	0	1	4	—	.....		
Alum: Lump (powder 10/- ex.)	ton	4	17	6	—	.....		
Ammonia: Carbonate	lb.	0	0	3½	—	.....		
" Muriate (Grey)	ton	22	5	0	—	.....		
" " (White)	"	26	0	0	—	.....		
" Sulphate	"	11	17	6	—	.....		
" Liquor	lb.	0	0	3½	—	.....		
Antimony	ton	.....			—	.....		
Bleaching Powder	"	5	7	6	—	.....		
Bisulphide of Carbon	"	13	10	0	—	.....		
Borax	"	30	0	0	—	.....		
Benzole (90 %)	gal.	0	4	0	—	.....		
" (50/90 %)	"	0	3	1	—	.....		
Copper Sulphate	ton	27	0	0	—	.....		
Copperas	"	2	0	0	—	.....		
Kieserit	"	.....			—	.....		
Lead: Nitrate	"	22	10	0	—	.....		
" White Sugar	"	24	0	0	—	.....		
" Brown "	"	19	0	0	—	.....		
Potash: Bichromate	lb.	0	0	4	—	.....		
" Caustic	ton	22	0	0	—	.....		
" Carbonate	"	19	10	0	—	.....		
" Chlorate	lb.	0	0	4½	—	.....		
" Prussiate (Yellow)	"	0	0	10½	—	.....		
" Sulphate (Basis 90 %)	ton	9	10	0	—	.....		
Precipitate: Red	lb.	0	3	1	—	.....		
" White	"	0	3	2	—	.....		
Salts: Epsom {Bags	ton	3	0	0	—	.....		
Salts: Epsom {Casks	"	3	15	0	—	.....		
" Glauber	"	1	10	0	—	.....		
Sulphur: Sublimed Flowers	"	9	0	0	—	.....		
" Recovered	"	4	10	0	—	.....		
Soda: Ash	d/g.	0	0	1½	—	.....		
" Caustic (White 70%)	ton	8	17	6	—	.....		
" " (" 60%)	"	7	17	6	—	.....		
" " (Cream 60%)	"	7	7	6	—	.....		
" Crystals	"	2	12	6	—	.....		
" Bicarbonate	"	5	12	6	—	.....		
" Hyposulphite	"	6	5	0	—	.....		
Solvent Naphtha	gal.	0	3	6	—	.....		
Tartar, Cream of	cwt.	5	12	6	—	.....		
Zinc Sulphate	ton	7	10	0	—	.....		

Messrs. S. W. Royse & Co., Manchester, report as follows:—

CHEMICALS.—We have to record another rather quiet week as far as new business is concerned, but prices are firm all round, manufacturers having plenty of orders in hand. Caustic soda is in short supply for prompt delivery, and soda ash also is very scarce. Bleaching powder is, however, quiet. There is a steady demand for alum and sulphate of alumina. Sulphate of ammonia remains steady, but little doing. Benzoles are unchanged. Carbolic acids seem to have found a level for the present.

OILS.

		£	s.	d.
Cocoanut: Cochin	per ton	26	0	0
" Ceylon	"	23	10	0
Cottonseed	"	22	5	0
Cod	"	21	0	0
Lard	"	36	10	0
Linseed	"	22	5	0
Palm, Lagos	"	23	10	0
Rapeseed: English	"	34	10	0
Seal: Pale	"	27	0	0
" Brown	"	22	0	0
Sperm	"	46	0	0
Whale	"	24	0	0
Turpentine	per cwt.	1	11	3
Coal	per gal.			
Petroleum (Refined)	"	0	0	5¾
" Spirit	"			

FOREIGN TELEGRAPHIC ADVICES.

(From our own Correspondents.)

PARIS, Feb. 27.—*Iron.*—The tone of the market here is weaker. Bars are being offered at 160s. and joists at 164s. Reports from provinces good. Haute Marne prices firm. Demand for wire brisk; makers sold for three months ahead. Bright No. 19, 184s. to 188s.; annealed, 188s. to 192s. Nord business moderately active, and prices firm; plates, 200s. for common. Ardennes market quiet but strong.

Metals.—The metal market continues its downward course. Copper is giving way more rapidly, the efforts of speculators to sustain the market having become fruitless. Chili bars, £53 at Havre; best selected, £57 15s. Tin is steadily declining: Banca, £101; Straits, £98. Lead is firm at £13 Paris. Spelter is again lower: Silesian, £24 Havre. But there are signs of a recovery in the market for zinc.

BERLIN, Feb. 27.—*Bourse.*—The uncertainty of the industrial situation arising out of the labour movement now in progress shows itself more and more clearly in the business of the Bourse. Industrial securities fluctuate violently; but the general tendency is downward. Collieries are again lower, and iron and steel works are receding a little.

Iron.—Business in the iron market is moderately active. The recent advance in prices is firmly maintained. Silesian bars are quoted 210s. a ton. As much as 212s. 6d. has been paid. There is a moderately strong demand for joists and sheets.

Metals.—Business in the metal market continues slack, buyers holding aloof in expectation of lower prices. Copper is unchanged at £59 10s. to £60 for Mansfeld refined and £57 to £59 for English brands. The downward movement in tin has made further progress; Banca, £101 to £103. Lead is again lower; Clausthol refined, £15 10s. to £16. Spelter has had a sharp drop. Silesian ordinary, £24 10s. to £25.

BRESLAU, Feb. 27.—*Iron.*—The market continues animated and buoyant. One firm quotes bars 1s. a ton above the syndicate minimum of 210s. for quick delivery. All finished iron and steel works, however, book full for four and five months forward. Pig iron active; prices unaltered. Founders are more busy. Export orders numerous.

Metals.—The efforts of "bear" speculators on the London and Paris markets, though felt in Berlin, has had no effect here, where the situation is better understood. Prices show no tendency to weakness. The W.H. brand of spelter is out of the market for the present, and Hohenlohe produce is hard to find at £23 10s. Ordinary sorts firm at last week's prices. Lead, after exhibiting symptoms of weakness, is firm again.

DÜSSELDORF, Feb. 27.—*Coal.*—The market continues extremely active at the prices quoted last week. The threatening attitude of the miners causes great anxiety, and seriously retards the development of trade in every kind of manufacturing industry. It seems now tolerably certain that a strike will be declared early next month.

Iron.—For some sorts of pig iron prices have receded a little. Rhenish-Westphalian and Siegen forge may be bought, the former at 92s., the latter at 93s., and foundry No. 1 is quoted 98s. to 100s. Business is fairly active in finished iron and steel, but there is a noticeable absence of buoyancy in the market. Prices are firmly maintained; the advanced rates for wire are readily paid. Foreign orders for bars and hoops are coming to hand more freely.

The Proposed Berlin Exhibition.—The North-West group of iron and steel manufacturers, an association which includes nearly all the ironmasters and engineering firms of the Lower Rhenish and Westphalian districts, have in meeting assembled unanimously condemned the project for holding a great industrial exhibition in Berlin. The scheme is, therefore, likely to fall to the ground.

CHARLEROI, Feb. 27.—*Coal.*—The market having settled down to something like a regular level of prices, business is resuming its accustomed course. Buyers are beginning to operate for future delivery—a sign of returning confidence. The outlook is, however, still clouded by fears of further labour disturbances. The federated unions of the four coal fields of Belgium have agreed to send an ultimatum to the colliery proprietors on March 1st, to reduce the hours of labour to eight a day.

Iron.—The demand for iron is a little brisker, and there is reason to believe that trade is reviving. But the current of business is yet by no means strong. Prices are, however, firmly maintained. Bars No. 2 are quoted 152s.; angles, 152s.; joists, 148s.; and No. 2 plates, 176s. a ton. The price of these plates was in our last week's report given in francs by mistake, namely, 220fr. = 176s. per English ton.

GHENT, Feb. 27.—*Flax and Yarns.*—Dealings in Russian flax are now on a smaller scale than they were a week ago. Prices are weak. The market is well supplied with home-grown flax, the demand for which is increasing. French buyers are operating largely. The market is firm for linen and tow yarns, for which there is a steady, but not strong demand.

WE have received two of the series of fire brigade handbooks which are being published by Messrs. Shand, Mason, & Co., London. One is called "Fire Brigade Drills, with Hints on Management," and is well adapted for the use of superintendents of volunteer and other fire brigades. The other is called "Rules and Regulations for Volunteer and other Fire Brigades," and is full of useful hints and suggestions to both officers and men.

MR A. E. W. GWYN, 3, Ducksfoot Lane, Cannon Street, London, E.C., has sent us his illustrated catalogue. This catalogue is a polyglot in English, French, and Spanish, and contains full descriptions of the various machines and apparatus supplied by Mr. Gwyn, including steam cranes, excavators, dredgers, diving plant, pumps, &c.

WE have received catalogues of electric light fittings, switches, and Ayrton and Perry spring instruments from the Acme Electric Works.

MESSRS. BURKE & CO. have sent us a bound illustrated price list of their electric bell fittings, electric light fittings, and larger electrical plant.

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HOME INDUSTRIES.

LONDON 27th February, 1890.

The Money Market.—The reduction of the Bank rate has had much less influence than could have been expected. For one thing, the outside market has been decidedly short of money, and so rates were kept pretty well in touch with the official minimum. As bills have apparently been left in the background until the Bank directors submitted to the pressure of the mercantile community, the active business which has been doing in discounts, shows how greatly the general business of the country required relief from the tension in the money market. The Stock Exchange has not benefited as it expected from the fall in money. On Tuesday, when a new account opened, there certainly was a slight revival, but the advance must be maintained and prolonged before the effects of the recent depression can be removed. Fears of trouble among the coal miners keep the stocks of the mineral carrying railways under a cloud, and counteract any tendency there might otherwise be towards buoyancy. American railways show a disposition to revive, but they cannot be said to be in great favour. Canadian railways are an uncertain market, with a turn towards better prices. The foreign department is quite lifeless in sympathy with the Continental Bourses. Argentine securities, after a sharp collapse, have picked up again, although the premium on gold at Buenos Ayres is again growing. Little interest is evinced in mining shares, and the miscellaneous market is subject to spasmodic jerks in individual securities without much to cause. The nitrate group is lifeless.

Companies.—The following companies have been registered since our last report: Pittsburgh Consolidated Gold Mines, Ld., with a capital of £80,000; A. G. Scott & Co., Ld., with a capital of £10,000, to carry on the business of tin box and canister makers; The Temescal Tin District, Ld., with a capital of £350,000, to acquire tin, gold, silver, or copper or other mines in California; Lynx Creek Gold and Land Co., Ld., with a capital of £47,500, to acquire certain mines in California; The Dutch Guayana Exploration Syndicate, Ld., with a capital of £6,000, to acquire lands and mines; Woodruff & Co., Ld., with a capital of £4,000, to acquire machinery and plant for making block fuel; East Pontop Coal Co., Ld., with a capital of £24,000; John Whittaker & Sons, Ld., with a capital of £10,000, to acquire cotton mills at Padiham; Henry Bannerman & Sons, Ld., with a capital of £300,000, to carry on the business of cotton spinners, &c.; The Howden Clough Colliery, Ld., with a capital of £30,000; P. & W. Maclellan, Ld., with a capital of £300,000, to carry on the business of engineers, metal merchants, &c.; The Hendre Gold Mining Co., Ld., with a capital of £60,000; Sugden, Keighley, & Co., Ld., with a capital of £60,000, to carry on the business of worsted spinners; The Pilcomago Syndicate, Ld., with a capital of £4,000, for the purpose of establishing a route for Bolivian produce to the Paraguay River; The Manchester Steel Co., with a capital of £50,000; The Anglo-Columbian Development and Exploration Co., Ld., with a capital of £100,000; Hatton, Sons, & Co., Ld., with a capital of £80,000, to carry on the business of ironmasters, &c.; Poole & White, Ld., with a capital of £20,000, to carry on the business of electric lighting; Criccieth Pier and Harbour Co., Ld., with a capital of £30,000; The Driggs-Schroeder Ordnance, Ld., with a capital of £350,000.

The Late Dock Strikes.—The results of the late dock strikes are continue to show themselves in the reports of the half-yearly meetings of the shipping companies. On Tuesday the General Steam Navigation Company of London reported that they had lost not only £22,000 gross profits referred to in the accounts, but also an amount equal to a 20 per cent. dividend. Mr. Tritton, the Chairman, said that if another similar strike occurred their ships would be transferred to other ports in order to follow the departing trade.

The Southern Railways.—For some time rumours have been afloat of an approaching combination in the working arrangements of the South-Eastern and London, Chatham, and Dover Railways. Mr. Stevens, the secretary of the former railway, however, states that the question has not been considered by the Board of Directors, nor has it even been brought before their notice.

Engineering.—The Government of India have just published a report on agricultural implements and machinery. Among other recommendations we notice one on the hand-pumps made by Messrs. Hayward, Tyler, & Co., Whitecross Street. These pumps are reported to be easily adapted for both deep and shallow wells, and to be free from objections common to some pumps.

Tenders Wanted.—The Portuguese official *Gazette* of the 15th inst. invites fresh tenders for the harbour works to be executed at Povoa do Varzim, which tenders will be opened on the 15th of March at the Department of Public Works at Lisbon. Documents showing the nature of the works, &c., may be inspected at the Commercial Department of the Foreign Office.

Imports of Fresh Meat.—The quantity of beef received from abroad during January was 125,293 cwt., against 93,150 cwt., 120,590 cwt. having been consigned *viâ* the Atlantic ports of the United States against 87,371 cwt. The imports of mutton were 127,035 cwt., as compared with 59,427 cwt. for the same month of last year. The above total includes 51,304 cwt. from New Zealand, against 32,137 cwt.; 13,264 cwt. from New South Wales, against 5,400 cwt.; 30,037 cwt. from the Argentine Republic, against 10,660 cwt.; 15,112 cwt. from Germany, against nil; and 8,926 cwt. from Holland, against 10,975 cwt. The imports of pork were 7,448 cwt., against 27,275 cwt., Holland supplying 4,049 cwt., against 22,350 cwt.

A Miners' Life Preserver.—By an inrush of water into a colliery at Pontypridd, in April, 1877, five miners were imprisoned for ten days without food, but were ultimately released by the rescuers holing through a wall of coal. The circumstance led Mr. A. Upward, of 150, Holland Road, Kensington, to invent an apparatus for ascertaining the contiguity of either water or gas to workings, and others for passing food to imprisoned miners and for rescuing them. The apparatus for ascertaining the state of a mine as regards approaching danger is firmly held to the face of the coal by means of struts and a piece of timber fixed vertically to the rear between the roof and the floor of a mine. It consists of a chamber fitted with a slide valve, which can be opened and closed at pleasure. Through a stuffing box in the chamber on the working side passes a boring tool, with which the miner drills a hole in the coal to the distance inwards to which he intends to work. Assuming this to be, say, 8ft., when he has reached that distance he withdraws the boring tool, and if neither gas nor water has made its appearance he knows that he can safely work so far in. Should he tap water or gas during the boring there would be an inrush of the one or the other into the chamber of the apparatus, and its presence would be indicated by a pressure gauge. The boring tool would then be withdrawn as far as the stuffing box, the slide valve would be closed in front of it, and steps would be taken to insure safety in the workings.

MANCHESTER, 27th February, 1890.

The Engineering Trades.—There is a perceptible lull in the demand for engineering work, but it is not expected to be more than a temporary one. Prospects of foreign work are encouraging, and engineers are not sorry for the present slackening, as it gives them time to get some of the more pressing work out of hand. Boiler makers are very actively engaged, and have no difficulty in finding a sufficiency of new business. Locomotive builders are also fully employed, and, generally, the makers of engines and gearing of all kinds are well off for work. Machine tool makers do not generally experience any great falling off in demand, although statements to that effect have been made. So far as the Manchester district is concerned, makers have plenty of orders offered. In some cases the long time wanted to complete the orders rather checks the conclusion of business, but otherwise tool makers have little cause to complain. Textile machinists are working at full pressure, and have large orders in hand. In some cases, prices have been largely raised without checking the demand, and, although it is true that at present few large new mills are being erected in this country, a continuance of the present prosperity of spinners will undoubtedly lead to a further development. Loom makers continue to be fairly busy without experiencing any great pressure. In the trades connected with copper goods, there is not quite the volume of business going on that there was, although there is not much ground for complaint at present.

Baking Machinery.—The Secretary of State for War has adopted the latest patent steam oven of Mr. James Johnston, C.E., 10, Balloon Street, Manchester, and has placed with him an order for four ovens for the new bakery at Woolwich.

Boiler Insurance.—The thirty-first annual meeting of the Boiler Insurance and Steam Power Company, Limited, was held a few days ago, when the report presented was of a very gratifying nature. The premium income has increased considerably, being £63,168, as against £57,941 in 1888, and £55,604 in 1887. During last year the Company took over the business offices and staff of the Staffordshire Boiler and Engine Insurance Company. It may also be mentioned that this Company has recently concluded a transfer of the business offices and staff of the South Wales and Monmouthshire Boiler Insurance Company. To many, a satisfactory feature of the report is the wiping out entirely of the £50,000 balance of purchase account. The clearing away of this item has been accomplished by issuing 7,000 shares at a premium of £5 per share, thus realising £35,000, and by adding to this the sum of £15,000 standing to credit of reserve fund, together producing the required total of £50,000. This amount has been invested in first-class securities, thus considerably strengthening the financial position of the Company. A special vote of thanks was passed to the chief engineer in recognition of the satisfactory results achieved during the sixteen months of his management, as also to the secretary and the staff of the Company.

Rapid Mill Building.—Messrs. Barlow & Jones, Limited, of Bolton, have just erected a new mill to contain 63,000 mule spindles, which has been remarkably quickly erected. The first brick was laid on the 31st May last, the machinery is now going in, and cotton will be spun during the month of March. It is a good type of a modern cotton mill, the boilers having been made by Messrs. W. & J. Yates, of Blackburn, and the engines by Messrs. John Musgrave & Sons, Limited, of Bolton. The latter are a fine specimen of the horizontal compound mill engines made by the firm, and were adopted by Messrs. Barlow & Jones after a long experience of other engines of the same makers. The spinning machinery is mainly by Messrs. Platt Brothers & Co., Limited, of Oldham.

Road Parcel Post.—The postal authorities are organising a system of road carriage and delivery of parcels by coaches between Manchester and Liverpool. They are erecting a number of light vans or coaches, which are to make the journey to or from either town to the other during the night. This movement has had its rise in the rates charged by the railway companies for the carriage of parcels, which the authorities think excessive.

Steaming Weaving Sheds.—The Home Secretary has decided to entrust the administration of the Act of last year, dealing with the above subject, to Mr. E. H. Osborn, one of the present factory inspectors. He has had a large experience of the subject, and is entrusted with full control in the counties of Lancashire, Cheshire, and Yorkshire. He is empowered to report directly to the chief inspector in London, so that he is, practically, head of a new department.

GLASGOW, 27th February, 1890.

Pipe-founding.—It is rumoured that a syndicate is about to be formed for the purpose of amalgamating the pipefounding businesses in the neighbourhood of Glasgow. The firms of Messrs. Andrew & James Stewart, Messrs. A. Y. Stewart & Co., and other pipe founders are mentioned in connection with the project, and Mr. William Arrol is said to be also interested. The capital of the proposed concern will, it is understood, amount to £750,000.

Scottish Railways.—The engineers appointed by the Corporation of Edinburgh (Sir John Fowler and Mr. B. Baker) to report upon the proposed underground railway in Edinburgh, promoted by the Caledonian Railway Company, have reported to the effect that they are of opinion that the vibration of the trains, should the proposed railway be carried under the south side of Prince's Street, would be highly prejudicial. Of the Scottish Railway Bills which have been announced for procedure in Parliament this session, the West Highland Railway Bill has passed the Examiner of the House of Lords; the Partick, Hillhead, and Maryhill Gas and Electricity Bill, and the Cathcart District Railway Bill, have passed the Examiner of the House of Commons; while the North British and South-Western Railway Amalgamation Bill has been found not to comply with the standing orders in respect of efficiency in the published notices.

Shipbuilding.—There is still a dearth of fresh orders. Messrs. Wm. Simons & Co., Renfrew, have contracted with the Mersey Harbour Board to supply them with a set of powerful sand pumps to be fitted to a steam hopper barge, one of the fleet of these vessels which Messrs. Simons & Co. have built for the Mersey. The sand pumps will be employed in cutting a deep channel through the Mersey Harbour bar.—Mr. James H. Hutchison, who has been for some time manager to Messrs. Russell & Co., Port Glasgow, has been appointed manager of the shipbuilding works of Messsrs. McMillan & Sons, Dumbarton, which firm is to be carried on in future as a limited liability company.—Mr. M'Gowan, manager to Messrs. John Reid & Co., Port Glasgow, has been appointed assistant manager to Sir William Armstrong, Mitchell, & Co.

Pig Iron.—The iron market has been further depressed this week, and very large sales were made, especially last Friday and Monday, when the impression went abroad that there would be no strike in the Durham district such as had been expected during the previous week. The prolonged lull in the demand leads people to wonder what is to be done with the additional 700,000 or 800,000 tons which we now make in this country, compared with about this time last year. The increasing production in America attracts also a good deal of attention, as it largely supplies some of the demand which otherwise would come here. Prices of makers' iron here are extremely irregular; hardly any is asked for, and very little for sale.

Clyde Firms and Limited Liability.—The capital for Messrs. P. & W. Maclellan, Limited, of Clutha Iron Works, Glasgow, has been subscribed for three times over The conversion of this well-known engineering business into a limited liability company is only one of several such changes now being effected and under contemplation in connection with Clyde firms. The old-established shipbuilding business, carried on in the dockyard, Dumbarton, by the McMillan family, is being reconstituted as a limited liability company, and the well-known shipbuilding and engineering business of Messrs. James and George Thomson, Clydebank, will, we understand, shortly undergo a similar change. Others firms are rumoured to have the same step under consideration, and it would seem as if strictly private co-partnery in any business of more than moderate dimensions was quite a thing of the past.

The Railway Rates Inquiry.—An inquiry regarding the schedules lodged by the Scottish railway companies with the Board of Trade will be held in Edinburgh on the 17th March and following days. Lord Balfour of Burleigh and Mr. Courtenay Boyle propose to hold a preliminary meeting with such representatives of the railway companies and objectors as choose to attend on Monday, the 3rd. The object of this meeting is to give information on matters connected with the procedure to be adopted at the inquiry, and to make such arrangements as will secure that all the important interests concerned shall have as full an opportunity as will be possible for expressing their views without

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undue multiplication of evidence. The time which can be alloted to the inquiry in Edinburgh is necessarily limited, and without careful arrangement and organisation it will not be possible to utilise it to the best advantage. This meeting will take place within the Council Chamber, at 12 o'clock on Monday, March 3rd.

(From our own Correspondents.)

LIVERPOOL, 26th February, 1890.

Dock Labour Agitation.—The men at the docks are still in a very unsettled state, and although many of them are very anxious to remain at work at the present pay and under the same conditions without complaint, they are disturbed by the local agents of the Dock Labourers' Union. Instructions have come from headquarters that all men belonging to the Union and seeking employment must wear a circular metallic badge provided by the society. This has been objected to by many members, but after March 3rd the wearing of it is to be compulsory. The Liverpool Employers' Labour Association have recently held a meeting, and are fully prepared for the advent of any strike, and, if necessary, men will be drafted from other ports.

The Liverpool Shipping Trade.—The trade of the port has greatly improved within the last few months, and the strongest evidence of this is in the reports of the directors of the various shipping companies, most of which are very satisfactory, and recommend the payment of substantial dividends. In the passenger traffic to and from New York there has not been much of an increase in the number of saloon passengers, the greater number having been taken by the North German Lloyd steamers. Last year the number of saloon passengers from America landed in Liverpool was 27,000, while 30,500 went south by way of the North German Lloyd steamers. Of the saloon passengers landed in Liverpool last year 12,000 were carried by the Cunard Company.

SHEFFIELD, 26th February, 1890.

Coal.—At present no attempts are being made to stock coal or coke in anticipation of a stoppage of supplies from the miners. No doubt one reason for this is to be found in the fact that present requirements take all the coal it is possible to obtain. The present state of prices for coal, except house coal, is certainly not favourable to the miners' advance of 10 per cent.

Iron and Steel.—In the iron and steel trades business continues active. The armour plate mills are now assured of sufficient work for two years, independent of any orders from abroad. Messrs. Vickers have completed a huge gantry tube-dipping crane, which has a clear perpendicular lift of about 80ft. Hitherto the tubes have been dipped at Messrs. Firths', who have had long experience in this, the most crucial, operation in the construction of modern built guns. Steel castings are in increased demand. Local makers have energetically striven to produce castings true to pattern and free from gas cavities. Marine engineers show their appreciation of our steel castings by continuing to send orders. The staple trades of the town are well off for orders. The spring knife cutlers have succeeded in obtaining an advance of 10 per cent. Messrs. Hadfields' Steel Foundry Company, Limited, are experiencing a little difficulty with their workmen, owing to the introduction of some new rules; the matter will, no doubt, be arranged amicably, as this firm always treat their men well.

CARDIFF, 26th February, 1890.

Coal and Coke.—The steam coal market continues active, with prices steady, and as there is no difficulty in securing tonnage the shipment is being proceeded with satisfactorily. Colliery owners complain about the small output which they get from the collieries compared to what was produced when prices were unremunerative, but on the other hand it must be remembered that perhaps the high prices are maintained through the reduced output. Sinking operations are being carried on vigorously in the neighbourhood of Pontypridd, where there is a large coal field undeveloped within easy distance of the port of shipment. Shipowners seem to be doing an indifferent business, for while freights have been drooping the price of bunker coal and wages have been steadily advancing, in addition to which the detention at ports of loading and discharge is very great. All of this tells heavily against the steamers, and unless freights show an early improvement boats will have to lay up as in the depression a few years ago. House coal finds a ready market, and, as a large quantity is being taken for export, the prospects for the summer months are good. In the coke trade prices are not so firm, but sellers have no reason to make any concession, as they are all well sold forward.

Iron and Steel.—The market for manufactured iron and steel is most irregular, and it is exceedingly difficult to indicate prices for any particular article. In cases where works are full of orders, no abatement in the recent high figures is made, but merchants who have bought in view of an advance are able to take lower prices than makers. Steel bars are quoted at £7 15s., a price which tinplate makers are quite unable to pay with the present price of plates. The heavy fall in pig iron warrants has suspended business, buyers being convinced that the lowest point has not been touched.

Iron Ore.—There is but little doing in iron ore, all the ore obtainable in Bilbao having been bought some time ago. Rubio ore is quoted at 17s. per ton c.i.f. Cardiff and Newport, 18s. 6d. Glasgow, 18s. Middlesbrough, 17s. 9d. Tyne. Freights from the ore ports are a little firmer on account of the long detention which steamers experience at Carthagena and Bilbao, and also at the discharging ports. Steamers have to wait several days before they are loaded in Bilbao, and the same difficulty is experienced on arrival at discharging port.

BARROW-IN-FURNESS, 26th February, 1890.

Proposed Restriction of Hematite.—The makers of pig iron on the West Coast have already held a meeting with the view of determining on some system for restricting the make of hematite pig iron, in order to counteract the unsatisfactory influence of speculative sales. The policy of restriction was agreed upon, and the details of a scheme are to be submitted to another meeting shortly. Prices of warrants have this week shown very erratic movements, and were quoted on Tuesday at 64s. 6d. per ton, but makers are still firm, with their quotations up at 80s. to 82s per ton for mixed Bessemer Nos. They cannot, however, maintain this figure long unless an improved demand sets in. There has been but little new business in hematite pig iron this week.

Steel.—There is still an easy tone in the steel trade, and orders are not offering on a large scale. Makers are very busy and likely to remain so for some time, and it is anticipated in the meantime that the market will gain new life. There is, however, less inquiry for steel shipbuilding material, tinplate bars, and rails, but it is the general belief that orders are being held back with the view of placing them at an early date at lower prices. It cannot yet be determined whether prices will experience a decline, but in the meantime makers are very firm.

MIDDLESBROUGH, 26th February, 1890.

Pig Iron.—Pig iron fell in price a day or two ago, but has now recovered. It was sold in the market yesterday at 1s. advance on the day before. No. 3 G.M.B. was quoted at 53s. per ton, early delivery, by merchants, but makers refuse to break their minimum price of 60s., and prefer to go without orders in the meantime. Those who want iron prefer to take warrants, which are quoted at 52s. 4½d. to 52s. 6d. cash. Grey forge is scarce, and 56s. must be paid for it. Hematite is quoted by merchants at 78s. per ton f.o.b. nominally, but it can be had cheaper. The stock in Connal's store on Monday, the 24th inst., amounted to 179,786 tons, against 181,264 tons on the preceding Monday, showing a decline of 1,478 tons.

Shipments of Pig Iron.—The shipments last week were very poor, but over the month they are still about 4,000 ahead of the January shipments. Up to the 24th they amounted to 37,255 tons, against 33,381 tons in January to a similar date. Germany and Holland have taken more, but Scotland and other parts of England and Wales have taken less.

SUNDERLAND, 26th February, 1890.

Shipbuilding and Engineering.—The scarcity of genuine inquiries and the absence of new orders continue. These features do not, however, appear to influence the industrial classes. The claims of the engineering employés for another shilling rise, within a month of the similar rise just conceded, are being actively pushed, and at a meeting held here on Monday united action as regards the latter claim was resolved upon by eleven branches of workmen engaged in the engineering establishments. According to the first annual balance-sheet of the Wear Steel Works, the capital expended on their construction has been £133,266 7s. 9d., as against £100,000 estimated cost. Partially the increase is due to the rapid rise in the price of materials and partially to the works having been constructed so as to admit of a greater output. Nine 30-ton smelting furnaces have been provided, as against six of a smaller size, and additional re-heating furnaces have been built, so that 40,000 tons of finished steel can be manufactured per annum.

Shipping.—The unsettled condition of the Durham coal trade is affecting the chartering of vessels very considerably, but outward rates to the Mediterranean show no change. Homeward business from America continues brisk, but goods are being carried to the States at very low rates. Black Sea rates are not yet satisfactory. Local coal shipments continue low, 56,962 tons being shipped during the last week, as against 75,402 tons and 60,961 tons in the immediately preceding weeks, a decrease for the week of 18,940 tons.

River Wear Commission.—The returns for the first month of the year show a revenue of £11,055 5s. 2d., a decrease, as compared with the corresponding period of last year, of £166 9s. 3d. The falling off in coal shipments far more than accounts for the diminution of revenue, only 309,910 tons of coals being shipped, as againgst 369,000 tons in January, 1889.

The Coal Trade.—The Durham coal trade is in a very unsettled condition, and many contracts have been lost owing to the prevailing uncertainty as to the future. The miners' notices expiring in a fortnight have been handed in, but it is hoped that a general strike will be averted by the action of the colliery owners.

NEWCASTLE, 26th February, 1890.

Shipbuilding.—Though inquiries have largely fallen off, and the difficulty of obtaining new contracts has become accentuated of late, it is pleasant to be able to state that a few firms of this district have been able to add to their contract engagements within the past few days. Among these may be mentioned Messrs. C. S. Swan & Hunter, of Wallsend, who have recently obtained a contract from foreign owners to build three vessels of a superior class. Messrs. R. Stephenson & Co., of Hebburn, have also been among the successful competitors for such work as has recently been on offer, the firm having contracted with Messrs. Wilson & Sons, of Hull, to build a large cargo steamer for the Atlantic trade. The vessel is to be 385ft. long by 46ft. wide, and will carry upwards of 5,000 tons of cargo. The engines, which will also be supplied by Messrs Stephenson, are to be constructed with a special view to the development of a high running power in rough weather. They will be capable of driving the vessel at a speed of 13 knots an hour, but their full power will only be exercised in special circumstances. This is the third steamer ordered from Messrs. Stephenson by this well-known firm of steamship owners, and it is the only one which has been given out by them to contract since the opening of the year. It may be added that the vessel will be fitted throughout with the electric light, will have eight powerful steam winches, and will be supplied with every appliance which can tend to make her unique as a cargo boat.

Engineers' Wages and Hours.—On Tuesday afternoon an important conference of master engineers and representative workmen connected with the engineering works on the Tyne and Wear took place at Newcastle, to discuss the men's claim for a further advance of 1s. per week in the wages rate (1s. having been already conceded at the beginning of the month), and the alteration of the stopping time on Saturdays from 1 to 12 o'clock. After a prolonged discussion, the employers offered an additional 6d. per week, but declined to make any alteration in the working hours. This decision, which is understood to be final, will be immediately placed before meetings of the men at the various centres, and the result will be made known to the employers' secretaries as soon as possible. If the men persist in their demand for an hour less working time on Saturdays, a strike must ensue, as it is definitely understood that the employers will not negotiate upon the matter, and the subject is one which scarcely admits of a settlement by arbitration.

The Coal Trade.—The shipments of coal and coke at Tyne Dock for the week ending February 22nd amounted to 107,686 tons, being an increase of 1,898 tons as compared with the shipments for the corresponding week of last year.

Chemicals.—The Tyne Improvement Commissioners have just issued their statement of goods imported and exported into and from the Tyne during 1889. These figures go to show the continued decay of the Tyne chemical trade. The exports of soda crystals, when compared with 1888, have fallen off 18 per cent. Alkali and soda ash exports have decreased 35 per cent., bleaching powder 9 per cent., and bicarbonate of soda 34 per cent. On the other hand, caustic soda exports have increased 31 per cent., and there was a slight increase in the exports of manganate of soda.

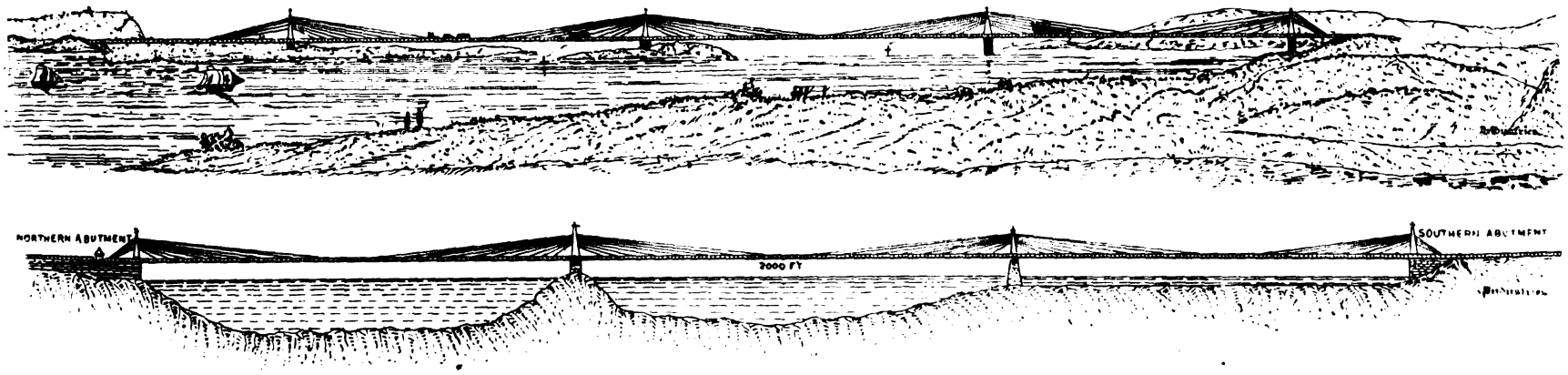
DUNDEE, 26th February, 1890.

Flax and Jute Trades.—The market here has been dull of tone during the past fortnight. In flax there is little doing. Very little is at present doing in goods ex-warehouse, and sales on contract are limited with a downward tendency in quotations. The flax yarn market is in favour of buyers, but transactions are on a small scale. There is no change in the home and foreign demand for linen goods. Manufacturers are still well employed on past orders, and they are looking forward to a better inquiry in the course of the spring. Sailcloth is in fair request at firmer rates. In the Calcutta market loose jute and baled jute are meeting with a slow sale. Supplies are believed to be good, and buyers are holding off in expectation of a decline in quotations. The demand for Dundee goods in New York is limited, and the tendency of the market weak. Burlaps, 40 in 10½oz., are this week quoted at 5½c. to 5⅝c. per yard, against 5⅝c. last week. In this market jute sales are of limited extent, and it is anticipated that prices have not touched their lowest point. First marks have been selling at from £13 10s. to £13 5s. c.i.f. Jute yarns are slow of sale, and buyers are not disposed to transact business unless at a reduction The market for goods is not animated, but prices are fairly well maintained. There is less doing in tarpaulin.

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VARIOUS DESIGNS FOR BRIDGING THE FORTH.

(*For description see page* 200.)



FIGS. 1 AND 2.—PERSPECTIVE VIEW AND LONGITUDINAL SECTION OF A DESIGN MADE EIGHTY YEARS AGO.

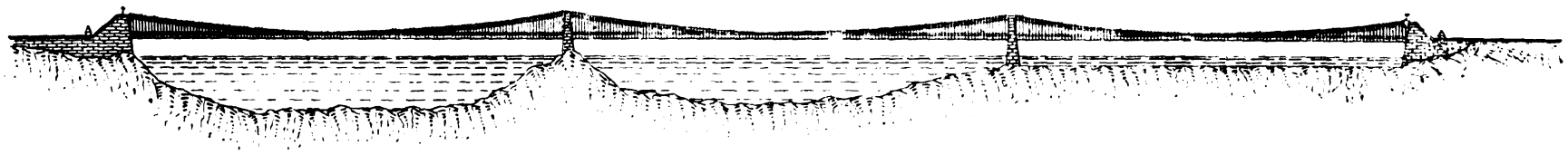
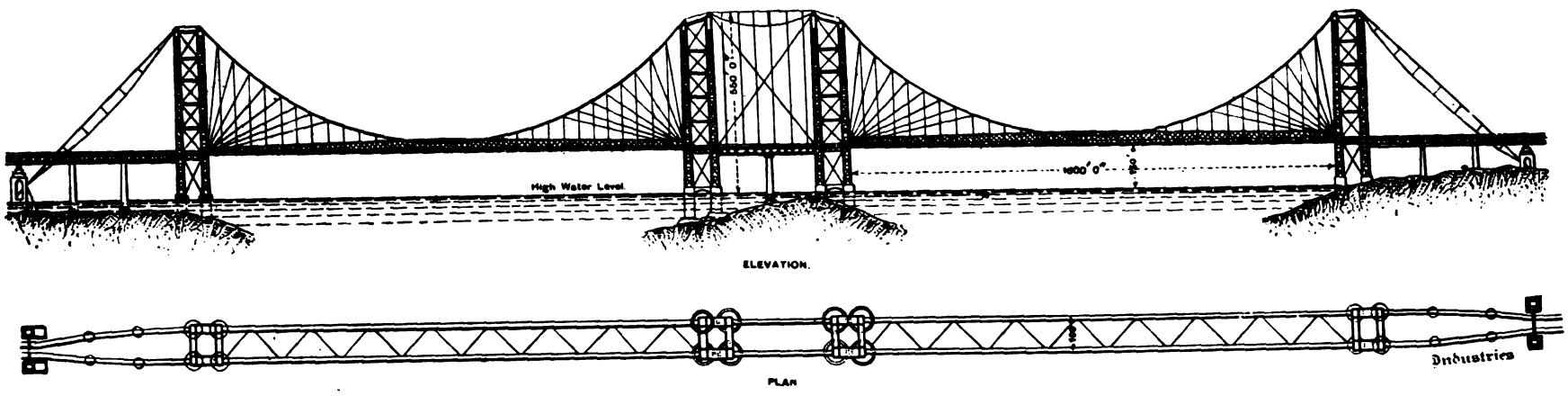
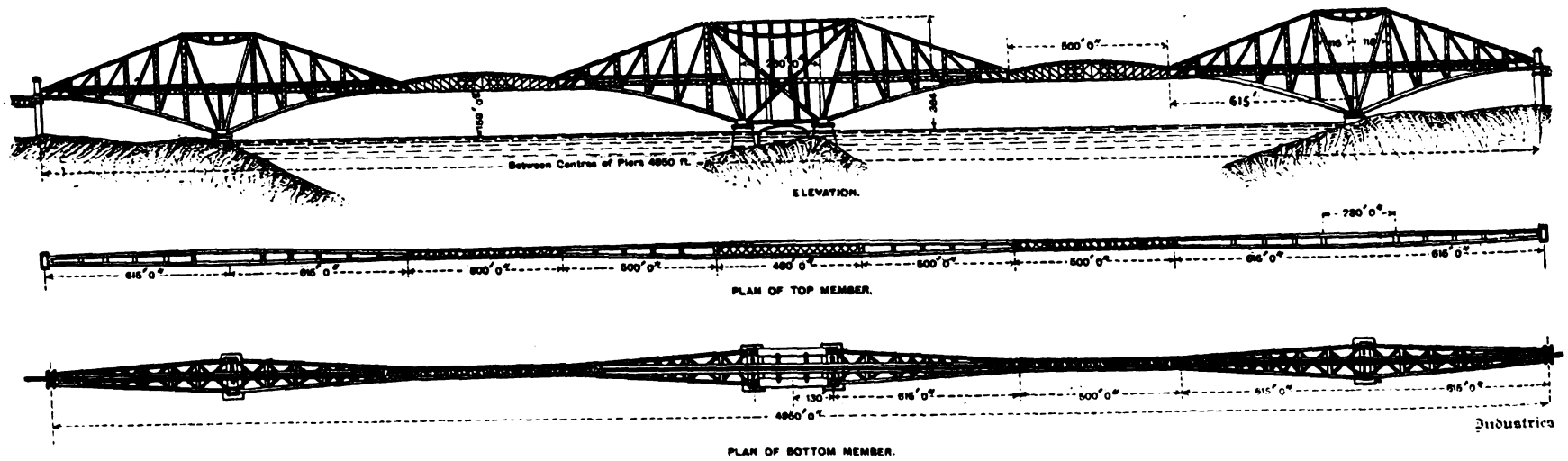


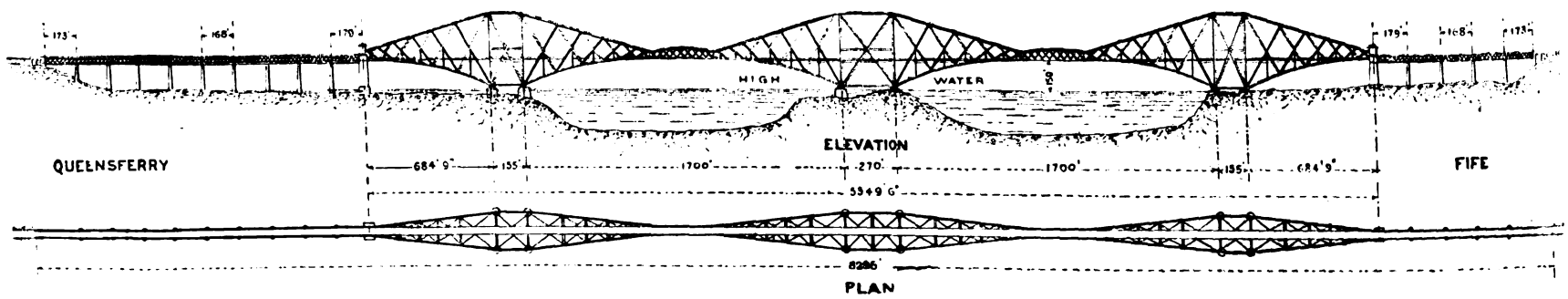
FIG. 3.—ALTERNATIVE DESIGN MADE EIGHTY YEARS AGO.



FIGS. 4 AND 5.—SIR THOMAS BOUCH'S DESIGN.



FIGS. 6 AND 7.—PRELIMINARY DESIGN OF PRESENT STRUCTURE.



FIGS. 8 AND 9.—DESIGN OF BRIDGE EVENTUALLY ADOPTED.

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As we go to press early with certain of our advertisement pages, all Alterations to Standing Advertisements should reach the Publisher not later than 2 o'clock on Wednesday afternoon in each week.

All accounts are payable to GEO. CAWLEY, 358, *Strand, London, W.C. Cheques should be crossed Manchester and Liverpool District Banking Co., Limited, 75, Cornhill, London, E.C. Post Office Orders should be made payable at the Post Office, 369, Strand, London, W.C.*

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70, Market-street, Manchester.
93, Hope-street, Glasgow.

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Writing Room at the Chief Offices of this Journal, for the use and benefit of visitors.

Contents.

	PAGE
The "Lukin" Lathe (*Illus.*)	193
Training for Trades and Crafts—II.	193
Sending Pictures by Telegraph (*Illus.*)	195
The Straightening of Chimney Shafts	195
The Discovery of Coal in Kent	195
Radial Drilling Machine (*Illus.*)	196
Improved Reducing Valve (*Illus.*)	196
Improved Grate for Vertical Boilers (*Illus.*)	196
Foreign Industries (Corres.)	198-199
The Opening of the Forth Bridge (*Illus.*)	200
Notices of Meetings	201
Prices Current	201
Foreign Telegraphic Advices (Corres.)	201
Home Industries (Corres.)	202-203
The Opening of the Forth Bridge	205
The Exemption of Machinery from Rating	206
The Edinburgh Underground Railway	206
The Railway and Canal Traffic Act, 1888	206
Four Single-page Supplements and PORTRAITS of the ENGINEERS, CONTRACTORS, &c., of the FORTH BRIDGE.	
The Late Sir Robert Kane, F.R.S.	206
Letters to the Editor:—	
Fog and Atmospheric Electricity	207
The Kent Coal Discovery	207
The Institute of Marine Engineers	207
The Manchester Association of Engineers	207
Books Received	208
Reviews	208
Electric Locomotive for Mines (*Illus.*)	209
The Institution of Electrical Engineers	209
Magnetic Phenomena	210
The Physical Society	211
The Detection of Water-Gas	211
The Outlook in the Salt Trade	211
The Trade in Nitrate	212
Notes	212
"Industries" Patent Record:—	
Applications and Acceptances	213-214
Illustrated Abridgments	214-216
One Four-page Supplement giving	

To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

We cannot undertake to return manuscripts or drawings, and must request correspondents to keep copies.

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Industries:

FRIDAY, 28TH FEBRUARY, 1890.

THE OPENING OF THE FORTH BRIDGE.

IN February, 1883, the actual work of the building of the Forth Bridge had just begun; now, after seven years, the bridge is completed, and will be formally opened by His Royal Highness the Prince of Wales on Tuesday next. Therefore within a few days this great bridge will be as much a matter of course as any other part of our railway system. The technical features of it have been so amply described in our "FORTH BRIDGE SPECIAL," just published, that it is unnecessary to do more than refer to them most briefly in this place. The wisdom of adopting the cantilever and central girder principle has been entirely justified by the event. The testing of the bridge, which seems to have been carried to all reasonable extent, has shown that the calculations of the deflections due to the passing of trains have been amply vindicated, while the repeated severe gales which have subjected the bridge to tests of wind pressure have found even the temporary erections on it fully able to withstand the most severe storms which have swept the Firth of Forth during the past seven years. The one quality which such a structure ought to possess, in the eye of the public who are to use it, is stability, and there is every reason to believe that this quality has been very thoroughly secured. Confiding as the public usually is in the skill of professional people, there has been—owing to the Tay Bridge disaster, and owing also to recent collapses of bridges in America—an anxiety on the part of the public lest there should be any unseen element of weakness in this structure, over which there must be so enormous a daily traffic. The Forth Bridge Railway Company, the engineers, and the contractors have clearly all along set themselves to ensure that a feeling of confidence in the strength of the bridge should spontaneously arise in the mind of everyone who sees it. Both design and workmanship have from the beginning been directed to the end of producing a manifestly strong construction. It is no rhetorical exaggeration to say that, had the bridge been built by national resources, regardless of cost, it could not have been raised with a more single eye to its thorough efficiency. So many considerable things have to be done nowadays under the stress of competition, that it is a hopeful sign for a company to have set itself, not to meet minimum requirements, but to meet a reasonable maximum. The result is that everyone who sees the bridge—and who will not, ere long, if possible?—must be impressed with its enormous reserve of strength. For the public this is the first, second, and third essential. But it strikes some of the non-technical public in another way. Mr. William Morris, in an offhand speech at the Art Congress in Edinburgh in November last, pronounced the bridge the climax of ugliness in iron. It is perhaps beside the question to discuss the Forth Bridge as if it were a work of art; but it is worth while to vindicate it from the accusation of being a paragon of ugliness. Mr. Baker has, in answer to Mr. Morris, made a felicitous quotation from Mr. Ruskin, to the effect that strength and beauty are closely associated. "If a workman is working in iron, he should insist upon and exhibit its strength and tenacity, and he will invariably find the material grateful, and that his work is all the nobler for being eulogistic of the substance of which it is made." This really answers Mr. Morris's objection. What was required was not a piece of decoration over a mile long and a hundred and twenty yards high, to be set into a landscape with a river, but what was required was a manifestly strong bridge; and a manifestly strong bridge has been built. If we were able to dismiss from our minds all our unreasoned prejudices concerning this or that form, or curve, or line, and then asked ourselves what form we liked fundamentally, would it not be a form which in the first place was structurally sound, and is there not therefore a utilitarian basis for our æsthetics? One of the virtues of the design of the Forth Bridge is that there is no attempt at ornamentation of any kind whatever. The columns, top and bottom members, struts and ties are left to tell their own tale; they are there for use and not decoration. Yet there is, from such a distance as may enable one to take the whole design into the range of vision, a certain gracefulness of outline, a certain obvious naturalness of pose as it were, an equipoise of parts—in brief, just those elements which go to explain why it is we like a work of art and don't like a daub. The Forth Bridge owes little of its impressiveness to its mere magnitude. A model of it is impressive. In this it is quite different from the Pyramids, which appeal to nothing except our sense of size. They are big; but if they ever are beautiful, their beauty is due, not to any artistic qualities that they have—for they have none—but to atmospheric causes. In the same way a railway embankment or a heap of waste shale might be considered beautiful. But the Forth Bridge has elements of beauty in its design, and these elements of beauty, consisting as they do in detail, in lines, and forms, carried out in material on a scale of immense size, must be observed from an appropriate distance. It is true that the bridge dwarfs the landscape on either side, but this is the fault of the landscape: the height and form of the bridge were conditioned by the breadth and depth of the river, not by the height of the hills on one side or the other. Looked at, then, from the point of view of rational æsthetics, we expect Mr. Morris's dictum would be found erroneous, and that the bridge, from its definite adaptation of obvious means to obvious ends, had, at all events, fulfilled one of the canons of art. It is trickery, and not art, which conceals how a thing is done. So much for the æsthetic aspect of the bridge; the engineering merits of it are already pretty amply expounded and recognised.

There is, however, one aspect of it which deserves special notice, and that is its place in the Scottish railway system and its probable effect on the future of railways in Scotland. Its connection with the railway system is shown in a map published on another page, and it will be seen that the chief advantage of the opening of the bridge will be the saving in time and distance on the journey between Edinburgh and Perth and Dundee, and, therefore, a corresponding saving in the journey between London and the North of Scotland *viâ* Edinburgh. Since the Forth Bridge is an integral part of the North British Railway Company's system, that company will benefit from it chiefly; but the East Coast Route as a whole must benefit largely. The existing traffic which hitherto has gone by Granton, and by payment for way-leaves over the Caledonian line *viâ* the Forth Bridge at Alloa, will necessarily cross the new bridge, thus saving the ferry on the one side, and the way-leaves to the Caledonian on the other. In addition, the attractions of the Forth

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Bridge and Edinburgh combined will doubtless draw off some portion of the passenger traffic from Euston north by the Caledonian system *vid* Stirling. Indeed, the competition between the Caledonian and the North British Railway Companies for predominance in Scotland has, by the building of the Forth and Tay Bridges, and by other means, reached an acute stage. The proposed amalgamation of the North British Railway and the Glasgow and South Western Railway has resulted in a counter-proposal by the Caledonian. Thus, Scotch railway matters will shortly prominently occupy the attention of Parliament. One of the most striking features of the financial situation in Scotland during the past few years has been the remarkable and steady rise in the price of Scottish railway stock. The strong position which the Scottish railways hold financially has led them into the various enterprises which they have now on hand, and the great increase in strength of the North British Railway Company relatively to the Caledonian, especially in the few past years, has brought the two companies into very close rivalry indeed. For many years railway rivalry in Scotland has taken the form of extensions of lines and building of stations to meet a continually growing traffic, rather than of competition in passenger fares, or even in goods or mineral rates, except in special cases. Now it would appear within the bounds of possibility, as if the two great railways, facing each other in a duel for supremacy, should elect to fight it by reducing rates. There is, however, an alternative which railway administrators in Scotland are beginning seriously to look forward to—that is, the absorption of all of the smaller railways by the two great ones, and the final amalgamation of these into one great railway monopoly. There can be no doubt whatever that, if this were permitted, it would be necessary to devise very special means for preventing the public interests from being jeopardised by such a combination. The railways are on a unique footing as regards the State; they have been privileged and State-regulated from the beginning, and they owe their position of power as the monopolisers of inland carriage to the privileges thus granted. It may be necessary in this case to extend State-regulation in order to prevent a State privileged corporation from wielding its power to the public disadvantage. The opening of the Forth and Tay Bridges, and the other extensions of the railway system which are now being constructed, or for which powers are to be asked in Parliament in the session just entered upon, must bring the Scottish railways within measurable distance of some such issue as that indicated. The Forth Bridge Railway Company and the various railways among whom its stock is held are to be congratulated upon the successful completion of an enterprise which has only been carried out by the indomitable perseverance and courage, and by the hearty co-operation, of the able men who have financed it, designed it, and built it.

THE EXEMPTION OF MACHINERY FROM RATING.

In our issue of the 15th November last we directed attention to the circumstances which had led to the institution of the National Society for the Exemption of Machinery from Rating, and at the same time pointed out some of the principles which should guide legislation in the matter. We mentioned that not only was the special case which had raised the question being carried to the highest legal tribunals, but also that a Bill to secure the exemption of machinery from rating was being promoted by the Associated Chambers of Commerce, and that the Parliamentary and pecuniary support which had been given or promised was most encouraging. The energetic manner in which the Chambers of Commerce branch associations took up the subject in all the manufacturing centres was a guarantee of a successful issue. We have been informed that, by the aid of Mr. Winterbotham, M.P., a Bill for carrying out the objects of the Society has been ordered for second reading in the House of Commons on the 16th of April. Such a matter as this should of course be decided entirely on its merits, and we are sure that the promoters of the Bill have no other object in view; but the amount of ignorance or apathy on all matters lying outside of ordinary everyday experience is so great that it becomes all who are interested in the subject to enlighten our legislators as to the objects in view, and to the dangers which would arise if the decision from which appeal is being made be not overturned. The committee of the National Society for the Exemption of Machinery from Rating has therefore issued a circular requesting that those who are directly interested in the subject should try to place it in all its bearings before such Members of Parliament as they happen to know, as they think that so favourable an opportunity for bringing their work to a successful issue may not soon occur again. As we entered into the merits of the question in the article to which we have referred, we need not here repeat any of the arguments we used in support of the position taken up in the Bill, but we hope that these will be carefully studied by all concerned, so that a just decision may be arrived at. Any information which may be desired on the subject may be obtained from the secretary, Mr. Humphreys Davies, 22, Buckingham Street, Adelphi, London, W.C.

THE EDINBURGH UNDERGROUND RAILWAY.

For some time past the people of Edinburgh, especially those resident in the neighbourhood of Prince's Street, have been agitated about the proposals of the Caledonian Railway Company to have an underground railway, or, more correctly, a series of such railways, in their neighbourhood, and discussions on the subject have been both loud and long. At a recent meeting of the Town Council it was unanimously agreed to petition against the Bill which is being promoted by the Caledonian Company for carrying out their object, and in the face of this opposition there is not much probability to its being agreed to by Parliament.

The subject can be looked at from several points of view, and the decision which is arrived at will, of course, depend on the relative importance of the various factors in it. The Town Council instructed Sir John Fowler and Mr. Benjamin Baker to report on the matter, and they, of course, confined themselves mainly to the engineering problems involved. The whole of the work would present no serious difficulties in its execution, although it might cause a considerable amount of temporary inconvenience. It is estimated that the operations of construction for the Prince's Street part would occupy about two years, and the consulting engineers are of opinion that, with energy and good arrangements, it is quite possible that they might be completed in that time. In order, however, to do this without seriously interfering with the street traffic, it would be necessary to work at night, and thus render the two years a period of great discomfort to visitors or persons having their residence in Prince's Street, and to hotel-keepers and others who are dependent on visitors to Edinburgh this discomfort might be a very serious loss. The engineers add, however, that if the permanent advantage to be attained by the citizens of Edinburgh generally were very great it might be necessary for private persons and particular localities to submit to such temporary loss and discomfort. The consulting engineers have reported that they did not think that structural injury need be apprehended to house property by the construction of the railway if proper precautions be exercised. They admitted, however, that a considerable amount of vibration was inevitable with passenger, and still more with goods, trains, and they pointed out that an amount of vibration which would be immaterial in many cases would be highly prejudicial in the instance of Prince's Street, where for many months in the year there is probably a greater number of persons whose sleep would be dependent on quiet during the night hours than would be found in the same length of street in any town in Great Britain.

The consulting engineers then consider the inconvenience to passengers by the proposed railway from defective ventilation, and point out that if the present plan be carried out the difficulties of ventilation would be considerably greater than in any closed part of the Inner Circle Railway in London. While admitting that if sufficient power be provided to work fans it is possible to obtain any degree of ventilation required, still it is proper for safe guidance to look at what practically happened in the underground railways of London, where fans were proposed, but were found so costly that other cheaper, although less effective, means were adopted. At the present time there is only one place where a fan is at work on the whole of the Inner Circle Railway, and that is where the stations are very near together. With present experience in other railways the consulting engineers say that it may be concluded that to efficiently ventilate the railway down Prince's Street there would be required engines and fans of great power, placed in or near the street, and causing noise and disturbance, or the still more objectionable alternative of openings in the street, and they are of opinion that only a great public necessity would justify either of these alternatives, having reference to the high and valuable character of the business and residential property in Prince's Street.

Apart altogether from the engineering aspects of the question, it was pointed out that if the works were carried out as proposed they would inflict an injury of the grossest kind on the architectural and artistic features of the city for which Edinburgh is at present famous. Professor Baldwin Brown said that any such wanton destruction as might possibly be entailed should the scheme pass would involve a blot upon the reputation of the city for good taste, and would be remembered against the citizens by future generations. Taking everything into consideration the Town Council arrived at the unanimous decision to oppose the scheme, and, on the whole, we do not see how they, as guardians of the public interest, could have done otherwise. Some of the objections urged to the scheme might in time be reduced by improved mechanical or electrical arrangements; but it would be a grave mistake to sacrifice either the comfort or the appearance of the finest city in the kingdom for a small matter of convenience. There is certainly need for improved station accommodation in Edinburgh, and the consulting engineers give some hints which might be adopted with advantage. If the North British and the Caledonian Railway Companies, instead of attending only to their own interests, would unite and bring forward a scheme which, while respecting the rights of owners and of the community, also met the convenience of the general public, it would receive the support of all concerned, and would in the end lead to their own advantage.

THE RAILWAY AND CANAL TRAFFIC ACT, 1888.

At recent sittings of the inquiry now being held before Lord Balfour of Burleigh and Mr. Courtenay Boyle, representing the Board of Trade, the case for the traders of the country has been under consideration. In their behalf it is alleged that the railway companies' classification is altogether incomplete, and that the attempt to increase the charging powers of the companies is contrary to the intentions of Parliament, and will adversely affect the industrial position of Great Britain. With regard to the former the traders urge the acceptance of the Clearing House classification; and as to the latter, they uphold the adoption of one working schedule of rates, as opposed to the constitution of a statutory and a working schedule. It seems probable that in this respect they are doomed to be disappointed, and, speaking generally, we are not sure whether the attainment of their object would prove an unmixed benefit. In times of good trade, the expenses of railway traffic are much enhanced, not only from the increase of goods to be handled, but from higher prices of fuel and labour. If the statutory rates are to be the working rates, it is evident that an average schedule would have to be fixed which would prove a serious burden in times of great depression in trade. Provided the maximum rates are not fixed above a figure suited to times of good trade, it seems somewhat in the interests of commercial centres that in periods of severe depression the companies should have the power to reduce their charges. During the years 1886–88 many instances of reduced charges came under our notice, and it is well known that for various reasons the companies do not, as a rule, exercise their maximum powers. As long as the railway transit monopoly exists, traders cannot expect, either through Parliamentary interference or otherwise, that their lot will be a happy one.

Comparisons have been made between the rates in this country and those prevalent on the Continent, and it is a recognised fact that such comparisons are uniformly in favour of Continental rates.

THE LATE SIR ROBERT KANE, F.R.S.

To the younger generation of readers the name of Sir Robert Kane may be so little known that they will be surprised to hear of his death, which occurred in Dublin, on the 16th inst., in his 80th year. The work which perhaps brought him most prominently before the public was his book on "The Industrial Resources of Ireland," which was published forty-six years ago, and which in many respects is still a standard work and a model of exactness and method, and now, when there is talk of

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attempting to develop the resources of Ireland, it is always referred to for information.

Sir Robert Kane, F.R.S., was born in 1809 in Dublin, and was the son of a manufacturing chemist of that city. His early life was devoted to the study and practice of the medical profession, but his leanings were towards the educational and literary sides of his work, and in 1834 he was appointed Professor of Chemistry to the Apothecaries' Hall of Ireland. In 1844 he was appointed Professor of Natural Philosophy to the Royal Dublin Society, a position which he held until 1847, and he obtained various honours for his researches in chemistry during this period. He took an active part in the work of the Council of the Royal Irish Academy, and afterwards became its secretary, a position he held until his appointment as first President of Queen's College, Cork. In 1843 he delivered a course of lectures on the industrial resources of his country, the substance of which appeared in the book to which we have alluded. In 1846 a Museum of Irish Industry was organised at his suggestion, and he was nominated its Director, a position which he occupied for a considerable time along with the Presidency of Queen's College, Cork. The two positions, however, being found incompatible, he resigned the latter in 1864. In 1875 he was appointed one of the Commissioners of National Education, and his death creates a vacancy on the Board. Of late years he lived in comparative seclusion, taking little part either in scientific or public matters. It is said that the distinction which gave him the greatest pleasure of any he ever received was that he was the father of Captain Kane, of the "Calliope," the hero of the Samoan hurricane last year.

Letters to the Editor.

FOG AND ATMOSPHERIC ELECTRICITY.

To the Editor of "Industries."

Sir,—As of late years great advances have been made in electrical science, I should be glad to know, from some reader, through your columns, whether means have been found to ascertain the electrical condition of the atmosphere at any time, and whether it is, or not, affected by fog.

It has long been a moot question in maritime circles whether fog does, or does not, affect the mariner's compass. A very competent observer, the late Captain Saxby, asserted that it did, and mentioned, in proof, that on one occasion a convoy of thirty sail all found themselves steering a wrong course through fog. Others, on the contrary, assert that it is not in consequence of error of the compass, but owing to the tide or to a current if a vessel gets out of her course in a fog.

My own opinion is that fog does affect the mariner's compass, and, though I am not an electrician, the following reasons appear to me conclusive: magnetism is a form of electricity, and so is lightning; lightning is in the clouds, and a fog is a cloud. Moreover, in the normal course of things, a cloud should rise in the air, whereas a fog descends.

Yours, &c.,
Wm. H. Daniels.

7, Cavendish Grove, The Avenue,
Southampton, February 24th, 1890.

THE KENT COAL DISCOVERY.

To the Editor of "Industries."

Sir,—While the announcement of the discovery of coal in Kent was probably wholly unexpected by the general public, it no doubt also came as a great surprise to many of those whom it will most materially affect, and who have been better informed upon the opinions of geologists as to the occurrence of coal in the south-east of England. Upon the first reception of the news, considerable doubt was expressed as to its truth, as it was felt that the engineers could easily have been misled by some lignite from the Kimmeridge clay, some jet from the lias, or a local development of trias plant beds. At the annual meeting of the Geological Society it was announced by the President that Professor Boyd Dawkins had identified some of the plants found with the coal as carboniferous species, and thus all doubt in the minds of geologists is set at rest. But, as many who are not geologists may not appreciate the value of this evidence at its true worth, I should like to refer to the reasons which have led geologists to believe in the existence of coal in the area in question.

It is now more than sixty years since Conybeare and Phillips first called attention to the striking resemblance of the coalfields of Belgium and Bristol, and concluded that they were probably connected beneath the newer rocks that occupied the area between them. The Bristol coalfield was found in its eastern margin to dip below the new red sandstone, and this in turn was covered by the various members of the jurassic system, and these by the cretaceous. It was concluded that the whole of these would intervene between the coal measures and the base of the tertiary rocks in the London district—that is to say, that the coal would be buried by at least 8,000ft. of superincumbent deposits, or could only occur at twice the maximum depth at which it is thought coal will ever be worked. Moreover, it was pointed out that, as the coal seams of the north and west of England are traced to the south-east they deteriorate in value, and thus, even if the coal could be reached, it would be almost valueless. Hence the question was thought to be of no practical value, and the discussion was regarded as possessing only an academic interest. Serious attention was first called to the matter in 1855, when a masterly memoir was presented to the Geological Society by Mr. Godwin Austen. In this he showed that the coal fields of Belgium, Northern France, and Bristol had once been continuous, that there was no reason to expect any serious deterioration in the value of the coal over any large part of its area, and that, as the lower mesozoic rocks in the south-east of England had probably thinned out in that district, the underlying carboniferous rocks would occur at a depth of little over 1,000ft. Very shortly afterwards the truth of this remarkable prediction was proved by the boring of a well at Meux's brewery in the Tottenham Court Road, when the old palæozoic rocks were struck at a depth of 1,066ft. Henceforward no subject has been watched with greater interest by London geologists than the exploration of this ridge of rocks which connects the coal fields of Belgium and the West of England. Borings alone, however, could throw any fresh light upon the subject, and these have been few in number, and as far as the present problem is concerned, not well placed; only one, the unfortunate attempt made by the British Association at Battle, in Sussex, was especially undertaken to settle this problem. Nevertheless, the palæozoic rocks have been struck at depths varying from 800ft. to 1,200ft. in borings at Kentish Town, Ware, Cheshunt, Crossness, Chatham, Harwich, Streatham, and Richmond. Until last week the coal measures had never been found, but the borings had ended in red rocks of doubtful (probably Devonian) age, Devonian or Silurian rocks. The borings had, however, afforded an almost complete verification of Godwin Austen's prediction, and as the older palæozoic rocks seemed to dip to the south geologists felt no doubt that somewhere in that direction the newer palæozoic rocks containing the coal measures would be found. Small fragments of coal had actually been obtained from the Richmond boring, showing that coal did once occur *in situ* in that district. It has, however, been impossible to predict exactly where the coal measures would be found, as they occur both in Belgium and the west of England as isolated narrow basins; thus, that of Liége is forty-five miles long by three-eighths of a mile broad, and similar proportions may be seen in the coal fields of the Ruhr, of Aachen and Hainaut. The same arrangement probably obtains in the south-east of England, and the coal basins may be found as long narrow basins surrounded by older rocks. Hence geologists have had to wait for more borings to give a better idea of the general distribution of the older rocks before predicting exactly where a search for the coal is most likely to be attended with success. Important evidence was expected from the Dover sinking, though no one dared to hope that, by a lucky chance, the coal should itself be struck. Until the dip of the beds at Dover can be ascertained, which probably cannot in this case be done, it is perhaps rash to prophesy the distribution of the coal measures, but they probably occur in a series of isolated basins tending north-westwards from Dover along a curved line following the North Downs. Thus they may be expected between Ashford and Canterbury, and between Maidstone and Chatham, and further west in the neighbourhood of Reigate and Guildford, and so on to the outcrop in Somersetshire. In view of the paramount importance of the discovery, which may have results absolutely revolutionary to British industry, the necessity for experimental borings along the line indicated may well be pressed upon the Government and local authorities. Cheap fuel may cause the return to London of the industries once the source of its prosperity, but which have migrated to the north, and the pressing social problems of East London may find their solution in the time when is fulfilled the old geological prophecy, "that the day will come when coal will be worked in the south-east of England."

Yours, &c.,
F.G.S.

London, February 24th, 1890.

THE INSTITUTE OF MARINE ENGINEERS.

A meeting of the Institute of Marine Engineers was held on the 10th inst., under the presidency of the Honorary Secretary, when the discussion on Mr. Sommerville's paper on "Ventilation and Heat Radiation," read at the previous meeting, was continued.

The chairman opened the proceedings by giving a brief *résumé* of the various ideas suggested by the paper, of which proof copies had been already supplied to members for the purpose of discussion. The presence of carbonic acid and other gases, and modes of expelling them, he referred to, and the plan adopted in mines for ventilating workings and drawing the foul air to the upcast was given as the foundation of a good system of ventilation. When, however, in place of the upcast being through the stokehold as its natural and proper channel, the engine-room skylight was made to usurp the province of the funnel, the results were highly detrimental both to ventilation and the efficiency of the machinery, inasmuch as the draught was away from instead of towards the furnaces, and the coal-dust and floating particles from the stokehold were carried into the engine-room, resulting in the open oil-boxes becoming filled with grit, which tended to heat the exposed bearings and bring about worry, anxiety, and fatigue to the engineers, and prospective expense to the ship. The want of attention given to the accommodation required for engineers when off duty in many of the smaller lines of steamers was alluded to, and the frequent changing of engineers resulting from this was remarked upon as being detrimental both to the interests of the owner and the machinery. Attention was next called to the injury done to boilers by injudiciously allowing the cold air to pass down the stokehold ventilators in great quantity, especially when cleaning fires, as it frequently was the cause of leaks at the back ends of the fire-boxes. In connection with this it was suggested that it is a good plan to have an arrangement of gear led into the stokehold for shifting the ventilator cowls with their head to wind, when the furnace or tube doors require to be opened, so as to lessen the introduction of cold air, and thus make the ventilator nearest the doors in question an upcast. The disadvantage of fans driven by the main engine shaft was alluded to as being only available when the engine was in motion, whereas ventilation is wanted quite as much when the steamer is at ports of call and the main engines stopped. The various forms of ventilator cowls were referred to; also various systems which had been tried with more or less success, such as the system of leading a pipe into an annular space around the funnel or into the funnel itself, with or without the application of exhausting fans.

The discussion was entered into by Messrs. J. McFarlane Gray, D. G. Hoey, J. H. Thomson, W. W. Wilson, R. Duncan, W. M. Thomas, and Captain Froude, while Mr. R. Adam read the remarks of Mr. Buckwell, who was unable to be present. During the discussion the theory of ventilation, and the principles on which the theory is based, were shown and illustrated by diagrams. The necessity of having a proper system of uptake and downcast was enforced, and the need for an efficient arrangement of ventilation, based on true scientific principles, was shown. The system in operation in some of the Channel Service steamers was described in the remarks by Mr. Buckwell as being very effective. In this system the vitiated air is drawn into an annular space around the main funnel. This space is divided vertically, the one portion being used for ventilating the forward part, and the other the after part of the ship. Another system was referred to, in which the foul air is drawn by artificial appliances from the various parts of the ship and discharged into the funnel, thus providing ventilation and forced or induced draught at the same time. The extraordinary disregard which is paid by many to the loss of coal involved in uncovered steam pipes, boilers, and other portions of the machinery, was commented upon; also the want of thought displayed in arranging the ventilators in steamers without regard to scientific principles. It was suggested that the various ideas brought forward in the paper read, and the discussion to which it had given rise, should be embodied in a future paper and brought to some practical issue.

THE MANCHESTER ASSOCIATION OF ENGINEERS.

At the meeting of this Association, held on the 22nd inst., Mr. G. Kiernan read a paper on "Continuous Brakes."

In commencing his paper, the author gave the history of the subject so far as it concerned this country, and recited the well-known stipulations of the Board of Trade in regard to brakes. The five requirements insisted on by that Department had been embodied in an Act passed last year, and the Board of Trade had, by the powers then given them, fixed the time for the adoption of continuous brakes complying with their conditions, this term expiring on the 24th April, 1891. Mr. Kiernan then proceeded to give a number of figures showing the relative employment of the automatic vacuum and the Westinghouse brakes. The former, he stated, was used in this country by companies having 12,000 miles of railway, and the latter on a length of 6,220 miles. In 1878 mechanical brakes were in use on 4,350 vehicles; in 1883 on 9,000; and in 1889 on 3,000 only. In the same time the use of atmospheric brakes had increased from 3,380 vehicles to 56,000. Dealing in a similar way with vacuum and pressure brakes, he found that the numbers in use of the former in 1878, 1881, and 1889 respectively, were 2,415, 8,700, and 37,800; and of the latter in the same years, 1,059, 6,000, and 18,000. Distinguishing between automatic and non-automatic or simple vacuum brakes, the numbers were as follows:—In 1878, 1,000 automatic and 2,500 simple brakes were in use, while in 1889 the numbers were 46,200 and 9,600. Further figures were given to show the striking advance made in the use of the vacuum automatic, and the cause of this was found in the simplicity and efficiency of the mechanism which allowed, he said, of the nicest regulation with less liability to error than any other brake. The chief difference in the vacuum and Westinghouse brakes lay in the fact that in the former the piston itself is made large enough to apply the necessary pressure to the wheels, while in the latter it is merely used to control a valve which admits air to and from the brake cylinder.

The author then proceeded to deal with the most recent development of air-brakes—viz., their application to long trains of, say, fifty coaches, the total length of which would be over one-third of a mile. Unless the brakes were made very quick in action the front part of

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the train would be stopping before the rear had the brake on, and the train would be subject to severe shocks. It was impossible entirely to avoid this defect, but it could be so minimised that all practical objection would be removed. Both classes of brake had been remodelled to meet the requirements of this class of traffic, and, in a trial made with an improved Westinghouse brake at the Brussels Exhibition, pressure was applied on the twenty-fifth coach wheels in two and a half seconds. A special model of fifty cylinders and 1,830ft. of 2in. piping had been constructed by Messrs. Gresham & Craven, Limited, Salford, to correspond with actual working conditions, the cylinders being in series separated by exactly the length of pipe existing in actual practice. A trial made by Sir Douglas Galton gave the result that the brake was applied on the tenth cylinder in $\frac{1}{10}$ second, on the twentieth in $1\frac{1}{2}$ seconds, on the thirtieth in $2\frac{1}{4}$ seconds, on the fortieth in 3 seconds, and on the fiftieth in $3\frac{1}{2}$ seconds. Thus the Westinghouse applied the brake on the twenty-fifth coach in $2\frac{1}{2}$ seconds, and the vacuum on the thirtieth in $2\frac{1}{4}$ seconds. In order to facilitate rapid action a special valve had been made in each case. In the vacuum this valve was fixed on the train pipe, and consisted of a hollow stem valve with a ball valve in the centre, a diaphragm placed so as to lift the valve as afterwards described, and a pin projecting into the hollow stem. So long as the brake was off, air could enter the cylinder freely from the train pipe, the pressure upon the valve being greater than that on the diaphragm. When a rapid application was required the vacuum in the train pipe was destroyed up to the first valve. This caused the ball valve to lift, and reduced the vacuum below the stem valve, the pressure on which became less than that on the diaphragm. This lifted the stem valve and allowed air to enter the train pipe freely, the ball valve, which rose with the stem valve, being pushed off its seating, and the air flowed to the underside of the piston and applied the brake. A graduated application was obtained by a slow admission of air, and the ball valve was not in this case raised from its seating. In the Westinghouse the triple valve was operated upon, and in the author's opinion this valve is complicated. It was designed to admit a little air into the cylinder, and thus more speedily reduce the train pipe pressure. As now constructed the so-called triple valve consisted of five different valves, and an application necessitated the use of all of them. As the pressure was released the air to the right of a piston valve was allowed to escape, and the air pressure in the reservoir forced the piston over, thus closing a feeding groove, moving a slide valve, and closing the atmospheric port, which at the same time was opened to the reservoir. In this way the compressed air entered the cylinder and applied the brake. A detailed description of the method of making gradual and quick applications of this brake was then given, after which the question of the amount of air used was dealt with. In the first case it was assumed that the brake was fitted to a train of ten coaches with 400ft. of piping. The automatic vacuum, under these circumstances, required 61,812 cubic inches of air when fully applied, and the Westinghouse 287,338, the latter being an increase on that used with the ordinary type of over 100,000 cubic inches. With trains of 50 coaches and 2,000ft. of piping the air required by the two brakes were respectively 256,156 and 688,650 cubic inches, the vacuum brake, he said, again having the advantage. Quick action brakes had not yet been fitted in this country, although several long train trials had been made on the Manchester, Sheffield, and Lincolnshire Railway. After remarking that the Indian Government had adopted the vacuum brake, the author concluded by saying that he thought the time had come when a universal brake should be adopted.

In the course of the discussion which followed, some objection was taken to the size of the pipes used for the vacuum brake because of the extra weight and difficulty of fitting, and it was pointed out that in some places the mechanical brake was preferred for use on steep inclines.

Mr. C. F. Budenberg said he had tested the action of the rapid valve on the model at Messrs. Gresham & Craven's works, and could confirm the results obtained. He thought, however, that it would be difficult to put on the brake slowly, as he had found it extremely difficult to prevent it going on full. The valve named was very simple, and one feature of the arrangement was that the release of the vacuum brake was gradual and without shock. The point to be aimed at was to prevent skidding, and this was a cardinal feature in the use of the regulating valves. A previous speaker had referred to the cost of air, but if the curves of exhaustion and compression were plotted it would be found that the proportional values of the work done were as 1 to 5. Even assuming that ejectors were not so effective as pumps, it would be seen that there still was a large margin left in favour of the former.

In replying to the discussion, Mr. Kiernan said that the behaviour of air brakes on inclines was quite satisfactory and equal to that of mechanical brakes. To produce a vacuum in the whole of a train of the length named would require with a small ejector 3 to 4 minutes and with a large one about 50 seconds. With the Westinghouse plant the filling of the reservoir with air at the required pressure would take 15 to 20 minutes, so that after all the amount of air used did count in the calculation. With reference to the difficulty of application referred to by Mr. Budenberg, this could be easily overcome by a slight modification in the application valve. While the mechanical construction of the Westinghouse brake was probably more ingenious than any of its competitors, still, for simplicity and efficiency he thought the automatic vacuum was far superior.

Books Received.

Turning Lathes. A Manual for Technical Schools and Apprentices. Edited by JAMES LUKIN, B.A. Colchester: The Britannia Company.

Commercial London. A Manual of Business Information for 1890. Edited by TH. SIMPSON JONES. London: The Inter-Colonial Publishing Company, Limited.

Transactions of the American Society of Civil Engineers, October, 1889.

Tables Relating to Live Salvage on the Coasts of the United Kingdom during the Year ending 30th June, 1889. London: Eyre & Spottiswoode.

Leçons sur L'Electricité. Par H. PELLAT. Paris: Georges Carré.

Traité des Piles Electriques. Par DONATO TOMMASI. Paris: Georges Carré.

A Modern University, with Special Reference to the Requirements of Science. A paper read before the Glasgow University Club, 11th April, 1889. By HENRY DYER, C.E., M.A.

Transactions of the American Society of Mechanical Engineers. Vol. 10. 1889.

Reviews.

FARBELECTROCHEMISCHE MITTHEILUNGEN. By Dr. F. Goppelsroeder. WENZ & PETERS, Mülhausen-i.-E. 1889.

Dr. Goppelsroeder exhibited at the Manchester Exhibition a collection of the more important of the results which he has obtained in his endeavour to dye by means of electrolysis. Before 1887 he had contributed papers to the Austrian *Wollen und Leinen Industrie Zeitschrift*, in which he gave details of his earlier experiments in this direction. The present pamphlet consists of a *résumé* of his work, and describes the Manchester exhibit in detail. Briefly, Dr. Goppelsroeder's experiments may be described as the utilisation of the oxidising and reducing action of the electrodes of a battery for the purpose of producing changes in the colour of dyestuffs on the fabric. There may be in the future an industrial opening for his experiments in printing with these readily reducible or oxidisable colours; at present, however, they form only an interesting series of lecture experiments illustrating the chemical constitution and reactions of some of the aniline dyestuffs. The electric pen might, however, be considered as an industrial application. The pen forms the positive electrode, and passes over a sheet of paper soaked in aniline hydrochlorate solution resting on a pad containing the negative electrode. The chlorine and oxygen liberated at the point of contact of the pen cause the dehydrogenation of the aniline molecules to aniline black, and leave therefore a black line where it has passed over the paper. The pamphlet concludes with an historical sketch of electro-chemical telegraphy.

THE AMATEUR'S WORKSHOP. By the Author of "Pattern Making," &c. London: SWAN SONNENSCHEIN & Co.

In the present day it is highly desirable that almost every one should have a considerable knowledge of practical mechanics, and be able to use his hands and some of the more common workshop tools, in such a manner as will fit him to keep things in order in any establishment not of a purely mechanical nature with which he may be connected, without the necessity of sending for a tradesman for every little job. Hence the demand which has arisen for manual training in connection with schools of various kinds. We have always advocated such training where it was kept subsidiary to the ordinary subjects of education, and used as a means of making the instruction real and the knowledge of the students more thorough.

The book we are about to notice shortly is intended to meet the wants of amateurs, and is mainly a reprint of articles which appeared in the *English Mechanic*. Its object is to supply, in a simple and concise manner, information respecting the principles of construction and modes of operation of engineers' machines and tools, and hints respecting the judicious use of the same, and it seems well arranged to meet this object. It is divided into two parts, in the first of which the uses of the ordinary machines found in small establishments are explained, and, in the second, of the more common hand tools. The majority of amateur workshops will not be supplied with any of the ordinary prime movers, but in order to meet the wants of those of larger size some useful hints are given in the first chapter about the working of small steam and gas engines. Then follows a description of lathes suitable for amateurs, of lathe chucks, drilling machines, shapers and planers, circular and band saws. The value of the description is in some cases increased by sufficient details and dimensions being given to enable skilful amateurs to construct these things for themselves. A short description is given of a small smithy and brass foundry, and of the apparatus required, so that those who are able to have such departments may have a fair idea of the best method of arranging them. There are two chapters on a considerable number of miscellaneous appliances, but the most of these are only likely to be wanted by those who can afford to go in for considerable expense. The second part, treating of the ordinary hand tools, both for working metal and wood, is the one which will be most useful to the majority of amateurs whose space and means are both limited. The principles of cutting tools are clearly explained, and those who study this part of the book should have little difficulty in keeping their tools in good order. The last chapter is taken up with tools for measurement, and gives an explanation of the ordinary rules and scales, as well as gauges and other special appliances for exact measurement, such as micrometer and vernier calipers. The scope of the book does not allow the processes and operations performed by the machines and tools to be described, but the author states that should his present work meet with a favourable reception he may probably devote a companion volume to the subject of handicraft. We hope that this encouragement will not be wanting, as we think the book is well suited for the purposes for which it is intended.

THE JOURNAL OF THE IRON AND STEEL INSTITUTE. No. 1. 1889. London: E. & F. N. SPON.

The inaugural address of Sir James Kitson, as President, with which this volume commences, although largely devoted to showing the excellences of Yorkshire iron, will yet be found by steel-makers to contain a fund of information valuable to them. Some idea of the wide ground surveyed may be gathered from the fact that this address is illustrated with twelve plates giving details of the most modern examples of blast furnaces, blowing engines, hydraulic charging apparatus, steam hammers, shearing machines, testing machines, and forging presses. The advantages obtained by the use of modern appliances in industrial operations could not have been better illustrated than by the case of the Consett Plate Mills. Here live rollers are not only used to feed the mill, but to traverse the plates from the roughing to the finishing rolls as well, with the result that the output has been so much increased that they have rolled in one turn 105 tons of marketable plates, equivalent to 1,000 tons per week, where twenty-five years ago 250 tons per week was considered very good work. A somewhat interesting table is given on the subject of steam hammers, that might, at a first glance, reasonably cause apprehension, for whilst England can show nothing heavier that the 35-ton hammer at Woolwich Arsenal, Germany and Russia possess 50-ton hammers, and France heads the list with one of 80 and two of 100 tons. The President, however, reassures us when he adds that the steel forging capacity of England is not represented by a comparison with steam hammer power, and describes the 4,000-ton press of Sir John Brown & Co., which was made by Messrs. Tannett, Walker, & Co., of Leeds. Electrical welding comes in also for a share of attention, and when we are assured that the weld is as strong as the same section in any other part of the bar, we cannot doubt that there is a great future for such a process.

The subject of iron alloys, regarded from a general point of view in the President's address, is treated with special reference to the alloys of nickel and steel in a paper by Mr. Riley. Such remarkable results have been obtained by the addition of nickel to steel, in regard to elongation and tensile strength, not only by the process of M. Marbeau, but also by Mr. J. F. Hall, of Sheffield, independently, that a new era seems to be opening out before the constructive engineer—always provided that the price of the alloy does not prove prohibitive. Mr. Hall tells us that more than a year ago he got 97 tons tensile resistance and over 7 per cent. elongation out of a piece of iron and nickel alloy made by himself. During the discussion Mr. W. H. White asked, "Could engineers and shipbuilders, in dealing with composite riveted structures, depend upon getting rivets which would be workable and trustworthy, and of which the strength

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should be adequate in proportion to the high tensile strength of plates of the new material that would have to be combined?" This question did not receive a very satisfactory answer, but it is, nevertheless, one to which the makers of these alloys will have to give a practical reply, for, as the strength of a chain is that of its weakest link, so the strength of any riveted structure is frequently only that of its built-up seams.

The valuable paper on the manufacture of basic open-hearth steel, by Mr. J. H. Darby, and that on the progress made in the German iron industry since the year 1880, by Mr. Schroedter, of Düsseldorf, are linked by a common interest, as it is chiefly due to the process named that the great strides referred to have been possible. How valuable the process has proved, and how energetically it has been applied, can be inferred when we read that "the old spoil banks of cinders, which have found an unexpected utilisation for the production of basic pig iron, are almost exhausted, and the supply is now limited to the slag produced in current working." There is no lack of ore, however, as the amount available in the Luxembourg-Lorraine deposit is estimated at 2,400 million tons, which makes it gratifying to learn that the German ironmasters are finding a good trade developing at home at remunerative prices. This is said to be in a great measure the result of the expenditure of large sums of money from a common fund to open up new fields for the application of iron, more especially in building construction, as a substitute for stone and wood—a concerted action that may be worthy of imitation amongst ourselves. We must not omit to mention that during the discussion on Mr. Darby's paper Mr. E. Windsor Richards, after explaining his experience with several new forms of furnace, circular and elliptical, remarked: "Why they had all gone away from the rectangular form of furnace of Sir William Siemens he could not for the life of him imagine. However, they had come back to it, and their troubles had pretty well ceased." Mr. Richards considers a large furnace the best, and that it should hold at least 20 tons of steel.

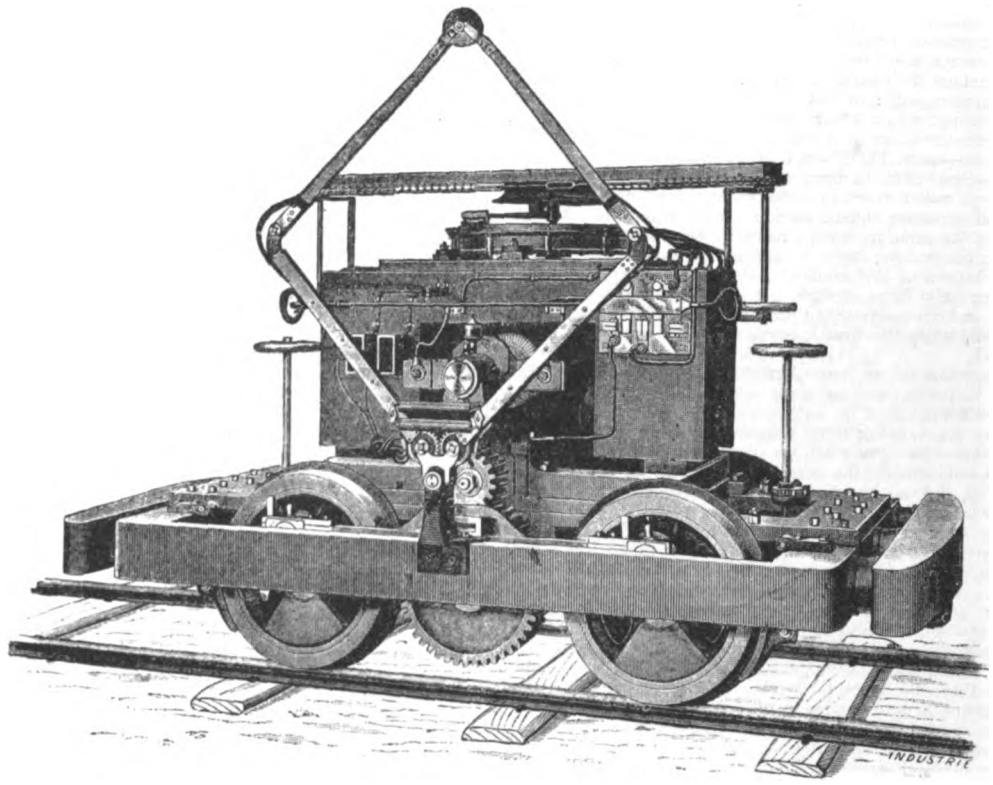
The remaining papers include one "On the Influence of Copper on the Tensile Strength of Iron and Steel," by Dr. Ball and Mr. Wingham, who tell us that the principal effect that the presence of copper appears to exert on iron and steel is to render it extremely hard. With regard to the question of the possibility of producing true alloys of iron and copper, the authors are of opinion that when carbon is present the metal is distinctly far more homogeneous than when no carbon is present. The paper by Mr. Sack, "On Universal Rolling Mills for the Rolling of Girders and Cruciform Sections," is an interesting contribution, although he incorrectly assumes that it is only possible to overcome the difficulties of rolling large girders in steel by means of four rolls as applied in his mill. Such a method was devised by a Mr. Brown many years ago, and consisted in an ingenious arrangement of the grooves in ordinary rolls, the details having been successfully worked out at Landore, where by this means such thin H sections were produced from ingot metal that they were the admiration of all engineers who saw them. M. Pourcel's contribution, "On the Application of Thermal Chemistry to Metallurgical Reactions," is an attempt to introduce into the field of practice an instrument which "is not as yet of such a character as to have a direct bearing upon most studies of chemical phenomena." That the manufacture of iron and steel offers scope for its application cannot, however, be doubted, and M. Pourcel's effort merits commendation, for, as he says, "If thermal chemistry is still poor in results, work should be done with a view to add to their number, and not to question their value." The last paper is one by M. Gautier, "On the Thomasset Testing Machine," which, with the discussion that followed its reading, constitutes a valuable addition to the literature of a subject of great importance to the manufacturer as well as to the engineer who has to use iron and steel in his structures. A series of communications is thus brought to a close which is quite up to the high standard of those reported in former volumes.

ELECTRIC LOCOMOTIVE FOR MINES.

We illustrate above an electric locomotive for mines which has recently been built by the Thomson-Houston Electric Company for the Hillside Coal Company, Scranton, Pennsylvania. The wheels are 3ft. gauge, and the dimensions are: Length, 9ft. 7in.; breadth, 5ft. 3in.; height, 5ft. 6in. The weight is 4½ tons, and the maximum speed is 6·2 miles per hour. The electromotor is capable of supplying 40 h.p. Suitable resistances are placed upon the machine for the purposes of regulation. The current is collected by a lazy-tongs apparatus from an overhead wire, and the return current is carried along the rail.

ELECTRIC LOCOMOTIVE FOR MINES.

CONSTRUCTED BY THE THOMSON-HOUSTON ELECTRIC COMPANY, LYNN, MASSACHUSETTS, U.S.A.



THE INSTITUTION OF ELECTRICAL ENGINEERS.

At a meeting of this Institution, held on the 20th inst., a paper was read on "Some Points in Dynamo and Motor Design," by Mr. W. B. Esson. We give a short abstract of the paper as follows:—

1. MAGNETISING FORCE FOR A SIMPLE MAGNETIC CIRCUIT.—The formula of Drs. J. and E. Hopkinson is now adopted by most designers who desire to economise their time. Reduced to ampere-turns, this formula for the magnetising force is—

$$A_1 = L\,f\left(\frac{N}{a}\right) + L_1 \cdot 8\frac{r_1 N}{a_1} + L_2\,f\left(\frac{r_2 N}{a_2}\right) + L_3\,f\left(\frac{r_2 N}{a_3}\right) + \ldots$$

Here A_1 is the magnetising force; L, L_1, L_2, and L_3 are the mean lengths, in centimetres, of the separate parts which constitute the magnetic circuit—comprising in this case armature core, air gaps, magnet limbs, and yoke—while a, a_1, a_2, and a_3 are the cross sections, in square centimetres, of these several constituents. Of the induction produced in the magnet cores, only the portion N, which passes through the armature and is enclosed by the coils at the brushes, is serviceable. In the above expression r_2 is the ratio of the induction in the magnets to that in the armature, the total lines induced being therefore r_2 N. The functions $f\left(\frac{N}{a}\right)$, $f\left(\frac{r_2 N}{a_2}\right)$, &c., are read directly off curves found experimentally.

2. MAGNITUDE OF THE STRAY FIELD.—In order to employ the expression in 1 we require to know the stray field. The value of r_2 in different types of machines depends not only on the shape of the magnetic system, but on the position of adjacent masses of iron in bed-plates, bearing brackets, fly-wheel, &c. It must be remembered that no two machines of the same type have exactly the same value of r_2 unless their dimensions correspond in every particular. The values of r_2 have been ascertained for the following machines, and probably for all modern types they lie between these limits.

Stray Field in Different Dynamos.

Name of Machine.	Field.	Armature.	Remarks.	Value of r_2.
Edison-Hopkinson	Single Magnet, 2-pole	Drum	Poles next bed-plate	1·32
Siemens	Single Magnet, 2-pole	Drum	Yoke next bed-plate	1·30
Phœnix	Single Magnet, 2-pole	Cylinder	Yoke next bed-plate	1·32
Phœnix	Double Magnet, 2-pole	Cylinder	Horizontal	1·40
Manchester	Double Magnet, 2-pole	Cylinder	Bed and one pole cast together	1·49
Victoria	Double Magnet, 4-pole	Ring	Ordinary pattern	1·40
Ferranti	Double Magnet, multipolar	Coreless Disc	Ordinary pattern (alternating)	2·00

When the linear dimensions of a machine are increased in the same proportion, r_2 remains approximately unaltered. As only a small portion of the magnetising force is needed for the magnets an error in the determination of r_2 makes very little difference in the resulting machine. In practice differences in the quality of the iron lead to much greater errors than are likely to arise from an error in the estimation of the stray field.

3. SYMMETRY OF THE FIELD.—It is of some importance to obtain a symmetrical field through the armature, as it is only when the field is symmetrical that the armature is electrically and magnetically balanced. The pole pieces should not be thinned down, else there is an upward force which lifts the armature and heats the bearings. In well-designed machines of the single-magnet type there need be no trouble, however, from magnetic pull on the armature. The magnetic pull may be balanced by the very simple device of placing the armature eccentrically in the field, as I suggested two years ago. In cylinder-wound armatures not only is there a want of magnetic balance when the field is unsymmetrical, but there is a want of *electrical* balance, and it becomes, in consequence, doubly important to get a symmetrical induction. Though the lines were unequally divided there might not be any appreciable difference in the e.m.f.'s generated in each half with the brushes diametrically opposite; but from the fact that a want of electrical balance requires rather more lead to be given to the brush farther from the yoke, it is possible that the e.m.f.'s in the two halves of the windings may be unequal, the result being a local current round the armature, and consequent waste of power.

There are several methods of obtaining an approximately symmetrical field besides placing the armature eccentrically in the cavity. What we have to do, if possible, is to make the path for the induction through the half of the cylinder core which is farther from the yoke of similar resistance to the path through the nearer half, so that a similar number of lines may flow through each. In the Phœnix dynamo we employ sometimes, with this object in view, a specially designed device. Here the cast-iron magnet has the inside corners cut away, the other top corners being left on. Other modifications on the same principle may be used.

4. RATIO OF ARMATURE SECTION TO FIELD-MAGNET SECTION.—In the early days of dynamo designing the cross section of the armature core in cylinder machines was very small in proportion to that of the field magnets, the copper in the armature was excessive, and the air gap correspondingly great. The result was an induction no greater than in modern machines, but an enormous stray field. In the machines made by my firm six years ago the section of the armature core was about one-third of the section of the magnets, the latter being of wrought iron. I may say these machines anticipated Mr. Swinburne's latest notions, inasmuch as the 14in. armatures of those days were loaded to 25,000 ampere-turns. The first great improvement consisted in doubling the iron and halving the copper, a machine so modified giving about the same output, but with less heating and less sparking, and requiring less magnetising force. We got the same output for two reasons: first, the decreased magnetic resistance resulted in an increased total induction; secondly, of this induction a far higher proportion was utilised. The ratio of the armature section to the magnet section, when modified as above, stood at ·66; but we went much beyond this in increasing the iron in the armature, finding that we obtained for every increase, keeping the air gap the same, an increase in the induction. When Mr. Kapp read his paper here on "Characteristics," I mentioned that then the ratio in our dynamos stood at ·75. Since then we have, in machines for incandescence lighting, returned to ·6. The weight of the armature is only a fraction of the total weight of the machine. The field magnets are

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many times heavier, but, besides these, the bed-plate, bearings, &c., make up a large portion of the weight; and since the weight of neither magnets nor bed-plate is increased by an increased armature section, manifestly, if a large output for the weight is the object, and if nothing occurred to interfere with the process, the cross section ought to be increased to such dimensions that for any further increase to the total weight of the machine we get no corresponding advantage. Pressing the induction up to high values is not advisable, as the magnetism then costs too much. Everything considered, 17,000 per square centimetre is probably the best degree of saturation to employ for cylinder armatures, and makers who once employed a greater induction are, I believe, coming down to this. If we work lower we get on the bend of the curve, or on that part where the angle changes rapidly; so that it is not possible to obtain in compound machines with a lower induction such perfect regulation. In four-pole machines it is usual to saturate the armature to a lower degree—about 14,000—and in alternators the induction is still less—about 6,000. In drum machines the induction per square centimetre is rather over half of the value given for cylinders, and the ratio of armature to field section varies from ·8 to 1·0. The diameter of the armature being fixed with reference to the number and size of conductors, there is nothing to be gained by cutting away the interior of the washers. On the contrary, by cutting an opening only large enough for the shaft, the induction is kept low, and the magnetising force for the armature correspondingly small, while the heat generated due to hysteresis is also diminished.

5. Interference of the Armature Field.—Though iron may vary in quality, and so upset occasionally our calculations, no great difficulty need be experienced in approximating pretty closely the magnetising force required for a given induction in the armature core. But when we allow a current to flow in the coils, and so magnetise the core, we superpose on the original a second field, and the interference between them renders the case no longer simple.

6. The Effect of Distortion on the E.M.F.—The distortion of the field produces in a dynamo run without lead a diminution in the e.m.f. for two reasons—first, because the induction acts differentially on the conductors lying between the brushes; secondly, because the currents flowing in sections active when short-circuited under the brushes weaken the field. These local currents induce lines in the opposite direction to the forward induction. Let the machine run as a motor in the opposite direction, the currents flowing through the field magnets and armature being of course in the same direction. The e.m.f. is induced in the armature in the opposite direction, and since in an active coil short-circuited under the brushes the current will flow in the direction of the induced e.m.f., its effect will be to directly strengthen the field as it increases the forward induction. We may say, then, that the effect of distortion is to diminish the e.m.f. in a dynamo run without lead, and increase it in a motor, owing to the local currents generated in the short-circuited coils. The difference in the e.m.f. of a machine run without lead as dynamo and motor may be considerable, as shown by Professor Ayrton's experiments at the beginning of last year.

7. Position of the Brushes in Dynamos and Motors.—If dynamos are to run sparklessly there must be a lead given to the brushes. When a section is short-circuited under the brush any lines of force which were induced, due to the current flowing in it, are annihilated, the current tending by self-induction to continue in the same direction round the short-circuit. The e.m.f. of self-induction depends, obviously, upon the variation in the number of lines through the section which the cessation of the current is capable of producing, on the speed of the armature, and on the number of turns per section. When an armature core is saturated at 17,000 per square centimetre it will be realised that the variation in the lines through the section which the short-circuiting is capable of producing is very small—in fact, practically negligeable. The brush must be placed in advance of the neutral point: in an armature, for instance, having 50 sections, presuming that 5 volts are wasted in the armature, a section when it leaves the brush must move in a field having such strength as will neutralise the effect of self-induction and give one-fifth of a volt over. If the armature has 100 sections the field must give a resultant of one-tenth of a volt, but the e.m.f. due to self-induction will be in the latter case only one-fourth of what it was in the former. By saturating the core and making the sections sufficiently numerous we can make the self-induction as small as we please. We see, then, that in a dynamo the brushes must be set in advance of the neutral point, and that self-induction increases the lead. Is the trail in a motor similarly increased? It is. It appears that the best position for the brushes in a motor is the position in which they have about the same trail as they have lead when the machine works as a dynamo, and that in a motor the trail is *increased* by self-induction.

8. The Load to be Carried by Armatures.—Assuming that a machine is properly designed, a position can be found for the brushes where the sparking is *nil*. If, on the other hand, the machine is badly designed, or if the current carried by the armature is too great, a sparkless collection will be found impossible, from the excessive distortion produced by the armature field. The cross induction depends on the width of the air gap; for the greater the cross section of the gap, the greater the cross induction for a given cross section of armature core and a given magnetising force. It depends also, but to a less extent, on the induction in the core. The forward induction we can give to a machine may be considered as proportional to the cross section of the armature core. Now the distortion of the field depends upon the ratio of the cross to the forward induction. The cross induction is proportional to the ampere-turns on the armature and to the width of the poles, measured parallel to the direction of rotation, and inversely proportional to the length of the air gap. Inserting what appears to be the mean value, we have for the ampere turns which may be carried by an armature the expression,

$$A_2 = \frac{r\,/\,85{,}000}{w}.$$

9. Magnetising Force Required to Compensate the Backward Induction.—The weakening of the field by the current flowing in armatures wound on the von Hefner-Alteneck principle has been studied by Drs. J. and E. Hopkinson; but from the fact that the lead upon which the weakening depends is in Gramme-wound armatures much greater, and to a large extent indeterminate, it follows that, in designing, some approximate rule must be employed to fit the types of machines in which these are employed. I have met with some very curious rules for determining the compensating turns. These generally take the form of adding to the magnetising force determined for the required induction at full load such additional ampere-turns as will increase the induction about 5 per cent. It is assumed that at full load the e.m.f. will be as desired, the 5 per cent. extra being for compensation.

10. Total Magnetising Force.—To the magnetising force required for a simple magnetic circuit as given in 1, we have to add the force required to compensate the backward induction, as given above. If the series coils are connected in series, to get the number of compensating turns on each horse-shoe we have only to multiply the external conductors on the armature by ·165.

11. Working Temperature.—The ultimate rise in temperature of coils wound with double-cotton-covered wire varnished on the exterior is, approximately in degrees centigrade,

$$C^\circ = \frac{W\ 355}{S},$$

where W is the rate at which energy is dissipated in watts, and S the cooling surface in square centimetres. If for the latter we substitute square inches, S_1, the equation is

$$C^\circ = \frac{W\ 55}{S_1}.$$

The coefficients have been obtained from practice, but they are liable to some uncertainty. For armatures—which in rotating induce a current of air—the equation is different, and the coefficient given above may have a much lower value, according to the velocity and ventilation. For armatures the surface velocity of which is 50ft. per second (3,000ft. per minute), and the exterior diameter of the core 1½ times the interior, the length being about equal to the diameter, the rise is, approximately,

$$C^\circ = \frac{W\ 225}{S},$$

or

$$C^\circ = \frac{W\ 35}{S_1},$$

acordingly as the surface is taken in square centimetres or square inches. Here the whole of the cooling surface inside, outside, and at the ends is counted, W being the total watts dissipated in both electrical waste and hysteresis. The latter must, under no circumstances, be neglected, as it may reach 20 per cent. or more of the total. Considerable difference of opinion exists with reference to the temperature rise which should be permitted in dynamos. The rise of about 11° C. allowed by the Admiralty is admitted by all engineers to be absurdly low, while, on the other hand, the machines sent out by some manufacturers get at their normal output dangerously near the temperature at which the insulating material would become useless. In my opinion, an ultimate temperature of from 70° to 75° C. may be permitted with perfect safety, but this should not be exceeded. Independently of the ultimate temperature, the rise in working should not be too great, and accordingly we have in the Phœnix dynamo fixed this limit at from 30° to 35° C. For armatures having the proportion stated, the surface requires to be about 7·3 square centimetres (1·13 square inches) per watt, but here it is less easy to formulate rules. The temperature of the surfaces does not measure the temperature of the bottom layers of wire or of the armature core itself, and when I speak of a temperature of 70° C., I mean, of course, that of the hottest part. Of course it will be understood that the coefficient given for the rise of temperature will be greater for those armatures in which the central opening in the core is less than two-thirds of its external diameter.

12. The Best Relation between the Iron and Copper in the Armature.—Suppose we have a cylinder armature of certain radial depth over the winding: while keeping this depth the same, we may vary the iron and copper of which it consists within wide limits. The question is, what relation of copper to iron will give the best results, premising that, however the relation is varied, the temperature shall remain the same. The cooling surface we will take to be unaltered, and this means, neglecting hysteresis, that the heat generated in the winding shall be constant. Since the waste is constant, the point of maximum coincides with that of maximum output. If the copper on the outside of the armature is considered as a shell of t thickness, we may, within the limits of our inquiry, take the current that may be carried to generate the same heat $= \sqrt{t}$. The e.m.f. produced will be proportional to the radial depth of the armature core, a, and assuming in each case the same degree of saturation, the greatest output for a given radial depth of armature is obtained when $a\sqrt{t}$ is a maximum. This occurs when the exterior layer of copper is about one-fourth the depth of the armature core. It may be assumed, without any great error, that the weight per unit length of circumference is constant, however the proportions vary. With a square or bar winding this is about correct. Machines are not always designed so that the proportions give maximum output, since other considerations arise besides that of the best result from the armature considered by itself. The question of magnetising the core has to receive attention, and the question is resolved into, What is the best proportion for the machine, considered as a whole? The answer to this depends entirely upon the design. For drum armatures the relation for maximum output can be similarly determined, and similar conditions fix the limit of departure from the maximum. One point with reference to these considerations should be noticed, and that is, that neither for cylinders nor drums does the point of maximum efficiency or output coincide with the point at which watts/weight of copper or volts/yards of copper is a maximum, and that these ratios, as applied to compare the performance of dynamos, are accordingly misleading. Given a limiting temperature, the only factors upon which the commercial value of machines should be based are cost and commercial efficiency. Whether the magnets shall be made of wrought or cast iron, whether there shall be a large amount of copper or a small amount, are questions for the manufacturer to decide. In some cases it may pay him to increase the copper and use cast iron, in other cases diminish the copper and use wrought iron. But the finished product is to be judged by its cost to purchase and its cost to run.

13. Motor Designing.—As a general rule, the question of weight does not enter into dynamo designing, except in so far as cost is affected, and a lighter machine means a somewhat increased cost for the output. But in motors it is sometimes necessary to keep the weight as low as possible, and the point to be emphasised here is that in designing light-weight motors we proceed upon lines precisely similar to those adopted in designing light-weight dynamos. It has been asserted that in motors the armatures ought to be larger compared with the field magnets than in dynamos; and by "larger" must be meant either that the armature cross section is greater, or that the ampere-turns on it are more numerous. As regards the former, it has been shown in Section 4 to what extent the relation between the cross sections of the armature and fields influences the dynamo, and the same reasoning applies to motors; as regards the latter, curiously enough, some examples show no overloading, but about the same number of ampere-turns is carried as by dynamo armatures—a fact which does not favour the "large armature" school.

14. Constant-Potential Motors.—Now as regards another thing which we have been told sometimes—that the armature and magnet fields are added in a motor—so far is this from being the case, that, under the usual and proper conditions of a trail on the brushes, the weakening of the field due to the current in the armature may play a most important part in the governing of motors at constant speed. In an article contributed to the *Electrician* in 1886, I hinted at this, saying, "By reason of the current in the armature reacting to weaken the field, does not a shunt motor contain within itself the germ of self-regulation, which, by suitable proportion, may be made effective without a series coil at all?" Since that date motors have been constructed in which the truth so foreshadowed has been realised. It must not be thought that because a motor transmits power it is necessary to manipulate electro-mechanical equivalents until we get torque in pound-feet or foot-pounds per revolution, or some other mechanical quantities. This is only a waste of time. In designing a motor, we know the horse-power or watts to be given off on the brake at a certain speed, and if we make the machine run at the proper number of revolutions, and in accordance with the conditions of electrical supply, the torque will come out all right without our troubling about it.

15. Constant-Current Dynamos.—There seems to be an impression that dynamos for high differences of potentials cannot be worked successfully with Gramme commutators; the reason for this opinion being, I suppose, the breakdown of some imperfectly constructed machines. That there is no difficulty with the insulation between the conductors and armature core is obvious from the fact that high-potential alternating-current machines are working successfully with armature sections similarly disposed; the fault appears, therefore, to have been solely with the commutators. I need only reiterate the remark I made here a short time ago—that there is no difficulty whatever in constructing Gramme machines up to 1,000, 1,500, or even 2,000 volts, provided the designer knows what he is about. Several attempts have been made to compound machines for constant current, all of them uniformly unsuccessful. It is beginning to be realised that—Deprez notwithstanding—it cannot be accomplished, and during the next six years the equations for constant-current compound winding may finally disappear from our text-books. But it may take longer.

MAGNETIC PHENOMENA.

On Friday evening, the 21st inst., Mr. Shelford Bidwell delivered a lecture at the Royal Institution, on "Magnetic Phenomena."

After some general introductory remarks on the nature of magnetic phenomena, and on Faraday's conception of "lines of magnetic force," the lecturer called attention to a very delicate reflecting magnetometer, consisting of a small magnet attached to a suspended mirror, the deflections of which were made visible to the audience by means of a lamp and scale in the usual manner. He then proceeded to show that various small iron objects, such as a pocket knife, a nail, and a door key, none of which had been intentionally magnetised, nevertheless exhibited traces of magnetism. The well-known experiment, illustrating the earth's power of magnetic induction, consisting in holding a bar of soft iron in a vertical position and observing its polarity, then inverting it and tapping it, on which its polarity is reversed, was very well shown by the magnetometer, a very light tap being sufficient for the purpose. A soft iron bar, which had previously been deprived of its magnetism by raising it to a yellow heat, and allowing it to cool in an east and west direction, and therefore with its length perpendicular to the earth's lines of force, was then moved parallel to itself into the neighbourhood of the magnetometer without producing any sensible effect, but a deflection was immediately visible when the bar was turned into a vertical position, the direction of the deflection showing that the lower end had become a north pole.

The lecturer next proceeded to give a brief account of Joule's experiments demonstrating the elongation of iron bars when magnetised, and described the apparatus which he had himself employed when, in the year 1885, he had extended Joule's observations by the investigation of the behaviour of iron bars under much more intense magnetic fields than those employed by Joule. The field was produced in the interior of a vertical coil traversed by an electric current, and the bar to be experimented on was placed in the axis of this coil. The lower end of the bar was fixed, and upon its upper end rested the extremity of the long arm of a lever turning about a horizontal axis, and carrying at the end of its shorter arm a mirror, the motion of which was

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read on a scale at a distance of 21ft. This apparatus was so delicate that an elongation of one twenty-five millionth of an inch could be detected. These researches, and subsequent ones made by Professor Ewing, had shown that while in the case of iron elongation took place in magnetic fields of an intensity less than a certain value between 200 and 300 C.G.S. units, as the strength of the field increased beyond this limit contraction began to occur of an amount gradually increasing until the strength of the field somewhat exceeded 1,000 C.G.S. units, after which there appeared to be no further change in the amount of the contraction. The lecturer stated that Professor Barrett had discovered that nickel did not elongate like iron, but began at once to contract with considerable rapidity, gradually diminishing as the strength of the field increased, until ultimately no further contraction appeared to take place. The behaviour of cobalt was exactly the reverse of that of iron—viz., it first contracted, and then became elongated as the strength of the magnetic field was increased.

Great difficulty was experienced in making these experiments owing to the effect of change of temperature, the elongation produced in an iron bar by a rise of a degree in temperature being about twenty times as great as the maximum magnetic elongation.

This was illustrated by means of an apparatus of the nature previously described, in which a motion of the spot of light over an inch of the scale corresponded to an elongation of three-millionths of an inch in the bar, the spot being made to move rapidly along the scale by simply holding the hand near the bar.

The lecturer stated that he had succeeded so far in overcoming this difficulty, that he had obtained results which could be relied on to within at least one three-millionth of an inch.

The lecture was brought to a conclusion by the exhibition of some specimens of Dr. Hopkinson's alloy of iron with 25 per cent. of nickel, some in their natural state, and others which had been cooled in frozen carbonic acid gas. The former were shown to be non-magnetic, while the latter were so strongly magnetic that a moderately heavy specimen was easily lifted by a small horseshoe magnet.

THE PHYSICAL SOCIETY.

At a meeting of this Society, on the 21st inst., Mr. F. B. Hawes read a communication "On a Carbon Deposit in a Blake Telephone Transmitter." The author exhibited photographs of the interior portions of the transmitter on which the deposit had taken place. These portions consist of a metal diaphragm, a highly-polished carbon button, and a platinum contact piece carried by a German silver spring placed between them. The diaphragm presented a mottled appearance due to the deposit, but the part which had been behind the German silver spring seemed comparatively clean. The deposits on the carbon button and German silver spring were much less dense than that on the exposed parts of the diaphragm, and the space near the point of contact between the platinum and carbon was free from deposit. The deposit was fairly adherent, considerable rubbing being necessary to remove it, and on examination under the microscope particles of copper and metallic crystals could be seen. The author believes the deposit due to some kind of bombardment of carbon particles, but was unable to say why it should occur, or why the varnished diaphragm should receive the greater deposit, although it was further from the carbon than the German silver spring.

Mr. C. V. Boys said the photographs reminded him of a phenomenon he observed some time ago on a glass sheet, against which one terminal of a dry pile had been resting for some weeks. Just as on the carbon button, the glass near the point of contact was clean, and had a comet-shaped deposit formed around it. He could offer no explanation of the appearance.

A communication was then read on "The Geometrical Construction of Direct Reading Scales for Reflecting Galvanometers," by Mr. A. P. Trotter. In a recent paper "On Galvanometers," by Professor W. E. Ayrton, F.R.S., T. Mather, and Dr. W. E. Sumpner, read before the Society, the opinion was expressed that proportionality of scale reading to current was very desirable, and the present paper shows how to bend a scale of equal divisions so as to give the required proportionality. Suppose the currents required to produce several deflections have been experimentally determined; a full-size plan of the scale is then drawn, and radial lines from the points on the scale at which the observations were taken are drawn towards the centre of the mirror. Let these radii be numbered 0, 1, 2, 3, &c., commencing from zero azimuth. According to the procedure recommended, distances proportional to the several current strengths are marked off along the edge of a strip of paper, a few inches being left over at each end. Call the marks a, b, c, d, &c., a being the zero point. Two points on the radii, 0, 1, and equidistant from the mirror, are now found such that the distance between them is equal to that between a and b on the strip, and the points marked by fine needles stuck in the board. The zero end of the strip is now fixed so that the marks a and b lie against the needles, and the strip is swept round until the mark c coincides with the radius 2, where also a needle is placed. Repeating the process gives a series of points which, on being joined, form part of a polygon. A line can then be drawn between the inscribed and circumscribing curves, which has the same length as the sum of the straight lines, and this is the curve to which the original scale may be bent so as to give proportional readings. Diagrams, showing such curves, constructed from the calibrations of instruments given in the paper above referred to, accompanied the paper. The author showed that a family of curves may be drawn, each of which satisfies the required condition. Of the two limiting curves, one is tangential to the usual scale line at zero azimuth, and the other passes through the vertical axis of the mirror. The flattest of the various curves is generally the most convenient.

Mr. J. Swinburne asked whether good definitions could be obtained when such curved scales not equidistant from the mirror were used, and also whether it was not easier to divide a flat scale unequally so that the readings are proportional to the current.

Mr. Trotter, in reply, said Dr. Sumpner thought there would be no difficulty as regards definition with the flat curves shown. He (Mr. Trotter) also added that a curved scale might be advantageous in reading the deflections from one side of a table, as the more distant part of the scale could be more nearly perpendicular to the line of sight. For such an arrangement, however, a parallel beam of light would be required.

Mr. Trotter also read a communication on "A Parallel Motion Suitable for Recording Instruments." This is a modification of Watt's parallel motion, in which the two fixed centres are on the same side of the line described by the "parallel point." The arrangement consists of two vibrator arms, one of which is twice the length of the other, and whose outer ends are jointed respectively to the middle and end of a short lever: the free end of the latter describes an approximate straight line. The motion was arrived at by considering the curve traced out by a point on the radius of a circle such that its distance from the circumference measured towards the centre is equal to the radial intercept between the circle and a tangent line. The equation to the curve is $r = 2 - \sec. \theta$ (conchoid of Nicomedes), and the radius of the osculating circle at the point where the intercept is zero is given as half that of the initial circle. This osculating circle, the author finds, practically coincides with the curve over a considerable angle (40°), and hence may replace this part of the curve; hence the motion.

The author thinks the motion will be useful for recording barometers, ammeters, and voltmeters, as it is more compact than that of Watt, and needs no fixed point beyond the straight path.

THE DETECTION OF WATER-GAS.

The well-known poisonous nature of carbonic oxide has undoubtedly been a hindrance to the progress of water-gas, and as already there have been cases of death attributed to an escape of the gas, it is necessary to provide against any chance of fatality from its use in the future. The danger from this source is considerably augmented from the fact that house piping is often in a very leaky state, and that many of the gas fittings at present manufactured are far from gas-tight. It will be remembered by our readers that Mr. Samson Fox, in the discussion which followed the reading of Sir Lowthian Bell's paper on "Gaseous Fuel" at the meeting of the Iron and Steel Institute last autumn, estimated that 25 per cent. of the amount of the gas bill was owing to the leakages throughout the country. It is therefore of extreme importance that in all cases in which it is proposed to distribute water-gas in any district special attention should be given to the plumbing and fitting of the pipes and connections. Even when this has been carefully attended to, it is difficult to prevent occasional leakage, and the escape from an open cock might cause serious results. It has been proposed that where water-gas is employed in dwelling-houses for heating or lighting purposes it should be rendered odorous by passing it through some volatile liquid having a characteristic and penetrating smell, the vapour of which being present in the gas would at once give warning on any escape taking place. Many liquids have been proposed for this purpose, but unfortunately most of those with strong odours are likewise so unpleasant that their use is attended with many objections. Some of the volatile organic sulphur compounds—*e.g.*, mercaptan—have been tried, but the persistent nature of their odour is such that, even when the gas-fittings are thoroughly tight, the momentary escape of the unburnt gas when the stopcock is first opened before lighting is sufficient to scent the room for a considerable time. This difficulty can, however, be overcome by using those burners in which the gas is kept continually alight. Sulphur compounds are, however, undesirable on other grounds, as the products of combustion of unpurified coal-gas have a very injurious effect upon health, metal work, and paints. Of all the liquids which have been produced for thus rendering water-gas odorous pyridine is probably the best, as its odour is by no means so objectionable as that of many of the organic sulphur compounds, and, as it contains no sulphur, the gaseous products formed by its combustion are free from any deleterious qualities.

Besides these methods for detecting the escape of water-gas based on the use of volatile odorous liquids, Rasine has recently devised an ingenious carbonic oxide detector constructed on an entirely different principle. Platinum black, as is well known, has the property of absorbing gases in which it is placed, and brings about the union of mixtures of oxygen and combustible gases. The inventor has constructed an apparatus in which this property of platinum black is utilised. It consists essentially of a thread of gun-cotton dusted with platinum black, and so placed that on catching fire it determines the closure of an electric current containing an alarum. He states that the firing of the gun-cotton takes place in air containing 2·5 parts of carbonic oxide per 1,000. It will, therefore, give an indication of the escape when the composition of the air in its neighbourhood reaches this figure. It will require, however, further experiments to be made with this apparatus before it would be safe to rely upon its indications, and we should like to see what influence the simultaneous absorption of hydrogen would have upon its working. It is well known that the blood absorbs carbonic oxide from an atmosphere containing only 0·02 per cent. of the gas, and that with 0·1 per cent. present in the air, half the blood of an animal becomes poisoned, so that the apparatus in its present form will not prevent such slow poisoning. It may be that the platinum black absorbs carbon monoxide from a gas containing a lower percentage than 0·25, and that if time be given the accumulation of carbonic oxide in this way will be sufficient to determine the firing of the cotton thread. With the exception of this thread, the apparatus is of a permanent nature, and will, therefore, be easy to keep in order. The two metallic plates which close the circuit are so arranged that one is immediately above the other. This upper plate is held in position by the combustible thread, and is also connected by a bent rod to a lever, which thus prevents the plate from being displaced.

THE OUTLOOK IN THE SALT TRADE.

Our Cheshire salt industry has not yielded very satisfactory returns for the business of the last year. The statistics show that there has been a marked decrease in the export trade since the operations of the Salt Union have influenced the market. The quantity exported during the year only reached a total of 745,111 tons, as compared with 1,022,334 tons in 1888, and 994,726 tons in 1887. This falling off is, no doubt, mainly to be attributed to the increased price for export salt demanded by the Salt Union, which has naturally driven our foreign buyers to other countries and to develop their own local resources. It would be interesting to compare the dividends of the salt companies before the amalgamation with the 10 per cent. recently declared by the Union. The most marked decline is, however, noticeable in our colonial trade, especially in that with India. The quantity shipped to Calcutta has diminished from 314,332 tons in 1888 to 221,616 tons for the present year. Other diminished exports are those to Canada, which was 15,000 tons less than in 1888, and to the United States, which has fallen off to the extent of 25,000 tons. Recent trade advices seem, however, to point to a more active demand in the Mersey district, which may indicate a revival of the industry, and that these statistics for 1889 only denote a temporary depression in the export trade. In the Tees-side district most of the larger salt producers have been extending their works, and other schemes for increasing the produce of the salt beds are being projected. The Durham deposits lie at a much greater depth than those of Cheshire, and present more difficulties for successful working. The New Durham Salt Company, at their recent meeting at Leeds, were furnished by a report to the effect that the company's borings had not yet succeeded in reaching the requisite depth for obtaining a remunerative brine. For the encouragement of the Tees-side industry, the building of a railway from Stockton to Port

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Clarence is contemplated, which, when completed, together with the increased facilities on the Tees, will no doubt considerably augment the export trade from this district. Last year the output from this locality was upwards of 200,000 tons, and the price at the close of the year was only about 1s. over the current price in December, 1888. The rise in price of salt has not been proportional to the increase in the value of the coal, which has nearly doubled during the same period, as several of the Cleveland saltmasters are able to disregard the state of the coal market through their furnaces being driven by waste heat from the blast furnaces. The total production in Europe is estimated at about 3,000,000 tons, of which more than two-thirds was supplied from Great Britain, and about 750,000 tons, or one-third of the production, is consumed by British metallurgists and chemical manufacturers.

THE TRADE IN NITRATE.

THE trade in South American nitrate has developed in a marvellous degree in recent years, and in order still further to extend it the Chilian President in his message has intimated that the executive has in view the establishment of a system of propaganda for the purpose of opening up new markets for nitrate in Asia and America, as well as in Europe. To this effect agents will be sent to the various countries with the object of making known this fertiliser, by means of publications and experiments on the land. These agents will be under the superintendence of a central committee established in Europe, and composed of persons, who, from their knowledge of fertilisers, and their scientific and industrial position, will be fitted to fulfil the office successfully and zealously. This committee will collect the most complete statistics with regard to the land susceptible of cultivation in the various countries and the nature of the fertilisers employed on it; will carry out experiments with the object of demonstrating the advantages of nitrate of soda; will set forth the modes of applying it most to be recommended; will publish information regarding the importance of nitrate and the manner of using it; will offer premiums for the best works treating of the advantages offered by nitrate of soda, &c. This is a very elaborate system of pushing trade to be adopted by any Government, and may be justified in the case of one which is largely interested in the industry named, but it is not likely to be adopted by our Government to any extent. We mention it, however, for the purpose of showing how trade in every department is being pushed, and how necessary it is for each one interested in a special department, not only to make himself acquainted with the requirements of his probable customers, but also to make them aware of the properties of his goods.

Notes.

MINERALS IN CANADA.

THE Geological and Natural History Survey of Canada has issued the annual report for 1888, on mines and minerals, from which it appears that the total value of the production was $16,500,000. The principal item is coal, of which 2,658,134 of the value of $2,259,832 at the pit's mouth, was obtained. About four-fifths of this output was from Nova Scotia. There were 61,310 ounces of gold produced, of the value of $1,098,610. The production of iron ore was 78,587 tons, of the value of $152,068.

THE COTTON INDUSTRY.

THE cotton trade, so far as weaving cloth from bought yarns is concerned, continues in a poor condition—that is to say, the demand from the great Eastern markets is of an indifferent character, and the margin in most makes is unremunerative. This state of affairs has led to looms in many sheds being allowed to stand idle, and, further, employers have not kept their machinery running at full stretch. It would appear that the present rate of production of cloth is too large for the requirements of the various foreign markets. The home trade section of dry goods keeps fairly healthy, most of the distribution channels being, on the whole, busy with the prospects of a good year. Coming now to spinning yarns, as distinct from weaving cloth, the position of affairs has gradually gone worse since the opening of the year. The year opened with cotton nearly ¼d. per lb. lower than Tuesday's rates, and yarn remunerative. This week the margin is little more than change for a shilling, for cotton is at 6d., and coptwist and weft is in sluggish demand at prices that will hardly pay in an old concern. For the reasons previously referred to, yarn is in larger supply, the floating supply between spinners and users being now chiefly in the hands of the former. The probable yield of American cotton this season is still a matter of very diverse views. Messrs. Neill Brothers hold to their original estimate of 7,600,000 bales of 480lb. each, whilst other authorities in Liverpool consider that the total crop will not reach more than 7,250,000 bales. Be the crop what it may, the official figures relating to receipts at the ports and at the plantations are rather in favour of a large output.

CHINESE ENGINEERING LITERATURE.

PERHAPS the first Chinese translation from the English of a technical work on railway and harbour construction consists of eight chapters of Mr. Matheson's "Aid-Book to Engineering Enterprise." The title of the translation would read in English, "Essay on Construction. Englishman Matheson gave the idea. Englishman Fryer and Chang Tien translated it." Printed on fine thin rice paper, from large type, this book is enclosed in loose boards of polished rosewood, held together with silk ribbons, each chapter being separately stitched into a silk cover. The original engravings have been faithfully, though quaintly, reproduced on a larger scale.

THE WEALTH OF THE UNITED STATES.

THE wealth of the United States is increasing with fabulous strides. According to the *New York Herald* its total amount now exceeds the total wealth of the whole world at any time previous to the middle of the eighteenth century, and the amount invested abroad is alone equal to the national wealth of Portugal and Denmark, while the total wealth of five minor nations is only equal to the mere increase of that of the United States in the past nine years. The total wealth of the latter has quadrupled since 1850, and doubled since 1870. There was a decrease in the decade ending 1870, as compared with the previous decade, due to the war, but, with this exception, the increase has gone on by leaps and bounds. In 1889 it had risen to $61,459 000,000.

PROGRESS OF TRADE COMBINATIONS.

IN every department of trade and industry the tendency is towards combination, either in the form of a syndicate or of unions for purposes of protection, and all tend in the direction of monopoly. The latest attempts we have heard of are those connected with the chemical manufacturers who are trying to form a Chemical Union. We are also informed that the makers, or rather refiners, of sulphur are trying to form an association for the purpose of selling the whole product through one broker. Again, at a recent meeting of the cement manufacturers, it was unanimously agreed to form a Cement Union, for the purpose of dealing with such labour questions as may arise in connection with the trade from time to time. These combinations are signs of the times, and must inevitably lead to great changes in economic and industrial conditions.

HOURS OF LABOUR.

AT a time when labour associations, manufacturers, and public men have before them the question of an eight hours day, the reference to this question in Australia in Sir Charles Dilke's new work, "Problems of Greater Britain," comes very opportunely. He states that in most of the Australian colonies the eight hours day for artisans is enforced by general custom, though not by legislation. It was in April, 1856, that the Melbourne stonemasons held the first public meeting on the subject at a time when ten hours a day was the rule for the trade. The other unions followed their example, a meeting of the united trades was held, an eight hours league formed, and notice given that after the 21st April they would only work eight hours a day. The triumph was complete, and a public holiday is still kept in commemoration of the occasion.

JAPAN AND COREA.

IT is rather curious to observe Japan, a country which a quarter of a century ago was practically sealed to foreign trade, now assisting in opening up the only remaining country in the world which is shut to foreigners. But so it is, a new commercial treaty having been signed between Japan and Corea by which an additional port has been opened, and by which the former country gains several advantages. On the other hand, the Coreans have been astute enough to look after their own interests. The whole population of Corea is clad in cotton, and consequently piece goods are the chief articles of import. Formerly Manchester goods entered Corea almost entirely through Japan, where, after paying import duty, they are sent to Corea, paying export duty on leaving Japan and import duty on entering Corea—in all, three duties. In future only one—the Corean—will be payable. The treaty also arranges for the export of various Corean products on paying an export duty of 20 per cent.

AMENDMENT OF THE LIMITED LIABILITY ACTS.

WE have on several occasions pointed out the abuses which take place under the provisions of the Limited Liability Acts, and made suggestions for their improvement. The Manchester Chamber of Commerce seems determined to take up the matter in earnest. At a recent special meeting called to consider the question, Sir W. H. Houlds worth, M.P., suggested that there should be two forms of registration, one provisional and the other complete, and that 75 per cent. of the nominal capital should be subscribed before complete incorporation was granted, with a certain amount paid up. He thought, moreover, that care should be taken to see that the balance sheet showed the depreciation taken off each year. In order to prevent the floating of bogus concerns, the subscribers to the original memorandum should be compelled to take a substantial interest in the concern. These proposals seem reasonable and not at all likely to hinder any *bonâ-fide* concern from being floated, and we trust that this matter will be taken up with vigour, and a Bill pushed through Parliament as quickly as possible, so that legitimate enterprise may be encouraged, and mere speculation discouraged.

ELECTROLYTIC WHITE LEAD.

THE *Electrical World* has recently given an outline of a process for the electrolytic production of white lead, which has been patented by Mr. T. D Bottome, of Hoosick, New York. The patentee electrolyses a solution containing sodium and ammonium nitrate, which is saturated with carbonic acid gas. The electrodes consist of metallic lead, that forming the anode being oxidised by the nitric acid, and ozone (*sic*) liberated, forming hydrated lead oxide, which combines with the free carbonic acid present in the solution, precipitating the white lead in a fine state of division, and which on drying is ready for use. It will be noticed that carbonic acid, lead, and water are the only materials used up in the process, the original solution of sodium and ammonium nitrate lasting for an indefinite period. The patentee states that the lead dissolves at the rate of 59·82 grains per ampere-hour, forming 71·35 grains of pure white lead. The author's estimates of cost, &c., are, however, written "in American," and are therefore better not reproduced at present. The new material is, of course, found to have much greater covering properties than ordinary white lead.

THE FRENCH NAVY.

SOME time ago we gave details of the proposals for increasing the American Navy, which, if carried out, would give America an unquestioned place in the ranks of the great maritime powers. The French seem determined to keep well up in the race, and Germany is inclined to follow the example. In fact, it looks as if we were going to have almost as much naval as we have military aggrandisement. The following figures show the French programme of naval construction for 1891, and the British one for last year, from which it will be observed that the French have resolved to keep up a large number of torpedo boats, while our programme, when carried out, will give us a strong position as regards cruisers:—

	French.		British.
Ironclads	10	...	10
Cruisers	11	...	42
Torpedo cruisers	2	...	18
Torpedo despatch boats, &c.	8	...	—
Torpedo boats, seagoing	12	...	—
Torpedo boats, first-class	35	...	—
	78		70

These two lists somewhat reflect the characters of the British and the French nations. The former are solid, and believe in ironclads and swift cruisers, while the latter seem to put more faith in light torpedo boats. No doubt the relative numbers are also influenced by the conditions which would arise should either of the nations become involved in war.

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Patent Record.

(Compiled from "The Illustrated Official Journal (Patents)."

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

10th February, 1890.

2112. McFerran & Pirrie..... Spinning frames.
2120. Latham, H. W. ..... Machinery for grinding cutlery.
2121. Fox, S. ..... Looms.
2127. Farrar, J. ..... Doubling yarns.
2128. Pollitt & Mangnall ... Reducing valves.
2132. Martin, M. T..... Knitting machines.
2133. Watkins, R. R. ..... Producing rotary motion.
2137. Andersen, L. J..... Sewing machines.
2139. Bellot, O. ..... Heat in furnaces, &c.
2140. Paul, M. J. ..... Discharging coal from lighters to ships or wharves.
2141. Mewburn, J. C. ..... Compressed air supply pipes (*Powell & Kummer*).
2151. Brady, F..... Boring apparatus.

11th February, 1890.

2159. Hodd, F. H..... Railway rails.
2165. Pullan, A. ..... Water gauges.
2175. Rutledge, J. ..... Cultivating land.
2181. Stuart & Binney..... Hydrocarbon engines.
2183. Monie & Rutnagur ..... Carding engines.
2184. Entwistle & Entwistle Carding engines.
2185. Donald, G. G..... Boat-lowering apparatus.
2186. Morris, E. ..... Valve for steam pumps.
2187. Cresswell & Bloom..... Feeding printing machines.
2192. Dunham, G..... Machine for finishing nuts.
2203. Kuba, F. ..... Duplex pump.
2204. Wood, J. J. ..... Journal bearings.
2205. Colas, P. ..... Rotary steam engines.
2206. Reeve, E. D. ..... Washing and drying machinery.
2208. Fraser, J. H. ..... Packing for flanged surfaces.
2216. Shanks, H. H..... Feeding printing machines.
2217. Marshall & FitzGerald Tubulous steam generators.
2218. Marshall & FitzGerald Surface condensers.
2220. Clark, A. M. ..... Lathes (*Zimmermann*).
2221. Carter, H. ..... Excavating machines.
2228. Bruce, L. F. ..... Machine guns.
2229. Wise, W. L..... Pneumatic guns (*Robinson & Reynolds*).
2230. Lake, H. H..... Excavators and elevators (*Smith*).

12th February, 1890.

2247. Jones, J. P. ..... Foot power hammer.
2252. Burgon & Burgon ..... Machinery for shearing sheep.
2254. Heidler, A..... Knitting machines.
2258. Rose, Rose, Rose, & Godman ..... Tool holders.
2274. Wicksteed, C..... Internal roller tube cutters.
2278. The Western Coil and Pipe Cleansing Company by R. W. Applegarth ..... Water coil and pipe cleansing boilers.
2279. Goes, W. ..... Machinery for cleaning metallic sheets.
2280. Millard, W. ..... Printing machines.
2281. Cole, J. C. ..... Crushing and grinding machines.
2284. Higginbottom, J. ..... Machines for reducing grain.
2285. Thompson, W. P. ..... Chain pumps (*Atkinson*).
2287. Haddan, H. J..... Hydrocarbon engines (*Spiel*).
2288. Taylor, J. ..... Coupling for railway waggons.
2290. Barker, W. B. ..... Siren or fog signalling apparatus.
2291. Turner, A..... Anchors.
2292. Brown, A. ..... Elevating ferry steamers.
2295. Schurr, A. E..... Railway couplings.
2301. Allart, L. ..... Wool combing machine.
2304. Davison, R..... Presses for baling hay.
2305. Fabian, P. ..... Friction brake for railway vehicles.
2306. Morris, R. ..... Magazines for rifles.

13th February, 1890.

2314. Jackson, W. M. ..... Pressure gauges.
2315. Sunderland, J. ..... Warp beaming machines.
2316. Ainsworth, J. ..... Looms.
2317. Barbeau, L. E. ..... Grain separator.
2320. Denison, Denison, & Ward ..... Brick-making machines.
2321. Denison, Denison, & Ward ..... Brick-pressing machines.
2334. Robson, J. ..... Motor.
2342. Linkleter, J. ..... Detaching boats.
2343. Wrigley, T. ..... Mechanical stokers.
2349. Metcalfe, T. ..... Slide valves.
2359. Haddan, R. ..... Automatic railroad switches (*Belcher*).
2368. Cottrell & Hancox..... Machinery for grinding knives.
2371. Edwards, C. H. ..... Manufacture of bricks.
2372. Boult, A. J..... Valve (*McNeill & Clarke*).
2373. Fernie, J. H. ..... Looms.
2375. Colley, H. ..... Paper making apparatus.
2376. Boult, A. J..... Seeding machines (*Noron*).
2382. Marsh & Trust ..... Propellers.
2384. De la Touche, W..... Hot-air engines.

14th February, 1890.

2388. Thwaite, B. H. ..... Gas generators.
2390. Buchanan, J., Jun. ..... Gold and silver extraction.
2392. Sumner, H. ..... Governor for engines.
2399. Lodge & Fletcher ..... Stone breakers.
2410. Jackson, I. ..... Elevator buckets.
2416. Guy, C. W. ..... Crushing and leaching mills.
2418. Wood, C. H. ..... Fog signalling apparatus.
2419. Lucas, G. E. ..... Apparatus for placing fog signals on rails.
2423. Wylie, R. P. ..... Raising sunken vessels.
2427. Fryer, A..... Concentration of solutions.
2441. Mackie, J. ..... Driving pulleys.
2456. Desmond, J..... Injectors.
2458. Downton, J. ..... Sewage pump.

15th February, 1890.

2478. Roberts, P..... Metallic packing.
2479. De Mattos, De Mattos, & De Mattos ..... Propelling ships.
2483. Thompson, W. J. ..... Fastening rails to chairs.
2489. Eves, J. V. ..... Frames for spinning flax.
2494. Robinson & Jackson ... Presses for bricks.
2502. Renshaw, W. R..... Heating, cooling, and condensing fluids.

ELECTRICITY.

10th February, 1890.

2113. Schoth, G. A..... Secondary batteries.
2153. Dewar, D. ..... Telephone switchboards.

11th February, 1890.

2172. Boardman, H..... Switch for electric tell-tales.
2199. Currie, S. C. C. ..... Cores and armatures.
2219. Rudolph, H. O. ..... Telegraph printing apparatus.
2234. Nutting, S. E. ..... Electric arc lamps.

12th February, 1890.

2255. Macaulay-Cruikshank, G. ..... Telephonic and telegraphic systems (*Schwabacher*).
2272. Cockburn & Teague ... Operating electric currents.
2273. Postlethwaite, G. R.... Primary batteries.
2296. Richardson & Holland Electrolytic production of caustic soda and potash.
2297. Richardson & Holland Electrolytic apparatus.
2298. Gardiner, S. ..... Electric calls.
2302. Weymersch & McKenzie Electric batteries.

13th February, 1890.

2337. Postlethwaite, G. R. ... Electromagnetic motors.
2347. Forbes, Sir C. S. ..... Primary batteries.
2364. Davis, A. L..... Batteries and glow lamps.

14th February, 1890.

2404. Bathurst, F. ..... Electrical switches.
2439. Roberts, F. S..... Storage batteries.

15th February, 1890.

2464. Dorman & Smith ..... Electric light fittings.
2476. Walton, A. H. ..... Cut-outs.
2496. King & Bickle ..... Electrical conductors.
2503. Saunderson, L..... Electric arc lighting.
2504. Wynne, F. ... . Propelling vehicles by electricity.
2606. Verschave & Baron..... Electric batteries.

CHEMISTRY.

11th February, 1890.

2195. Braithwaite, I..... Dyeing with indigo.
2226. Lebedeff, N. ..... Extracting metals.
2242. Hlawaty, F. ..... Preparing benzol from petroleum.

12th February, 1890.

2248. Harbord, F. W..... Utilisation of tinplate scrap.
2283. Hughes & Gipprich ..... Manufacture of oil gas.
2312. Teague, J. ..... Extracting tin from refuse.

13th February, 1890.

2341. Scudder & Colman ..... Rendering water-gas odorous.

14th February, 1890.

2428. Bowen, S. B. ..... Cleaning grease from tinplates.
2432. Chance & Crowther ... Nitrate of ammonia.

15th February, 1890.

2477. Teague, T. ..... Extraction of tin from slags.
2499. Lake, H. H. ..... Colouring matter (*Oehler*).

MISCELLANEOUS.

11th February, 1890.

2212. Lewis, H. F. W..... Fire alarm telegraphs.

13th February, 1890.

2318. Kenyon, Sen., Kenyon, Jun., Kenyon, & Kenyon ..... Endless driving bands.

14th February, 1890.

2406. Strange & McMahon ... Fire escape.
2411. Ingham, T. ..... Dyeing cotton.
2430. Fenwick, W. ..... Lock nuts.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form, of such opposition.

Year 1889.

2232. Goodfellow & Sanders.
2457. Daniels.
2462. Jessie Ball.
2561. Pring.
2676. Godden.
2911. Stother.
3119. Wynne.
3236. Bullough.
3279. Hart.
3496. Kaye.
3641. Hughes (*Vaile*).
3701. Brooks.
3781. Franklin.
4122. Baggaley & Boardman.
4169. Daniel.
4371. Hookham.
4377. Fielding.
4396. Offenbacher.
4530. Price & Dowsing.
4553. Von Schmitz & Heymeier.
4602. Seegall.
4814. Ware.
4924. Hutchison.
5115. Davies.
5199. Millet.
5284. Trott.
5310. Kaye.
5395. Boult (*Miller*).
5495. Little, Hall, & Archer.
5609. Wardroper.
5634. Brotherhood.
5728. Childs.
5748. Willing.
5790. Emden.
5814. Farran & Crawford.
5855. Dunbar.
5995. Fitz-Gerald.
6039. Griffin.
6050. Barron & Harding.
6060. Browne (*Pyne*).
6080. Parensen
6094. Constantine
6111. Coultas.
6134. Sturgeon.
6154. Charlton.
6171. Heap.
6175. McKee.
6212. Johnston.
6219. Astrop.
6233. Marsden & Thompson.
6243. Radcliffe.
6249. Horn.
6279. Warburton.
6289. Kiddier, Kiddier, & Kiddier.
6298. Haddan (*Belcher*).
6306. Marsden.
6316. Procter, Morris, & Wilkinson.
6325. Main, Main, & Darwin.
6352. De Pass (*Carbonnier*).
6364. Ralston.
6385. Ransom.
6401. Evans.
6406. Morison.
6421. Brown.
6441. Lake (*Richter*).
6451. Edwards (*Timoni*).
6485. Wrigley & Patterson.
6539. Lake (*York & York*).
6568–72. Dorman.
6618. Irvine.
6694. Brookes (*Greeven*).
6797. Boult (*Saltzkorn & Nicolai*).
6911. Naumann.
7064. Harris.
7515. Lelièvre.
7719. Schoop.
8067. Walker, Walker, & Walker.
9500. Leach.
10846. Linton.
10883. Hardt.
11215. Goulding.
13090. Wilcox.
14604. Hopton & Deuther.
14608. Dumbell.
15702. Fletcher, Fletcher, & Fletcher.
15863. Hall, Smith, & Bennett.
16596. Bowmaker.
17240. Wood.
18194. Bibbwyck.
18734. Marsden & Frost.
19288. Lake.
20421. Lynde.
20694. Wright, Wright, & Budd.
20748. Jenks.
20837. Kincaid.
2248. Upward.
2388. Fox.
2461. Wynne.
2472. Wise (*The Gibson Electric Company of Europe*).
2688. Defries & Feeny.
2983. Burns.
3228. Bigwood, Bigwood, & Bigwood.
3399. Drey.
3501. Hoskins & Harvey.
3683. Brocklehurst & Constien.
3983. Harris.
4166. Edge.
4219. Hickling.
4376. Eddington & Steevenson.
4479. Newton (*Nobel*).
4546. Butler.
4571. Pomrol.
4600. Wilson.
4744. Webb.
4849. Boys.
4985. Hutchinson & Madgin.
5159. Woodward.
5213. Boothroyd, Renouf, & Rucker.
5374. Nicol.
5459. Horton & Horton.
5525. McNamara.
5545. Thorp.
5632. Von Blinsdorf & Adler.
5738. Fitch (*Drummond*).
5767. Mulvany & Royston.
5806. Prince & Clough.
5844. Lodge.
5871. Kirkaldy.
6026. Rose (*Rose & Dennes*).
6045. Hundleby.
6059. Brooks.
6077. Shillito (*Burdick*).
6093. Myers.
6108. Stubley.
6125. Clarke & Wheatley.
6136. Downing.
6161. Partridge & Brutton.
6174. Kirkbride.
6198. Lapthorn.
6213. Cabanis.
6222. Cheavim.
6242. Haig.
6248. Dougill.
6271. Phalp.
6281. Brown.
6290. Kiddier, Kiddier, & Kiddier.
6303. Burrow & Johnson.
6310. Sibson.
6320. Clough & Carter.
6323. Ashwell.
6327. Hurst.
6353. Darier-Gide.
6368. Yeadon & Middleton
6399. Lundholm & Sayers.
6405. Williams.
6415. Selby.
6440. Harvey.
6445. Clarke.
6452. Bowman.
6486. Wrigley, Patterson, & Taylor.
6596. Reischel.
6668. Netto.
6762. Brougham (*Messrs. Adt Bros.*).
6881. Jones.
7041. Underwood.
7508. Townend, Eaton, & Townend.
7837. Byatt.
8354. Nicoll.
8533. Schulz.
10238. Holzapfel (*Noll*).
10875. Wilkinson.
11173. Phillips.
12208. Ratcliffe & Ratcliffe.
13901. Brook, Schaefer, & Shaner.
15673. Lumley.
15854. Thompson (*Messrs. Holst & Fleischer*).
16478. De Kunwald.
16519. Minns.
16972. Byrne.
17919. Clarkson (*Rodwell, Secord, & Moore*).
19001. Clegg.
20259. Tuck & Merritt.
20504. Bezares & Calvo.
20712. White & Boyd.
20735. Haddan (*Coles*).
20760. Thompson (*Petterson*).
20859. Lindstrom.

1890.

171. King.
256. Halladay.

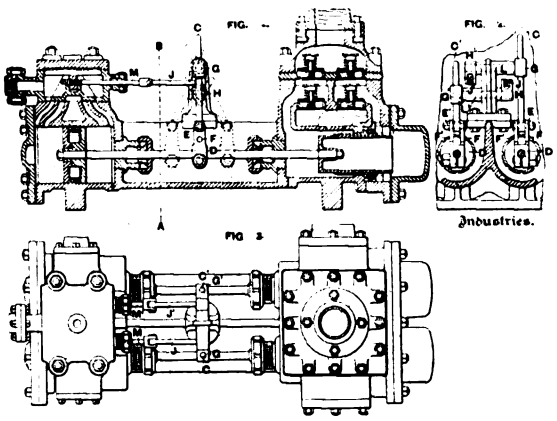
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270. KNUBEL.
286. CLARK (*Almond & Freligh*).
312. WOOD.
459. MITCHELL.
469. GREEN.
496. LUCAS.
528. NORTON.
598. WYNNE & MORRISON.
647. DODGE.
650. DOW.
671. CLARK (*Foerster*).
679. LOCKWOOD.
699. LAKE *Woodruff*).
703. HADDAN (*Bertrand-Leplat*).
741. MORT.
782. CLARK.
277. WASHBURN, CROFT, & WHEELER.
320. GRONWALD & OEHLMANN.
494. SPIGENER.
522. AUGUSTE - GODCHAUX. (4th October, 1889.)
611. HUGHES.
649. DODGE.
664. BOULT (*Converse*).
675. STILWELL & THAYER.
693. CURRIE.
700. LAKE (*Krom*).
704. COLVIN.
705. COSGROVE.
765. BROWNE (*Fichtner*).
793. FOLEY.
994. MEAD.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

VALVE GEAR OF PUMPING ENGINES.—*J. E. Rogers, Birmingham.*—The valve gear is adaptable to the duplex type of pumping engine, in which the engines are arranged side by side. The piston rod of one engine is made to work the slide valve of the other. Referring to the illustrations, Fig. 1 is a sectional elevation, Fig. 2 sectional end view upon A B, and Fig. 3 a plan of a duplex pump. C C¹ are sliding levers, D D¹ clip joints jointed to the levers by suitable pins and clamped to the piston rods by bolts. The sliding levers pass through the heads G G¹, and have their motion communicated to the cranks H H¹ by the shafts L L¹ to which the cranks and heads are attached. The cranks H H¹ are

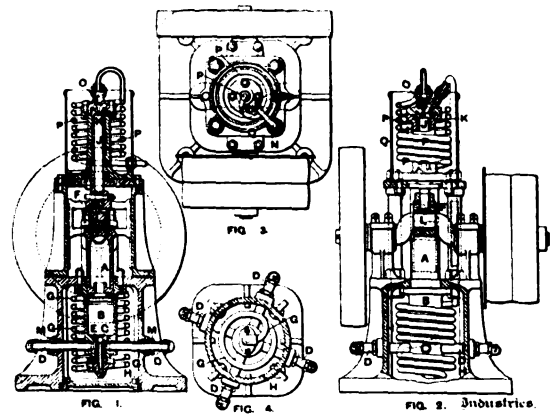


connected to the slide valve rods. The dotted lines show position of valve gear at each end of the stroke of each pump. The action of the valve gear is as follows: Suppose the piston rod of one pump to be at one end of the stroke, in moving to the opposite end it carries with it the clip joint D in which is jointed the sliding lever C; this sliding lever C gives a partial rotary movement to the cross shaft L, which moves the crank H sufficiently to give the required motion to the slide valve of the duplicate engine, each engine in turn giving motion to the slide valve of the other through the gear. Claim: The joints D and D¹ in combination with sliding levers C and C¹, sliding lever cross shaft heads G and G¹, cross shafts L and L¹, cranks H and H¹, giving motion to the slide valves through the connecting rods J and J¹ and valve rods M and M¹, substantially as shown and described. —No. 3557. February 28th, 1889. 6*d*.

A PNEUMATIC DISTRIBUTOR.—*A. Wallis, A. H. Wallis, J. E. Wallis, & W. A. Wallis, Basingstoke.*—The machine is provided with hoppers and reservoirs for containing the seeds or liquid to be distributed. A fan is mounted and is geared to the travelling wheels. The air is conducted from the fan by means of a pipe, to which the dry material is fed at any suitable point. On the end of this pipe is fitted a spreading mouthpiece. This mouth is divided where it joins the blast pipe by partitions running longitudinally, and by this means the discharged material is spread abroad. For distributing liquids fine jets are provided, which allow the liquid to fall on the blast a short distance outside the blast mouth, or the jets may be carried on so that they deliver the liquid in the blast a short distance outside the blast. The spreading discharge mouth is attached to the blast pipe at any angle, so that the material can be delivered in any direction. Claims: (1) In a machine for sowing or distributing dry material or liquid by wind blast, the combination of travelling wheels, gearing fan, and blast pipe with a hopper or receptacle for liquid, and with an adjustable mouthpiece arranged as described; and (2) and (3) referring to the parts as illustrated in the specification.—No. 3904. March 6th, 1889. 8*d*.

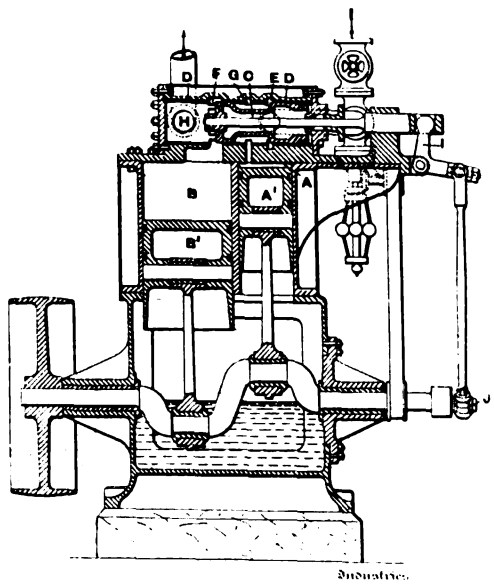
GEAR WHEELS.—*C. Lock, London.*—These wheels are constructed with teeth formed of balls. The balls are located in sockets in the wheel rim, from which they project a distance slightly less than half their diameters, so that they will not drop out of their sockets. The wheel which works in conjunction with the gear wheel described is formed with a series of recesses in its periphery to receive the projecting parts of the balls located in the other wheel, as the wheels revolve. The construction of wheels as described is intended to reduce the friction and form a wheel especially suitable for the driving mechanism of bicycles, &c. Claims: (1) A wheel having a series of balls located in its rim, the said balls projecting sufficiently far to form teeth for gearing with another wheel or with a chain as and for the purpose described; (2) the manufacture and use of gear wheels as described.—No. 4708. March 18th, 1889. 6*d*.

APPARATUS FOR COMPRESSING AIR.—*C. F. H. Hayes, London.*—This system of pumps is designed for compressing air or gases by stages. In the accompanying drawings Fig. 1 represents a sectional side elevation, Fig. 2 a front elevation partly in section, Fig. 3 a plan, and Fig. 4 an under view of the lower part of the apparatus with the base plate removed. The lower cylinder B is fitted with a plunger A, which is connected to the slotted crosshead F driven by the crank L and belt pulleys M. The cylinder



B communicates to the crank suction pipes D by a suction valve C. In the valve C is an exhaust valve E communicating to the coil G in the chamber H. In the top cylinder I is a second plunger J, which is also connected to the crosshead F, and so partakes of its motion. The plunger J works in a sleeve valve K, which is held up by a spring to close the passage N. A valve O is situated at the top of the cylinder I for the exhaust. The working of the appliance is as follows:—The plungers are set in motion, and the lower one A draws in air or other fluid by the pipes D and the valve C. Upon the return stroke of the plunger A the fluid is compressed and forced through the valve E into the coil G, which is surrounded by water in the chamber H. The coil G is connected by a pipe to the passage N, so that as the top plunger J descends the fluid is drawn into the cylinder I, and upon the return stroke it is further compressed and delivered to a second coil P surrounded by water in the vessel Q. Claims: (1) The construction and use of a suction valve having a cavity in its shank or stem containing a delivery or discharge valve in combination with the other parts of a compressing or other apparatus; (2) the construction and use of a valve having a sleeve fitting into but free to move in a cylinder, and itself forming the true cylinder in combination with the other parts of a compressing or other apparatus; (3) the construction and use of a slotted crosshead with a crank passing through it and operating it in combination with a compressing apparatus or force pump.—No. 1424. January 25th, 1889. 8*d*.

STEAM ENGINES.—*R. Kennedy, Kilmarnock.*—This invention refers particularly to the valves and arrangement of ports in compound or duplex single-acting steam engines. In the illustration A and B represent the high and low pressure cylinders, with their pistons A¹ and B¹. Working upon the cover of these cylinders is the slide valve and in the cover are the ports communicating to the cylinders and the valve chamber. The slide valve C is a hollow double piston reciprocating valve, with closed inner end, working within the steam casing D, which is preferably lined. Annular ports E and G are formed in the valve casing D for admitting the live steam to the annular



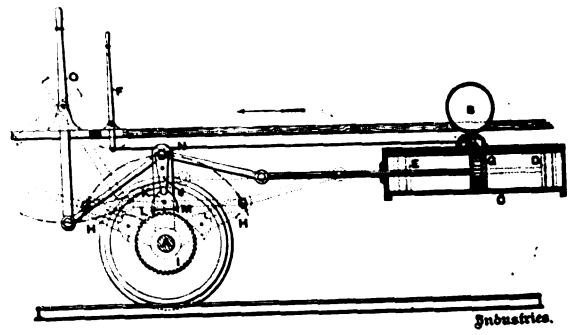
space surrounding the piston, and from there to high-pressure cylinder. From the high-pressure cylinder the steam is exhausted to the low through the port F, and ultimately exhausted from the low-pressure cylinder by the same port F to the escape pipe H. The valve is actuated by a bell-crank lever I worked by the eccentric J. Claims: (1) The construction or general arrangement and combination of the parts of high speed compound or duplex single-acting steam or other fluid-pressure engines, with their valves and ports and actuating fittings; (2) in compound or duplex single-acting engines the constructing of a double piston reciprocating valve within the steam casing, arranged to admit steam through annular ports to the high-pressure cylinder, and from this to the low-pressure cylinder, and from it to the atmosphere or condenser, and arrangement of mechanism for actuating the same.—No. 3676. March 1st, 1889. 8*d*

ROCK BORING TOOL.—*E. Salendre, Paris.*—The tool cuts with a rotary and forward motion which is imparted to it by a screwed mandril. The mandril is supported in a long screwed socket which is held in position by a supporting post and chains. The axes of the socket, mandril, and drill are in the same straight line. The mandril is turned by a lever, and as it turns it is screwed out of its socket, so feeding the drill and revolving it. The socket is made in two longitudinal halves which are hinged together, so that by opening them the mandril can be taken out or shifted to any position in its socket. Claim: The boring or drilling apparatus constructed as described.—No. 4471. March 14th, 1889. 6*d*.

SHIPS' ANCHORS.—*W. Rose, Halesowen.*—Instead of making the cross head and arms in one cast piece as is usual, the inventor makes them separately, and of wrought iron. The head is constructed in the shape of a cross, whose shortest arms are slotted to receive the flat head of the anchor's shank, and the longer arms hollowed out to receive a square bolt. The square bolt passes through the long arms with its axis coincident with the axis of the arms, and supports the gripping arms of the anchor at each end and the shank head at its centre. The shank head works in a slot of the cross head and permits the latter to only make a partial revolution as the arms cant over from one position to the other. Twelve claims are made.—No. 3902. March 6th, 1889. 11*d*.

SHIPS.—*A. C. A. Holzapfel, London.*—The ship is built without frames and consists of plates whose sides are flanged inside at a suitable angle. These sides are riveted together, and do not require any frames, keelsons, &c. The system also admits of the use of hydraulic punching and riveting machinery. In building a ship according to this method wooden frames are erected corresponding to the shape of the ship, and the plates are laid inside these frames and riveted in place. Claim: The building of ships or other plated structures of plates flanged on all four sides.—No. 2233. February 7th, 1889. 4*d*.

STARTING VEHICLES.—*E. H. Morgan, Dover.*—This invention relates to means of applying to a vehicle a temporary force for starting it into motion, independent of the force normally applied to keep it in motion. For this purpose compressed air is employed to act upon a piston and give partial rotation to some of the wheels of the vehicle. B is a reservoir of compressed air,



which, when the vehicle has a brake apparatus worked by compressed air, may be charged directly from the main reservoir or train pipe, or in other cases may be charged by a small air compressing pump worked by a motor or by the running wheels while the vehicle is in motion. The air from this reservoir is admitted to the ends D and E of a cylinder C, and the admittance of air controlled by a valve worked by the lever F. The rod of the piston G is linked by a connecting rod to the end of a lever H which is fitted free to turn on one of the running axles A of the vehicle, on which axle at the side of the lever is fixed a square-toothed wheel I. On the face of the lever H are pivoted a gearing lever J and a double-nosed pawl K having noses L and M. One end of the lever J is slotted to receive an eccentric N, and its other end rounded to fit a notch in the cam K. To start the vehicle in the direction of the arrow, the handle O is pushed forward until the piston G is at the end D of the cylinder. The nose L of the pawl K engages with the teeth of the wheel I as shown by the dotted lines. The lever V is next moved to admit air to the end D of the cylinder and give the necessary impetus to the vehicle. As the lever L assumes its vertical position the pawl disengages with the wheel I and the valve of the cylinder is closed by an arrangement of tappets not shown. Claim: Apparatus for starting a vehicle, consisting of a compressed air reservoir, slide valve, cylinder, and piston, in combination with a lever centred on one of the axles of the vehicle, this lever carrying a double-nosed pawl having its attitude determined by an eccentric or crank on the lever so as to engage with teeth of a wheel on the same axle, for driving in the one direction or the other substantially as described.—No. 18909. November 25th, 1889. 6d.

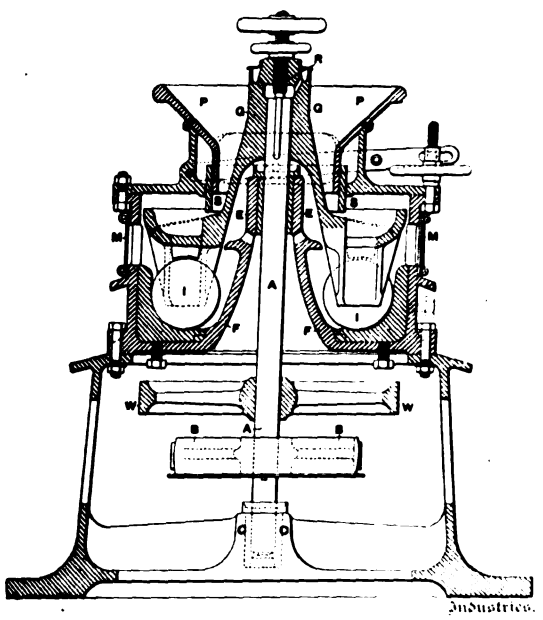
VICES.—*W. Lorey & C. Getz, Philadelphia, & F. S. Dickenshied, Hosensack, Pennsylvania, U.S.A.*—This vice is formed by the combination of a leg vice and parallel vice. The movable jaw is pivoted to the vice slide, and it has a depending leg, which corresponds to another depending leg upon the slide. Pivoted to one of these legs is an eccentric, which bears upon the other leg, and when revolved by a suitable lever opens the two and causes the jaws to close upon each other. In using the vice the movable jaw is screwed out along with the slide and its depending leg to receive the work. It is then closed upon the work by the slide screw and tightened by the eccentric and legs. Claims: (1) A vice having a stationary jaw, a movable jaw, a slide to which the movable jaw is pivoted, depending legs, and an eccentric which is adapted to tighten the jaws as described; (2) a vice having a stationary jaw, a movable jaw pivoted to said slide, a nut secured to stationary jaw, a screw swivelled to the slide and freely passing through the movable jaw and working in said nut, the said slide and movable jaw each having a depending leg and means connected to one of said legs for clamping said jaws, said parts being combined as described; (3) in a vice, jaws having parallel motions in opening and closing in combination with a slide to which the movable jaw is pivoted and an eccentric which is mounted on said jaw in order to close the same against the other jaw as described.—No. 14934. September 21st, 1889. 6*d*.

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STEAM ENGINES.—*T. Deakin, Manchester.*—The nature of this invention may be understood from the following claim:—In the construction of steam or other fluid pressure motors, making one or more of the parts through which the work of the fluid pressure is transmitted elastic, that is to say, compressible or extensible, so as to present or raise to a greater or less degree surfaces or operating parts which act directly upon the valve spindles or gear, so as to open or close the valves to a greater or less extent, or more or less quickly, in accordance with the position of the said operated parts, or accordingly as more or less pressure is required to meet the load or to regulate the speed of the engine. Six other claims are made referring more particularly to the construction and arrangement of the elastic parts on the prime motors.—No. 2875. February 19th, 1889. 1*s.* 3*d.*

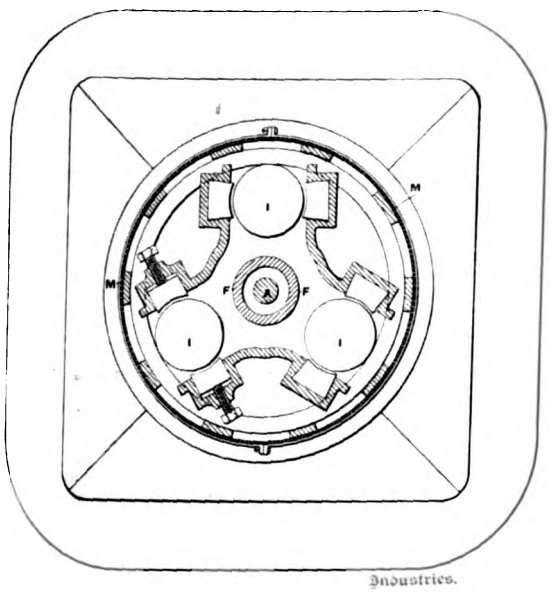
GRINDING MILLS.—*J. S. Chenhall, Bristol, & J. W. Chenhall, Totnes, Devonshire.*—The mill is designed for the purpose of grinding ores and such like material. The illustrations show Fig. 1, a sectional elevation, and Fig. 2, a sectional plan of the machine. A is the driving shaft, driven by a belt pulley B, and its motion steadied by the flywheel W. The lower end of the

FIG. 1.



shaft is supported in the step C, and its top in the socket E of the conical portion of the pan F. The ball carrying frame G is supported upon the shaft and caused to turn with it by a feather, which, however, permits the frame to rise and fall. The frame G is made adjustable upon the shaft by the screw R. The surfaces in contact with the grinding balls I are made of hard metal and are renewable. The operation of the machine is as follows:—The ore or other material is placed in the hopper P, and the vertical shaft with its attachment set in motion by the means provided; the balls will rotate, and as the material from the hopper descends it will be crushed by the balls, but if the supply is too rapid and the bed of the chamber becomes full, the balls rise and

FIG. 2.



lift the frame G which checks the supply by partially closing the opening S, and when only the proper quantity is in the chamber the balls will fall and the frame G will enlarge the aperture and thus automatically regulate the supply. As the operation proceeds the crushed material is discharged by centrifugal force from the perforated screens M. Claims: (1) The automatic arrangement for regulating the supply of material; (2) the adjustable ring S; (3) the insertion of blocks in the pan and the means of adjusting and fixing them; (4) the means for discharging the crushed ore by centrifugal force through apertures in the periphery.—No. 19363. December 2nd, 1889.

REFRIGERATING MACHINES.—*M. C. Bannister, Liverpool.*—Some difficulty has hitherto been experienced in designing a pump or circulating apparatus in such a way that the contents will not freeze solid. To overcome this difficulty large Indian bamboos are used to form the barrel or cylinder of the pump. The joint of the bamboo constitutes the cylinder bottom. The central hole of the bamboo is usually cylindrical, and maintains its shape after long exposure to moisture. The bamboo is also a bad conductor of heat, and it is very tough and strong. Claim: As a new article of manufacture a pump cylinder or barrel formed of the internode of a bamboo, one end of the said barrel being formed either of the adjacent node or of a separate piece of material as described.—No. 4357. March 13th, 1889. 6*d.*

SCREW PROPELLERS.—*E. E. de Facien, Rangoon, India.*—The improvements here described are for the purpose of preventing water escaping laterally from the blade of the propeller, due to the tangential force imparted to it by the propeller's rotation. The propeller blades are provided with a terminal flange at right angles to the terminal plane of the blade. The outer edges of the blades where they bend at an angle to form the flanges are not square or concentric with the shaft, but the leading edge is raised so that in the rotation of the propeller the edge describes the frustum of a cone whose axis coincides with the axis of the shaft. Four claims are made for various forms of the flange formed on the propeller blades for the purpose described.—No. 4888. March 20th, 1889. 8*d.*

BUFFERS.—*S. W. Carlton, Swansea.*—The spring buffers, such as are used for railway purposes, are liable to take a permanent set, so that the buffer heads become loose and are not retained in their forward or outward positions. The object of this invention is to compensate for this slack. For this purpose the bearing of the buffer spring is taken upon a wedge piece. The wedge piece is constructed to slide in behind the spring at right angles to the axis of the buffer. When the buffer spring takes a set it would, in the ordinary form, become loose between its seat and the buffer, but in this case the wedge is forced in behind the loose spring, and so shortens the distance between its seat and the buffer. The wedge is forced in by suitable springs that exert no resistance to the proper action of the buffer, but force in the wedge as the buffer spring becomes set. Claims: (1) In a buffer the combination with the buffer rod and buffer spring or springs, of a supplementary spring or springs, and a wedge automatically controlled by another spring, the arrangement being such as to automatically compensate for slack caused by the permanent set of the buffer spring or springs; (2) the improved buffer, constructed with a supplementary spring and wedge controlled by another spring, as hereinbefore described.—No. 4854. March 20th, 1889. 6*d.*

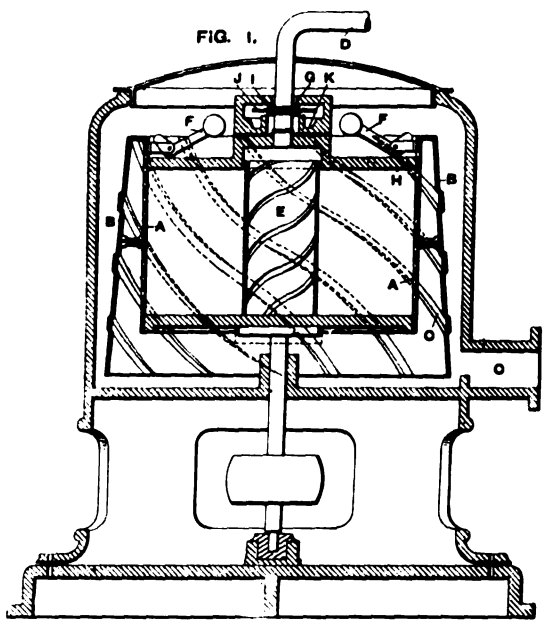
PUMPS.—*J. C. R. Okes, London.*—The pump parts are constructed in accordance with a previous patent, No. 6249 of 1888, and the present improvement is intended to facilitate its use in mines or wells. The suction and discharge pipes are in line with the barrel of the pump and its stroke. The discharge pipe is formed with a swan neck or bend situated just above the pump. The pump rod by entering this bend passes centrally into the pump barrel, whilst the outside part passes up to the surface of the well, through guides fixed to the side of the rising main. In the case of two or more pumps use is made of two or more swan necks uniting into one rising main, which serves to form the support for the pump rod guides. Claims: (1) A hollow plunger pump or pumps, in combination with the patent No. 6249 of 1888, constructed as described; (2) in pumps the combination of a hollow plunger or plungers, the valves and valve boxes of which are constructed in accordance with the patent No. 6249 of 1888, with a rising main formed with a swan neck as described.—No. 4789. March 19th, 1889. 6*d.*

THRUST BEARINGS.—*J. B. Hardwicke, London.*—The bearing here described is of that class in which friction wheels or rolls are employed. In the present invention the rolls are arranged with their axes radial to the axis of the propeller shaft. They are placed upon each side of a flange or collar which is fixed to the propeller shaft in such a manner that the flange travels upon one set or the other as it is thrust against them by the motion of the propeller. The rolls are supported in a bracket secured to the keelson of the vessel. Two flanges or collars may be formed upon the propeller shaft, and one set of friction rolls used between them. In the case of a double set of rolls whose faces are broad the rolls may be made conical and their smallest ends put towards the shaft. By this arrangement the smallest parts of the rolls travel in contact with the surface of the flange or collar nearest to the shaft, whilst the largest part of the cone rolls move in contact with the outer part of the flange. It also provides means for adjusting the rollers closer to the flange by moving them inwards in the direction of their axes. Claims: (1) The method of using anti-friction rollers revolving in fixed bearings for the purpose of taking the thrust of propeller shafts, in the manner described; (2) the arrangement of one or more sets of pairs of parallel rollers, each set revolving in contact with a collar on the propeller shaft as described; (3) the use of the aforesaid arrangement of rollers alone or in connection with the usual thrust bearing, and the use of the same in connection with an end collar on, or with collars placed between, the ends of the shaft; and (4) and (5) referring to the illustrated parts as shown in the specification.—No. 4788. March 18th, 1889. 8*d.*

BOILER TUBE STOPPERS.—*W. Dover, Liverpool.*—The appliance is for temporarily plugging an injured or leaky boiler tube. It consists of a mandril having certain parts threaded upon it. A tube is first placed loosely upon it, a little less in length than the tube to be stopped. Upon each end of the bolt and butting against the ends of the tube are next placed hollow or recessed collars, which are fitted to slide upon the bolt. Other collars are now placed upon the ends, and they fit the recessed portion of the first collars and form between the two a small annular space. Between these collars, and in the annular space are inserted rings of lead. When this appliance is introduced into the tube, and nuts placed upon the end of the bolts made to close the parts one against the other, the annular spaces between the collars become diminished, and by reason of the bevelled sides, the lead is forced out radially into contact with the inner surface of the tube. A shield, consisting of a thin piece of metal, may be placed upon the end of the bolt to protect the operator when fixing the appliance against the outrush of liquid or steam. Claims: (1) A tube stopper for marine or other multitubular boilers, in which a ring of lead or other suitable compressible material, of approximately the same diameter as the internal bore of the tube and mounted concentrically on a bevel-edged washer secured on a central operating mandril within one end of the tube, and a like ring or similar material mounted on a similar washer loosely placed on the aforesaid mandril within the opposite end of the tube, are adapted to be simultaneously brought towards one another and to be pressed or squeezed between their respective washers, and bevelled rims of cheeks also mounted concentrically within the tube and kept at a determined distance apart on the mandril aforesaid, whereby they are simultaneously upset or expanded against the inner walls of the tube and form tight plugs or joints at or near each end thereof; (2) in combination with a tube stopper such as described a shield adapted to be mounted on the operating mandril, or on a sleeve placed near the extremity of said mandril, at the front of the boiler, and so formed as to protect the operator, while plugging a fractured tube, against the escape of steam or boiling water; (3) a tube stopper for plugging marine or other multitubular boiler tubes in case of leakage, the whole combined as described.—No. 5005. March 22nd, 1889. 8*d.*

CENTRIFUGAL APPARATUS.—*A. Waldbaur, Stuttgart, Germany.* This apparatus is intended for continuously washing, dyeing, drying, and impregnating fabrics, and the improvements are for the purpose of conducting away the liquors more advantageously. The Figs. 1 and 2 are sectional elevations of two slightly different machines. In them A is the perforated basket for the material to be treated. Attached to the basket is a casing B, with spiral grooves C (Fig. 1), or divisions C (Fig. 2), to more

FIG. 1.



readily deliver the spent liquors to the bottom of the case. The liquors used are delivered through the pipe D to the centre chamber E in the machine. The wall of the chamber E is constructed of perforated plates with grooves as shown in Fig. 1, or of a series of annular plates G, with interstices between them, as shown in Fig. 2. The liquors fall from the pipe D to the bottom of these chambers E, but, by reason of their construction, immediately ascend the walls and pass through in all directions to the material in the outer chamber or basket. After passing through the material, and the perforations in the basket, the liquor is deflected by the casing B, and delivered from the machine by the pipe O. The basket is provided with a lid H automatically closed

FIG. 2.

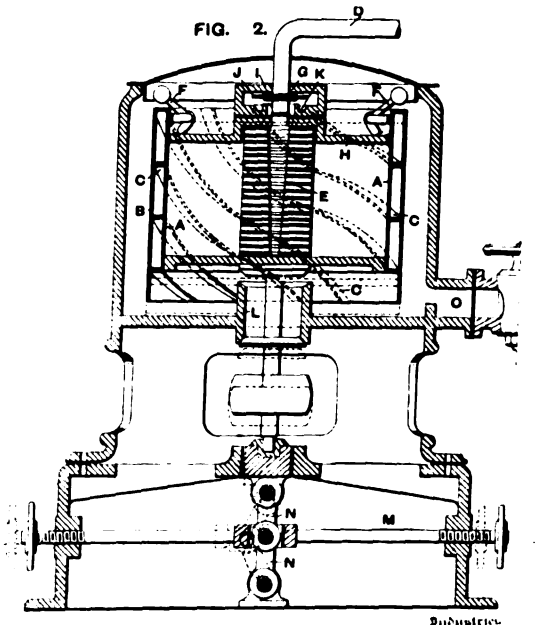
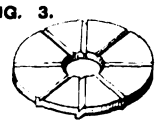


FIG. 3.



by weighted cam levers F, which are thrown from the position shown in Fig. 1 to that in Fig. 2 by the centrifugal force due to the rotation of the basket and its fittings. A tight joint is made for the feed pipe D by attaching to the lid H a round vessel I, constructed with a gutter K, to receive a small quantity of liquid. In the vessel I is a flange J fixed to the pipe D, and therefore held stationary. When at work the vessel I revolves and causes the liquor in the gutter to rise and assume a position round the

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larger diameter of the vessel and covering the periphery of the flange J, thus making a liquor-sealed joint. As it is desirable for some materials to use the centrifugal apparatus *in vacuo*, or under steam pressure, the bottom of the apparatus, or evacuation channel, is fitted with a packing hoop or ring L, upon or in which the correspondingly turned bottom of the basket runs tightly at its lowest part. The shaft of the basket may be raised or lowered by suitable means, such as making the step adjustable by a screw M and an angle lever N (Fig. 2). In order to enable cops to be exposed to the full effect of steam in this apparatus, rings or portions of rings are inserted into the apparatus, which at the inner side are provided with elastic wire-bundles, against which the cops are placed and held fast. Six claims are made for the improvements described.—No. 2806. February 18th, 1889. 8*d*.

ROTARY ENGINE.—*L. C. Huson, Elmira, New York, U.S.A.*—This is a compound rotary engine constructed of three chambers or cylinders with similar working parts. Live steam is applied to two of the chambers, and the exhaust steam from these passed alternately to the third chamber, which is situated between the other two. Referring to the illustrations, Fig. 1 is a longitudinal

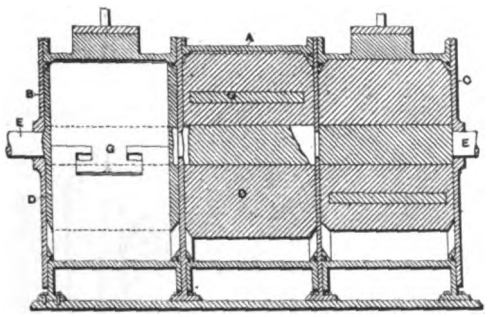


FIG. 1.

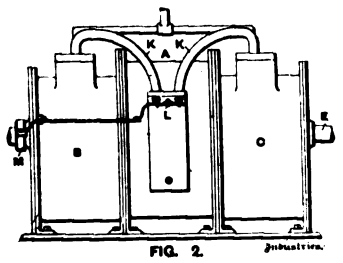


FIG. 2.

section of the engine, Fig. 2 a front elevation, and Figs. 3 and 4 transverse sections. A, B, and C are the three chambers or cylinders through which passes eccentrically the piston rod E. Upon the rod E are fixed the three drums or piston heads D, with sliding plates G. The plates G constitute the piston proper, and are made to assume contact with the sides of the chamber by the introduction of steam between them through the vent holes H as shown in Fig. 4. In each cylinder, I is the inlet pipe for the

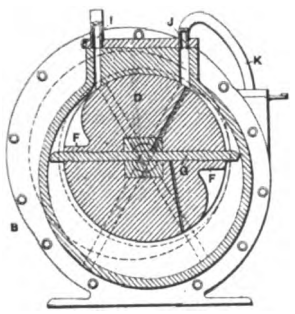


FIG. 3.

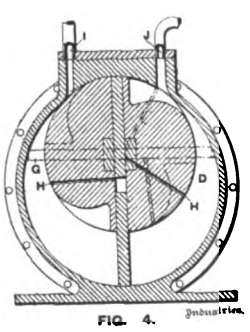


FIG. 4.

steam and J the exhaust. The steam as it is admitted by I strikes against the face F and the part of the piston G that projects, causing the piston rod to revolve. As the piston revolves more of it becomes exposed to the action of the steam until it reaches its maximum effective position, Fig. 4, and the exhaust of the other side commences. The exhaust from the cylinders B and C is conducted by the pipes K and the valves L to the third cylinder A. The valves L are operated by an eccentric M upon the piston rod E. Ten claims are made for the rotary engine described—No. 3469. February 26th, 1889. 8*d*.

REMOVING SNOW FROM STREETS.—*O. A. Warren, Liverpool.*—The method adopted is to apply to the snow, by distributing machinery, a liquid mixture of salt and water artificially heated. The apparatus is mounted upon wheels, and consists of a steam generator, a vessel for holding salt, a second vessel for receiving snow, and a tank for holding the liquid resulting from melted snow and the addition of salt. The salt vessel is situated at the top of the apparatus, the snow beneath it, and the tank below that. The snow is melted by passing steam from the generator into the snow vessel. As the snow melts the resulting liquid falls into the water tank below, where it is mixed with salt and heated to a higher temperature by coils passing from the steam generator through the tank. The liquid thus heated is forced out by steam through nozzles arranged along the bottom of the apparatus. The mixture of salt with the liquid in the tank is conducted either by hand or mechanical means, such as a revolving feed screw. Five claims are made.—No. 2987. February 20th, 1889. 8*d*.

MACHINE FOR WRINGING CLOTHES.—*S. Crow, Huddersfield.*—The principal features of this machine are the appliance used instead of springs for pressing the rollers together and the device for fastening the machine to the edge of a tub. The clothes are passed between two rollers made preferably of vulcanised india-rubber, whose elasticity compensates for the action of springs, and allows various thicknesses to pass between the rollers. The machine is constructed of two side plates secured together by a shaft, which forms the bearing for levers supporting the roller spindles. These levers are situated close to the side plates at each end of the shaft. Between the legs of each set of the levers are placed small cams attached to the guide board of the machine in such a manner that, by lowering the guide-board into the position for working the machine, the rollers are closed together by the action of the cam. For fastening the appliance to the edge of a tub the side plates are formed each with a depending leg, and one of the levers upon each side of the machine has a similar leg. The tub is nipped between these legs by the action of the cams produced by lowering the guide board as described above. Four claims are made for the machine as described.—No. 20579. December 21st, 1889. 6*d*.

PERCUSSION TURBINES.—*C. L. Hett, Brigg, Lincolnshire.*—Improvements are here made in the method of supplying the water to the turbine. Hitherto the water has been supplied by a simple nozzle or nozzles, and the flow regulated by a cock or valve. This method has been found to be defective, inasmuch as when a portion of the water was shut off the velocity of the jet was diminished and a loss of efficiency resulted. In this invention use is made of an adjustable nozzle of a similar character to the steam jet valve of an injector, by which the quantity of water striking the buckets of the percussion turbine may be regulated without loss of efficiency. The flow is regulated in this case by shifting the conical valve within the conical-shaped nozzle to or from the discharging aperture and so varying its area. Claim: The combination of a controlling nozzle fitted with a cone valve as described with a percussion turbine or impulse wheel.—No. 20708. December 24th, 1889. 6*d*.

MILLING CUTTERS.—*T. Eynon, Cleveland, U.S.A.*—Instead of making the milling cutters with the teeth and head of one piece of steel, and having the teeth to extend the whole width of the head, the inventor constructs the two separately and the cutting parts of small pieces of round steel rod. The object of this is to produce a milling tool in which the power is gradually applied and to prevent the tool heating. The head of the tool is bored with a small round hole radially to its axis for the insertion of the short steel rods. The rods are held in place by set screws and the protruding ends cut or milled away to form the cutting edges. All the teeth or cutters are of the same length, and project the same distance from the periphery or face of the head, so that all points of the cutting edges are equi-distant from the centre of rotation of the head. The cutters are preferably arranged in parallel lines around the face of the head, so that they alternate, the teeth of one series slightly overlapping the line of the teeth of the other, so that when in operation there will be no fin or unfinished portion left upon the surface of the material being milled. The milling tool head may be made of a number of similar plates screwed or bolted together, and the short lengths of steel nipped between them. Nine claims are made.—No. 20726. December 24th, 1889. 8*d*.

TURNING CYLINDRICAL STAVES.—*C. Werner & R. Pötzsch, Meerane, Germany.*—The operation of turning the staves is performed by passing the rods in their rough state through a hollow conical cutter-head revolving upon its axis; the staves are passed through in the direction of the conical cutter-head's axis. A head-stock supports the hollow mandril upon which the cutter-head is mounted, and a guide for the staves as they are passed through the cutter-head. An adjustable holder for the staves is fitted upon the bed of the machine in a line with the axis of the cutter-head. The cutter-head supports three or more flat, shear-like knives, lengthways of the cone. These knives are fitted upon slides which are worked by screws geared to a common large gear wheel or annulus concentric to the cone and fitted at its base free to revolve. By the revolution of the annulus, or one of the screws, the whole of the screws revolved and the cutters are shifted simultaneously either in a direction from the apex to the base of the conical cutter-head or the reverse, so opening or closing the cutters from or to each other. Five claims are made.—No. 5008. March 22nd, 1889. 8*d*.

CENTRIFUGAL SEPARATING MACHINES.—*W. L. Wise, London. (S. Jonsson, Schoenbergsgade, Denmark.*)—This invention relates to an improved method of supplying milk to centrifugal separating machines. The milk is caused to enter the separator exactly at that point at which is situated a milk stratum of specific gravity similar to that of the entering milk. The reason for so supplying the milk is not to disturb the strata of milk which have already formed, so that the centrifugal process goes on undisturbed. If the milk is entered close to the wall of the separator, it tends to go towards the centre until it reaches that stratum of milk whose specific gravity is equal to its own. If, on the other hand, the milk is entered where the specific gravity is less than itself, it is carried out towards the periphery of the machine and so again disturbs the process. To effect the delivery according to the invention, a supply pipe leads down into the vessel behind a ring of an S-shaped section fixed near the bottom. The liquid flows in behind the ring, and enters and mixes with the other milk by passing under the edge of the ring. Two claims are made for supplying the milk to a part of the separator containing milk of equal specific gravity, and for the appliance to effect such delivery as described.—No. 4653. March 16th, 1889. 8*d*.

ELECTRICITY.

TELEPHONE MOUTH PIECES.—*R. Cotterell, Crossmyloof, Renfrew.*—The object of this invention is to increase the volume of sound and render more certain the action of vocal sounds in telephone transmitters. For this purpose a conical-shaped mouth-piece having open ends is fitted at its small end to the transmitter. The small end of the mouth-piece enters and is fixed to a metal band which is constructed to be clipped or fastened to the transmitter. A band of india-rubber surrounds the small end of the mouth-piece and intercepts the metal clip and the surface of the transmitter case. Claims: (1) A conical-shaped mouth-piece having no delicate internal fittings; (2) fixing conical-shaped mouth-pieces within a holder or clip; (3) fixing to the base of telephone mouth-pieces rubber pads.—No. 3022. February 20th, 1889. 6d.

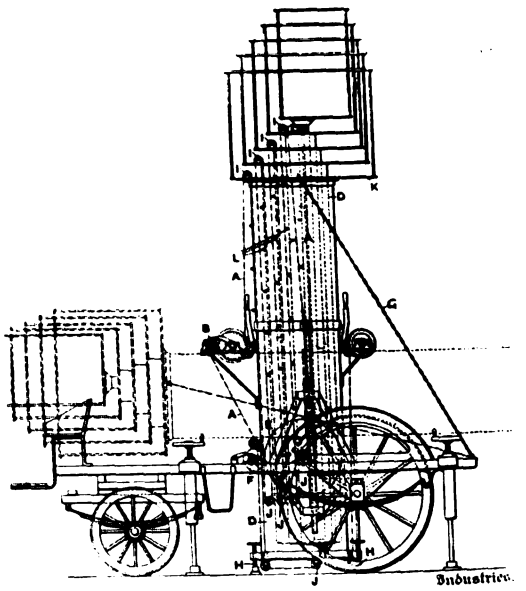
MAGNETO-ELECTRIC MACHINES.—*G. Bowron, London.*—The improvements here specified relate principally to the permanent magnet, but also to the commutator and brushes. In place of the ordinary horseshoe permanent magnet a straight one is used, and it conducts the magnetism through the armature by means of two suitably shaped pole pieces attached to the ends of the magnet. A Siemens shuttle-wound armature is used. This armature, as is well-known, delivers a varying current of electricity, which attains a maximum value twice during each revolution of the armature. The commutator and brushes are modified in such a manner that, when desired, the armature may be short-circuited either just before, or just after, the time when the armature is giving the maximum current. To accomplish this there are attached to the commutator two projecting arms which strike as they revolve a contact brush, and so short-circuit the armature. Claim: The improvements in magneto-electric machines as described.—No. 4998. March 22nd, 1889. 8*d*.

CHEMISTRY.

COATING METAL SHEETS WITH TIN, &c.—*R. Heathfield, Darlaston.*—The appliance is constructed to dispense with the ordinary rolls which are wholly immersed in the metallic bath and to substitute for them a pair of rolls placed upon the side of the pot. A pair of rolls is thus fixed to the inlet side of the bath and a pair at the outlet side; those at the outlet side being partly immersed in the metallic bath. The sheets are fed in by the inlet rolls and pass between curved guides in the bath to the partially immersed rolls upon the exit side of the pot. By this arrangement the wear and tear of the machinery is reduced. Claims: (1) In apparatus for coating metal, the rolls on the exit side of the pot, whether hung in an inner or outer frame and whether protected or not from the superfluous flux, in combination with the feed rolls upon the inlet side of the pot as described; (2) in apparatus for coating metal, removable main guides in combination with the other parts of claim 1 as and for the purpose described.—No. 7311. May 2nd, 1889. 8*d*.

MISCELLANEOUS.

FIRE ESCAPE.—*L. Smither & P. Duhamel, Paris.*—The escape is composed of a series of tubes which close one within the other when not in use, but when brought into action are drawn out by means of chains. The illustration shows a side elevation of this appliance closed, but moved into a vertical position ready for elevating. Its normal position is shown by the dotted lines. To move the tubes D to the upright position shown, racks C are pivoted to the outside tube and geared to the wheels E and F, which are revolved by a hand crank attached to the spindle shank of the wheel F. The racks C work in conjunction with the guy chains G, so that as the racks C are raised the chains G pull the tubes into an upright position, the tubes having a tendency to tilt towards the front. The weight of the tubes can be removed from the frame of the carriage by the foot screws H. The different lengths of tubing are forced out the one from within the other by the chains A attached to the windlass B, which is worked by a hand crank. The chains A pass over pulleys I and



under pulleys J upon the top and bottom of each tube as shown by the dotted lines. The tubes are of rectangular form, excepting the centre one, and guided one within the other by V pulleys running in their four corners. Upon the top of each tube are platforms K provided with rails, and down the side of each are bars L to form a ladder. The appliance is fitted with a second windlass for the purpose of raising and lowering a basket to or from the top of the tubes. Claims: (1) The construction of tubular ladder above described, fitted with trunnions, and capable of rocking in vertically adjustable bearings on a travelling carriage; (2) the means above described for raising the tubular ladder to a vertical position, sustaining it when extended, and lowering it to a horizontal position; (3) fitting the tubes which compose the telescopic ladder with platforms for the use of the attendants and for carrying the appliances; (4) the construction of divided axle; (5) the means above described for fixing the position of the apparatus and relieving the carriage from the weight of its load while the telescopic ladder is in use.—No. 1679. January 30th, 1889. 8*d*.

Copies of the British specifications may be obtained on application to H. READER LACK, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every 10d. or fraction of 10d. Remittances exceeding one shilling must be made by Post Office Order.*

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BAND-SAWING MACHINES FOR HEAVY TIMBER.

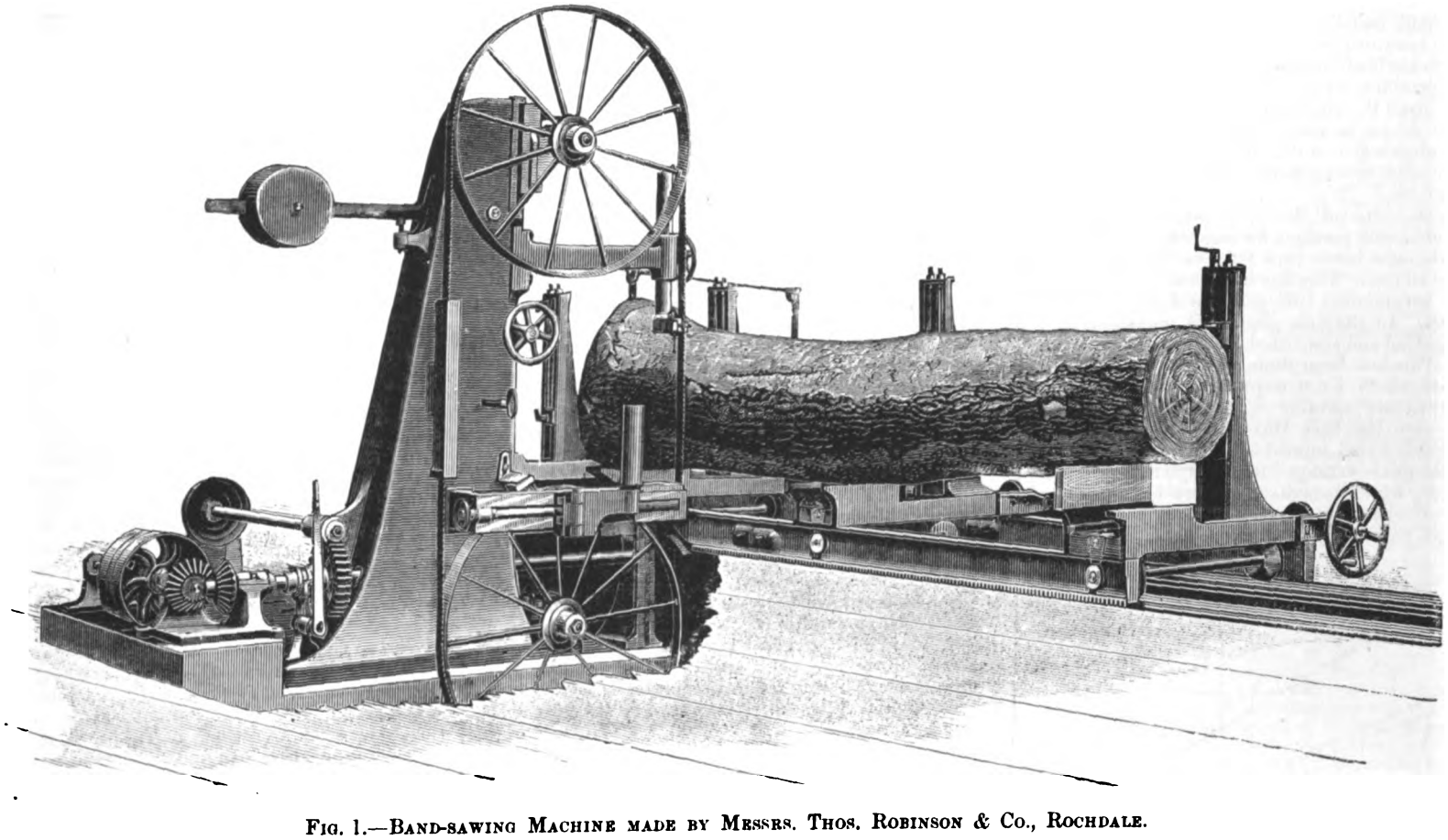


Fig. 1.—Band-sawing Machine made by Messrs. Thos. Robinson & Co., Rochdale.

BAND-SAWING MACHINES FOR HEAVY TIMBER.

By M. Powis Bale.

During recent years the introduction of band-sawing machines for converting heavy timber has made very considerable progress, more particularly in America, where a great number of machines of the largest size are in operation. When we consider that a well-constructed band-sawing machine will convert logs of the heaviest class with considerable rapidity, and at the same time effect a great saving in power and wood, it is somewhat remarkable that their development for log sawing has not been more rapid. This may be to a certain degree attributed to the difficulty there used to be in obtaining band-saw blades of the necessary width and temper to withstand the very considerable strain to which they are subjected, and to the want of provision of adequate means of keeping the saw in a true vertical line. These difficulties have now been entirely overcome and the machine made commercially successful. The object of the present article is to consider briefly some of the points to be desired in the construction and working of a machine of this class.

Main Frame.—In designing the main frame or column of the machine, strength with rigidity in working must be secured. In the best practice a hollow-cored or box casting made in one piece and arranged with an extended base is usually employed, although some American manufacturers prefer a wrought iron girder column bolted on to a heavy base plate. Whichever is used it is important that the base plate and foundations generally are sufficiently massive to absorb the vibration of the machine when working at its full speed. The base of the machine is fixed below the mill floor, and the foundation bolts pass entirely through the masonry. As regards the foundations dressed stone is best, as it offers a better resistance than brickwork. It should be accurately levelled, laid on a bed of concrete, and set as nearly perpendicular to the direction of the stress as possible. The quality of the work turned out and the longevity of high-speeded machines depend more on the stability of the foundations than is generally imagined, and any reasonable outlay in this connection is usually money well invested. With the object of securing increased steadiness in operation we have seen machines working with success in which the upper saw spindle runs in bearings fixed on the top of the column and the lower spindle in a vertical line beneath the base of the machine. An additional pair of bearings placed outside the driving pulleys of the bottom spindle to withstand the pull of the belt are an advantage.

Band Saw Wheels.—Perhaps the most important features in the construction of a band-sawing machine are the saw wheels. These should combine in the highest possible degree strength with lightness; this is more particularly the case with the upper saw wheel, as should it be too heavy it may over-run the bottom or driving wheel, and be a fruitful cause of the breakage of saws. It may be as well to explain the reason of this. The top saw wheel is driven by the tension of the saw blade upon it. When the top saw wheel is running at its full speed it acts somewhat after the fashion of a fly wheel; consequently, when the speed of the saw blade is suddenly checked by its entry into the wood as it commences to saw, the acquired momentum of the top wheel, not being checked in a like proportion, over-runs the saw and the driving wheel, and creeps, so to speak, up the back of the saw, which consequently buckles or fractures at the point of resistance—viz., where the saw enters the wood.

The wheels should be made of wrought iron or steel, covered with wood at the periphery, and this again covered with a band of vulcanised india-rubber or leather. The wheels should be turned all over, the top wheel mounted elastically, and both be *perfectly* in balance. Should they be the least out of balance the consequent centrifugal force causes a constant jumping motion on the wheels, which will ultimately break the finest saw blades. For log sawing the saw wheels must of necessity be of large diameter—in fact, within moderation, the larger the better—as, should the arc of contact of the saw with the wheel be too acute, the blades are rapidly cracked and fractured. The diameter of the wheels should be in proportion to the thickness of the log sawn, varying from 6ft. to 12ft. diameter, by about 8in. on the face. It is difficult to formulate a rule on the subject, but a wheel of, say, three times the diameter of the thickness of the wood to be sawn will generally be found to be suitable. The top saw wheel must be arranged to cant, so as to direct the saw blade to any desired point on the face of the wheel, and so equalise its wear; care must be taken, however, that the teeth are not allowed to run so far in as to tear the covering. The outside india-rubber covering should be a flat ring about 1in. thick, sprung on and carefully cemented in its place. If leather is used, two thicknesses, one of sole and one of buff leather, can be recommended; these will require riveting in their places.

The saw wheel spindles should be of steel supported by two pairs of bearings to each spindle; these can be mounted in an adjustable slide for the top wheel and in standards or pedestals for the bottom wheel. The author has found this arrangement much preferable for heavy machines to the plan of mounting the wheels to run on studs or using single bearings or bushes. The top wheel spindle and slide must be capable of being adjusted vertically to suit saws of various lengths; this can be secured by means of a hand wheel and screw working into a gun-metal nut fitted in the slide casting. To keep the saw to its proper tension, and therefore lessen the breakage of the blades, a weighted counterbalanced lever or spring combination arranged to act on the top saw wheel slide must in all cases be fitted. For covering the wheels with wood—which should be hard and well seasoned—ash or walnut, about 2in. thick, is suitable; it should be accurately sawn in segments, lap-jointed, and glued together, fastened to the wheel with counter-sunk coach screws, and turned up in its place. Strong steel or wrought iron tubes make excellent spokes for the wheels, combining, as they do, strength with lightness. With the object of preventing the upper saw wheel over-running the lower, some engineers make the latter about one-third heavier than the former, so that the increased momentum may prevent its speed being materially reduced when an increase of work is put upon it. For machines where the duty is very severe, the spokes of the wheels may be "staggered" with advantage; in this case the centres should be made heavier, and the rim of the wheel strengthened with wrought iron plates or pads where the spokes are attached. The top wheel can be set to an angle with the lower wheel by means of a set screw, cam, or worm gearing, whichever the arrangement of the wheel or slide may render most convenient. Wheels without flanges are to be preferred, as the flanges do little to support the back of the saw blade, and have a tendency to twist and buckle it, and heat and crystallise the steel. Some American makers construct the lower saw wheel of greater diameter than the top, but the writer fails to see the advantage of having the arc of contact of the saw different on the two wheels. By thus lightening the top wheel, the tendency to over-run the bottom wheel would of course be reduced. With the same object in view—viz., to equalise the speed of both wheels—centrifugal governor gear has also been fitted to the top wheel, but the writer is unable to speak from experience as to its success or otherwise.

Tension Apparatus.—To secure effective working, and prevent as far as possible the fracture of the saw blade arising from a rigid tension, the slide or bracket carrying the top saw wheel is always mounted elastically. This is effected through the medium of a strong spiral or coach spring, or by means of a counterbalanced compound lever, the amount of tension in the latter case being regulated by moving the weight nearer to or

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further from the fulcrum. No absolute rules can be made as to the amount of tension necessary on the blade, as this depends largely on the size and nature of the wood, the gauge, width, and condition of saw and rate of feed of the wood. If the rate of feed is fast the tension of the saw must be increased to enable it to face the wood without buckling. Great tension is bad, and often leads to fractures, especially if there should be any small cracks in the blade, a condition often found in saws of hard or crystalline steel. More tension on the saw should not be given than is required to keep it to the line. The slide should be so evenly elastic that, should the saw meet an obstruction and give a jump, the spring or lever compensating arrangement would give with it, and so save a fracture.

Saw Guides.—One of the chief troubles found in the early band-sawing machine for logs was the difficulty of keeping the saw blade in a true vertical line when sawing heavy timber. This has now, however, been in a large degree surmounted through means which we will briefly discuss. In the first place it is important that the saw be guided and supported as it enters and leaves the wood. This has been done in a variety of ways. The best with which I am acquainted is to fit in the table an adjustable metallic friction revolving guide wheel to receive the back thrust of the saw, and an adjustable guide fitted immediately beneath the table, with a similar guide arranged in an adjustable counter-balanced slide, fixed immediately above the surface of the wood. If the work is very difficult two pairs of movable steel rollers placed immediately above the cut

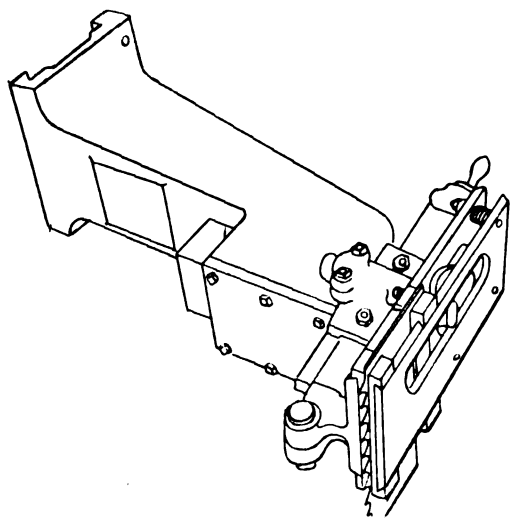


Fig. 2.—American Guide and Arm.

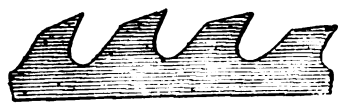


Fig. 3.—Saw Teeth for Ordinary Timber.

and below the table can be used. With these revolving rollers the friction is very small, and the saw is supported considerably. The ordinary flat adjustable guides are usually of wood. Apple or pear wood soaked in oil is suitable, but some makers use plates of steel. In sawing resinous woods, where it is necessary to keep the blade clean by lubricating it, the writer has used with advantage an oil-box guide. This is made in gun-metal, and consists chiefly of two flat oil-boxes, placed one on each side of the saw. The sides of the boxes nearest the saw blade are made adjustable, and drilled with a number of small holes, through which the oil can percolate. Hard brushes can also be fixed to sweep the blade clean at the back of the machine with advantage. The packing pieces, whether of wood or metal, should be adjusted so as to just touch the blade on either side and so prevent its undue vibration in working. Another plan to keep the saw to the line is to deflect the blade as it enters and leaves the cut by means of side friction rollers placed on a spindle vertically and made to bear against it. The revolving steel roller receiving the back thrust of the blade must be capable of adjustment, as the duty is very severe, and the blade must not be allowed to cut too deeply into it, or it will have a tendency to heat and twist the blade. The roller need not be more than $\frac{1}{2}$in. thick; it should be about 4in. diameter, made of hardened steel, fitted on a steel spindle carefully mounted in phosphor-bronze bearings. These, together with the lower side guides, can be mounted with advantage on a bracket arranged to swivel so that the guide may be readily adjusted to the plane of the saw blade.

We illustrate above (Fig. 2) an improved form of guide and guide-arm, of American origin, in which the pivot is in line with the teeth of the saw, but slightly to one side, and it is stated that the amount of movement which this position entails upon the cutting edge of the saw is so slight as to be immaterial. The hardened steel roller is fitted between steel plates; the outside plate is $\frac{3}{8}$in. thick, with a slot cut in it to make room for the nut on the roller. This outside plate is bolted to the guide casting by three stud bolts, which pass through adjusting screw plugs, thus enabling the distance between the plates to be adjusted at will. The upper and lower edges of the plates are bevelled as shown, and the side guides, which are gibs of brass or steel, are slipped on and screwed fast. The whole guide is then pivoted close to the cutting edge of the saw, and by loosening one nut the guide may be adjusted by the handle shown at the back whilst the saw is in motion.

We have seen another very good guide, consisting of a hard steel disc, arranged to rotate on its axis, so as to present fresh wearing surfaces to the back of the saw. The side guides are two half-discs, which are made to embrace the sides of the saw, and can be readily adjusted by a screw when the saw is in motion.

Timber Carriage.—This is usually a table of wrought iron running on friction rollers or rails, and operated by rack and pinion and friction gearing. It should be fitted with adjustable sliding heads and dogs for holding the timber firmly in position, and be speeded to travel from, say, 3ft. to 30ft. per minute, according to the size and nature of the wood to be sawn. By means of a hand lever and suitable friction gear the traverse of the table may be readily started, stopped, or reversed as may be required. By the employment of a friction disc the rate of feed may be regulated to a nicety. Rope feeds and feeds similar to those used in rack saw benches are also used, but care must be taken that the speed of the feed is not excessive, or the saw blade may be buckled and broken, as, being of much thinner gauge and usually running at a slower speed than a circular saw, it will not stand so much "crowding." The levers and hand wheels controlling the stopping, starting, feeding, and adjusting of the logs should be placed so as to be readily under the control of the operator, and as near together as may be. In the most advanced machines the head blocks can be simultaneously moved by a lever, and the thickness of the cut regulated to the greatest exactness by means of an indexed gauge plate.

Band Saw Blades.—It need hardly be said that, no matter how well a machine be designed and made, unless the cutting tool is of the finest quality the result is always unsatisfactory. What is required in a band saw is toughness, combined with a certain degree of hardness. If the blade be too soft it will not stand to its work, and will require constant sharpening. If it be too hard it will crystallise and break; it must, however, be sufficiently hard to keep well its cutting edge. French band saws have long been held in the best repute, but some English firms are now making very good ones. It is not easy to distinguish by inspection the quality or temper of a saw blade, and a user must necessarily rely to a great extent on the repute of the saw maker. Not a bad test is to "hammer set" a few of the teeth coarsely, and if the temper is too hard, a tooth will probably crack. The gauge of the saw should be in proportion to the diameter of the saw wheels and the nature of the work. A thin gauge saw will stand better than a thick one, therefore a saw of a greater gauge than is required to stand up to the work should not be selected; but for cutting hard close-grained woods, such as oak, beech, &c., a thicker saw will be required than for medium and soft woods. Long blades will stand better than short ones. To do thoroughly satisfactory work a band saw should have teeth correct in shape, and the blade be uniform in gauge, width, toothing, sharpening, setting, and temper. The question as to the shape of the teeth is a matter not easy to deal with, as it should be regulated by the nature of the wood they have to cut. Teeth with square or angular gullets should be avoided, as they are much more liable to crack at the roots of the teeth than those with rounded gullets. For converting ordinary timber a saw with teeth similar to Fig. 3 is suitable. For sawing oak, ash, elm, and hard woods generally* more teeth should be used than for soft wood, and these filed further back. For woods of woolly fibre, such as poplar, saws with deep teeth and coarse space and set should be employed, to allow an easy clearance for the sawdust, and overcome its clinging properties. Coarse teeth and set should also be used for cutting pitch pine. For soft woods, ordinary hand saw teeth are often used. It is important that all the saw teeth be sharpened and set alike. With this object in view automatic sharpening and setting machines have been introduced with satisfactory results. A suitable gauge for saws 8in. wide for cutting soft and medium woods is 17 S.W.G. with a pitch of about $1\frac{1}{4}$in. The amount of set should vary according to the density of the wood, the harder the wood the less the amount of set necessary and the greater the number of teeth. For converting very hard woods, such as iron wood, the author prefers fine-toothed and set mill saws to either circular or band saws. For sawing deals, band saw machines carrying two blades have been introduced into this country with success, a cutting speed of about 6ft. per minute being maintained, with a kerf loss of about $\frac{1}{16}$in. for each cut. It is very important, in order to secure an even motion on the saw blade, that the brazing be very completely done, and that the joint be of exactly the same thickness as the rest of the blade.

Speed of Saw Blade.—The question of the speed of the blade is a factor of considerable importance in securing efficient working. A short saw running over medium-sized wheels cannot, with safety, be run so fast as a long saw running over large ones, by several thousand feet per minute. A speed of from 5,000ft. to 10,000ft. per minute—according to the nature of the work and construction of the machine—may be considered a fair margin.

Notes on Working.—Keep the saw to a moderate tension and see that the wheel coverings are not allowed to get rough or worn. In heavy machines it is important that the machine be set in motion gradually, as it takes a little time to overcome the inertia of the top saw wheel, and if the power be suddenly applied there is a risk of snapping the blade, especially if worn or defective. Saw blades should in all cases be slackened out after finishing work, to allow of their contracting freely, as in working the blade is found to expand considerably, the slack being taken up by the workman, and if it is left with too rigid a tension, and cannot contract readily, it cracks, and flaws are set up. When sawing resinous woods, keep the blade as clean as possible by lubricating and brushing it. After taking a cut the log should be set back very slightly, so as to clear the teeth of the saw, as the table runs back, preparatory to taking another cut. The saw should never be crowded with too quick a feed, or it will twist and buckle, and not cut true and regular.

Circular and Band Saws Compared.—Circular saws for breaking down heavy timber, when compared with band saws used for the same purpose, possess the advantage of greater output, and are perhaps a little more easily managed. On the other hand, the band saw uses much less power and wastes much less wood. The first cost of a good rack-feed saw bench and a band saw for logs is slightly in favour of the former. In America, where circular saws are used of much thicker gauge than they are here, the saving in power and wood through using a band saw is correspondingly greater. In sawing pine the average output on a first-rate circular saw in America may be set down at about 40,000ft. per day of ten hours, whilst a band saw in the same time would produce about 30,000ft. I believe these figures have been exceeded, but I think they may be taken as a fair average. An American authority, in comparing circular and band saws, says that "the kerf of circular saws average $\frac{5}{16}$in., and in sawing 1,000ft. of inch boards 312ft. is turned into sawdust. The average kerf of the band saw is about $\frac{1}{12}$in., and in sawing the same amount of boards it turns 83ft. into sawdust. This shows a clear saving of 229ft. in favour of the band saw on every 1,000ft., and on 1,000,000ft. of 229,000ft.," an enormous saving, to say the least. The figures here given must, however, be very considerably discounted when applied to this country, as the circular saws in use here are of very much thinner gauge; but supposing a reduction of 50 per cent., and the saving is still very great. This is, of course, particularly the case when valuable woods are converted. Again, if the band-sawing machine is carefully made and handled, the work produced is superior to that of the circular saw. This may be chiefly accounted for through the greater freedom from vibration of the band saw when cutting. As the advantages arising from the employment of band saws become better known and appreciated, there is little doubt that they will, on their merits, rapidly supersede large circular saws for converting heavy logs.

We illustrate in Fig. 1 (page 217) a band-sawing machine for breaking down heavy logs, made from the designs of Messrs. Thomas Robinson & Sons, Limited, of Rochdale. The main frame is a hollow-cored casting, mounted on a substantial bed-plate, to secure, as far as may be, freedom from vibration when working. The saw wheels are of wrought iron, mounted on steel spindles, running in double bearings. The top saw wheel is adjustable vertically, and can be made to cant, so as to alter the pathway of the saw. A weighted compensating tension lever, to take up the slack of the saw and prevent its breakage, is fitted. The travelling table is arranged with a rack feed, and fitted with improved adjustable head blocks, for regulating the thickness of the cut. The rate of feed can be readily adjusted to the nature of the wood, and all the motions of the machine are immediately under the control of the operator.

* See "Saw Mills, Their Arrangement and Management," by M. Powis Bale.

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NOTES ON PATENTS.

IV.

THE COMMERCIAL EFFECT OF THREATS.

MANUFACTURERS frequently find that their market is destroyed by threats that their goods are infringements of Letters Patent. They have, of course, no cause of complaint where there is an actual infringement of valid Letters Patent. It is found, however, that threats of infringement are very common where no *legal* rights are infringed. Genuine patentees will, in cases of infringement, test their rights with a substantial manufacturer instead of destroying the market. Unscrupulous patentees make use of their so-called privileges by threatening the customers of their competitors. Many customers are fully aware that, by using or selling an infringing article, they are as liable as the manufacturer for the consequences of infringement. The customer feels, in nine cases out of ten, that it is not worth his while to inquire into the matter further; and thus the manufacturer loses the market for his goods, and possibly the threatening patentee secures the order.

Previous to the Patent Act of 1883 a patentee was within his rights in threatening persons with actions for infringement, provided he did so without malice. It was said in his favour that he was acting *bonâ fide*, and was merely cautioning the public of the existence of his patent rights. A complete change was introduced by the Patent Act of 1883. If a person claiming to be a patentee threatens any person with legal proceedings, he is now called upon to substantiate two things: 1, That his patent is valid; 2, That the goods complained of are infringements. This is the practical effect of Section 32 of the Patents Act of 1883. Any person aggrieved by the threats can commence an action to restrain a continuance of the threats, and for the damages sustained in consequence of them. There have been since the commencement of the Act several cases of this class. In most of them an injunction, with the costs, has been awarded to the plaintiff, but not damages of any substantial amount. There is no doubt that this Section has had a very beneficial effect. Patentees are now very cautious as to their threats.

It might be mentioned that, in the cases before referred to, the Courts have been most liberal in their construction of what is a "threat." Advertisements, notices to the trade, letters to individual customers, and even a lawyer's letter have been held to be "threats" within the meaning of the Section. There is no doubt that much damage was caused by unscrupulous patentees before the passing of the Act of 1883. This damage has been checked, but not done away with. Although a manufacturer is injured by threats, and has now the means of redress, it does not follow that it is worth his while to put the law in motion. The law is slow and expensive, and the patentee is frequently not a man of substance. This sometimes causes the manufacturer to find an antidote to the threats. This antidote occasionally effects what is desired, and enables the manufacturer and his customer to carry through their business.

It consists of an indemnity to the customer guaranteeing him against any legal proceedings. It is, of course, only worth while doing this where the contract is a large one. In an ordinary purchase there is no implied guarantee by the manufacturer that the article sold is not an infringement. The principle *caveat emptor* applies, and a few purchasers have found, to their cost, that they have paid for a machine which they have been prevented from using.

Patents are not always taken out for the purpose of protecting an invention, but sometimes for subsidiary objects. We had occasion, in a recent issue, to call attention to the fact that great numbers of patents were obtained for the purpose of marking goods with the word "patent." All privileges are liable to abuse; but means should be taken (for the benefit of genuine inventors) to revive the sanctity of Letters Patent. In certain foreign countries the penalty for the acts above mentioned is more severe than here, the defendant being liable to imprisonment and fine.

ON THE MECHANICAL APPLIANCES EMPLOYED IN THE MANUFACTURE AND STORAGE OF OXYGEN.*

Extraction of Oxygen from Atmosphere.—About thirty years ago the eminent French chemist Boussingault made the discovery that at a temperature of about 1,000° Fahr. the monoxide of the metal barium would absorb oxygen readily from the atmosphere, with the resulting formation of the dioxide; and that at a higher temperature of about 1,700° Fahr. the oxygen thus absorbed would be given off again, and the monoxide would apparently be restored to its original condition. Following up this discovery, Boussingault advocated the use of barium oxide for the economical preparation of oxygen on a large scale. He found however that the barium oxide gradually lost its power of recovery; and although many attempts were made by himself and others to overcome this difficulty, no one until within the last few years appears to have succeeded, and from a commercial point of view his discovery remained of little value. To the brothers Brin is due the credit of having surmounted this difficulty, and thereby paved the way for a method which within the last two years has been developed by the Brin's Oxygen Company into a reliable commercial process.

Barium Oxide.—As this is the basis on which the Brin process is founded, a brief account will be given of the way in which it is prepared and used, before going into the mechanical details of the process. Barium oxide is a mineral substance closely resembling lime in its properties. It is found combined in nature as "heavy spar" (sulphate) and "witherite" (carbonate), both of which occur most frequently in lead districts. One of the most important salts formed from the raw material is nitrate of barium BaN_2O_6, which when in the crystalline form is found the most suitable for conversion into the barium monoxide BaO employed in the Brin process.

This oxide, which is known commercially as "baryta," is formed by decomposing the nitrate in the following manner. A series of fire-clay crucibles, each of about eight pints or one gallon capacity, are heated in a suitable open coke fire to about 1,600° Fahr. Without being removed they are gradually charged with barium nitrate, which becomes rapidly liquefied by the heat, and boils for about three hours. During this process of boiling, gases are driven off in the form of nitric oxide N_2O_2 and oxygen. When the boiling ceases, a porous mass of hard barium monoxide, equal to about half the original weight of nitrate, is left in the crucible; and this is allowed to bake for another hour, under the same conditions as to heat, in order to drive off as far as possible all remaining traces of nitrogen oxides. The crucibles are then taken out of the fire, and placed in a closed chamber, where they are allowed to cool down slowly. The baryta is afterwards removed, and stored in air-tight drums until required for use.

Baryta thus manufactured lasts a long time, and costs about 75s. per cwt. It is not claimed for this method of preparing the oxide that it is a cheap one. When the Brin's Oxygen Works in Horseferry Road, Westminster, were erected three and a half years ago, this particular form of baryta was not commercially known; and as, owing to its permanent nature, the quantity required for the Brin process was so limited, it was thought advisable to manufacture the oxide on the premises in the manner just described. An oxide of barium, however, is largely prepared in a somewhat similar manner for use in the production of the powerful bleaching agent "peroxide of hydrogen" H_2O_2; and the manufacturers of this material have already taken the matter up, with the result that lump baryta in a porous state can now be procured for about 50s. a cwt. As yet, however, this material is hardly supplied in the physical condition required for the production of oxygen, for it fails to combine in the requisite degree the qualities of porosity and hardness. In appearance a lump of baryta might be mistaken for pumice stone, but in action it is very different. When put into water it slakes with greater rapidity than lime, and gives off much greater heat.

Production of Oxygen.—While the careful preparation of the baryta is very important, its treatment when in actual use for the production of oxygen is even more important. It was found by Messrs. Brin that, when the air was properly purified before being brought in contact with baryta thus prepared, it had little injurious effect; and also that, by peroxidising the baryta under a slight pressure, and deoxidising it under a partial vacuum, they were able to reduce the range of temperatures, and thus to avoid the high deoxidising temperature previously employed, which had acted destructively on the baryta. By the careful observance of these conditions the difficulty encountered by Boussingault and others has been practically overcome: in proof of which it may be mentioned that some of the baryta placed in the original oxygen-producer erected in Horseferry-road is still at work.

The Brin method of working was as follows:—By means of a suitable pump, air was *drawn* through a purifier containing caustic lime and soda, which extracted the moisture and carbonic acid. The purified air was then delivered under a pressure of about 10lb. per square inch into a series of steel retorts, charged with lumps of baryta about the size of a walnut. These retorts were placed horizontally in a brick chamber, and heated to a temperature of about 1,100° Fahr. In passing through the baryta the oxygen was extracted from the air, and the nitrogen was allowed to escape again into the atmosphere through a relief valve. After the baryta had taken up all the oxygen it could—which, theoretically, is about 1·25 cubic foot at atmospheric pressure per lb. of baryta, though this quantity is never reached in practice—the air pump was stopped, and the heat of the retorts was increased to about 1,600° Fahr. The pump was then restarted with its action reversed, so as to draw from the retorts. At a vacuum of 26in. of mercury, or nearly 13lb. per square inch, the baryta yielded up the oxygen it had absorbed during the previous operation, and this oxygen was drawn off through the pump and delivered into a n ordinary gas holder. When all the oxygen had in this manner been drawn off, the pump was again stopped, the heat lowered, and the first operation repeated.

On the starting of the works in Horseferry Road, an oxygen-producing plant was erected there on these lines; but it was soon found that the process would have to be much simplified before oxygen could be obtained cheap enough for industrial applications. The injurious effect of constant expansion and contraction on the steel retorts and on the brickwork of the furnace will be readily understood, as well as the waste of time and fuel, and the constant supervision required: all of which were the necessary results of working at two temperatures. Fresh experimental work was accordingly undertaken with a view to overcoming these difficulties, and has resulted in greatly simplifying and cheapening the entire process. These results have been brought about mainly by the adoption of one temperature for both operations, by the use of vertical instead of horizontal retorts, and by the automatic working of the entire process.

The figures on pages 220 and 221 illustrate a plant working on these lines, capable of producing 10,000 cubic feet of oxygen per day of twenty-four hours; and with the exception of the general arrangement being here slightly altered for the sake of clearness, it is in all respects similar to oxygen-producing plant recently erected.

Oxygen Producer.—The oxygen producer, shown in Figs. 1, 2 and 3, consists essentially of a self-contained carbonic oxide generator O, having a combustion chamber P on the top, which communicates on either side with chambers C containing the vertical retorts. The carbonic oxide generator is similar to that employed by Mr. W. A. Valon in the Ramsgate and other gas works; and it is well adapted for use in connection with an oxygen producer, where it is a matter of great importance to be able to maintain a uniform heat of from 1,350° to 1,450° Fahr. on the retorts containing the baryta, and where it is essential to have a producer requiring little attention. The generator is charged with coke every six hours through the firing door Q on the ground level, and is clinkered out every twelve hours through the door R. A feature of these generators is that they contain no fixed fire-bars; a slight steam-jet is used, mainly to prevent the formation of clinker on the walls. Air for primary combustion of the fuel is admitted through small portholes on each side of the clinker door R; and secondary air, for burning the carbonic oxide into carbonic acid in the combustion chamber P, is first heated by being drawn through passages in the walls on each side of the generator, up the back wall, as indicated by the arrows, and into the combustion chamber immediately above the opening in the crown through which the carbonic oxide is admitted. Combustion then immediately takes place, with consequent expansion. The hot gases leave the combustion chamber through the fire-clay sleeves G, which are so arranged as to prevent the gases from impinging directly upon the retorts. These sleeves are also fitted with fire-clay nostril pieces, which can be changed or adjusted at will through the openings in the side walls at H, thus giving a complete control over the heating of the retort chambers. The gases are drawn off from the bottom of each chamber, as indicated by the arrows, through fire-clay sleeves, into flues communicating with a common chimney in the back of the producer. The draught in each retort chamber is controlled by an independent damper; and the gases can either be conducted away direct, or be drawn down into any existing flue.

Retorts.—The retorts are of steel, twenty-four in number, twelve in each bay, in which they are placed vertically. They are 9ft. long in their exposed surface, 7in. external diameter, and ¼in. thick. Experiments are now being made with cast-iron retorts, with a view to the adoption of this material instead of steel. The retorts contain altogether about 2,100lb of baryta in lumps, as already described. The weight of the retorts is taken by a cast-iron box-plate at the top, through which they pass, and which is shielded from the action of the heat by special fire-lumps, as shown in Fig. 1. A cast-iron plate shielded in a similar way is used at the bottom of the retort chambers; but here a gland joint is formed by means of a ring of asbestos, to allow for free expansion of the retorts. The flanges and covers of the retorts are of cast iron; and the joint between them, which is found a particularly satisfactory one, is made as shown in section in Fig. 4, by beading the retorts at each end, recessing the covers to receive them, and placing a ring of thin sheet copper between the faces. The cover is then screwed down, thereby moulding the copper ring to the retort end and the cover, and so forming an absolutely clean air-tight joint. The copper ring can be used over and over again.

Connecting Pipes.—The bent connecting pipes between the retorts at the bottom, and between the retorts and the branch cast-iron pipes at the top, are of weldless steel, and are connected in every case by means of a conoid-conical joint. To prevent the possibility of these connecting pipes at the bottom of the retorts getting choked by small baryta lumps or dust, a cast-iron shield-plate is attached to the inside of the cover. As shown in Fig. 1, all the joints in connection with the bottom of the retorts are accessible through the clinkering pit of the carbonic-oxide generator. The arrangement of piping on the top of the producer and the details at V will be described later on.

Air Pump.—In small installations, such as that now described, the same pump is used for the twofold operation of pumping into and out of the retorts. It has therefore to be designed with a view to obtaining the high vacuum necessary for deoxidation. The pump shown at L in Figs. 1 and 2 is the type which up to the present has generally been adopted. It is manufactured by Messrs. Frank Pearn & Co., of Manchester, and is capable of creating under ordinary atmospheric conditions a vacuum of 29in. of mercury or 14lb. per square inch. It is a vertical combined double-acting steam engine and pump, with two air cylinders on top, each cylinder capable of passing one cubic foot of air per revolution. For cooling these cylinders they are surrounded by tanks containing circulating water.

Purifiers.—The purifying plant, shown at M in Figs. 1 and 2, consists of two wrought-iron or steel chambers of 96 cubic feet capacity, and two cast-iron chambers of 19 cubic feet capacity. The larger chambers are charged with quick lime CaO, and are filled only half full, in order to allow for expansion when the lime is hydrating; and the smaller ones are fully charged with caustic soda NaOH in the lump state. The purifiers are so connected by means of iron piping and valves, that the air to be purified passes through one or both of the lime chambers, and through only one of the soda. They are charged through a man-hole on the top, and emptied through a cleaning door at the bottom. The air passes through the purifiers on its way from the pump to the retorts, and is consequently under the same pressure in the purifiers as in the retorts. It is admitted to the purifiers at the bottom, and passes off at the top. It is first passed through one or consecutively through both of the lime purifiers, where the bulk of its carbonic acid and moisture is absorbed; and then through one soda purifier, where the remaining traces of impurity are trapped; the work done in the soda purifier is consequently very small.

The quantity of carbonic acid in the atmosphere is very slight, only about 0·04 per cent. in volume; and it varies but little under different atmospheric conditions. The quantity of moisture in the atmosphere is very changeable, and in this country may be said to vary in volume from 0·3 to 3·3 per cent.; and under average atmospheric conditions air contains in volume about 1·25 per cent. of moisture. The lime in the purifiers consequently hydrates with far greater rapidity than it carbonates. As a rough rule it may be said that one ton of quick lime will purify three million cubic feet of air. In the plant now described 86,000 cubic feet of air pass through the purifiers per day, and each purifier when charged contains about one ton of quick lime. If therefore the full efficiency were taken out of the lime, and the work done by the soda were disregarded, one lime purifier would have to be re-charged every five

*Paper read by Mr. K. S. Murray before the Institution of Mechanical Engineers, on the 31st of January, 1890.

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THE MANUFACTURE OF OXYGEN BY BRIN'S PROCESS.

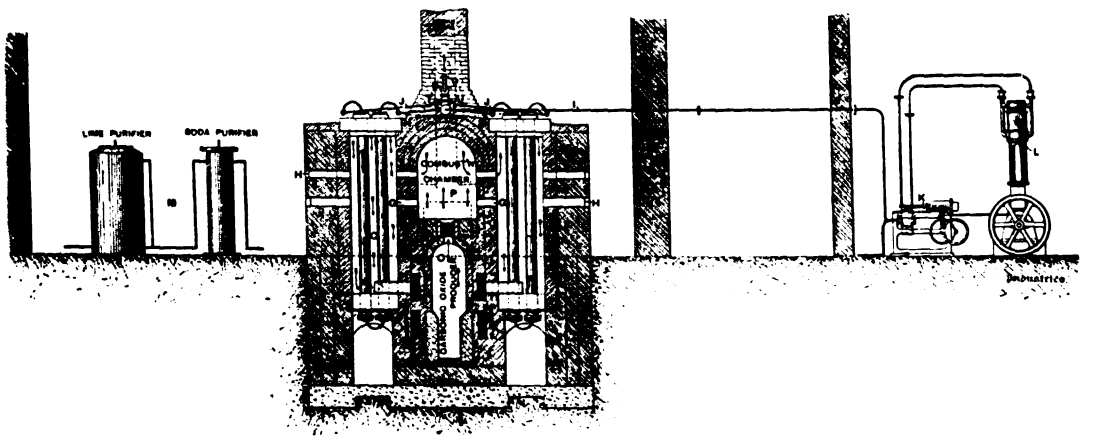


FIG. 1.—LONGITUDINAL SECTION OF PLANT.

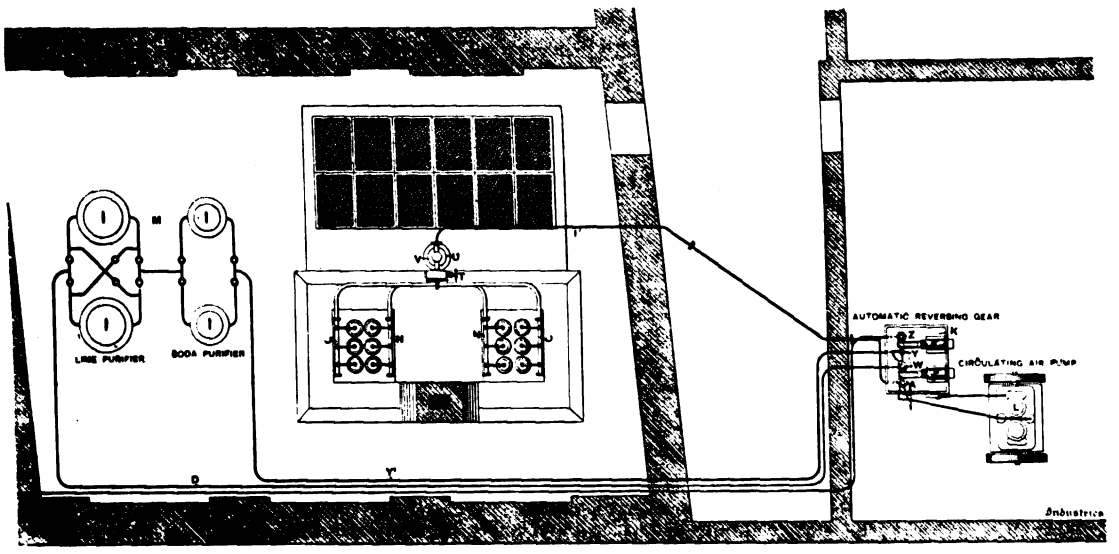


FIG. 2.—PLAN OF PLANT.

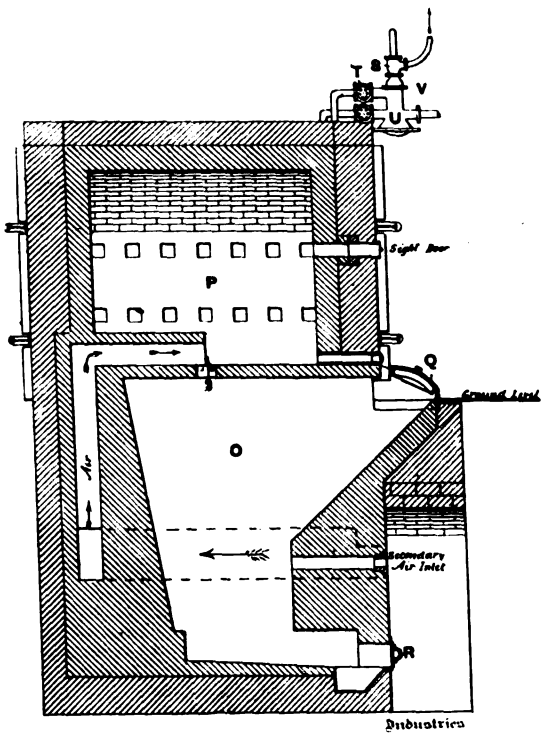


FIG. 3.—TRANSVERSE SECTION OF GENERATOR.

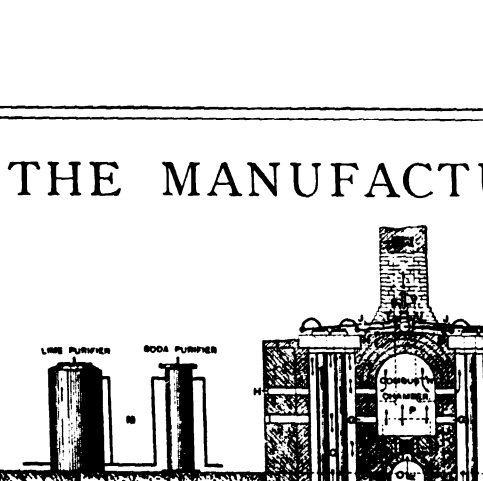


FIG. 4.—SETTING OF HEAD OF RETORT.

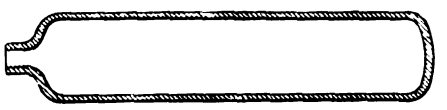


FIG. 5.—STEEL STORING CYLINDER.

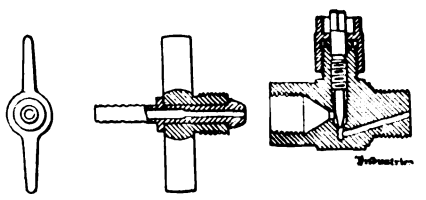


FIG. 6.—DETAILS OF NOZZLE FOR STORING CYLINDER.

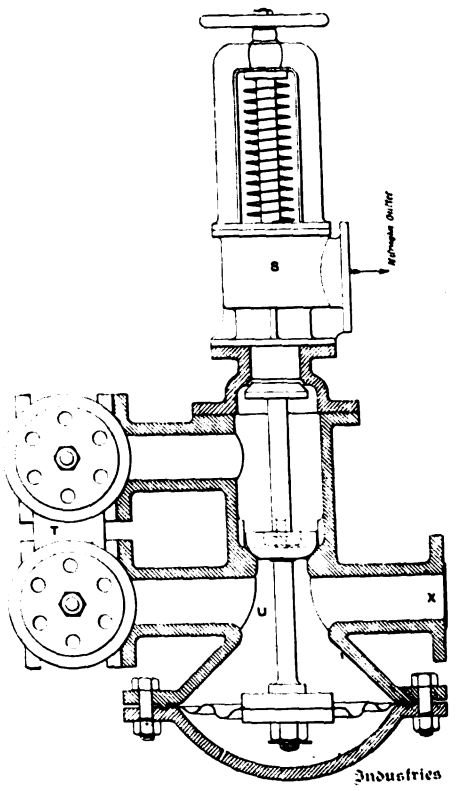


FIG. 7.—REVERSING DIAPHRAGM.

weeks. As complete slaking of the lime however means the formation of a mass offering a good deal of resistance to the passage of air, in actual practice the first of the two lime purifiers is thrown out of work as soon as ever it begins to occasion a perceptible back pressure, which with the purifiers now described would be after about four weeks' working. Whilst this purifier is being re-charged, the other lime purifier and the soda purifier do the work; and when the freshly charged purifier is re-started, the order of working the lime purifiers is reversed, so that the one last charged shall always be the second in action.

The life of the caustic soda depends on the efficiency of the lime purification. One of the two soda purifiers is always active; and as the soda has only to act the part of a catch to what has escaped the lime, it does not require to be often changed. Caustic soda has a very strong affinity for moisture and carbonic acid. As it hydrates, it liquefies; and this liquid has to be periodically drawn off through a tap at the bottom of the soda purifier. The amount of liquid thus drawn off is a good indication, not only of the efficiency of the lime purification, but also of the amount of caustic soda hydrated, the liquid soda being about double the weight of the caustic. When about half of the caustic soda has been drawn off in this way, the purifier has to be thrown out of work and filled up again, whilst the other soda purifier is brought into action.

Cost of Purification.—Assuming that after they had done work in the purifiers the slaked lime and the liquid soda were valueless, the cost of purification per 1,000 cubic feet of oxygen would be about threepence. But these materials, though spent so far as complete purification of the air is concerned, are by no means valueless. The slaked lime may be used for building purposes, for which it is found as good as lime slaked in the ordinary way; and in gasworks, where it is confidently hoped that the use of oxygen will be extensively adopted, this slaked lime has only to be taken to the ordinary lime purifiers, and there used for abstracting carbonic acid and sulphur from the coal gas in the usual way. The liquid soda, although the quantity used is very small, is disposed of for about one-half the original cost of the caustic material. From these facts it will therefore be seen that the purification of the air forms a very small item in the cost of oxygen manufacture.

The plan of purifying the air after it has passed through the pump, instead of before, has only recently been adopted. The advantages it offers over the old methed are:—Firstly, that as all the suction passages between the pump and the atmosphere are clear, the full quantity of air is drawn in and delivered by the pump; and secondly that traces of pump lubricants, which previously, in spite of all efforts to prevent their doing so, found their way into the baryta, are now effectually arrested by the purifiers.

Automatic Reversing Gear.—This gear is shown at K in Figs. 1 and 2. It consists of four cocks, A W Y Z, attached to a table, and geared with pistons, as shown in Figs. 8 and 9, by means of which they are actuated. Steam pressure is admitted to the cylinders in which the pistons work, by means of retention valves actuated at any desired moment by adjustable cams; and the motion to rotate the cam shaft is transmitted from the air pump by means of pawl and ratchet gearing. The cocks A and W and Y are reversed by means of the cylinder E. A is a three-way cock attached to the suction pipe of the air pump. N is a similar cock attached to the delivery pipe of the air pump. V is a two-way cock working in conjunction with A and W. Z is a three-way cock similar to A and W, and worked separately by the cylinder F.

The details shown at V on the top of the furnace work in connection with the automatic reversing gear, and are shown in Fig. 7. They consist of a double-acting automatic valve U, and a double hand distributing valve-box T. The automatic valves U are attached to the same vertical spindle, in such positions that when one is off its seating the other is on. They are actuated by a corrugated steel diaphragm, which is subject to vacuum or pressure according to the position of the cocks A, W, and Y. The diaphragm is about 12in. diameter and No. 26 W. G. or 0·018in. thick, and is corrugated cold between dies. The total fluctuation it is subject to is less than half an inch at the centre; and as proof of its efficiency it may be mentioned that the first of these automatic valves was started seven months ago, and has been steadily at work with the same diaphragm ever since. From tests actually made, the pressure obtained on the valve by the diaphragm under a vacuum of 28in. of mercury or about 14lb. per square inch is 700lb., the valve itself being 2½in. diameter. This valve is con-

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nected at one end to the pipe I, as shown in Figs. 1 and 2, and at the other end to the distributing valve box T. The latter is so arranged that, by screwing the hand wheels out or in, the direction of the air passing into the retorts may be periodically reversed, thus very much lessening the tendency the baryta has to settle when the currents of air are always in the same direction.

Cycle of Operation.—In order to convey some idea of the efficiency and cost of producing oxygen with the foregoing appliances, which constitute an existing plant for the purpose, the complete operation will now be described, assuming the air pump to be running at the rate of 60 revolutions per minute, and the automatic gear to be set so as to give four complete operations per hour, and assuming also that deoxidation has taken place and the automatic gear has just reversed all the cocks.

Air is drawn in from the atmosphere through the cock A into the pump at the rate of 120 cubic feet per minute. It is there compressed to about 10lb. per square inch, and delivered through the cock W and pipe D to the purifiers. Having passed through these, it returns by the pipe Y^1 to the automatic gear, passes through the two-way cock Y into the pipe I, and thence into the automatic valve U, where its pressure on the diaphragm causes the latter to close the bottom valve and open the top. The air being thus unable to get away through this valve passes into the distributing box T, where it is caused to enter the pipe N, in which it is subdivided, and passes consecutively through two retorts, where the oxygen is absorbed by the baryta. On leaving the retorts the nitrogen passes into the pipe J, and through another passage in the distributing box T into the upper chamber of the automatic valve U; and the top valve being open, it escapes thence through the release valve S into the atmosphere. It is by means of this release valve that the pressure in the retorts is controlled. When the peroxidation of the baryta has continued for 7½ minutes, or any other desired period, the requisite cam of the cylinder E comes round, and lifts a retention valve, which admits steam to the cylinder and thus reverses the cocks A, W, and Y. By this action the purifiers are cut off *under pressure*, and are thrown out of communication with the rest of the piping. The suction cock A is thrown into communication with the retorts, and the delivery cock W with the cock Z. Suction being thus created between the retorts and the pump, a vacuum is formed, which, acting on the diaphragm of the automatic valves U, reverses the position of these valves, closing the top and opening the bottom, thereby cutting off all communication with the atmosphere, and opening a communication with the top and bottom of the retorts, which enables the vacuum to be more rapidly created. As pure oxygen is not obtained until a vacuum of 26in. of mercury has been created in the retorts, it is necessary to blow away the gas drawn off before this vacuum is reached. The gas is therefore delivered through the cock Z into the atmosphere, until the proper quality of oxygen is obtained. The cock Z then reverses, and directs the oxygen into the holder, the reversal being caused automatically by suitable adjustment of the cams. When this deoxidation of the baryta has continued for the desired time, the automatic gear again reverses the cocks, and the whole process is repeated indefinitely.

A governor is used in order to control the speed of the air-pump when working under the different conditions of peroxidation and deoxidation; and a safety-valve is fixed on the delivery pipe between the pump and the automatic gear, so as to prevent any excessive pressure from being thrown on the pump whilst the operations are being reversed. It will thus be seen that the reversing of the operations is entirely automatic.

Labour.—Beyond firing the boiler and the carbonic oxide generator of the producer, and lubricating the pump and gear, nothing is left in the hands of the workman. Special labour is of course sometimes necessary: as, for instance, when a purifier has to be changed, or the baryta has to be taken out of the retorts to be broken up again, which latter, owing to a certain amount of cohesion, it is found advisable to do every three or four months. But working under ordinary conditions, with small installations such as the one described, where oxygen would be used in connection with some other process, and where steam could be taken from some existing boiler, no additional labour would be required.

Purity.—There is, however, another improvement of equal importance which has been effected by the automatic reversing gear, and that is in the quality of oxygen delivered to the holder. So long as the shifting cock Z was controlled by hand, the quality of oxygen could never be relied on, as any carelessness on the part of the workman might mean the admission of a quantity of air to the holder. With the automatic gear, however, such a contingency is impossible; and the quality of oxygen in the holder depends entirely on the length of time allowed between the reversing of the cocks A, W, Y, and the cock Z. The highest quality attainable in practice is from 97 to 98 per cent.

Cost of Production.—The cost of oxygen must always vary with the conditions under which it is made. The quantity of ordinary gas coke used in the carbonic oxide generator is from 12 cwt. to 15 cwt. per day; and as a rough rule, for installations ranging from 4,000 to 10,000 cubic feet per day, the pump power required is 1 i.h.p. per thousand cubic feet of oxygen, lessening, of course, as the plant increases in size. The actual cost of production, allowing for depreciation of retorts and baryta, probably ranges from 2s. per thousand cubic feet in coal gas works to 7s. in works specially erected for the production of oxygen only, where additional charges have to be made for labour and rent.

Although, in a process which has already shown itself capable of so much improvement, further improvements may yet be realised in the shape of a more perfect extraction of the oxygen from the atmosphere, there can be little doubt that the essential difficulties have now been overcome, and that a cheap and simple mechanical process for the manufacture of oxygen is at the command of engineers and chemists, who will not be long in finding applications for it.

In retail business with the supply of cheap oxygen the demand has been daily increasing. For while during 1887 Brin's Oxygen Company sold from their works in Horseferry Road no more than 142,000 cubic feet of oxygen for limelight and other purposes, the quantity they sold during 1889 amounted to just 1,000,000 cubic feet, notwithstanding that the Manchester Oxygen Company have within the last few months taken over the trade of the whole of the North of England.

High-Pressure Storage Cylinders.—All this gas has been compressed and delivered in high-pressure cylinders (Fig. 5), which are charged to 120 atmospheres, and vary in capacity at that pressure from 3 to 225 cubic feet, ranging from 3in. to 5½in. outside diameter. They are spherical at one end, and have a neck formed on the other, into which a high-pressure valve, shown in section in Fig. 6, is screwed and sweated. The material used in their construction is mild steel, and they are either solid-drawn or lap-welded. Up to 40 cubic feet capacity the cylinders used by Brin's Oxygen Company are solid-drawn and seamless; the larger sizes are lap-welded.

The seamless vessels are made by Messrs. Taunton, Delmard, Lane, & Co., of Birmingham, who, the author understands, now make them up to 9in. diameter and 5ft. long. They are made by taking a thick circular flat slab of steel, which by repeated heating and pressing in a hydraulic machine is moulded into a tube with a spherically closed end. The final processes of drawing are carried out with the steel in a cold condition, and annealing intervenes between each cold process. When the requisite size is obtained, the open end of the tube is nozzled or swaged in so as to form the neck. This repeated process of drawing acts beneficially on the strength and rigidity of the metal. The thickness of seamless vessels is rather less than that of lap-welded cylinders of the same diameter, and varies from ⅛in. for vessels of 3in. diameter to $\frac{5}{16}$in. for those of 9in. diameter. The ordinary hydraulic test applied is 2 tons per square inch. The trade in these cylinders has sprung into existence very rapidly, and Brin's Oxygen Company now have many thousands of them passing through their hands.

Compressors.—The compressors employed for filling the cylinders are of a three-stage type. They were originally designed by Mr. Howard Lane, of Messrs. Taunton, Delmard, Lane, & Co., and have since undergone many improvements and alterations. In those now employed, the first cylinder is double-acting, being 5½in. diameter with a stroke of 9in. The second and third cylinders are single-acting, having a stroke of 9in., and are 2⅜in. and 1⅜in. diameter respectively, being fitted with ordinary hydraulic rams instead of pistons. Gas enters the first cylinder direct from the holder, and is compressed in three stages until it leaves the third cylinder, from which it enters the vessel to be filled. The gland joints are formed with ordinary hydraulic leathers, together with a small quantity of water, which is admitted with the gas, and acts also as the cylinder lubricant. The water after it leaves the compressor is separated from the gas by gravity, and periodically drawn from a receiver. The three compressing cylinders, in order to be kept cool, are surrounded by a tank of cold water, which is always circulating.

The compressor is coupled to the crank-shaft of a 10 h.p. vertical engine, by which it is driven, the engine being fixed on the same foundation as the compressor. At a speed of 90 revolutions per minute this compressor will deliver 1,000 cubic feet of gas per hour at a pressure of 120 atmospheres.

Conclusion.—The compressor completes the mechanical appliances in connection with an oxygen factory. If the author has succeeded in showing that the Brin process is a simple mechanical method of manufacturing oxygen, the object of this paper will have been attained. For information respecting the industrial applications already established of this gas, reference may be made to a paper read by Mr. W. A. Valon before the Gas Institute at their annual meeting last year (Transactions, 1889, page 41), and also to a paper read by the company's chemist, Dr. Thorne, before the Society of Chemical Industry about a year ago (Journal, 1889, page 82).

THE MANUFACTURE OF OXYGEN BY BRIN'S PROCESS.

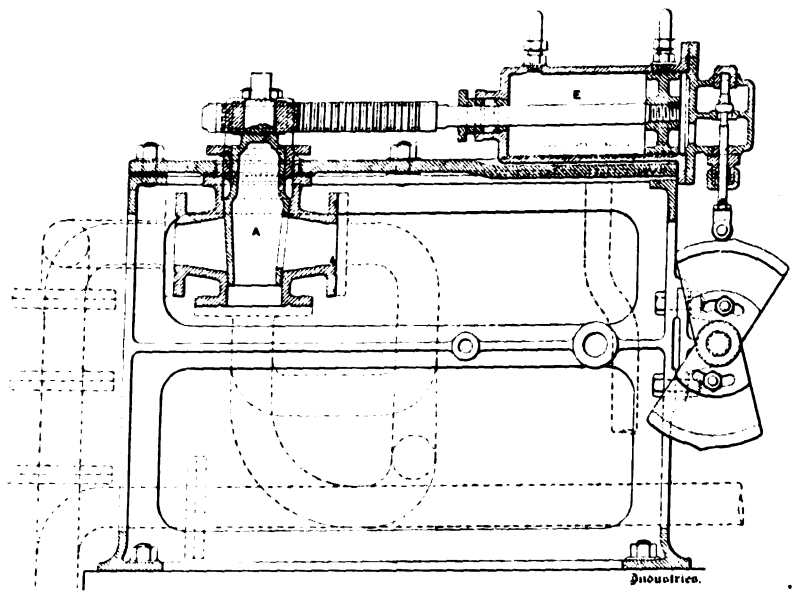


FIG. 8.—SECTIONAL ELEVATION OF REVERSING GEAR.

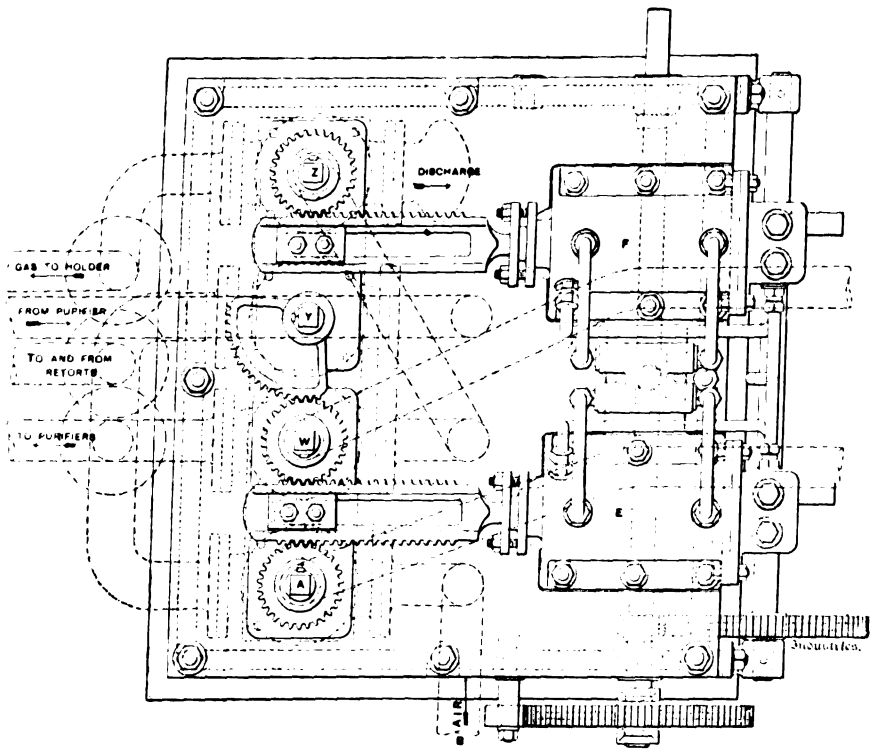


FIG. 9.—PLAN OF REVERSING GEAR.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

(FOR LATEST TELEGRAPHIC DESPATCHES SEE PAGE 225.)

PARIS, 4TH MARCH, 1890.

COAL.—The reports from all the centres of the coal mining industry describe the demand for industrial coal as exceptionally strong. This demand is not wholly due to an increased consumption of fuel. Consumers, fearing an interruption of the output by strikes, are imitating their German neighbours, and are stocking largely. Purchases are made for prompt delivery. The supply falls short, however, of the requirements, and prices are in consequence steadily rising. With the rise in prices the demands of the miners increase and their opportunity for exacting an advance in the rate of wages improves; so that the action of consumers, undertaken in self-defence, tends powerfully to bring about the dreaded event. One consequence of the high prices prevailing is a notable extension of the trade of the importers of English and Belgian coal. The former especially is now seen in localities where it had never before penetrated.

A BELGIAN CHAMBER OF COMMERCE FOR PARIS.—It has been decided to establish in the French capital a Belgian Chamber of Commerce, which, it is said, will have the sanction and support of the Belgian Government.

IRON.—Iron holds its position in the market, thanks, not so much to a brisk demand on the part of consumers, as to the high and still rising prices of coal. Here in Paris business is slack, and the tone of affairs weak; but in the provinces the situation continues fairly good. Manufacturers, generally, have plenty of work in hand, and though fresh orders do not come in so rapidly as they did a few weeks back, they are sufficiently abundant to ensure a good trade for the first half of the current year. Beyond this the prospect is less encouraging, for there are no large orders in sight, and it is not easy to see where a very brisk business is to come from. Pig iron in the Longwy district is less firm in price.

THE FOREIGN BREAD QUESTION.—An agitation is being set on foot to induce the Government to impose an import duty on bread. According to a statement prepared by the bakers' syndicate in the North, their industry is being ruined. At Roubaix, for example, there were 250 master bakers in 1887; now the number does not exceed 190. At Halluin there were in that year 25, while now only 4 remain. About $\frac{2}{3}$ of the bread imported comes from Belgium. The rapid growth of this trade is strikingly shown by the customs returns. In 1877 the imports for the year amounted to 63,442 cwt. Ten years later it had increased to 93,524 cwt.; in 1888 it rose to 253,814 cwt., and last year the amount reached 561,050 cwt.

NAVAL CONSTRUCTION IN 1891.—The French Minister of Marine has just made arrangements for the shipbuilding which is to take place in 1891, the total amount of credits to be asked for in the Budget of the department being about £2,320,000. The ships upon which this sum is to be spent, as well in Government as in private dockyards, comprise ten ironclads, one first and two second class ironclad cruisers, two first and four second class cruisers, two torpedo cruisers, five torpedo boats, two ironclad gunboats, one despatch boat, twelve open sea torpedo boats, and thirty-five first-class torpedo boats, or sixty-eight in all. Of the ten ironclads four—the "Neptune," the "Brennus," the "Tréhouart," and the "Magenta"—are in course of construction, and of the six new ones to be laid down one is to be named the "Carnot." The first-class ironclad cruiser, the "Dupuy-de-Lôme," is to be pushed forward at the Brest Arsenal, while the first-class cruisers, the "Alger" and the "Isly," are to be finished at the same arsenal.

ELECTRIC LIGHT AT PARIS.—At a meeting of the Municipal Council at Paris a short time ago M. Paul Brousse, the Prefect of Police, proposed that the Avenue de Clichy should be lighted by electricity. He stated that the number of crimes committed in that quarter was on the increase, and that as long as darkness prevailed the deeds of darkness would continue.

BERLIN, 3RD MARCH, 1890.

COAL TENDERS.—Only nine tenders were received this year for the supply of 17,170 tons of steam coal for the Berlin works, against 18 last year. Of these four were from mine-owners in Westphalia. Silesian coal was offered only through middlemen. The firm of Cäsar Wollheim, which deals with something like one-third of the production of Upper Silesia, tendered from 18s. 10d. to 20s. 6d. per ton, against 15s. 9d. to 16s. 10d. last year. The Westphalian coal was offered, for screened and washed nuts, at 26s. to 27s. 2d., against 16s. 9d. to 19s. last year. Berlin merchants tendered at 16s. 10d. to 19s. 5d. for unscreened and 20s. 2d. for round and nuts.

PIG IRON.—The high level of prices for German pig iron affords an opportunity to the importers of foreign iron, which they are turning to good account. English iron is being offered for sale both in the Eastern and the Western provinces, at prices which are several shillings below those asked for German produce of a like quality. As a consequence the tone of the market is weaker. The production of pig iron in Germany, including Luxemburg, in the month of January amounted to 374,066 tons, against 391,523 tons in December and 367,111 tons in January of last year. Production is still restricted in some localities by a short supply of coke.

LABOUR PROSPECTS.—The effervescence among the working men of all classes is increasing, and the prospects of German industry are thereby rendered, if not actually gloomy, at least much less bright. The probability of another general strike of coal miners is a cause of great anxiety. But the evil is by no means confined to the coal mining industry. A feeling of discontent is manifesting itself among the metal workers, and numerous partial strikes are now in progress in various parts of the country. Every industry is, indeed, more or less troubled by strikes.

THE JUTE TRADE.—The association of Austro-Hungarian jute manufacturers has appointed a committee to inquire and report concerning the present situation of the jute trade, and especially to consider the desirability of establishing an export syndicate. By reason of the greater rise in the prices of raw jute and the increased cost of production due to dearer coal and higher rates of wages, the margin for profits on woven goods has diminished to nearly the vanishing point. Efforts are being made to form a convention to regulate the home markets. The imports of raw jute last year amounted to 1,286,342 cwt. against 1,178,790 cwt. in 1888.

ASSOCIATION OF DISTILLERS.—The Association of Distillers, which has been holding its general meeting, now numbers 2,168 members. The annual report shows that, while the commercial situation leaves much to be desired, the technical development of the distilling industry is making constant progress. In the laboratory of the association 299 analyses were made for members. The school of distillery, with its sectional departments for the manufacture of starch and pressed yeast, was attended in 1889 by 16 distillery owners and 58 managers. The financial state of the association is satisfactory.

ELECTRIC LIGHTING.—After several adjourned discussions, the municipal authorities of Breslau have definitely decided to adopt the system of lighting by electricity. The contract for the installation has been given to the firm of Siemens and Halske, who will proceed at once to prepare the central station at the Carmelite Barracks. Power will be provided at first for the maintenance of 8,000 glow-lamps. To meet the cost the authorities have opened a credit of one million marks (£50,000).

STEAM HEATING ON THE PRUSSIAN STATE RAILWAYS.—On most of the main lines of the Prussian State Railway system the railway carriages are now heated by steam, and the success is so great that the carriages on the branch lines are to be fitted with similar heating arrangements. The steam is supplied from the engine, and travels along pipes which are arranged underneath the carriages. In the first and second class compartments the temperature may be regulated by the passengers, but in the third class compartments the travellers are baked or frozen according to the will of the guard or other official.

THE LEIPSIC CYCLE EXHIBITION.—The exhibition of cycles at Leipsic, which was opened on the 22nd ult., is not so great a success as was expected, and the novelties shown are not very striking. The space is only half occupied, and many of the leading European manufacturers are not represented at all. Mr. Larsen, of Liége, exhibits a cycle with pneumatic tyres, but it is very bulky and ugly.

TELEPHONES IN GERMANY.—The traffic on the telephone line between Berlin and Breslau is so great that the postal authorities are considering the advisability of erecting an additional wire between these two centres. The subscribers in the outlying towns of Upper Silesia complain that they can never get a word in with Berlin, as the telephone is continually occupied by Breslau subscribers. The second wire will therefore be very welcome in Upper Silesia.

MANUFACTURE OF OZONE.—A company has been started in Berlin, under the name of the Ozone Manufacturing Company of New York and Berlin, to work the patents of Dr. Graf & Co., of Berlin. The particulars of the process are not at present known, but if the process is feasible and simple the company will have an immense future before it.

VIENNA, 3RD MARCH, 1890.

THE COAL MARKET.—The brisk demand for Bohemian coals has been followed by such an increase of the price that people are becoming almost terrified. In Prague a committee has been constituted to petition the Government for taking measures against the steady increase of the prices. The capital value of the collieries is rising. The North Hungarian Coal Company has contracted for the construction of a railroad to connect their works with the State railways; by means of this line the Hungarian market will receive the production of three large collieries of the Grau district

THE IRON MARKET.—It is difficult to report about the situation of the iron market. Its position is so firm that it seems never to change. The events in the English market are followed closely by sellers here. Last week a distrust was felt, but now this influence has entirely disappeared. A little motion is visible in Bohemian foundry products, which increased a little. This fact shows that the consumption keeps at its height. The situation of the market is not only supported by home consumption but also by a good demand from abroad. Some Westphalian works are negotiating with the Alpine Montan Company for the delivery of a large quantity of ore and iron, and it will depend entirely on the railway tariffs if the contract will be closed or not. The Erste Brünner Maschinenfabriks-Gesellschaft held a meeting last week for the purpose of increasing its stock. The sale of this company last year was concluded at 1,200,000fl., but their capacity has not been great enough to make much profit. The resolutions of some railway companies to enlarge their lines and rolling stocks, new contracts for constructions, and the activity of the shipbuilding establishments show that there is an excellent prospect for the coming season.

BRUSSELS, 4TH MARCH, 1890.

THE COAL MARKET. The situation of the coal market remains very good. Prices meet with some opposition on the part of some buyers, but their resistance is of very little avail. Coke maintains its price of 35fr., and coking coal of good quality is nearer 23fr. than 22fr. A deputation of the associated colliery owners has met the Minister of Railways for the purpose of pursuading him to maintain the special railway tariffs connected with the carriage of native coal over the State railways. Although they did not gain their point, yet they are in hopes that the Minister will consider their case at a future time in a manner more favourable to them. The transport of coal over the Belgian State Railways is increasing steadily. Last week 25,420 waggon loads were carried, as against 22,000 during the corresponding period of 1889.

THE IRON MARKET.—At the recent meetings of the iron-masters of Belgium, the good position of the market has been continually upheld and prices have been marked by firmness. Eighteen francs is the minimum price for merchant bars, and for girders and joists 18fr. have been demanded on home orders and 17·50fr. for foreign orders. As regards plates, 22fr. may be considered as a minimum, and angles are at a basis price of 19fr. At all the works there is plenty of employment on all the branches of manufacture. Native pig holds its price well, and there is no stock to speak of.

THE GLASS TRADE.—The price of window glass is maintained at a fairly satisfactory level. Several good sales have been made to the United States, England, China, &c. The statutes of association of the syndicate for controlling the sale of window glass to the United States have now been settled, so that the syndicate will be in full working order shortly. The sales will be concentrated in the hands of a committee of the glass association.

BELGIAN REVENUES.—During the month of November last the receipts of the State Railways amounted to 11,484,276fr., being an increase of 650,000fr. over the income during the corresponding month of 1888. The income of the post office was 1,277,398fr. during the same month, an increase of 40,000fr. over that of November, 1888. The income of the telegraphs has increased during the same period by 39,700fr., being 313,905fr. during November, 1889.

DÜSSELDORF, 4TH MARCH, 1890.

COAL.—The all-absorbing question of the hour is that of the coal supply. What is to come of the threat of the miners to strike for an advance of 50 per cent. in the rate of wages does not yet appear with certainty; but even if wiser counsels prevail, and production be continued at the present rate, the difficulties of the situation will not be easily overcome. The output of the blast furnaces is still restricted by the want of fuel, and manufacturers of all classes are complaining of the insufficient supply as well as of the high prices of coal. In Upper Alsatia the stocks in hand will, we are told, be exhausted in a few weeks. Representatives of the manufacturers in that locality are being sent into the Saarbrück mining district to buy coal for immediate delivery. There is, however, but little available, and consumers are compelled to resort to Belgian and English merchants. A meeting of the coal merchants trading with Holland was held at Ruhrort the other day, at which it was decided to form a strong syndicate to control the markets till the end of the current year. No alteration was made in the prices agreed to at the former meeting.

IRON.—The tone of business in the iron market is certainly very different from what it was a few weeks ago. Confidence in the stability of the situation has been shaken. Now that the excitement has subsided, people are better able to appreciate the prospect, and for many it has lost its enchantment. The fact that English, and even French, iron is being offered in the markets of Germany from 5s. to 10s. a ton below the prices of home-made iron has a significance not easily explained away. The difficulty is how to reduce prices now that the raw materials of manufacture have so greatly increased in cost, and with a prospect of yet dearer coal and labour this difficulty appears insurmountable. Hence the feeling of anxiety that prevails. That the margin for profits will have to be cut down no one doubts, and already there are signs of a retrograde movement in the prices of iron. Pig iron has given way a little. The apprehensions of manufacturers are significantly expressed in the downward course of all industrial securities, but especially shares in collieries and iron and steel works.

LILLE, 4TH MARCH, 1890.

IRON.—The iron industry of this locality is suffering much from the short supply of coal. It is not easy to account for this deficiency, for the iron trade is not exceptionally active, and the consumption of coal in other manu-

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facturing industries cannot be much above the average. The scarcity exists, however, and the forgemasters are in consequence unable to deliver within the limits defined in their contracts. There is a falling off in fresh orders, but the syndicate rates are firmly adhered to. Finished iron from this district is now being offered in Germany at prices considerably below those of German iron. It is hoped that a good business will be done with German customers in the course of the coming summer.

TEXTILE MANUFACTURES.—Business in linen goods continues fairly active, but there is a want of vigour in the market, which, however, is not unusual at this time of the year. Paris houses continue to buy freely, but provincial orders are scarce. The statistics of trade in 1889 show the total amount of linen cloth sent away from the mills in the Armentières district to have been 323,286 cwt., a quantity slightly below that of the preceding year. Business is quiet in woollen goods at Roubaix. A committee of manufacturers, composed of twenty members representing every branch of the local industry, has been formed to protect the interests of the Roubaix woollen trade.

FLAX AND YARNS.—The demand for home-grown flax is fairly good for the season; but prices tend in favour of buyers. A large amount of business has been transacted in Russian flax. The demand is, however, scarcely so strong as it was a week ago. Prices have receded a little within the last few days. Tows are but little inquired for. Only the better qualities have found buyers. Spinners having made a small concession in prices, buyers have operated more largely this week, chiefly in wet spuns. The market continues very active for jute yarns at full prices.

AMSTERDAM, 3RD MARCH, 1890.

PATENTS IN HOLLAND.—Although an association has been formed, under powerful patronage, to re-enact the former patents legislation abolished some years ago, yet there is also a fierce resistance against the movement in some quarters. Many oppose a new patents law on theoretical grounds, holding that patents are useless and only afford a sham protection to the inventors who invoke them, but the objections of others, principally manufacturers, are founded mainly upon selfish grounds. They are working foreign patents without having paid for them, and now consider it a "hard thing" that they should be compelled to become honest again. The extent of Dutch manufacture of articles patented in other countries cannot, perhaps, be exactly known, but there is no doubt that it is greater than many imagine, and if patents were re-introduced it is certain that many industries would at first suffer. Therefore it would be wise to allow a certain lapse of time before the re-enforcement of the former legislation.

THE HARBOUR WORKS OF AMSTERDAM.—The new harbour works on the Y were recommended to centralise the transit trade of the capital under a Harbour Board. The Chamber of Commerce of Amsterdam has passed resolutions in support of the commission's recommendations, with the exception of that part thereof in which the appointment of a new committee is suggested to work out the plans laid down. The Chamber of Commerce has expressed a strong opinion that the existing commission ought, with the assistance of experts, to continue and, if possible, complete the task committed to it. The same Chamber has resolved to petition the States-General against the proposed re-imposition of an import duty on foreign grain, flour, and various cereals.

THE DIAMOND INDUSTRY OF AMSTERDAM.—The distress among the diamond cutters and polishers of Amsterdam, once one of the wealthiest classes of the community, still continues, on account of the dearness of the rough stone and the unwillingness of manufacturers to work upon the large scale of former days. Thousands of artisans are idle and nearly starving. They have appointed a committee, with the object of putting an end to this crisis. From a programme issued by the committee it appears that it is proposed to form an international association of jewellers, and of cutters and polishers of precious stones, strong enough to control the markets and narrow the exorbitant margin between rough and polished stones at present existing. The same association would have to support the efforts now being made to secure a legal working day of eight hours. It is likewise suggested by the committee abovementioned to start in Amsterdam a diamond bank, with a capital of £2 000,000, or even a little more. The Communal Council of Amsterdam has been appealed to by the committee for practical help, but it has said that it cannot see its way to way to do so.

BUTTER AND MARGARINE FACTORIES.—The number of butter factories on the Danish system is rapidly increasing in Friesland. In many villages, where already one factory existed, a second one is being erected, mainly by small companies or wealthy dairy farmers. In this system the milk is collected from various farms around the factory, where it is tested and mixed together. The butter produced is also combined with butters made in the neighbourhood, and thus equality in make and grade is constantly assured. Meanwhile, the new Margarine Act has not stopped or even impeded the important industry of butter substitutes, which still extends in every direction. The quantity of margarine manufactured last year in Holland is by far the largest ever produced in this country. A new factory has just been started by a company in Rotterdam with a capital of £100,000.

THE PORT OF ROTTERDAM.—It has been proposed to make Rotterdam a port of call for the boats of the subsidised line of steamers between Hamburg and East Africa, to be established as soon as the German Reichstag shall have passed the Government proposals as laid down in a Bill. This project has created much sensation in Rotterdam, where the communal authorities and the Chamber of Commerce have been hard at work to elaborate and forward to Berlin full particulars anent the port, its river accommodation, and the progress of the new waterway to the Hock van Holland. Various towns in the Rhenish provinces have also petitioned the German Government and the Reichstag in support of the claim of Rotterdam.

COPENHAGEN, 1ST MARCH, 1890.

NEW BREWERY IN SWEDEN.—Although brewing may have been overdone in some parts of the world, it is hardly the case in Scandinavia, where not only are the old-established breweries doing very well, but the erection of new ones is going on continually. Mr. A. Richter's brewery at Malmö, Sweden, is just about ready to commence work. A good site has been secured, and the interior arrangements are up to the requirements of advanced brewing. There are four large store cellars, and four yeast compartments, with 32 yeast vats. The front of the brewery is 240ft. long, and the depth of the cellars 17ft. underground. The ice reservoirs have a very considerable capacity.

NORWEGIAN SALVAGE STEAMERS.—The question of stationing salvage steamers on the Norwegian coast has been much discussed of late, and numerous voices have been raised urging the Government to take up the matter. The Government has asked for opinions from various institutions. An opinion of some weight has just been received from the Hangesund Nautical Society, recommending the building of three such steamers at a cost of about £10,000 each. They should be stationed respectively at Christianssand, Egersund, and in the vicinity of Bergen. It is also recommended to build ten life-boats, at a cost of £275 each, mostly intended for the protection of fishermen along the Norwegian coast.

BRITISH TRADE WITH NORWAY.—British trade with Norway is progressing in a most favourable manner. In 1887 it occupied the first place both in imports and exports, and in the succeeding year this position was more than maintained, although the total value of the foreign trade of Norway increased from £13,351,000 in 1887 to £15,600,000 in 1888. It should be mentioned that, for statistical purposes, Sweden is treated as a foreign country. Great Britain took 32·5 per cent. of the total exports of Norway in 1888, Sweden coming next with 13·9, then Germany with 13·3, Spain with 8·6, and France with 7·3. Of the total imports this country sent 27·9 per cent., Germany 26·9, Russia 13, and Sweden 12·3. The exports are mainly timber and fish, and, in connection with the former, it is interesting to note the extraordinary increase of the trade in wood pulp and cellulose, which in 1875 amounted to 8,540 tons, valued at £38,000, and in 1888 was 162,455 tons, valued at £510,000. The chief imports are grain and flour, manufactured and colonial goods, in the last of which especially there was a very considerable increase in 1888.

CEMENT MANUFACTORY IN SWEDEN.—Among the industries which have shown exceptionally rapid growth in Scandinavia during the last two or three years is the manufacture of cement. One of the newest works is the one at Limhamn, Sweden, which is just about to begin operations. The method of manufacture will be considerably simplified. The lime and the clay are conveyed into the building, where they are ground together in mills, with ordinary stones, to a certain degree of fineness. This substance is then made wet, and afterwards pressed into bricks. These are afterwards dried so as to remove the remaining moisture. The next process is the burning, and the produce is what is termed "raw cement." This is now conveyed to another part of the works, where it is ground and sifted, and afterwards conveyed to the stores to be packed.

MADRID, 3RD MARCH, 1890.

COKE MAKING AT BILBAO.—The large Bilbao establishment of San Francisco, which has been known as the Marquis de Mudela's works, has entered into a contract with M. Coppée, of Brussels, for the erection of a coke-making plant, with all his latest improvements both in furnaces and coal-washing devices. So far it is not intended to take advantage of bye-products, but the idea is to have as much gas as possible for raising steam. It is a great mistake not to give a preference to the systems which reduce the cost of coke by the sale of tar and ammonia.

CORUNNA WATERWORKS.—The municipality of Corunna is inviting tenders to carry out the supply of water to that important town. The cost of the works will be a little over £100,000, and the concession, which is on very reasonable conditions, will last ninety-nine years.

CADIZ SEWERS.—A scheme for remaking the old and badly kept sewers of Cadiz is engaging official and public attention, and a contract for reconstruction is to be arranged with some English capitalists.

STEEL-MAKING AT TRUBIA.—The Siemens 10-ton furnace, which has been building for some months at the ordnance works at Trubia is now nearly completed, and the question at present is to obtain a good practical smelter to instruct the local men in the management of large furnaces. The furnace will be ready for starting in four or five weeks.

THE PRICE OF ELECTRIC LIGHT.—The circulars of the English company, "The Electrical Supply of Spain," giving the prices, &c., have been issued. Their rate is enormous, but it is quite natural that they should try to get such prices, as gas is 9s. per 1,000 cubic feet. The Berlin company, which is to carry on business under the name of Compania Madrileña de Electricidad, has not published their price, but it will be very high. This state of things will last until the public find out that their prices are exorbitant, and encourage private installations.

NEW YORK, 22ND FEBRUARY, 1890.

THE COAL TRADE.—The weekly production of anthracite is now about half a million tons, and will probably remain about that figure for some time. Ordinarily about this time of year there should be a considerable demand for domestic sizes, but at present it is very light, for consumers either have a considerable supply on hand or are concluding that the severe weather is over. There are rumours of a strong combination to restrict the production and maintain prices. There ought to be no trouble in making the trade for the year a fairly profitable one, and a combination which would prevent ruinous cutting of prices would result in a fair year's business. Several of the leading companies propose opening large coal yards in the chief cities, thus cutting out the middlemen in the trade.

A LARGE CONTRACT.—The contract for a portion of the Chicago elevated road has been let to Carnegie, Phipps, & Co., of Pittsburg. It is for three and one half miles of road. The contracting firm will turn out the material at the Union Iron Mills. To erect the track contracted for will require about 8,000 tons of iron shapes. The iron used in the Brooklyn "L" roads, after which the Chicago road is patterned, cost between $80 and $100 per ton. A fair estimate as to the cost places it at from $800,000 to $1,000,000. The firm will complete the first mile by March 25th, and the entire work contracted for will be finished by July.

A LARGE MACHINE.—The Miles tool works, of Hamilton, Ohio, have finished and are now loading a large armour-plate bending roll, that is to be sent to the navy yard at Mare Island, Colo. The machine weighs somewhere near 400,000lb., and the freight will cost over $10,000. The Cincinnati, Hamilton, and Dayton Railroad has had a number of special flat cars built to carry the machine, and the train will be run through as a special. It is the largest single shipment, and is said to be the finest machine that ever left Hamilton, a town that sends out a great quantity of magnificent machinery.

THE NEW SHIPYARD.—Nearly a year ago it was stated that the Pennsylvania Steel Works at Sparrow Point, Md., would ultimately include in its business the making of heavy guns and the building of steel steamships, and plans are about completed for carrying this into effect. The first work to be done in the proposed shipyard will be two steamships for the steel works company, to be used in the iron ore trade with Cuba. Every movement of the company in increasing its machinery for the reduction of ore to iron and steel has had in contemplation the eventual capability of turning out all sorts of shapes, so that every part of a ship can be built in their own works. The superintendent says that the company will confine itself at first to building coastwise steamships, but a general business in competition with foreign shipbuilders was what they expected to end with, and he thought it possible for steamships to be turned out as cheaply here as abroad.

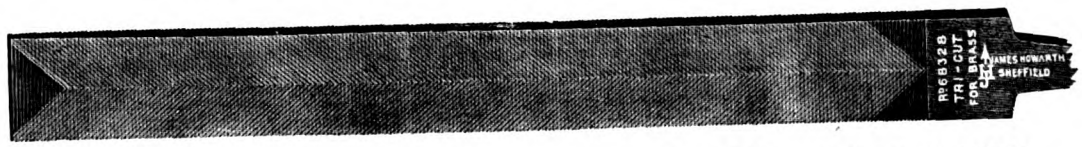
"THE RAPPAHANNOCK."—The new ship "Rappahannock," the largest wooden vessel ever built in this country, arrived in Philadelphia last week on her first voyage from Bath, Maine, where she was built at a cost of $125,000. She is 287ft. long, and 48¾ft. beam; her draught (loaded) is 28ft., and her tonnage 3,053 net. She is built of oak frames and Georgia pine ceiling and planking. She will load 1,200,000 gallons of oil in cases for Japan, the largest cargo of the kind ever exported.

CHESAPEAKE AND OHIO EXTENSION.—President Ingalls, of the Chesapeake and Ohio Railway, says it is a part of the plan of the company, in availing themselves of the franchises recently granted them by the General Assembly of Virginia, to establish lines of steamers between Newport News and New York to Liverpool. They also propose to build several branch roads through Virginia. The net earnings of the system for this fiscal year will reach seven million dollars, and could have been made much higher if they had the facilities to handle the business tendered them. The line was never in as good condition as at present. Two years ago there were seventy-three trestle bridges on the road, and to-day there is but one, and an iron structure is to be put up at this point.

READING IRON WORKS.—The directors of the Reading Iron Company met in Philadelphia recently, and decided to increase the capital from $300,000 to $1,000,000. The company, which less than a year ago was obliged to close down, is again on its feet, with good prospects ahead of it. The creation of the additional capital was to improve and repair the works, to acquire additional furnaces, and to provide sufficient working capital. The directors a short time ago secured control of the two Keystone furnaces, having a capacity of 500 tons, and which cost $500,000. With the enlarged stacks and new hearths the output is expected to reach 900 tons. The number of men employed in the different departments of the work is now over 2,000, and if there is no decline in the iron market this number will probably be increased to 3,000.

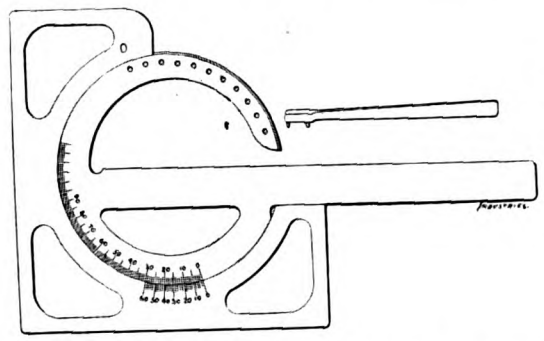
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HOWARTH'S TRI-CUT FILE.



IMPROVED DRAUGHTSMAN'S PROTRACTOR.

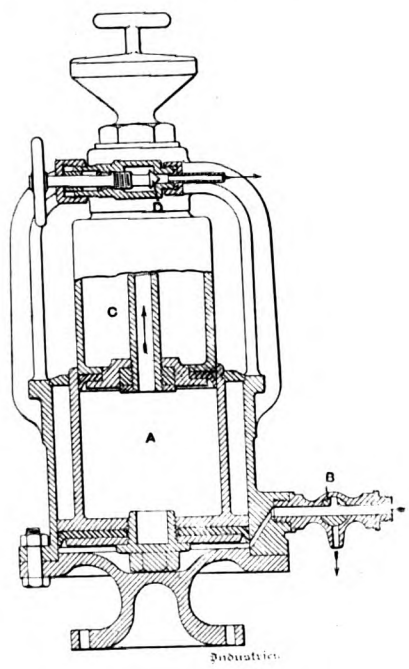
The accompanying illustration represents a new form of protractor which is being introduced by Messrs. Darling, Brown, & Sharpe, of Providence, Rhode Island, U.S.A. It is made from $\frac{1}{16}$in. sheet steel, and is, therefore, both light and durable. The protractor may be used



for laying off angles, dividing circles, &c., in conjunction with a T square or straight edge. It can be quickly and accurately set by hand to any desired angle, but a small lever is provided for very fine settings. As there are no projections on either face, it may be used either side upwards. The blade is $8\frac{1}{2}$in. in length.

A NEW LUBRICATOR.

In the issue of *Industries* of the 27th December, page 624, we described a new lubricant called "dynamine," which is now being made by La Compagnie Française des Graisse Minérales, and we now illustrate a lubricating apparatus which has been specially designed for the use



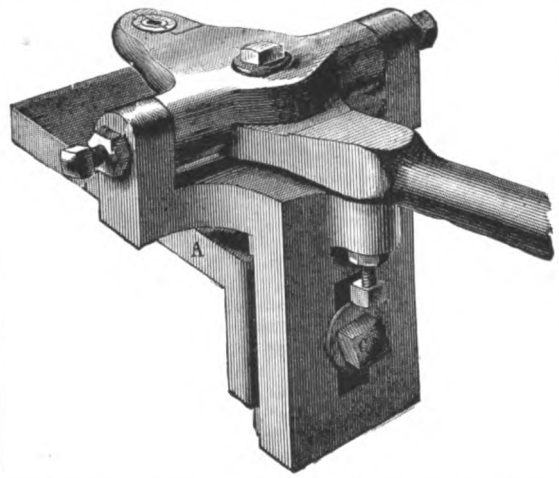
of this oil by M. Sanbenard. By a suitable arrangement of parts, a single lubricator is made to do duty severally in supplying oil to the cylinder, slides, bearings, &c. The cylinder A is filled with oil, and steam is allowed entrance underneath by means of the cock B. The piston C is fixed, and the cylinder A moves upwards under the force of the steam. The cock D regulates the rate of discharge of the lubricant. When the vessel A has been emptied, the three-way cock B is turned so that the water of condensation may be evacuated and a new charge of oil introduced through the screwed stoppers E.

HOWARTH'S TRI-CUT FILE.

We have carefully tried a new file now being brought out by Messrs. James Howarth & Sons, Broomspring Works, Sheffield. It is cut once straight across at right angles to the length of the file, and then each half is cut diagonally in different directions, as shown in the illustration above. An ordinary file has a tendency to slip off the work, and this has to be prevented by the workman. After some practice the workman counteracts this tendency unconsciously. Mr. Howarth's file, however, always tends to keep evenly over the work, and is therefore easier to use. It has no tendency to slip off the surface to be filed and make marks on some neighbouring place which has been already finished, and perhaps highly polished. The teeth are very clearly cut, and the file works well.

SCREW SLOTTING DEVICE.

We illustrate herewith a simple device for slotting the heads of screws, which can be attached to any ordinary hand lathe. The platform A is fastened to the bed by a bolt, and a long lever projects in front at right angles with the bed. A spindle carrying a circular cutter is held in the centres of the lathe. The lever is moved horizontally to open the jaws for inserting and removing



the screws, and downward to bring the screws to be slotted against the saw. The stop screw B governs the downward motion and regulates the depth of slot in the screw head. The working part of the apparatus can be raised or lowered on the platform front by means of the bolt C. This apparatus is made by The Brown & Sharpe Manufacturing Company, Providence, Rhode Island, U.S.A.

SOCIETY OF ENGINEERS.

At a meeting of the Society of Engineers, held on Monday evening, the 3rd inst., Mr. Henry Adams, President, in the chair, a paper was read by Mr. Ralph Hart Tweddell, M.Inst.C.E., on the "Application of Water Pressure to Machine Tools and Appliances."

The author referred to his previous paper read before the Society in 1877, and to the greatly extended adoption of his system of hydraulic machines and appliances during this interval. He gave figures showing the continually increasing power and size of this class of machines during the quarter of a century which has elapsed since he first introduced them, and very closely analysed the relative advantages of hydraulic, pneumatic, and electric transmission of power, considered in their special relation to working machine tools and the appliances in connection with taking the work to and from them.

The author, having emphasized the fact that the conditions to be fulfilled in the designing of a "complete system" of machine tools are very different from those affecting a "single machine," proceeded to point out the great number of conditions to be fulfilled by any motive power when applied to working machines varying greatly in their individual character and requirements. Dividing the subject of the relative merits of these three motive powers into (1st) the convenient storage of the power, (2nd) economy and facility in distributing the same over large areas, (3rd) simplicity in its application to machine tools and the appliances required to take them to and from their work, (4th) adaptability to perform work of the lightest and heaviest description, the author stated that, while electricity and air fulfil some of these conditions, they do not fulfil those of the most importance in connection with the class of work under discussion. On the other hand, hydraulic pressure not only fulfils all of the above conditions, but it is especially applicable to the working of machine tools and the appliances for lifting and transporting the materials operated upon by them. The author then referred to various improvements effected by himself and others in hydraulic machines now required to meet the altered conditions of riveting, flanging, drilling, &c., in order to make sound work in the heavy boilers now used with high steam pressure.

The author then proceeded to describe the riveting up of large bridges *in situ*, and referred to the first bridge so constructed, namely, the Primrose Street bridge, in London, which was riveted up on the author's system in 1873. After alluding to many other bridges, the author pointed out the absolute necessity of a largely extended use of labour-saving appliances in workshops, such as cranes, lifts, capstans, &c., which are necessary, not only on account of the greatly increased weight of the work now machined, but also to keep all classes of machine tools in more continuous work. In conclusion, he pointed out that hydraulic pressure was as suitable for working these appliances as for working the machine tools themselves.

SHIPBUILDING NOTES.

On the 19th ult. the s.s. "Eugenie," launched a few weeks ago from the shipbuilding yard of Messrs. Richardson, Duck, & Co., was taken to sea for a trial of her machinery. The engines are of the triple-expansion type, and have been built by Messrs. Blair & Co., Ld. The cylinders are 21½in. 35in., and 57in. in diameter, by 36in. stroke. The machinery worked very satisfactorily during the trial, but owing to the heavy sea no speed results could be obtained.

On the 19th ult. there was launched from Messrs. Craig, Taylor, & Co.'s. Thornaby Shipbuilding Yard, Stockton-on-Tees, an iron screw steamer of the following dimensions: Length, 278ft.; breadth, 37ft.; depth, 19ft. 8in. The vessel has been built with a long raised quarter-deck, bridge extending to and including foremast and forewinch, short well and topgallant forecastle. She is fitted with web frames in the after-hold, and has a double bottom for water ballast. She will be fitted with four steam winches by Messrs. Robert Roger & Co., of Stockton; steam steering gear by Messrs. Alley & Maclellan, Glasgow; patent windlass by Messrs. Emerson Walker & Thompson Bros., Gateshead; Messrs. Hastie's screw gear aft, and all modern improvements, so as to admit of rapid loading and discharging. The engines, on the triple-expansion three-crank system, are being constructed by Messrs. Westgarth, English, & Co., Middlesbrough-on-Tees, and have cylinders 20in., 33in., and 54in. in diameter, by 36in. stroke. As she left the ways she was christened "Shaftesbury."

On the 20th ult. Messrs. Edward Withy & Co. launched from their yard at Hartlepool a large iron screw steamer, built to the order of Messrs. Burdick & Cook, of London. The vessel has a long raised quarter-deck, short poop, long bridge-house, and a topgallant forecastle. The holds are fitted with iron grain divisions, and all decks, deck erections, skylights, bulwarks, bulkheads, &c., are constructed of iron. In the main and after holds the vessel is built on the web-frame system. The cellular bottom is fitted all fore and aft for water ballast. Four steam winches, large donkey boiler, patent steam steering geer amidships, screw gear aft, patent steam windlass, stockless anchors hauling into hawse pipes, and other modern appliances are fitted for the handy working of the vessel. On leaving the ways the vessel was christened "Amie."

On the 22nd ult. the steamer "Coomassie" was launched from the yard of the Naval Construction and Armaments Company at Barrow. She has been built for Messrs. Elder, Dempster, & Co., of Liverpool, and is 312ft. long, 39ft. beam, 27ft. 6in. deep. The engines are of the triple-expansion type, and have cylinders 23in., 38in., and 62in. diameter, by 42in. stroke. Steam is supplied from two single-ended boilers 14ft. 6in. diameter and 10ft. 6in. long, with 160lb. per square inch working pressure.

On the 22nd ult. Messrs. Workman, Clark, & Co., Limited, Belfast, launched a steel screw steamer named "Chichester" for Mr. W. R. Rea, Donegal Quay, Belfast. Her dimensions are:—Length, 285ft.; breadth, 38ft.; depth, moulded, 22ft. 2in. She is a well-decked steamer, with topgallant forecastle, short well at fore hatch, long bridge-deck, and raised quarter-deck. The decks are of steel, and there is a cellular double bottom all fore and aft. She is schooner rigged, with steel masts and square sails on the foremast. The engines and boilers are being made by Messrs. Muir & Houston, Glasgow.

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On the 22nd ult. Messrs. Harland & Wolff, Limited, Belfast, launched a large four-masted steel sailing ship for Messrs. Ismay, Imrie, & Co., Liverpool. This vessel has a registered tonnage of over 3,000 tons. Her dimensions are:—Length, 318ft.; breadth, 45ft.; depth of hold, 26ft. 6in.

Notices of Meetings.

NEXT WEEK.

Institution of Civil Engineers.—Ordinary meeting, Tuesday, March 11th, at 8 p.m. Discussion upon the papers by Messrs. Burge, Walton, and Cruttwell on the Hawksbury, the Dufferin, and the Blackfriars Bridges.

Society of Arts.—Wednesday, March 12th, at 8 p.m. "The Chemin de Fer Glissant, or Sliding Railway." By Sir Douglas Galton, K.C.B., D.C.L., F.R.S.

Institution of Electrical Engineers.—Thursday, March 13th, at 8 p.m.. Adjourned discussion on the following papers: "The Theory of Armature Reactions in Dynamos and Motors," by James Swinburne; and "Some Points in Dynamo and Motor Design," by W. B. Esson.

PRICES CURRENT, 5th March, 1890.

Quotations at per ton, unless otherwise specified.

PIG IRON.

Middlesbro' Warrants, No. 3		49/9	Cash
Scotch Warrants, m n		50/1	"
Hematite Warrants, m n		62/6	"
Stocks in Stores — Scotch	865,066.—Dec. for week,	9,451	Tons
Middlesbro'	177,099.—Dec. "	1,984	"
Hematite	382,467.—Dec. "	3	"

Exclusive of stocks in makers' yards.

	No. 1.		No. 3.		
Coltness	74/-	.....	65/6	f.o.t.	Glasgow.
Gartsherrie	74/-	.....	64/-	"	"
Langloan	73/-	.....	67/6	"	"
Summerlee	71/-	.....	65/-	"	"
Glengarnock	73 6	.....	66 6	"	"
G.M.B. ex Store	51/-	.....	50/9	"	"

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	77/-	68/-

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	7 15 0	.....	8 5 0	f.o.t. wks.
" Angles	7 10 0	.....	8 0 0	"
" Plates	7 15 0	.....	8 5 0	"
Staffordshire Bars (cheaper makes)	8 17 6	.....	9 7 6	London.
" Angles	8 17 6	.....	9 7 6	"
Crown Sheets	9 0 0	.....	9 10 0	"
" Hoops	8 2 6	.....	8 12 6	"
"Siemens-Martin" Steel Boiler Plates			9 15 0	"
" Ship and Girder			8 15 0	"

Market quiet.

METALS.

Spelter: Ordinary	£23	10	0	to	£23	15	0
Copper: British Cakes and Ingots	55	0	0	"	56	0	0
" Chili Bars, G.O.B.'s	46	15	0	"	47	2	6
" Other sorts, G.M.B.'s (equal to Chili Bars)	46	15	0	"	47	2	6
" Manufactured (strong)	63	0	0	"	.....		
Lead: Common Pig	13	12	6	"	13	15	0
" English Sheet	14	2	6	"	14	5	0
Tin: Straits	89	17	6	"	90	5	0
" Australian	89	15	0	"	90	5	0
" English Ingots	95	0	0	"	.....		

Messrs. Carrick & Brocklank, Manchester, report as follows:—

Copper: There has been but little variation in prices of Chili bars during the past week, the market having been pretty steady and free from important fluctuations. The general uncertainty in the metal markets deters buyers. The stock of copper on 28th February was returned as 95,152 tons, the decrease during February having been but slight. Manufactured continues in slow demand, quotations being—sheets £63, bottoms £66.

Tin remained very quiet up to the end of last week, but on Monday there was a strong market, prices advancing from £89 15s. to £90 17s. 6d. cash. The advance, however, was not maintained, and quotations to-day are the same as in our last report—viz., £89 17s. 6d. to £90 5s., with an active business.

Lead: A quiet market has been experienced during the week, and prices have declined somewhat, to-day's London quotations for English being £12 10s. to £12 15s., with foreign £12 7s. 6d. to £12 10s.

Spelter continues very firm, the stocks being small.

CHEMICALS.

		£	s.	d.		£	s.	d.
Acid: Carbolic Crystals	lb.	0	0	10½	to	0	1	0
" " Liquid	gal.	0	1	2	—	.....		
" Citric	lb.	0	1	7	—	.....		
" Oxalic	"	0	0	3¼	—	.....		
" Sulphuric	ton	1	12	0	—	.....		
" Tartaric	lb.	0	1	4	—	.....		
Alum: Lump (powder 10/- ex.)	ton	4	17	6	—	.....		
Ammonia: Carbonate	lb.	0	0	3½	—	.....		
" Muriate (Grey)	ton	22	15	0	—	.....		
" " (White)	"	26	10	0	—	.....		
" Sulphate	"	11	17	6	—	.....		
" Liquor	lb.	0	0	3⅜	—	.....		
Antimony	ton	.....			—	.....		
Bleaching Powder	"	5	5	0	—	.....		
Bisulphide of Carbon	"	13	10	0	—	.....		
Borax	"	30	0	0	—	.....		
Benzole (90 %)	gal.	0	4	0	—	.....		
" (50 90 %)	"	0	3	1	—	.....		
Copper Sulphate	ton	26	10	0	—	.....		
Copperas	"	2	0	0	—	.....		
Kieserit	"	.....			—	.....		
Lead: Nitrate	"	22	10	0	—	.....		
" White Sugar	"	24	0	0	—	.....		
" Brown "	"	19	0	0	—	.....		
Potash: Bichromate	lb.	0	0	4	—	.....		
" Caustic	ton	22	0	0	—	.....		
" Carbonate	"	19	10	0	—	.....		
" Chlorate	lb.	0	0	4½	—	.....		
" Prussiate (Yellow)	"	0	0	10½	—	.....		
" Sulphate (Basis 90 %)	ton	9	10	0	—	.....		
Precipitate: Red	lb.	0	3	1	—	.....		
" White	"	0	3	2	—	.....		
Salts: Epsom — Bags	ton	3	0	0	—	.....		
Salts: Epsom — Casks	"	3	15	0	—	.....		
" Glauber	"	1	10	0	—	.....		
Sulphur: Sublimed Flowers	"	9	0	0	—	.....		
" Recovered	"	4	10	0	—	.....		
Soda: Ash	deg.	0	0	1⅜	—	.....		
" Caustic (White 70%)	ton	8	17	6	—	.....		
" " (" 60%)	"	7	17	6	—	.....		
" " (Cream 60%)	"	7	7	6	—	.....		
" Crystals	"	2	12	6	—	.....		
" Bicarbonate	"	5	15	0	—	.....		
" Hyposulphite	"	6	5	0	—	.....		
Solvent Naphtha	gal.	0	3	6	—	.....		
Tartar, Cream of	cwt.	5	12	6	—	.....		
Zinc Sulphate	ton	7	10	0	—	.....		

Messrs. S. W. Royse & Co., Manchester, report as follows:—

Chemicals.—There is still a scarcity of new business, but old contracts are keeping manufacturers well employed, and prices remain steady. Bleaching powder is, perhaps, a little easier for spot delivery; on the other hand, soda ash is a little dearer. Sulphate of copper for early delivery is a little easier, and there is not the same disposition to buy forward. The demand for green copperas has ceased, with a fair number of orders for forward. Sulphate of ammonia is more pressed, but prices remain fairly steady.

OILS.

		£	s.	d.
Cocoanut: Cochin	per ton	26	0	0
" Ceylon	"	23	10	0
Cottonseed	"	22	5	0
Cod	"	21	0	0
Lard	"	36	10	0
Linseed	"	22	5	0
Palm, Lagos	"	23	10	0
Rapeseed: English	"	34	10	0
Seal: Pale	"	27	0	0
" Brown	"	22	0	0
Sperm	"	46	0	0
Whale	"	24	0	0
Turpentine	per cwt.	1	10	6
Coal	per gal.			
Petroleum (Refined)	"	0	0	5¾
" Spirit	"			

FOREIGN TELEGRAPHIC ADVICES.

(From our own Correspondents.)

Paris, March 6.—*Iron.*—The market here continues somewhat weak. Merchants refuse, however, to sell bars below 160s. and joists below 164s. The provincial markets are steady, but they have lost something in buoyancy. A better tone prevails in the Loire-et-Centre. In the Haute-Marne the demand for wire, wire nails, and chains continues unabated. In the Nord business is active and prices are firm.

Metals.—The metal market continues steadily its downward course, copper leading the way. Chili bars are now quoted at £52 and less; best selected, £56. Banca tin has dropped to £98 10s. and Straits to £96. Lead is a point lower, £12 16s. Spelter has recovered a little; Silesian, £25 5s.

Berlin, March 6.—*Bourse.*—The continued downward tendency of all industrial securities shows that confidence has been rudely shaken. Within the last few weeks colliery companies' shares have dropped at least 35 per cent. In some instances the fall has been much greater—up to 90 per cent. Iron and steel companies' shares have followed the collieries at no great distance. Prices further receded yesterday. To-day the market opened weak.

Iron.—The market has lost a little of its activity, and prices are less buoyant. Silesian bars are quoted 205s. to 210s. a ton. Buyers hesitate to operate for forward delivery. Fear of labour disturbances is visibly checking the current of trade.

Metals.—The metal market is lifeless. There is very little buying of anything, and prices are made the subject of much bargaining. Copper is very dull: Mansfeld refined is still quoted £59 to £60, but English brands have receded a point to £56 to £58. Tin is also a point lower: Banca, £100 to £102. Lead is firm: Clausthol refined, £15 10s. to £16. Spelter is a shade better: Silesian W.H. brand, £25 15s. to £26 10; ordinary, £24 15s. to £25 10s. Antimony regulus firm.

Breslau, March 6.—*Iron.*—The market continues active, but the upward tendency of prices is disappearing under the influence of foreign competition. English pig is being offered at 66s. a ton on trucks at railway stations in Upper Silesia; and French bars are offered by a Hamburg firm at 190s. delivered free either at Beuthen or at Kattowitz. Joists are in brisk demand. Bars are quoted 210s.; boiler plates, 250s. to 260s.; and thin sheets from 255s. to 265s. a ton.

Metals. Contrary to expectation, the market for zinc has lost in firmness within the last day or two in consequence of the Silesian Mining and Zinc Manufacturing Company having pressed for sale some old stocks of spelter. The weakness thus occasioned is not likely to be of long duration. "Bear" speculators are making the most of this circumstance. Lead remains moderately firm. The demand is sufficient to absorb the whole of the production.

Düsseldorf, March 6.—*Coal.*—The market keeps steady. Sellers refrain from forcing up prices in view of the threatened strike of colliers, in order not to provoke that movement. The sharp weather of the last few days has given a fillip to the trade in household coal. The supply of coke is still short of the current requirements of consumers. Belgian coal is arriving in larger quantity.

Iron.—The demand for pig iron is slack, and the tone of the market hesitating. Some lots in the hands of speculators have been sold at lower prices to close accounts, but manufacturers maintain their rates firmly. The market for finished iron and steel is a little less active. The demand for joists has fallen off. Business is being checked by apprehensions of labour disturbances. Prices are unaltered. Export trade very quiet.

Charleroi, March 6.—*Coal.*—The market has not yet returned to its normal state, a circumstance largely due to the uncertainty of the situation in Westphalia and in England. Coke is still quoted 28s. a ton. Foreign orders are coming to hand in abundance. There is a good deal of buying on Portuguese account, a consequence of the ill-feeling against England in Portugal.

Iron.—Business is not brisk, but inquiries are more numerous. Prices are firmly maintained. English-buying orders for joists are coming to hand freely. Offers of 175s. a ton from English houses for large quantities have been refused. Makers' prices are 185s. The tone of the pig iron market is strong.

Glass.—Makers complain of the insufficiency of the demand to absorb the production. The market is slack. Some important New York orders have, however, been received within the last few days, and others are in sight. The new glass manufacturing company, whose works are to be situated between Roux and Gosselies-Courcelles, has been formally constituted.

Ghent, March 6.—*Flax and Yarns.*—The demand for home-grown flax being brisk, and the quantity on offer somewhat less than it was a week ago, the tone of the market is stronger. In Russian very little doing. The demand for yarns is sufficient to enable spinners to maintain their prices without much difficulty.

Proposed New Railway in Denmark.—The Danish Government has introduced a Bill into Parliament about the construction of a new railway along the coast of the Sound to Elsinore. There is already one railway between this town and Copenhagen, but the new one will form a continuation of the present Klampenborg line. The length will be about 25 miles, and the cost is calculated at 4,100,000kr., and 920,000kr. for rolling stock, &c.

Black Granite in Sweden.—In the vicinity of Varberg "green" granite has for several years been a favourite specialty, and found an extensive sale both at home and abroad. Of late black granite has superseded it. Black granite had, however, to be brought from distant parts, but an important discovery of this stone has now been made on the Brunnsberg estate, a find which will, no doubt, prove of great value, and which has already attracted considerable attention.

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HOME INDUSTRIES.

LONDON 6TH MARCH, 1890.

THE MONEY MARKET.—The money market has been very easy all the week in anticipation of a further reduction in the Bank minimum. Rates have fallen. The only thing which menaces the market is the probability of gold exports to New York. The exchange has been steadily going against us for some time, and now the point has been reached at which it will pay the Americans to import specie from London. Although the Bank's position is strong and the market is well supplied with money, this probability causes some little apprehension. The stock markets have been very dull. Consols improved in the beginning of the week on buying for the Sinking Fund. Home railways have been depressed, partly because of the disappointing dividend declared by the Caledonian, which was ¼ per cent. below expectation. American railways are an uncertain market, brisk one day and depressed the next. Foreign stocks have been comparatively lifeless, with the exception of Argentine securities, which have fallen heavily in response to a sharp upward movement in the premium on gold at Buenos Ayres. Industrial and miscellaneous securities have been quiet, but the shares of the Salt Union have had a fair recovery. Copper shares are out of favour, and gold mines are altogether neglected. The nitrate group has experienced another relapse.

COMPANIES.—The following companies have been registered since our last report:—The Reliance Portland Cement Works, Ld., with a capital of £60,000; Boschkop Silver Mining Co., Ld., with a capital of £100,000; The Victoria Mill (Clayton-le-Moors) Co., Ld., with a capital of £9,000, to carry on the business as cotton spinners, &c.; Pahang-Semiliang, Ld., with a capital of £200,000, to acquire lands and mines in the Malay Peninsula or Archipelago; The Brownmills Patent Manhole, Gully, and Grate Co., Ld., with a capital of £2,500; Harvey, Graham, & Co., Ld., with a capital of £15,000, to carry on the business of engineers and machinery exporters; The Blyth and Tyne Brewery Co., Ld., with a capital of £60,000; The Forest of Dean Wagon Co., Ld., with a capital of £5,000; The King's Norton Metal Co., Ld., with a capital of £140,000, to carry on the business of manufacturing metal sheets and other articles; The Penjom Pahang Gold Co., Ld., with a capital of £190,000; The Richmond Ironworks, Ld., with a capital of £25,000, to acquire interest in rolling mills, &c.; Bournehills and Withymoor Collieries and Fire Clay Co., Ld., with a capital of £15,000; Bonnick & Co., Ld., with a capital of £2,000, to carry on the business of machinists, &c.; Robert Walker & Sons, Ld., with a capital of £50,000, to acquire the Providence Cotton Mill, Hyde, Cheshire; Appleton, French, & Scrafton, Ld., with a capital of £160,000, to carry on the business of flour millers and corn factors; Le Champ D'or French Misgund Gold Mining Co., Ld., with a capital of £100,000; The Cortex Calorifuge Co., Ld., with a capital of £10,000, to manufacture, deal in engines, &c., for ships; Sharp Murray Ld., with a capital of £20,000, to acquire the bleaching and dyeing business carried on at Park Mills, Bradford; Henry Lister & Son, Ld., with a capital of £80,000, to carry on the business of worsted spinners, &c.; The Italian and General Exploring Co., Ld., with a capital of £5,000; The Montgomeryshire Brewery Co., Ld., with a capital of £70,000; The Ruby Mining Co., Ld., with a capital of £100,000, to acquire mines at Eureka, Nevada, U.S.A.; Toms & Co., Ld., with a capital of £22,000, to carry on the business of brewers.

SHIPPING.—Freights have inclined to a lower level all round, which, in conjunction with the higher and increasing cost of working steamers, makes it a difficult matter to secure anything like good profits on any round voyage. The first two months of the year has been time lost to many steamers. Out-freights in all directions have come to a very low ebb, and are difficult to secure. Wages are still high, and especially in the outports. In shipbuilding there is an appreciation of the danger of further increasing the present over-supply of tonnage, and fresh orders are scarce. Shipbuilders are actively prospecting for new work, and several own to having booked nothing this year.

COPPER.—Good merchantable copper has declined £2 per ton during the past month. This was due to the number of warrants on the market and the difficulty of financing them with the Bank rate at 6 per cent. From £49 on the 1st ult., sales were made down to £46 15s. on the 11th, from which point there was a reaction to £48 12s. 6d. on the 17th, but values subsequently receded to £46 12s. 6d. on the 24th, closing with buyers at £47 cash and £47 12s. 6d. three months' prompt. Furnace material has only been sold to a limited extent, but at full prices. Holders are firm and expect that smelters will shortly have to replenish their stocks. Recent sales of American matte have been chiefly to sulphate of copper manufacturers, for which there has been a very strong demand at high prices. American supplies have been much less than usual.

GOVERNMENT CONTRACTS OPEN.—The India Office is seeking tenders for four spans of 60ft. roadway bridges for the Assam Public Works, Khasi and Jaintia Hills division, one span of 65ft. roadway bridge for the Basu Nala Bridge for the service of the North-West Provinces and Oudh Remittance Provincial Funds Public Works, and five bridge piers, two being abutment piers and three intermediate piers, for the four spans above-mentioned. The three tenders are independent, but are all to be handed in at the India Office not later than the 11th inst. The usual stipulations as to tests, quality of work, delays, &c., are embodied in the specifications. Each contractor is required to give a price for delivery at London, Liverpool, and one other port. The bridge piers are formed of screw piles connected by couplings, and braced together with angles tees, and plates. The material may be either of wrought iron or mild steel for the round iron piles and bracing, but the screws are to be of cast iron. The approximate quantities are 17 tons in one intermediate pier, and 5¾ tons in one abutment pier. The total weight is to be 63 tons 13 cwt. The 65ft. spans are formed of lattice main girders, with cross girders and trough flooring. The top booms of main girders are of 10in. by 3½in. by ½in., the bottom of plates on edge being stiffened with zigzag bracing. The approximate weight for one span is 24¼ tons. The 60ft. span is of similar construction to the 65ft. spans, with the exception that the main girders are of the Whipple-Murphy type, with swelled links and pin connections for the bottom boom. The top boom is to be of channel iron. The approximate weight is 24 tons for this span.

A NEW FRESCO CEMENT.—On the 5th inst. Mr. Edwin Lucas read a paper before the Civil and Mechanical Engineers' Society on a new medium for fresco painting, called "Fresco Cement." The composition, invented by Mr. Kremeyer, consists largely of tufa, together with Portland cement and lime, and the patentee claims for it that, being hydraulic, absorptive, and acid-proof, it is absolutely unaffected by the severest climate. He quoted a favourable report from Mr. H. Faija, M.I.C.E., who tested the strength of specimens which had been immersed in water for 28 days. The average tensile strength of five specimens was found to be 312lb. per square inch.

THE SANITARY INSTITUTE.—The Council have accepted an invitation from the Town Council of Brighton to hold the autumn Congress and Health Exhibition in that town in September next.

MANCHESTER, 6TH MARCH, 1890.

THE COTTON TRADE.—In giving evidence before the Royal Commission on Railway Rates, Mr. S. Andrew, the Secretary of the Oldham Cotton Spinners' Association, stated that about £67,000,000 of new wealth was created by the cotton trade every year. The cost of the cotton used up in this country was £35,000,000, and the value of the manufactures exported was £72,000,000, and £31,000,000 was sold in this country. The charge for terminals was strongly objected to, and it was shown that the Continental rates were much lower than in this country. The increase in the number of spindles in this country was only 500,000 from 1884 to 1889, while the number of spindles abroad were larger by 3,000,000. Any addition to the burdens for carriage would be very prejudicial to the interests of the whole body of spinners.

THE SALT TRADE.—The exports of salt have shown a large increase during February, having risen from 37,578 tons in the same month last year to 62,111 tons. These shipments are at the higher prices now ruling. In connection with this trade the Salt Union are boring in the Cheshire district in order to ascertain whether there are minerals below the salt beds. It is intended to bore 3,000ft. to 4,000ft. to ascertain whether coal exists at that depth.

THE IRON TRADE.—There is considerable hesitation in the market here as the disparity in the prices of warrants and makers' iron continues. There has been an undoubted slackness in the number of orders, which have neither been large or numerous. Makers are disposed to meet the market for good orders, but there are not many of these moving. Most consumers are well bought and are not inclined to buy so long as warrants remain at present rates, believing that there will be rather a fall of the price of iron than an advance in that of warrants. Finished iron is strong but it is principally because of old contracts which keep the works going fully. The general consumption in the district is good and regular, and there is no lack of specifications against contracts, but few of the latter are being made. Generally the tone is weaker, but merchants and makers look to the opening of the spring shipping trade to revive the demand.

HUMIDIFYING APPARATUS.—A new form of humidifier is being introduced for use in weaving sheds. The peculiarity of it is that instead of using live steam to effect the object, the vapour arising from the cooling tanks used for the condensation water is employed. The outlet of the pipes is covered by a chamber and a current of air is drawn through the chamber and propelled into the shed by means of a fan. The humidity is thus set up by vapour at a low temperature, and pure cold air is fed into the room. If condensation water is not used a dish or tray containing water can be heated by a small coke fire so as to emit vapour at about 110°. It is found that there is no dropping of water within the shed. The temperature and humidity can be accurately regulated, and the cost of live steam is entirely obviated. The inventor of the system is Mr. R. H. Neill, King Street Flour Mills, Belfast.

THE LINEN AND JUTE TRADES.—The business passing in the local wholesale dry goods houses is brisker, although rain and bitter cold on Tuesday kept many buyers away. Pale roughs are selling at prices lower than ever before known, and were it not for the plentiful and cheap supply of suitable flax the trade would, from the manufacturers' point of view, be in a very desperate condition. An active inquiry for linen yarns which are used for the backs of Brussels carpets prevails in Kidderminster, 3's, 4's, 5's, and 6's being the favourite counts. Handkerchiefs, which have had a good run, still continue in active request, and several representatives of Manchester houses engaged in the linen and cotton departments of the business left for New York by the "Teutonic" the other week, so that orders from the other side may be expected to arrive ere long. Prices are rather lower for linen handkerchiefs, although wages have advanced and cost of production generally tends upwards. Hessians are slow. Jute goods generally will, it is hoped, command better rates shortly. Fancy varieties are selling well, and jute Brussels maintain their hold upon public favour. The advances which have been made by designers and others engaged in this branch have been considerable during recent years, with the result that the public have taken much more readily to the goods.

IMPROVED BELTING.—Messrs. Greenwood & Co., Limited, of Todmorden, are introducing a new kind of belt, for which many advantages are claimed. It consists of a thin layer of buffalo hide, covered on each side by woven cotton or hair belt. The edges can be formed so as completely to resist wear by a strap fork, and this special variety is in demand for mule driving. The makers claim great driving power for the new form of belt, which possesses the advantages of strength arising from the use of the buffalo hide, and the adhesiveness and wear of the woven belts.

GLASGOW, 6TH MARCH, 1890.

ENGINEERING.—Messrs. William Simons & Co., Renfrew, have secured a contract with the Mersey Docks Board for the supply of a set of powerful sand pumping apparatus. The machinery is to be employed in cutting a deep channel through the Mersey bar, and is to be fitted on to one of the steam hopper barges which was built for the Board some time ago by the same company.

SHIPBUILDING.—A contract for two steel screw steamers has been secured by Messrs. Murdoch & Murray, shipbuilders, Port Glasgow. Both vessels are intended for the fruit trade between America and the West Indies, and are each of 175ft. keel and about 500 tons gross register. They are to be supplied with triple expansion engines of 800 i.h.p., and in each steamer accommodation will be provided for about sixteen first-class passengers. A contract for four electric launches has been secured by Messrs. T. B. Seath & Co., Rutherglen. The order was from Messrs. Morton & Williamson, Glasgow, who were acting for the Electric Traction Company in London, who will supply the electrical apparatus for propelling the launches. They are intended for service on the Seine.

ELECTRICAL TRANSMISSION.—A case of fire which is alleged to have been due to defective insulation, and consequent short-circuiting through a gas pipe, has just occurred in Glasgow. An inquiry is being made into the matter, on behalf of the engineers, by Sir William Thomson. It is premature to ascribe the fire to electricity until this inquiry is completed.

PIG IRON.—This has been the quietest week that we have had in the pig iron market for some months past. Selling out by outsiders has still been the principal feature, but all their iron was daily absorbed by a good number of buyers, whose principal ground of confidence seems to be the increased cost of production and scarcity of material. The large deliveries ex store, fully 9,000 tons per week, contribute also to impart steadiness to the trade. The agitation in England for an increase of wages threatened at one time to interfere seriously with the production in Cleveland and Cumberland, but the fear of this has passed away in the meantime.

(From our own Correspondents.)

LIVERPOOL, 5TH MARCH, 1890.

THE DOCK STRIKES.—The strike amongst the dock labourers is now assuming large proportions, and although there were only about 150 men out at the North End on Monday, there are now nearly 5,000 men affected, and the numbers are increasing daily. The Dock Labourers' Union are extensively placarding the dock walls recommending the men to strike, and are offering the men 13s. per week strike money. The shipowners have offered to pay the labourers 5s. instead of 4s. 6d. per day; for breaking out screwed cotton, 6s. instead of 5s. and 5s. 6d.; and stevedores will be paid 7s., foremen and boys to be paid according to agreement. The men, however, have refused these terms. A large number of men are being imported from other towns, and at present no serious delays have been occasioned by the strike.

SHIPPING AND EMIGRATION.—Dr. J. Stopford Taylor, the medical officer of health, has just issued his annual report, in which he states that the total number of vessels which entered the port last year was 23,475, of which 22,227 were British; of these vessels 5,528 were engaged in the foreign trade, and 17,947 in the coasting trade. The great increase in the number of coasting vessels may be partly accounted for by the number of wooden coasters employed by the subcontractors of the Ship Canal. The number of emigrants which passed through Liverpool last year was 197,855, showing a considerable decrease on the number of the year before, when 240,566 passed through, being the largest number recorded for many years.

LIVE STOCK AND DEAD MEAT IMPORTS.—Ten steamers arrived in the port last week, with 1,956 cattle and 12,745 quarters of beef, showing a decrease of 514 cattle and 5,032 quarters of beef from the imports of the previous week.

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SHEFFIELD, 5th March, 1890.

The Coal Trade.—The threatened strike is the talk of the hour. A stoppage of the coal supplies would prove a most serious matter in all branches of industry. Colliery owners are beginning to stock coal in earnest, so as to be ready for any emergency. The great iron and steel firms who have collieries of their own are not in such a serious position. Messrs. John Brown & Co., Limited, of the Atlas Works, are reported to have bought outside 12,000 tons of of coal. Their three blast furnaces will, however, soon make short work of this. Messrs. Cammell are endeavouring to lay in a stock of fuel with a view to contingencies. Altogether matters are assuming a serious aspect.

Iron and Steel.—A much quieter tone has prevailed here during the past week, and there is a decided tendency towards a lowering in values all round. The demand for railway materials shows no abatement. Most of the home railways are in the market for rolling stock, and there is also a large amount of work in hand for English Colonial railways. The Cape has been an excellent customer. Indian States also have done well in this respect.

Traction of Heavy Castings.—The question of moving heavy masses of iron and steel is becoming of great importance here. It is not at all uncommon to see twenty-four horses attached to a heavy lurry carrying a casting or forging of 40 or 50 tons. A few broad-wheeled traction engines, by Fowler, of Leeds, have been introduced with excellent results, and, as most of the streets are laid with concrete foundations, very little damage is done to them.

NORTH STAFFORDSHIRE, 5th March, 1890.

The Iron Trade.—There is no disguising the fact that in sympathy with the northern markets there is a material falling off in the revival of trade. Demand is decidedly flat, inquiries for new work are scarce, and orders are being withheld. The consequence is that makers are making concessions from the best prices which have ruled. The forges and mills are still working full time, but order books are not in such a condition as to inspire confidence with regard to the immediate future. Pig iron is only being bought to cover immediate requirements, and it seems likely that consumers will soon be in a position to force makers to lower figures. The agitation amongst the miners for a further advance in wages causes another complication in the industrial situation.

The North Staffordshire Mining Institute.—The annual meeting of this Institute was held last week, when the president, Mr. James Heath, delivered an interesting address, dealing with the work of the Institute and general mining topics. The occasion was utilised to present Mr. T. Wynne, the late Government Inspector of Mines for the district, with a purse of £100. Mr. Sawyer, the assistant Government Inspector, announced his resignation of that office, he having decided to migrate to the Witwatersrand goldfields, which he visited last year.

LEICESTER, 5th March, 1890.

Wool Spinning and Yarn Trade.—The local wool market is in a very undecided condition, though there is not much change. There are indications from some quarters of a tendency to take less prices. The market is quiet, as many users have filled up their stocks at the late London sales, and they are inclined generally to hold out for a small concession. Skin wools are most in demand. Spinners are all fairly well employed, and have orders on hand to keep their machinery fully employed for some time. Though a good deal of new business is on offer, spinners are not eager and hold for a little advance.

Boot and Shoe Trade.—The large turnover now being made is much above the average for very many years. Orders continue to come to hand, and these new orders, with those already on the books, are causing a difficulty in meeting the demand. All the houses are in full work, and the workpeople are not sufficient to cope with the requirements of buyers. Some authorities are inclined to look on the present activity as a "boom," and hint at overbuying; but the majority of the trade think that the business is sound, and that there is every probability of its continuance for some time to come. At any rate the present condition of business is eminently satisfactory for both employers and employed.

SWANSEA, 5th March, 1890.

Tinplates.—There is no noticeable alteration in the market value of tinplates, and although further stoppages are reported, making the total of idle mills to exceed sixty, it is announced that eight new mills are to be laid down at Pentyrch. In regard to the much-talked-of general stoppage during the week commencing the 10th inst., it is computed that, if taken up with complete unanimity, stocks would be reduced from their present figure of 500,000 boxes down to 250,000, a result that could only have a beneficial effect on prices. As Llanelly, however, almost entirely depends on the tinplate trade, the proposal is not taken up in that place with the enthusiasm that would augur success for the movement. Several works—notably the South Wales, Messrs. Moorewood & Co., and the Western—hold aloof from the combination, as their stocks are depleted and they are bound to complete certain contracts. It is feared, therefore, that on this, as on previous occasions, concerted action of the whole trade is impossible.

Gas Companies.—The Cardiff Gas Company, at their 106th half-yearly meeting recently held, declared a dividend at the rate of 10 per cent. per annum on the "A" shares. The directors are considering the offer of the Corporation to take over the works at a twenty-seven years' purchase upon the maximum dividend paid by the company during 1889, amounting to £16,450. The company propose to keep the reserve fund, which amounts to £15,403, for compensations, &c., and that the Corporation shall pay the amount now owing upon capital account, namely, £44,337. The offer is generally looked upon with such favour that the stock has increased in value 20 per cent.—The Carmarthen Gas Company show a decline of 800,806ft. in their sales of gas during 1889 when compared with those of the previous year, but are still able to declare a dividend at the rate of 7½ per cent.

Extensions at Cyfartha.—A fourth blast furnace and three additional stoves are now in rapid progress at these works, which it is intended shortly to bring into vigorous operation.

Briton Ferry Chemical Company.—This company, which only three years ago was started with a capital of £25,000, has already paid in dividends to its shareholders £14,300, or considerably over 50 per cent. on the capital. Mr. E. A. Pontifex, chairman of the company, stated at the recent meeting that the directors look for a considerable increase of profit in the future from sulphate of copper, owing to its great demand to resist the ravages of the phylloxera.

CARDIFF, 5th March, 1890.

Coal and Coke.—The steam coal business still exhibits a healthy appearance, and, as the demand is considerable, prices show no sign of weakness. In fact, colliery proprietors are so well contracted over the year that there is every prospect of prices being maintained, at any rate for the next six months. Merchants are taking the opportunity of shipping all the coal they can to their customers and coaling depôts abroad while the freights keep low. A large amount of coal which formerly came to Cardiff Docks is now being diverted to Barry, but as business is so brisk the docks at Cardiff do not seem to be appreciably affected; it is when times become depressed that the strain will come, as the Barry authorities, who are all large colliery owners, will certainly support their dock and railway in preference to Cardiff. Meanwhile the trustees of the Marquis of Bute are offering facilities for the development of an import and factory business, for which Cardiff is admirably well placed. The price of small coal continues high and house coal is difficult to obtain. The coke trade is quiet as far as new business is concerned, but coke makers have more than they can do to execute deliveries under existing contracts.

Iron and Steel.—The rail trade is a little less active, and lower prices for single parcels have been accepted. Makers, however, are firm in their quotations for forward delivery. Tin bars are firm. In pig iron only a limited business has been done, and that principally by merchants who have bought from works, who are bound to take delivery.

Iron Ore.—The iron ore market is firm, but no business of importance has been reported. Rubio is quoted at 16s. 6d. to 16s. 9d. c.i.f. Cardiff and Newport. Freights from the ore ports are steady.

BARROW-IN-FURNESS, 5th March, 1890.

Restriction of Output of Pig Iron.—A policy for restricting the output of hematite pig iron is still being urged on the attention of makers of pig iron, and a meeting is to take place shortly with a view to carrying into effect this difficult problem if at all possible. In the meantime makers are doing no business, but are busy on old orders, and have work in hand for about three months. Although the cost of producing iron is put down at 76s. per ton makers are quoting as low as 72s. Hematite warrants are changing hands at 64s. 6d. per ton. The market shows no signs of increased firmness.

The Steel Trade.—There is great industrial activity in every department of the steel trade, but the orders coming to hand are very few in number. Buyers are waiting for lower prices, and makers are not ready to concede these at present. The ruling quotation for heavy rails is £6 12s. 6d. per ton, but no business has been done at this figure. Shipbuilding steel is in quieter demand, but makers are busy on old orders.

The Tinplate Trade.—Many of the tinplate mills have suspended operations owing to the inability of making a profit. The consequence is that an important branch of the local steel trade will soon be without orders.

Stocks and Shipments.—After three weeks' successive reductions in the stocks of hematite warrants, a further decrease is reported this week to the extent of 893 tons, the stocks at present representing 380,437 tons, or 1,210 tons less than at the beginning of the year. Shipments continue to show an increase. This week they have represented 22,152 tons, compared with 18,667 tons in the corresponding week of last year, an increase of 3,485 tons. The shipments from the beginning of the year, however, show a decrease of 11,955 tons as compared with 1889, but spring shipments are expected to be on a large scale.

MIDDLESBROUGH, 5th March, 1890.

Pig Iron.—The market held yesterday was very flat. There were few present, and very little business was done. Buyers are waiting to see which way the market will turn. Makers are firm, and will not sell lower than 60s. for No. 3 G.M.B. prompt. Those who require iron prefer warrants, which have dropped to 51s. 7½d. cash. There is little desire shown to buy forward at present. In hematite mixed numbers of makers' iron are quoted at 78s. per ton East Coast brands, but in warrants they can be had at 63s. 10d. The stock in Connal's store on Monday, the 3rd inst., was 1,768,666 tons, against 179,786 tons on the previous Monday, being a decrease of 2,920 tons.

Shipments of Pig Iron.—The shipments abroad are rather more than they were at this time last year, but those coastwise are just about half. The total for the month of February amounted to 41,967 tons, against 57,426 tons for the month of February last year.

Ironmasters' Returns.—The total make of pig iron of all kinds for February amounted to 221,517 tons, against 236,327 tons for January, showing a decrease in the make of 14,810 tons. There were three more furnaces blowing, but there were three days fewer in the month. At the end of January the total stocks amounted to 271,892 tons, and at the end of February 279,029 tons, showing an increase of 7,137 tons.

Manufactured Iron and Steel.—Manufactured iron and steel are very quiet at present. There are no new orders and very few inquiries, and prices are inclined to droop. Iron ship plates are at £7 10s.; ship angles, £7 5s.; bars, £7 10s.; steel ship plates, £8 10s.; ship angles, £8 5s.; sleepers, £7 10s.; rails (heavy section), £6 12s. 6d. per ton, less 2½ per cent. on trucks at manufacturers' works.

Coal and Coke.—These commodities have been easier since the acceptance of the 5 per cent. by the miners. Manufacturing sorts are at from 9s. 6d. to 13s. per ton delivered at works; and households range from 14s. to 17s. according to quality. Coke is quoted at from 26s. to 28s. delivered here.

NEWCASTLE, 5th March, 1890.

The Dispute in the Engineering Trade.—The operative engineers have rejected the offer made by the employers of an additional 6d. per week in lieu of the curtailment of the working time by one hour on the Saturdays, and have given notice to discontinue working on the 8th, unless the last-named demand is complied with. The situation has consequently become very critical, as a strike is certain to ensue if the employers remain firm in their determination to resist any reduction of the present working hours. A meeting of the employers will probably be held in Newcastle some day this week, to consider what action, if any, can be taken by them under the circumstances, and it is possible that as the outcome of that meeting a proposal may be made involving such a rearrangement of the working hours as will—without reducing them—practically give to the men the privilege of ceasing work at noon on Saturdays. Such a proposal if made to reasonable men would almost certainly lead to a settlement, but it is to be feared that the engineers, in their present temper, will refuse to listen to any proposal which involves the acceptance of anything less than their full claim. Should a strike take place several thousands of men will be directly affected in the Tyne district, and its continuance will very soon bring enforced idleness to a much larger number.

The Coal Trade.—The acceptance by the Durham miners of the 5 per cent. advance offered by the coalowners in response to a demand for 15 per cent. has caused a good deal of satisfaction in commercial circles, and greatly helped to dissipate the feeling of uncertainty which, while it existed, was seriously hampering trade. As the announcement of the miners' decision only became generally known on Monday the effect of the better feeling established is scarcely yet felt in the market, but no doubt is entertained that business will undergo improvement shortly.

New Ordnance Works.—The announcement has just been made that the Palmer's Shipbuilding and Iron Company, Jarrow, contemplate the immediate addition to their extensive works of a department for the manufacture of ordnance and its accessories, including gun-carriages. Colonel English, R.E., who is at present engaged at the Woolwich Arsenal, is to superintend and direct the department, which, when thoroughly under way, is expected to constitute one of the most important and interesting features of the company's great establishment. The number of men at present employed by the Palmer's Company, including those at the Howdon shipyard, is about 7,000, and it is expected that the new enterprise will give employment to 1,500 more. It is understood that for the purposes of the undertaking new capital will be called for immediately, and that the erection of the necessary buildings will be commenced without delay.

Chemicals.—Alkali makers here are feeling very severely the increased cost of manufacturing consequent on the high value of coals, and unless prices of soda products improve presently, there must inevitably be a restriction in the output. The gentlemen engaged in the formation of an Alkali Union have lately visited this neighbourhood, and have interviewed the various alkali manufacturers. The scheme has met with much favour here. Stocks of soda are large, as is commonly the case at this time of year, amounting to a little over 4,000 tons.

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MESSRS. ARBEY'S TOOLS AT THE LATE PARIS EXHIBITION.

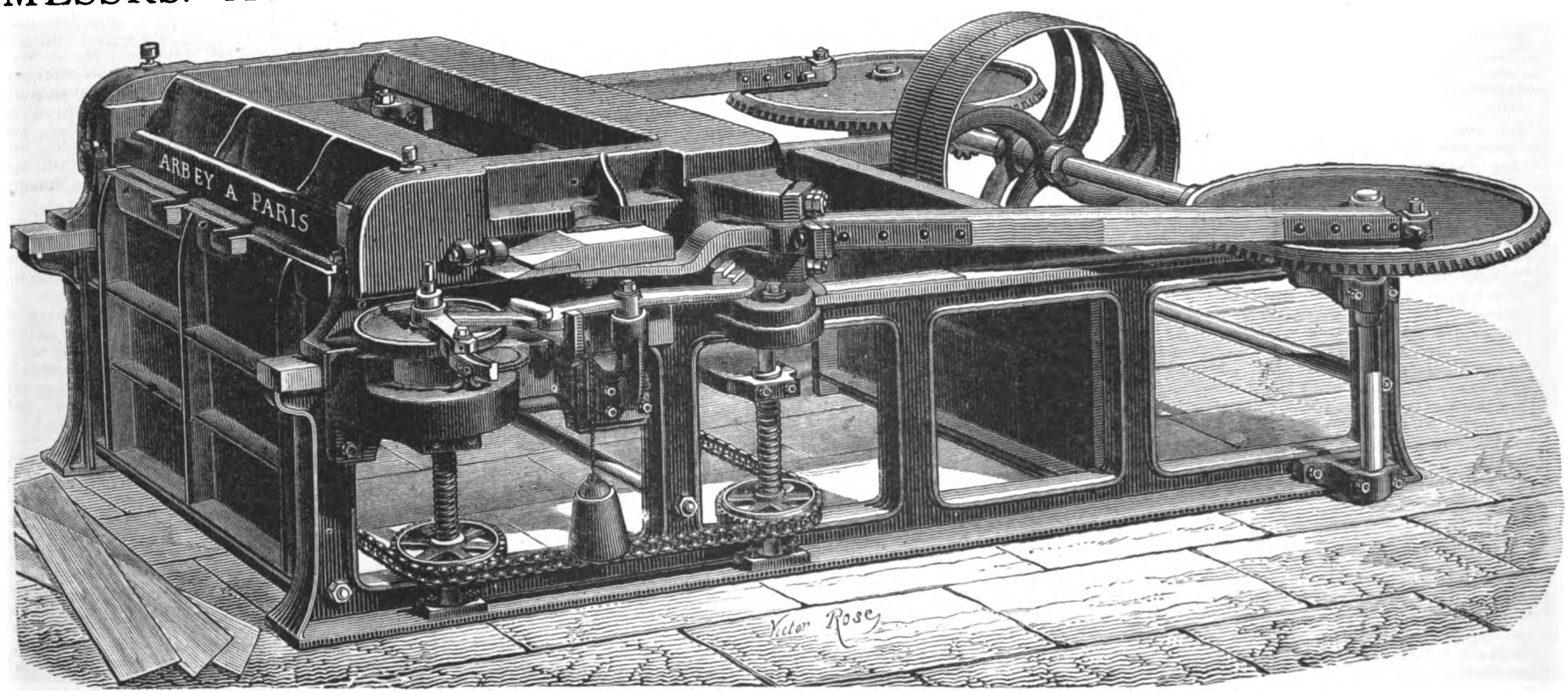


FIG. 1.—GENERAL VIEW OF VENEER CUTTING MACHINE

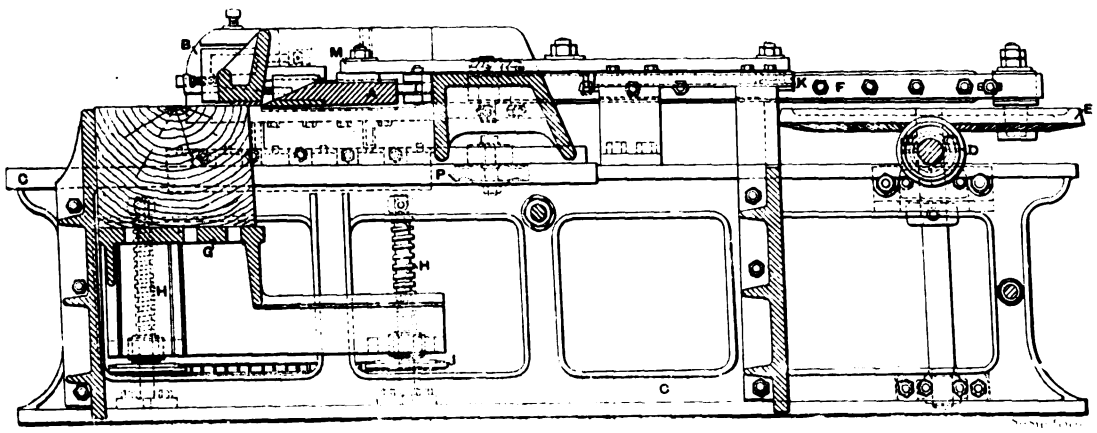


FIG. 2.—SECTIONAL ELEVATION.

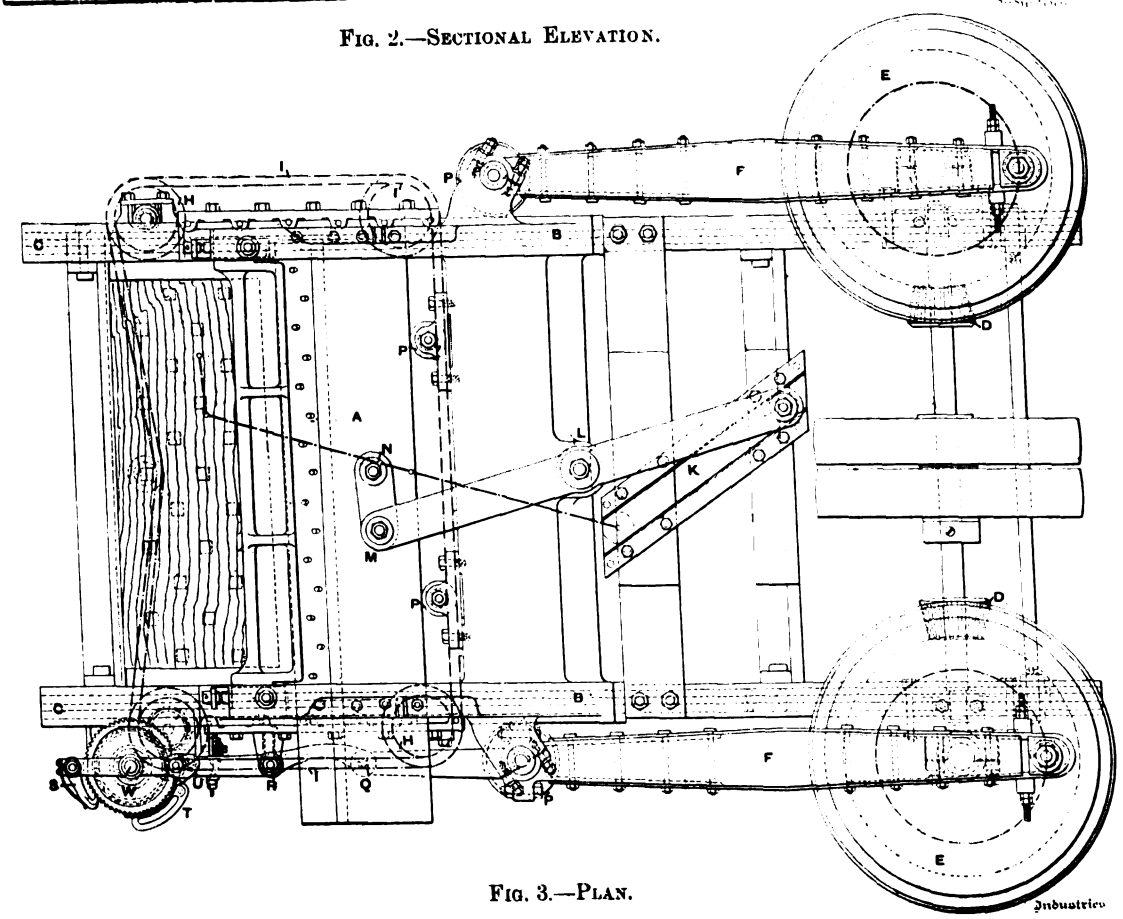


FIG. 3.—PLAN.

MESSRS. ARBEY'S TOOLS AT THE LATE PARIS EXHIBITION.

III.

A VENEER cutting machine exhibited by Messrs. Arbey is shown in Figs. 1, 2, and 3 herewith. Fig. 1 shows the general arrangement of the machine, Fig. 2 is a section through the middle of the machine taken longitudinally, and Fig. 3 is a plan. The wood to be cut into veneers is fastened on to the table G, which is raised and lowered by means of four screws H. The knife A is supported by the carriage B, which slides backwards and forwards over the wood to be cut, supported by slides on the top of the bed C. As the knife advances over the wood a lateral motion is given to it in addition to its forward movement. We shall first describe the mechanism for moving the knife. On the driving shaft are two bevel pinions D which work into two inverted bevel wheels E. Pins attached to the wheels E connect them with the carriage B by means of the connecting rods F. One of these being fastened to each side of the carriage B, a very steady motion is obtained. Wheels P attached to the carriage B, and running against vertical surfaces on the bed C, give additional steadiness to the carriage without increasing the friction. The traversing motion of the knife is obtained as follows: Guides K are fixed to the bed of the machine, a lever M K has its fulcrum L on the carriage B. The end K is compelled to move along the groove K K, the end M being connected with the knife A by means of the link M N. Thus as the groove K is traversed by one end of the lever the knife is compelled to oscillate across the carriage. The feed motion for the table is obtained by prolonging the connecting rod F to Q. A pin at Q moves one end of the lever U R Q. The end U of this lever vibrates the ratchet S, to which it is connected by the lever S U through a short connecting link. The ratchet wheel W turns one of the screws H by means of gearing, and this causes the table to rise or fall as required. The feed may be varied by sliding a stop T over the teeth of the ratchet wheel, thus causing the ratchet to take only one, two, or more teeth as they may be exposed. Chain wheels fastened to each of the screws H, and connected by a chain I, compel all the screws to move together, and thus the table is kept horizontal. The advantage of cutting veneers in this machine instead of sawing it is that no material is wasted and no sawdust is produced. The first of these machines was made by this firm in 1835, and since then it has been gradually developed until it has reached the state of perfection shown by the machine now illustrated, which produces a beautiful veneer, very fine and with a good surface. The machine shown will make veneers up to 1 metre long, 0·35m. wide, and up to 6mm. in thickness.

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Contents.

	PAGE
Band Sawing Machines for Heavy Timber (*Illus.*)	217
Notes on Patents. IV.—The Commercial Effect of Threats	219
On the Mechanical Appliances Employed in the Manufacture and Storage of Oxygen (*Illus.*)	219
Foreign Industries (Corres.)	222-223
Improved Draughtsman's Protractor (*Illus.*)	224
A New Lubricator (*Illus.*)	224
Howarth's Tri-Cut File (*Illus.*)	224
Screw Slotting Device (*Illus.*)	224
Society of Engineers	224
Shipbuilding Notes	224
Notices of Meetings	225
Prices Current	225
Foreign Telegraphic Advices (Corres.)	225
Home Industries (Corres.)	226-227
Messrs. Arbey's Tools at the Late Paris Exhibition—III. (*Illus.*)	228
The Development of the Steam Engine	229
The Compulsory Load Line Bill	230
The Late Sir Edward Baines	230
Sir William Arrol on Labour Questions	230
Letters to the Editor:—	
"Rack-Rented" Tradesmen and their Customers	231
Mining Machinery for South Africa	231
The Opening of the Forth Bridge	231
The Forth Bridge	232
Reviews	232
Clyde Shipbuilding in February	234
Adams' Automatic Bolt Cutter (*Illus.*)	234
The Weymersch Primary Battery	234
The Institution of Electrical Engineers	234
The National Electric Light Association of America (Corres.)	235
Notes on Alloys—II.	236
Notes	236
"Industries" Patent Record:— Applications and Acceptances	237-238
Illustrated Abridgments	238-240

To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

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Industries:

FRIDAY, 7TH MARCH, 1890.

THE DEVELOPMENT OF THE STEAM ENGINE.

IN a recent issue (see *Industries*, Vol. VIII., page 16) we shortly reviewed Professor Thurston's sketch of the development of the philosophy of the steam engine, in which he gave an account of the most important steps in the progress of the steam engine and of the principles which underlie that progress. In the concluding sentence of his paper, as read before the British Association, he expressed the opinion that the further development depended largely on the results of experiments on the lines of transfer of heat between metal and vapour, and in a postscript he indicated the results of some of the most recent experiments. From these, he said, it was now possible to construct a theory of heat-engines which may serve as a guide in design and in construction, and as a check upon the experimental determinations of efficiency made at test trials. It was further possible to predict, on theoretical grounds, the performance of any well-constructed steam engine, and to base upon preliminary computations a very approximate estimate of the probable consumption of steam, heat, and fuel of any steam apparatus which it may be proposed to design. It was also practicable to make intelligent and useful estimates of the relative value of alternative plans of construction of proposed new types of engines, and of probable actual costs of operation and of efficiencies for any given type, size, and design of engine. Although, however, the theory of the compound engine was now sufficiently well understood for most practical purposes, Professor Thurston of course recognised that it had not taken its final and complete, and its most perfect and practically available form; and he was of opinion that its final shape would probably be given by some such master of mathematical and physical science as was Rankine or Clausius. It is, of course, difficult to speak definitely about finality, but we would expect the most useful developments to come from men who have followed the works of Rankine, Clausius, and the other mathematicians, and who at the same time have had the advantage of good practical experience. Some of our younger men, if they could only free themselves from the bonds of conventional methods, or from following too closely the examples of their teachers, might be expected to lead the way. It must be confessed, however, that our present methods of education seem to lead to a decay of originality.

Professor Thurston may in a sense be looked upon as a pupil of Rankine and of Clausius, for, although he has not had the advantage of their personal influence, he has carefully studied their works, and his methods of thought and action have been largely moulded by them. We do not wish it to be inferred that he is wanting in originality, for his writings show that he has a considerable share of that valuable quality, and he is one of the most industrious workers in the field of steam engineering. His latest contribution to the department is a paper on the philosophy of the multi-cylinder or compound engine, its theory, and its limitations, which was presented at the twentieth meeting of the American Society of Mechanical Engineers, held in New York, November, 1889, and which has been reprinted from the Journal of the Franklin Institute for private circulation. It may be looked upon as a supplement to the book or paper we recently reviewed, and it brings the matter, not only up to date, but also indulges in speculations as to future developments. To make the paper complete he gives a short *résumé* of previous investigations, and enumerates the different causes of wastes in steam engines. These are: (1) External wastes, brought about by the conducting and radiating properties of the materials of construction; (2) internal wastes consisting of two parts—(a) the thermodynamic, unavoidable losses of heat rejected at the lower limit of temperature of working fluid, (b) wastes by internal conduction and storage of heat followed by later rejection with the exhaust steam; (3) wastes of mechanical energy. The unavoidable thermodynamic waste is rarely less than 75 or 80 per cent. as compared with an ideally perfect engine, and the internal wastes by conduction and storage with subsequent rejection by cylinder or internal condensation, and by leakage, range from 10 to 30 per cent. It is this which constitutes, ordinarily, the great source of loss and efficiency of the real, as distinguished from the ideal, engine. The wastes of mechanical energy through the inefficiency of the mechanism are seldom large in engines of good construction, as compared with the magnitudes, at least, of the other kinds, and may in some cases, by careful design, good construction, and skilful management, be brought down to less than 5 per cent. in non-condensing, and to perhaps 10 per cent. of the total energy in condensing engines of simple forms and high mean working pressures.

The most important developments of the steam engine since Watt's time have therefore been for the purpose of reducing the internal wastes, and these may be classified under three categories: (1) superheating; (2) steam jacketing; and (3) compounding. Attention has been largely diverted from the first since high pressure steam became so common, but we are of opinion that, with the improved materials and methods of construction, a considerable amount of superheating might now be introduced with advantage. As the greatest part of the waste arises from the action of the condensed steam, the simplest method of preventing it seems to be to raise its temperature if possible to such an extent as to leave it at the end of the expansion practically dry. If engineers would only direct their attention to the still further improvement of materials, we believe that a great advance is possible. Steam jacketing is another and common partial remedy for internal waste, and may be used in conjunction with "compounding," or in single engines, but it must never be forgotten that the steam jacket is a sort of necessary evil, justified only by the physical properties of the steam and of the materials hitherto used in construction, for, while it increases the work done by the expanding steam, the increase is by no means so great as it would be if the heat employed in the steam jacket had been applied to generate more steam for use in the cylinder. Hence in multiple expansion engines, in which the variation of temperature is not very great, steam jackets have either been wholly or partially omitted. "Compounding," or the use of the multi-cylinder engine, in which the steam exhausted from one cylinder is again worked up in a succeeding one, is the most familiar of devices for extending the economical range of expansion and increasing the efficiency of the engine, and it is to the past and future of this that Professor Thurston's paper is chiefly devoted. He states that common experience with the best constructions, which confirms theoretical con-

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siderations, shows that the engineer may reasonably expect, by good design, construction, and management, to secure an expenditure of steam per horse-power per hour, at the best ratios of expansion r in really good engines, as follows:—

r	3	4	5	6	7	8	10	12	15	20	25
Lbs. per i.h.p. per hour	32	27	25	22	20	20	19	17	16	15	15

and in peculiarly favourable cases 10 per cent. better figures than these have been actually reported. The practical question which faces the engineer is how far expansion is to be taken advantage of, for it is soon found that useful expansion has its limits. Our space will not allow us to enter into the details of Professor Thurston's reasoning, although we may return to it on some other occasion. We can only in the meantime give some of his results. The extent to which expansion may be economically carried in a simple cylinder will vary somewhat with the initial temperature and pressure, and with the physical condition of the working fluid; but it may be taken as ordinarily not less than $2\frac{1}{2}$ expansions for unjacketed engines with wet steam, and 3 or 4 for the better class of engines, and the total expansion ratio for the several types of multi-cylinder engines is given in the following table:—

No. cylinders	1	2	3	4
r	2·5 to 3	6·25 to 9	16 to 27	40 to 81
Init Pres. ...	25–30lb.	60–100lb.	120–300lb.	350–800lb.

expansion being assumed to be approximately hyperbolic and the terminal pressure to be 8lb. or 10lb. per square inch. High engine speed is the most modern device for reducing internal wastes, as well as of decreasing costs of engine construction, and to a certain extent it reduces the necessity for the other expedients for preventing waste, but all are to be adopted when high efficiency is desired.

Professor Thurston enters at considerable length into the question of the relative efficiency of the single engine and of the various classes of the multi-cylinder engine. His results are both interesting and instructive, as he even goes the length of considering the case of a quintuple expansion engine, working with an initial pressure of 500lb. on the square inch. He further considers the questions of commercial efficiency and proportions of cylinders, which we may also notice on some future occasion, and in the meantime we commend his paper to the careful consideration of our engineering readers.

THE COMPULSORY LOAD LINE BILL.

The Bill which is now before Parliament, for the purpose of amending the Merchant Shipping Acts relating to a load line, is one which commends itself to those who have really studied the question, and who are not biassed by selfish considerations, and we think that public opinion has now been sufficiently educated on the subject to allow us to ask that every endeavour should be used to get it passed during the present session. It has been introduced by Mr. Broadhurst, and is backed by Sir W. Harcourt, Mr. Burt, Mr. Howell, Mr. Staveley Hill, Mr. C. Wilson, Mr. Heneage, and Sir Edward Reed, and, moreover, has received the support of a large number of members of Parliament of all parties. The Bill is very short, consisting only of three clauses, and its main provision is the substitution in the twenty-sixth and twenty-seventh sections, of the following subsection, instead of the subsections numbered (2) in these sections respectively:—The centre of this disc shall be placed at such a level below the deck line marked under the provisions of this Act as may be approved by the Board of Trade from time to time, and shall indicate the maximum load line in salt water to which it shall be lawful to load the ship, until the position of the disc is altered by direction of the Board of Trade. The Bill further provides that the Board of Trade may from time to time appoint any of their surveyors or officers of any corporation or association for the survey or registry of shipping, to approve on their behalf from time to time the position of any such disc as aforesaid, and any alteration thereof, and may appoint fees to be taken in respect of any such approval.

When the Bill was first introduced it was thought that considerable opposition would be offered by the shipowners, but we are informed that the promoters have agreed to amend it so that Lloyd's Register Committee should be the agents to carry out the marking of the compulsory load line, and that opposition has been withdrawn. Lloyd's Committee is now, or about to be, made more representative of all interests than it has hitherto been, and we suppose that the shipowners think that it will be more amenable to reason than an irresponsible Government official, or even a Government Department, which very often means the same thing. We further understand that Sir Michael Hicks-Beach will give the measure official support. We trust, therefore, that no unreasonable opposition may be offered to the measure which will prevent it being carried into law at once. There can be no doubt, however, that in some of its bearings the matter will require to be very delicately handled, and care must especially be taken that we do not unnecessarily handicap our shipowners, and drive some of them to take refuge under a foreign flag. It seems only reasonable to insist on foreign ships being subject to the same regulations as our own when they are in our ports, and in connection with this it is worthy of note that at the recent meeting of the International Maritime Conference in Washington it was decided that the time was not yet ripe for the discussion of the question of a maximum load line. We do not know the grounds for this decision, but we cannot agree with it, and we cannot see any reasons why there should be any difficulty in arriving at an international understanding on the subject. We can at least insist on foreign vessels being subject to the same regulations as our own when they are in our ports, and, as Mr. Charles Wilson, of Hull, has said: "No consideration of what foreigners can do can justify English shipowners in loading their ships beyond what is ascertained to be their maximum capacity." A reduction in trade profits cannot be put forward as a reason against passing a measure which is needed to save life.

It is now more than fifteen years since the agitation on this subject was commenced by Mr. Plimsoll, and during that period public opinion has been ripening, and some measures have been passed which have effected a considerable improvement in the position of seamen. In 1880 the question of a compulsory load line was referred by the Government of the day to a Committee, and a Bill was introduced into Parliament by Mr. Chamberlain for the purpose of carrying out the decisions of that Committee. Some of these were rather harsh, and a considerable amount of bad feeling was displayed by both sides, and the Bill, being vehemently opposed, was withdrawn. This led to the appointment of a Commission in 1884, to ascertain the true facts of the case. Their report was about as authoritative as it was possible to obtain, and they had no difficulty in giving definite instructions about the load line. They made out tables for different classes of ships, which have been largely adopted by shipowners, and the result has been a considerable reduction in the number of disasters in consequence of overloading. But in every trade or profession there are some "black sheep," and without legal compulsion they would follow their own selfish ways. At present the load line is put on the ships by the owners themselves; in some cases they are too high, and in a few, Sir William Harcourt said, in introducing a deputation to the Board of Trade, they were put on the funnel. This of course was an exaggeration, for the law at present required the line to be put on the side of the ship, and a severe penalty was imposed on those who did not comply with the regulation. As, however, no definite authority exists for fixing the position of the line, it might in some cases be on the funnel for any good it does, for notwithstanding the improvement which has taken place there is still a considerable number of vessels lost every year through overloading. Mr. Plimsoll has collected statistics of these, but we need not at present enter into details.

As to the practicability of fixing a fair load line the report of the Commission leaves no doubt, as the members were unanimous in saying that they were of opinion that it is now practicable to frame general rules concerning freeboard, which will prevent dangerous overloading without unduly interfering with trade. Speaking of the scales of freeboard which they recommend, they say: "It will be observed by the tables that they refer exclusively to cargo-carrying vessels, but it must be understood that, under any circumstances, these tables contain the maximum loading that should be permitted to any class of vessels."

The points requiring most careful consideration are, first, the authority by whom the load line shall be fixed, for we can imagine that some shipowners, whose ships are not on Lloyd's Register, may object to Lloyd's Committee being named for that purpose, and may insist on an independent and representative body; and second, how foreign ships are to be affected by the legislation when in our ports. We think there need be no great difficulty over either of those points. A special representative committee might be appointed which would represent all parties, an arrangement which would settle the first point. As to the second, we have no hesitation in saying that foreign vessels when in our ports should be subject to all British regulations. In those days of international conferences we think that this is a matter about which an international agreement might be come to, and we fail to see any serious difficulties in the way, except those arising from wrong motives, and these could easily be overcome. We are glad to see that the questions are being taken up by men of all political parties, and we trust that they will be considered in a common sense business manner, and useful and definite conclusions arrived at as soon as possible.

THE LATE SIR EDWARD BAINES.

By the death of Sir Edward Baines, which took place at his residence, near Leeds, on the 2nd inst., Leeds has lost a well-known citizen. Born in the first year of the century he had thus reached his ninetieth year, and for seventy of these at least he might be looked upon as a working journalist. At his death he was the principal proprietor of the *Leeds Mercury*, with which his connection dates back to the year 1815, when he was fifteen years of age. Although journalism was his profession, and while he did all he could to advance the interests and improve the status of his paper, he by no means confined himself to the work connected with it, but took an active part in many social and political reforms, and especially in those connected with temperance and education. Over half a century ago he founded the Yorkshire Union of Mechanics' Institutes, of which he was president from its foundation. The Union has done most important work in its day by co-ordinating a large number of institutions, and thus economising work and money, and also in bringing together men engaged in the work of the education of artisans. It now includes nearly 300 institutes, with about 14,000 students in their various classes, the greater number of whom are studying technical subjects. In 1835 he published his "History of the Cotton Manufacture in Great Britain," which even yet is looked upon as the standard work on the subject, showing, as it did, extensive reading and research, and a considerable knowledge of mechanical details. When the Yorkshire College was founded he was one of its best friends, and became Chairman of its Council. In 1880, when his fellow townsmen showed their appreciation of his services, they raised a memorial fund, which, in accordance with his desire, was applied partly towards the erection of a wing of the Yorkshire College, and partly towards the creation of scholarships at that institution.

Sir Edward represented Leeds in Parliament from 1859 to 1874, and during that time he brought in many measures and took a very active part in various commissions of inquiry. In 1880 he received the honour of Knighthood.

SIR WILLIAM ARROL ON LABOUR QUESTIONS.

On the 26th ult. Mr. (now Sir) William Arrol was presented with the freedom of the town of Ayr, in recognition of his conspicuous skill and notable achievements as an engineer. This was a considerable honour, for it has been very sparingly given heretofore, and only to very distinguished men. Sir William, no doubt, finds such recognitions of his skill and ability as an engineer and his worth as a man highly gratifying, but we feel they are now to a certain extent superfluous. The "twa brigs" which Sir William spoke about are the best monuments he can have, and they will endure long after the memory of town council or even greater ceremonies of a like character have passed away.

To those who study the industrial questions of the day the ceremony at Ayr was interesting chiefly on account of what Sir William said on questions connected with labour. He is beginning to feel, what has been felt by our most distinguished engineers, that it is much easier to engineer matter than men and industrial conditions. We do not mean that he has had any difficulties with the men directly under his control, but rather with the more general conditions affecting labour and materials. He said he spoke as a representative of the working classes who had been able to raise themselves by their own energy and industry, and, therefore, he could do it with greater freedom than if he had only been a capitalist. He was afraid the working classes at the present moment had "got the bit in their mouth, and were going to run away with it." He said he had seen a few gentlemen that day, employers of labour, and they were all complaining about the prospects of the coming year. He was afraid that the working men would soon run away with the great prospects of the past year, and that at the end of the year we would be at a dead standstill. This he attributed to the present state of trades unions and stock exchanges. Trade could not get settled down to the same quiet

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steady pace they had a number of years ago. No person was safe to go in for any contracts that would last over two years. He knew that for his part he had been offered, within the past twelve months, work to the extent of more than a million of money, and he could not look at it in the present state of the labour and money markets. There was no safety in anybody going outside their own country. Things were no sooner settled than the whole of the trades unions were down upon employers, and raised the wages to such an extent that work could not pay.

Sir William also touched on the subject of the education of artisans, and said he was sorry that they were not profiting as much as they ought to by the opportunities which were now offered. Too many youths were aspiring to be clerks, or to get some other light employment, instead of learning a trade, and the result was that the country was being overstocked with that class, and it was found very difficult to get steady trustworthy tradesmen. If they advertised for a tradesman they would not get a single application; if they advertised for a clerk they would get more than 500. He thought that was a point that our legislation should take up, and instead of advocating an eight hours day induce more men to learn a trade. Many thousands of clerks and warehousemen never knew the advantage of an improvement in trade. It was only the few who, for instance, felt the advantage in the coal trade, and the same was true of other departments. Things were getting into so few hands that every year matters were becoming worse, and the only remedy was for a great many of our young men to learn trades, so as to enable them to get a share of the general prosperity and to keep things going as they used to. Sir William's remarks have such a direct bearing on the opinions we have often expressed on education, that we mention them for the purpose of showing the necessity for what is usually called "technical education" being placed on as wide a basis as possible, so that those who partake of it may see that by taking too selfish a view of matters they are not only injuring the community, but also themselves.

Letters to the Editor.

"RACK-RENTED TRADESMEN" AND THEIR CUSTOMERS.

To the Editor of "Industries."

Sir,—Permit me, on behalf of the "Tenant Tradesmen's Union" throughout England, to thank you very heartily for your generous advocacy of this important national movement—important to every family in the United Kingdom, who, however great or small their weekly purchases may be, unitedly pay many million pounds a year to meet the arbitrary and unjust exactions of the landlords of shop property. The Tenant Tradesmen's National Union is making solid progress. The question is being rapidly understood by all classes of society. Up to date the honest enterprising tradesman, who creates a business, finds himself, at the end of a short lease or agreement, fined by his landlord for that very business energy which has secured to the landlord payment of the rent and due care of the premises. The fines have been monstrous in many cases. Double or treble rent, heavy premium, rebuilding of premises—one or all of these ruinous conditions have been imposed by landlord or agent on the man who has alone made the goodwill of the business, and is alone honestly entitled to the beneficial result of his labour, capital, and skill. The owners of private house property cannot, dare not, attempt such pillage. It should be remembered, too, that while these extortions harass, impoverish, and, in thousands of cases annually, ruin the tenant tradesmen, the purchasing British public are the ultimate victims. From the incomes of his customers must the tradesman pay his predatory landlord. The day of reckoning for such landlords is at hand, and they know it. The Tenant Tradesmen's National Union are already prepared to promote local meetings throughout the length and breadth of England. Let shopkeepers in every part of London, and in every provincial town, signify their willingness to unite with their customers in this warfare against unjust landlords. Were united action promptly organised, within a few months local tradesmen would be able to undersell the barrack-like "stores," and their customers have the advantage of obtaining, in their immediate neighbourhood, the best articles of every description, and, in all respects, the best value for their money.

All communications addressed to me at "International College, Finchley Road, London." will receive prompt attention.

Yours, &c.,
James Haysman,
President of the Union.

London, 3rd March, 1890.

MINING MACHINERY FOR SOUTH AFRICA.

To the Editor of "Industries."

Sir,—It is somewhat surprising that none of the firms concerned in the export of mining plant have answered what is virtually a challenge in the statement of your Berlin correspondent a short time ago respecting the inferior quality of the plant sent out to South Africa. I was very dubious as to accepting his representations as correct, attributing them to the customary German theories, but since reading them I have found corroborative evidence in one of your financial contemporaries evidently derived from a totally different source.

The complaint made there is not so much in respect to inferior workmanship as to excessive weight. This is easily accounted for. Engineers in this country have always made a special point of the solidity of the machinery which they build, and have been inclined to jeer at the ricketty kind of work turned out on the Continent and in the United States. When, however, the transport of a ton weight to a gold mine in the interior of South Africa means a question of £30 this is a serious item in the cost of a plant

Our consuls have repeatedly, in various parts of the globe, drawn attention to the disregard by British manufacturers of local requirements, and this seems to be a case in point. It is evidently necessary that the standard patterns, however good in themselves, should be laid aside, and lighter apparatus constructed to suit the special requirements of the district.

I am not personally interested in any of the South African mining speculations, nor in the firms supplying the material, but I would look with regret on the departure of this branch of export business from these shores.

Yours, &c.,
S. A.

London, 4th March, 1890.

THE OPENING OF THE FORTH BRIDGE.

On Tuesday, the 4th inst., the Forth Bridge was formally opened by the Prince of Wales. The occasion was naturally made a great railway function, the directors and chief officials of the railways of the United Kingdom, and also of those of the Continent, being invited to be present. The lists of guests was a very distinguished one. There were present the directors of the railways most concerned in the success of the bridge, and a large contingent of foreign visitors, of whom M. Eiffel was perhaps the most widely known.

The Prince of Wales arrived at Dalmeny on Monday evening as the guest of Lord Rosebery. His Royal Highness was accompanied by T.R.H. the Duke of Edinburgh, Prince George of Wales, the Duke of Fife, &c. The dinner party on Monday evening included Sir John Fowler, Mr. Baker, and Mr. William Arrol. The Directors of the various railway companies and their invited guests left Edinburgh about 11 o'clock on Tuesday forenoon in two trains. On the arrival of the second of these at the Forth Bridge Railway Station the Prince of Wales and his party joined the train, travelling in a saloon carriage with glass on all sides. The train steamed slowly across the bridge, upon which there was found to be blowing a gale of considerable violence. The pathways on the bridge were open to a small number of invited guests, and though these, for the most part, did not venture beyond the arch which marks the end of the approach viaduct, their elevated situation, exposed as it was to the full force of the wind, was anything but comfortable. On the bridge itself bluejackets were stationed at intervals, and the time which elapsed between the first crossing of the Royal train and its return must have been, even for the sailors, an unusual experience of exposure. The Royal train passed on to the bridge shortly after eleven, and passed across it at a slow pace, H.M.S. "Devastation" firing a Royal salute during the passage. The train arrived at the north side in ten minutes after entering the bridge, and then proceeded at a higher rate of speed to Inverkeithing, through the tunnel and cuttings immediately to the north of the Forth. A return was then made by the old line to North Queensferry. On the arrival of the train at the old station the party walked to the pier and embarked on board two steamers, the Royal party being on board of the "Dolphin." The vessels steamed out into the Firth, passed underneath the north span, sailed round the island of Inch Garvie, and, after a voyage of about half an hour, returned to North Queensferry Pier, where the party rejoined the train, which was then shunted to the new line, from which it passed on to the bridge. It had been arranged that the ceremony should consist of two portions—one, the driving of the last rivet, was to take place in the north connecting girder in the centre of the north span, and the other, the declaration of the opening of the bridge, was to be performed at the stone arch into which the end of the south steel cantilever is fitted. This programme was carried out. A small platform, with a hydraulic riveter, which was supplied with the necessary pressure from Inch Garvie, was fitted in the centre of the connecting girder of the north span. With the aid of Mr. Arrol and Mr. Phillips, the Prince turned the valve fixed on the pressure main with a silver key. This ceremony, performed as it was in the middle of a severe blast, was witnessed by very few, the bulk of the guests preferring to remain in the comfort of the railway carriages. It was all over in about a couple of minutes, and the train proceeded to the arch at the south end of the bridge, where the Prince of Wales and a few of those more immediately concerned stepped for a minute or two from the carriages, and the engine was uncoupled, in order to allow the spectators on the west pathway of the bridge an opportunity of seeing the little that was to be seen. The Prince simply shouted, with his utmost vigour, "Ladies and gentlemen, I now declare the Forth Bridge open." With the wind whistling among the wind bracings, and ineffectually spending its fury on the top members of the bridge, more than a hundred feet above the viaduct, the bridge was opened in the middle of an appropriately severe trial. The perfectly calm security of the structure while so severe a gale was blowing must have impressed everyone who was present on this historic occasion. Immediately after this brief ceremonial the train passed to the Forth Bridge Station, where the party alighted and made their way to the model room, where luncheon was served. Mr. Matthew W. Thompson, Chairman of the Forth Bridge Railway Company, occupied the chair. The *menu* card was as artistic a piece of work as the invitation card was the opposite. It contained portraits of the three men whose names are in everyone's mouth as representing the builders of the bridge, and a list of the principal officers of the engineers' and contractors' staffs. The loyal toasts having been given by the Chairman, the Prince of Wales, in replying on behalf of himself and other members of the Royal Family, made a long speech, in which he recounted the chief features of the bridge.

In concluding his speech, the Prince of Wales announced that the Queen had been pleased to confer baronetcies upon Mr. Matthew Thompson, the Chairman of the Forth Bridge Railway Company, and Sir John Fowler, K.C.M.G.; that Her Majesty had made Mr. Benjamin Baker a Knight Commander of the Order of St. Michael and St. George, and also that Her Majesty had conferred a Knighthood upon Mr. William Arrol. The Prince of Wales also referred to the services of Mr. G. B. Wieland, the Secretary of the Forth Bridge Railway Company, especially in connection with the financial arrangements. The Chairman expressed acknowledgments for the honour conferred upon him, as also did Sir John Fowler, Sir Benjamin Baker, and Sir William Arrol. The Earl of Rosebery, Herr Mehrtens, and M. Picoll also spoke. The Prince of Wales left the luncheon room about four o'clock, and immediately afterwards the Directors and their guests returned to Edinburgh.

The following are among the interesting details with which the Prince of Wales was furnished for his speech at the luncheon on the occasion of the opening of the Forth Bridge:—The extreme length of the bridge, including the approach viaduct, is one and a fifth of a mile, and the actual length of the cantilever portion of the bridge is one mile and twenty yards. The weight of steel in it amounts to 51,000 tons, and the extreme height of the steel structure above mean water-level is over 370ft. above high-water mark, and above the bottom of the deepest foundation 452ft., while the rail-level above high water is 156½ft. Allowance has been made for contraction and expansion, and for changes of temperature, to the extent of one inch per 100ft. over the whole bridge. The wind pressure provided for is 56lb. on each square foot of area, amounting in the aggregate to about 7,700 tons of lateral pressure on the cantilever portion of the bridge. About 25 acres of surface will have to be painted with three coats of paint. About 8,000,000 of rivets have been used in the bridge, and 42 miles of bent plates used in the tubes, about the distance between Edinburgh and Glasgow. Two millions sterling have been spent on the site, in building the foundations and piers; in the erection of the superstructure; on labour in the preparation of steel, granite, masonry, timber, and concrete; on tools, cranes, drills, and other machines required as plant: while about 2½ millions have been the entire cost of the structure, of which £800,000 (nearly one-third of this amount) has been expended on plant and general charges. The works were commenced in April, 1883, and it is highly to the credit of everyone engaged in the operation that a structure so stupendous and so exceptional in its character should have been completed within seven years. The opening of the bridge must necessarily produce important results and changes in the railway service of the East Coast of Scotland, and it will above all place the valuable manufacturing and mineral producing district of Fife in immediate communication with the south side of the Firth of Forth. When the Glenfarg line, now nearly completed, is opened for traffic, the distance between Edinburgh and Perth will be reduced from sixty-nine to forty-seven miles, and instead of the journey occupying, as at present, two hours and twenty minutes, an express will be able to do it in an hour. Dundee, likewise, will be brought to within fifty-nine miles of Edinburgh, and Aberdeen 130 miles, and no sea ferries will have to be crossed.

Within an hour after the ceremony of the opening had been completed, regular goods traffic upon the bridge had begun. Trains of mineral and goods waggons had been accumulating for some days on the lines in the vicinity of the bridge, and these were despatched across it in rapid succession during the evening of the opening day. Passenger traffic began on Wednesday, the 5th inst., between Edinburgh and Dunfermline. The delay

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in the completion of the Glenfarg line has compelled the directors to defer the use of the bridge for the traffic to Perth and the North.

The amount mentioned by the Prince of Wales was the outlay upon the works. The total expenses of the work amount to a rather larger sum.

The total expenditure by the Forth Bridge Company upon construction has been as follows:—

Outlays on works to 31st December, 1889	£2,549,200
Add to this the amount expended in connection with Sir Thomas Bouch's suspension bridge (including all Parliamentary expenses).....	250,000
	£2,799,200
Parliamentary expenses in connection with cantilever bridge, engineering expenses, interest during construction, &c.....	378,006
Total expenditure to January 1, 1890.....	£3,177,206

It is estimated that a further sum of £50,000 will be required to complete the structure, the painting included.

For the erection alone of the Fife, Inch Garvie, and Queensferry piers the amount of wages paid, including salaries of officials in charge of the piers, amounted up to November 30, 1889, to £344,810. The total amount of wages and salaries paid on the works up to January 1, 1890, was £1,045,000.

The following is the estimated gain in point of time, due to the bridge, according to Mr. Acworth:—

From London to Perth:—

By West Coast.....is now 450 miles, will be 450 miles.
„ Midland Route „ 475¼ „ „ 455 „
„ East Coast „ 462 „ „ 441½ „
i.e., East Coast was 12 miles worse, and will be 8½ miles better than West Coast.

From London to Aberdeen:—

By West Coast.....is now 540 miles, will be 540 miles.
„ Midland Route „ 565½ „ „ 536½ „
„ East Coast „ 552 „ „ 523 „
i.e., East Coast was 12 miles worse, and will be 17 miles better than West Coast.

THE FORTH BRIDGE.

The twenty-eighth and final quarterly report of inspection by Major-General Hutchinson, R E., and Major Marindin, C.M.G., R.E., of the bridge over the River Forth has just been presented to Parliament. It runs as follows:—

We have the honour to report, for the information of the Board of Trade, that, in compliance with the instructions contained in your Minutes of the 26th October, 1882, and 4th February, 1890, and in accordance with the provisions of the Forth Bridge Ratlway Act of 1882, we have made our twenty-eighth and final inspection of the bridge over the Firth of Forth at Queensferry, which was commenced in April, 1883, and has just been completed.

The bridge, with its approach viaducts, has a total length of 8,295ft. 9in., and there are two spans of 1,710ft., two of 680ft. 6in., fifteen of 160ft., four of 57ft., and three of 25ft.

The approach viaduct at the south end, which is 1,993ft. 8in. in length, has four masonry arches of 57ft. span, and ten spans of 160ft. with steel lattice girders upon piers of granite, with concrete and rubble masonry backing. These piers have concrete foundations upon boulder clay or hard sandstone rock, and the highest of them has a height of 139ft. above ground level.

The approach viaduct at the north end, which is 980ft. 5in. in length, has three masonry arches of 25ft. span, and five spans of 160ft., with steel lattice girders upon piers, similar to those of the south approach viaduct. These piers have concrete foundations on greenstone rock, and the highest of them has a height of 130ft. above ground level.

The bridge proper, which is 5,321ft. 8in. in length, has two spans of 1,710ft. over the two deep water channels, one on each side of Inch Garvie, and two spans of 646ft. 4in., that at the south end being over shallower water, and that at the north end over dry land at North Queensferry.

The superstructure of these four main spans is composed of three great double cantilevers, built entirely of steel, the central or Inch Garvie double cantilever having a length of 1,627ft. 8in., and the South Queensferry and North Queensferry (or Fife) double cantilevers having each a length of 1,513ft. 9in.

The intervals of 346ft. 6in. between the north end of the South Queensferry cantilever and the south end of the Inch Garvie cantilever, and between the north end of the Inch Garvie cantilever and the south end of the North Queensferry cantilever, are each spanned by lattice girders, 350ft. in length, and 50ft. in depth at their centres, supported by the ends of the cantilever arms.

The compression members of the cantilevers are, as a rule, tubular, the principal ones having a diameter of 12ft., and the tension members are mostly lattice girders.

Each of the cantilevers rests upon a group of four low piers, built of masonry faced with granite, 49ft. in diameter (except the two north piers at North Queensferry, which are 45ft. in diameter), having their tops 18ft. above high-water mark. These piers are founded upon solid rock, or on concrete built up either from the solid rock or from a stratum of very hard boulder clay. They are arranged in pairs, 120ft. apart from centre to centre transversely across the bridge, and the north and south piers are 270ft. apart from centre to centre at Inch Garvie, and 155ft. apart at South and North Queensferry.

The south end of the southern cantilever and the north end of the northern cantilever rest upon granite piers, which also carry the ends of the adjacent girders of the two approach viaducts.

The four South Queensferry main piers are founded upon the boulder clay underlying the bed of the Firth upon the south shore, into which clay they are sunk to depths varying from 30½ft. to 45ft., and their bases stand at levels varying from 44ft. to 90ft. below high-water mark.

The four Inch Garvie main piers are founded under water upon greenstone rock, their bases standing at levels varying from 26ft. to 72ft. below high-water mark.

Of the four North Queensferry main piers two only are in the water, with their bases respectively 19ft. and 24ft. below high-water mark, the other two being upon dry land. The whole of them are founded upon greenstone rock.

The two cantilever piers are built of granite with rubble masonry backing; that at South Queensferry is upon the foreshore, and is founded upon boulder clay at a level of 34ft. below high-water mark, and that at North Queensferry is upon dry land, and is founded upon greenstone rock. The top of the former is 230ft. 3in. above ground level, and 208ft. 9in. above high-water mark, and that of the latter is 181ft. above ground level.

The foundations of all the piers are excellent, and the whole of the masonry is of a very superior quality.

The deepest foundation—that of South Queensferry north-east pier—is 90ft. below high-water mark, and the extreme height of the central portions of the three double cantilevers is 343ft. above the top of the piers, and 361ft. above high-water mark. The headway in the channels below the main spans is somewhat in excess of that required by section 5 of the Forth Bridge Railway Act, the actual minimum at high-water spring tides being as follows:—

	Ft.	in.
For 500ft.	150	10¾
„ 900ft.	128	8
„ 1,100ft.	108	9

The headway prescribed in the Act for these spaces is 150ft., 125ft., and 100ft.

The permanent way, which is for a double line, is on the cantilevers carried upon an internal viaduct supported by trestles resting upon the bottom members; at the central portions of the main spans it is placed between the girders, and upon the approach viaducts it is above the main girders. It is throughout laid in longitudinal steel troughs, resting upon cross girders, and acting as rail guards.

The rails are made of Siemens-Martin steel, and of a bridge form. They are in 28ft. lengths, and weigh 121lb. per yard; their ends being connected by joint plates 26in. in length. They are secured to the sleepers by wood screws, of which there are four at each joint in each rail, and twelve others placed 2ft. apart on alternate sides. The longitudinal sleepers are of Rangoon teak, 12in. wide and 6in. deep, bedded upon and secured to cross-bearers of teak, the spaces between which are filled in with creosoted pitch pine. Between the sides of the steel troughs and the longitudinals, teak wedges on the inside, and packing on the outside, have been inserted at every bearer.

The floor of the bridge is composed of steel buckle-plates, upon which a coating of gravel ballast is laid.

Proper and sufficient provision has been made for expansion and contraction both of the rails and of the main members of the bridge.

The whole of the superstructure of the bridge and viaducts, with the exception of the seven masonry arches, is composed of open-hearth or Siemens-Martin steel, which by the specification had to satisfy the following tests: Strips cut lengthwise or crosswise to have an ultimate tensile strength of not less than 30 tons, and not exceeding 33 tons per square inch of section, with an elongation of at least 20 per cent. on a length of 8in. for all steel subject to tensile stresses; and of not less than 34 tons nor exceeding 37 tons, with an elongation of at least 17 per cent. for all steel subject only to compression.

Strips cut crosswise or lengthwise 1½in. wide, heated uniformly to a low cherry red, and cooled in water of 82° Fahr., to stand bending double in a press to a curve of which the inner radius is one and a half times the thickness of the steel tested.

The requisite certificate, signed by the engineers, that these tests have been carried out is attached.

Under the authority of the Board of Trade, dated December 9th, 1881, $\frac{R\ 11,469}{81}$ = the bridge has been made of dimensions calculated to withstand a strain due to a rolling load of two trains of 50 loaded trucks drawn by two engines, giving a total weight for each train of 892 tons, and to a wind pressure of 56lb. to the square foot. Under the combined strains arising from these, and from the dead load, the steel, being of special quality, was authorised to be subjected to a stress of 8½ tons per square inch when in compression, and 7½ tons when in tension.

The stresses on the bridge, as constructed, have been carefully calculated, and are, as a rule, considerably below these amounts, in no case exceeding 7·6 tons in compression and 6·9 tons in tension, in the cantilevers; and 6 tons in compression, and 7·3 tons in tension, in the central girders.

The weight of steel actually used is 50,958 tons upon the main spans, and 3,118 tons upon the approach viaduct girders, making a total of 54,076 tons, of which 53,716 tons are riveted work.

The amount of masonry and concrete work is as follows:—
Granite, 640,300 cubic feet.
Concrete, 64,315 cubic yards.
Rubble masonry, 62,250 cubic yards.

At this, our final inspection, we have subjected every part of the bridge to severe tests, by running over it, and placing upon it, in various positions, two heavy trains, each made up as follows:—

	Tons.
Two engines and tenders (in front) each weighing 73 tons	146
Forty-four trucks loaded with iron, each 15 tons 10 cwt. gross weight	682
One engine and tender in rear	73
Total	901

Each of these trains covered a length of 896ft. 5in.

We have observed the deflections upon the main members, and other parts of the structure, and these have in all cases been smaller than might have been expected.

With the loads in positions calculated to produce the maximum deflections, these in no case exceeded 7·65in. at the ends of the cantilevers.

The deflections of the central girders, when loaded so as to produce the greatest effect, did not exceed 1·58in.

The deflections of the internal viaduct girders, approach viaduct girders, and cross girders were of a very moderate amount.

Careful observations were made to test the rigidity of the vertical members over the cantilever piers, and under the influence of the above heavy live loads the movements were very small, the "pull over" in the direction of the length of the bridge in no case exceeding 2in. at the top of the vertical columns. There appeared to be no appreciable movement of the top of these columns in a direction at right angles to the length of the bridge.

These results are most satisfactory, and, taken in conjunction with the theoretical strength according to the calculations and with the remarkable absence of vibration when the trains were running at considerable speed, prove that the bridge is one of exceptional strength and stability.

We are therefore able to report that the Forth Bridge may be safely opened for passenger traffic as soon as the approach railways have been completed.

The greatest wind pressures during the last quarter were registered on January 26th, 1890, and were as follows:—

On the large gauge at Garvie Castle, 18lb. per square foot.
On the small fixed gauge at Garvie Castle, 34lb. per square foot.
On the revolving gauge at Garvie Castle, 27lb. per square foot.

At the time of this gale the bridge was virtually completed, and the effect upon the structure is stated to have been no greater than would, according to calculation, be caused by a pressure of 10lb. per square foot over the whole surface. The maximum pressures during the progress of the work, of which there is a reliable record, were on the 16th November, 1888, when the three gauges above mentioned showed pressures of 27lb., 41lb., and 35lb. respectively.

The total number of fatal accidents during the seven years which the bridge has occupied in construction has been 56. Although this loss of life is greatly to be deplored, the fact that it has not been larger on a work of such magnitude, with so large a number of men employed in dangerous positions, shows that no reasonable precautions for their safety have been omitted.

In conclusion, we think it right to record our opinion that this great undertaking, every part of which we have seen at different stages of its construction, is a wonderful example of thoroughly good workmanship with excellent materials, and that both in its conception and in its execution it is a credit to all who have been connected with it, bearing testimony to the ability of the engineers who have designed it, to the skill and resource of those who have superintended and constructed it, and to the zeal and courage of the workmen who have been employed upon it.

APPENDIX.

FORTH BRIDGE.—STEELWORK.

We hereby certify that the whole of the steel used in the Forth Bridge has been made on the Siemens-Martin "open-hearth" system, and has been subjected to the following specified tests:—

Strips cut lengthwise or crosswise to have an ultimate tensile strength of not less than 30 tons and not exceeding 33 tons per square inch of section, with an elongation of at least 20 per cent. in a length of 8 inches for all steel subject to tensile stresses, and of not less than 34 tons nor exceeding 37 tons, with an elongation of at least 17 per cent. for all steel subject only to compression.

Strips cut crosswise or lengthwise 1½in. wide, heated uniformly to a low cherry red, and cooled in water of 82° Fahr., must stand bending double in a press to a curve of which the inner radius is one and a half times the thickness of the steel tested.

The results of the many thousands of tests made showed the steel to be possessed of toughness and ductility considerably in excess of the specified requirements.

FOWLER & BAKER.

February 14th, 1890.

Reviews.

MINUTES OF THE PROCEEDINGS OF THE INSTITUTION OF CIVIL ENGINEERS. Vols. XCVII. and XCVIII. 1889.

These bulky volumes of the Minutes of Proceedings of the Institution of Civil Engineers are so full of interesting matter, that within the limits at our disposal it would be impossible to adequately review it, and we can therefore only briefly notice a few of the more important subjects treated. The first paper published in these volumes is that by Mr. Gisbert Kapp, on "Alternate-Current Machinery," in which the author deals more especially with alternators, transformers, and motors. The most important problem which is investigated in the course of this paper is thus stated by the author: "Given an alternator, with excited field and running at a proper speed, and a pair of terminals, from which any desired strength of current can be obtained at a constant pressure, and having a frequency approximately corresponding to the speed of the alternator, what will be the condition under which the alternator will fall into step with the supply current, and what will be the relation between the current passing and the mechanical energy given off? Also, how will this relation be affected by variations in the strength of the field?"

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The paper by Mr. Francis John Waring, on "Indian Railways: the Broad and the Narrow Gauge Systems Contrasted," again raises the question, on which sixteen years previously a memorable controversy took place within the walls of the Institution, as to the merits of different gauges. The author gives statistics, as to both cost of construction and working, for all the leading Indian railways, and shows that, notwithstanding the higher capital outlay per mile, the average net return was 1·262 per cent. higher upon the broad gauge than upon the metre-gauge railways. In the course of the discussion many of our prominent railway engineers seemed to be in agreement as to the disadvantages of a break of gauge; the desirability or necessity for light railways was admitted, but, it was argued, let such railways, however light, be constructed to the standard gauge, and then, if the traffic subsequently developed to such an extent as to render greater carrying capacity essential, heavier permanent way could be substituted for that originally laid down, and more powerful locomotives introduced, with corresponding rolling-stock, at much less cost than would be required if the gauge had to be increased. This reasoning commends itself, in our opinion, to all practical engineers, and we have no doubt that in general principle it is correct.

The following paper is by Mr. Charles Edward Emery, of New York, on "The District Distribution of Steam in the United States," and contains a brief historical sketch of the rise and development of steam distribution and a description of the plant of the New York Steam Company designed by the author.

Among the "selected papers" in Vol. XCVII. is an interesting account by Mr. Frederick Lobnitz of "The Removal of Rock under Water without Explosives," which has been adopted on the Suez Canal. Steel-pointed rock-cutting rams are adopted, which are raised to a height of from 5ft. to 20ft. and allowed to fall on the rock. Each of these rams weighs 4 tons, and five of them are arranged on either side of the central well of a dredger, through which the crushed rock is raised by the buckets. By means of this machine, the invention of Mr. Henry Lobnitz, shipbuilder, of Renfrew, from 10 to 15 cubic yards of rock could be broken to ballast size and raised by the dredger per hour. The author estimates that the cost of continuous working for a machine similar to the so-called "Dérocheuse" would be about 5s. per cubic yard, not including the transport of the broken rock in barges, nor the depreciation, interest, and insurance of the plant.

Turning now to Vol. XCVIII., we find the opening paper by Sir Nathaniel Barnaby on "Armour for Ships," than which, perhaps, few better subjects for controversy could be selected. As the event showed, it proved itself admirably adapted for bringing into prominence the extremely divergent views held by those who are responsible for the defence of our empire. Sir Edward Reed opened fire in his well-known style, pouring, metaphorically speaking, a broadside into the author, and simultaneously attacking Mr. W. H. White with his heavy sternchasers. The battle resolved itself, in the main, into a sort of triangular duel between Sir Nathaniel Barnaby, Sir Edward Reed, and Mr. W. H. White, enlivened by spirited attacks on the part of the naval officers present. Whether the proceedings were of such a nature as to inspire the general public with confidence may be doubted, but we would commend to its serious consideration the concluding remarks of Captain Fitzgerald: "Whatever might be the cost [of the navy], it could bear no reasonable proportion to the riches to be defended, and the only possible way of defending them was by absolute supremacy on the sea, both as to number and as to the individual fighting ships."

The next paper in the volume is by Mr. W. H. Greenwood, on the "Treatment of Steel by Hydraulic Pressure." The author superintended the construction, erection, and working of the complete plant used at the Abouchoff Works, St. Petersburg, for the fluid compression of steel on the Whitworth system. The paper contains an account of the process of fluid compression, with an explanation of its effect and advantages, and records of comparative tests carried out with pieces from pressed and unpressed ingots. As might have been expected, the opinion of the meeting, as expressed in the course of the discussion, in which many of the leading steel manufacturers took part, was by no means unanimously in favour of fluid compression. By several speakers of great experience in the production of steel it was contended that just as good results could be obtained without as with compression; and Mr. John W. Spencer went so far as to state that the strength of steel, taking tenacity and ductility together, was not dependent, as commonly supposed, upon the work done on it, but that simple castings could be produced possessed of all the qualities required of the best steel forgings, without any mechanical work having been put upon them, by simply conforming to the natural laws of crystallisation.

Among the selected papers is one on "Experiments on the Strain in the Outer Layers of Cast Iron and Steel Beams," by Mr. Edward Carstensen de Segundo, a student of the Institution. For this communication the Miller Scholarship was awarded in the session 1888-89.

THERMODYNAMICS, HEAT MOTORS, AND REFRIGERATING MACHINES. By De Volson Wood, C.E., M.A., Professor of Engineering in the Stevens Institute of Technology, New York. JOHN WILEY & SONS. 1889.

This is essentially a students' text-book, and has been prepared by Professor Wood to meet a want experienced by him in his course of instruction in Thermodynamics in the Stevens Institute of Technology, and this fact we have carefully borne in mind when reviewing it. A book of this kind is intended to give the fundamental principles of a subject and their theoretical and mathematical developments, in the first place as a mental training for the students, and in the second as an introduction to the more practical work of the drawing office or the engineering laboratory. To say that such a book is of no use to ordinary engineers is utterly beside the question. The majority of such engineers have blundered into their knowledge of principles through a long practical experience, and while they may not know how these may be expressed exactly, they have a fair knowledge of their bearings on their practice, and they speak science every day without knowing, for science is nothing more than concentrated experience and common sense. We do think that sometimes professors allow their theories to run off with them, but in its proper place we cannot have too much of theory, for it is very often an apparently insignificant theoretical consideration which has most important practical bearings.

Understanding, therefore, that Professor Wood's book is meant for students, and is introductory to the more practical applications of the subjects, we have no hesitation in saying that he has simplified many parts which have hitherto puzzled students, and that his book, if used as a text-book, and accompanied by other instruction of a more practical nature, is a decided advance, in some respects, on the books on the same subjects which have preceded it. Professor Wood is evidently a great admirer of Professor Rankine, and his chief object has evidently been to lead his students up, by an easy and uniformly guided path, to Rankine's height, and at the same time familiarise them with the way, by a free use of illustrations, exercises, historic references, and numerical examples. These latter are very important features in the book, and should be of great use to the students in impressing the meaning of the different formulæ on their minds, and in enabling them to extend their reading to the original memoirs of the men who laid the foundations of the science. Professor Wood has, however, not confined himself to a mere amplification of the works of his predecessors, but has in some cases introduced new methods of presenting the subjects. For instance, that part of the book relating to "Entropy," or the "Thermodynamic Function," which has hitherto puzzled the ordinary student, is presented in a comparatively simple manner. We say comparatively simple manner, but it must be remembered that thermodynamics is a difficult science, and the modern young man should be given to understand that unless he is prepared to make a mental effort he had better leave it alone.

Our space will not allow us to make a detailed examination of the book, but we may say that we have looked over it with a considerable amount of satisfaction. The part relating to the principles of thermodynamics is a good *résumé* of our present knowledge of the subject, although, as might be expected, some of the definitions and explanations may be open to criticism, as indeed would any other definitions and explanations whatever, for we are still far from finality in such matters. The parts relating to heat engines and refrigerators form the basis for the more practical applications; they give in short the physics of the subjects. The practical use of some parts of these may not be evident to the young student, but he may rest assured that in the meantime their study will afford him a most useful mental exercise, and that when he becomes an engineer he will find it of the greatest advantage to be armed with all the appliances of well-based theory, for the engineer of the future will be a man who sees the bearings of his theories on his everyday work. The engineer of the past and the present has been too often one who has groped his way through trial and error, and he ought to recognise the necessity for a more thorough preliminary training. We must repeat our warning, which we have on previous occasions given to the professors, that they must remember that the chief object of their existence is to train engineers, and that, while we cannot have too much sound theory, that there is a time and place and due amount for everything, and by overloading their courses of instruction with too much mathematics they may prevent the really useful parts of their work from being appreciated.

KALENDER FÜR ELECTROTECHNIKER, 1890. F. Uppenborn. R. OLDENBURG, Munich and Leipsic.

This is the seventh year of this well-known annual. It is bound with flap cover as a pocket-book, measuring 6½in. by 4½in. by ⅝in., and contains about 300 pages of small but clear print. It is singularly complete, and seems to contain all the data an electrician could possibly want, and some things he certainly would not, such as the dimensions of the earth, and the combination heats of compounds quoted without reference to their physical states. Therefore, though we have not found anything left out that ought to have been put in, there are many things which might be omitted. Too much is said perhaps about the apparatus made by the firm of Siemens & Halske. The Pear Oil Lamp, for instance, is of no use as a standard, as its light is too yellow. Engineers do not measure currents with sine or tangent galvanometers. The tables and data of commercial dynamos, lamps, and secondary batteries, though they appear in most pocket-books, are of little value. We mention these points merely as suggestions for the next edition, and not with the intention of finding fault. Herr Uppenborn has really condensed into a small book an enormous amount of useful information, and we think it is as complete and universal as such a pocket-book could be.

TRAITÉ ÉLÉMENTAIRE DE L'ÉNERGIE ÉLECTRIQUE. Par E. Hospitalier. Tome I. Paris: G. MASSON. 1890.

This is the first volume of a book that has been wanted for a very long time. As electrical engineering has advanced, the necessity for what is narrowly called the theoretical knowledge increases, and the engineer finds that he must either confine his attention to books written by men with the same sort of training as himself, which do not give him the information he requires, or must wade through works written entirely from an academical point of view, which give him some of the information he wants, but deal with so much that is quite useless to him, that the return is hardly worth the labour spent.

M. Hospitalier now comes forward with a book intended to supply just what is wanted. The first volume is a sort of complete text-book of electricity, and errs rather on the academical side, too much of it being of the ordinary text-book type. Advanced mathematics are nowhere employed, while the author does not cripple himself by avoiding mathematical treatment altogether. Everyone acquainted with M. Hospitalier's style will expect the book to be written as clearly as the subject admits, and will not be disappointed. The introduction of such expressions as specific resistances in ohm centimetres is typical of the way he treats his subject. The only fault worth mentioning is that the author discusses far too many methods, phenomena, and instruments which are of no importance to electrical engineers. What is required is to give just as much of what generally appears in such treatises as that of Mascart and Joubert, or of Jamin and Bouty, as is needed by an electrical engineer, and nothing more.

M. Hospitalier's second volume will be even more difficult to write. We sincerely hope that we shall not have dynamos with empirical laws, and all sorts of curves which are never used in practical design, and transformers with coefficients of self and mutual induction, and leads following the interest on capital law.

The price of the present volume is exceedingly low for what it contains.

ELECTRIC LIGHT INSTALLATIONS, AND THE MANAGEMENT OF ACCUMULATORS. By Sir David Salomons, Bart. London: WHITTAKER & Co. 1890.

Sir David Salomons is well known as an enthusiastic electrical engineer, and the preparing of this work seems to have been to him a labour of love. There is a great deal of miscellaneous information about small points, and no doubt a book of this kind finds numerous readers among amateurs who have installations of their own, or who are thinking of doing so, and take a personal interest in the matter. There are a great number of technical mistakes, more especially when the author discusses the chemistry of accumulators. We find such substances as SO, SO_2, PbO_4 playing prominent parts in the reactions in accumulators. These may be misprints, but the whole of the chemical part is incorrect. We believe Sir David Salomons is not responsible for the theory that Pb_2SO_5 is formed and reduced by charging to the more healthy form $PbSO_4$. The method of charging cells while running on lamps given by the author is unnecessarily complicated. We may also mention that a special shunt machine, with little field excitation, which gives nearly constant current on cells, should be used for charging accumulators.

The work will be, and in the various earlier editions has been, very useful to amateurs, and will, we have little doubt, run to a sixth edition, as it deserves.

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CLYDE SHIPBUILDING IN FEBRUARY.

THE output of tonnage from the Clyde district during February amounts in the aggregate to 38,708 tons, which is considerably larger than the production during the corresponding month in any year since the shipbuilding industry was started on the Clyde. The majority of the vessels put into the water are of a superior class, and of considerable tonnage, there being five of over 3,000 tons each. The largest was the Hamburg-American liner "Normannia," built by the Fairfield Shipbuilding and Engineering Company, Govan, in which considerable interest is being centered at present. She is the largest merchant steamer ever constructed in the Fairfield establishment, and exceeds the tonnage of the Cunarders "Umbria" and "Etruria" by about 780 tons. Her dimensions are 500ft. by 57ft. 8in. by 38ft., and her tonnage 8,500 tons. She will be fitted with engines capable of developing 14,000 i.h.p. The guaranteed speed is 19 knots, and it is confidently expected that this speed will be maintained continuously at sea.

There is no scarcity of contracts in hand, and quite a large number of vessels are in a very forward state. This condition of things will certainly ensure a large output for the next month or two, providing that the present cheering relationship which exists between employers and employés continue. The prospects, however, are by no means encouraging, as the falling off in inquiries for new vessels, which set in a month or two ago, still continues; in fact, many shipbuilders have not had a single inquiry. The contracts secured during the month make up a total of about 3,500 tons, the most important order being for a four-masted sailing ship, which is to be built by Messrs. R. Duncan & Sons, of Port Glasgow, for Glasgow owners.

The following are the particulars of the vessels launched:

SINGLE-SCREW STEAMERS.

By the Ailsa Shipbuilding Co., Troon:—"Kasara" (steel), 1,125 tons, 1,800 i.h.p. Engined by Messrs. Dunsmuir & Jackson, Govan. Owners, British India Steam Navigation Co., for their Indian coasting trade.

By Messrs. Barclay, Curle, & Co., Whiteinch:—"Benares" (steel), 3,010 tons, 2,700 i.h.p. Owners, the Hamburg-Calcutta Co.

By Messrs. Blackwood & Gordon, Port Glasgow:—"Alfred Dumois" (steel), 650 tons. Engined by the builders. Owner, Mr. Jacob Christensen, of Bergen, for the West Indian and United States fruit trade.

By Messrs. Caird & Co., Greenock:—"Netherby Hall" (steel), 3,200 tons, 2,000 i.h.p. Engined by the builders. Owners, Messrs. R. Alexander & Sons, Liverpool.

By Messrs. David J. Dunlop & Co., Port Glasgow:—"Cyrnos" (steel), 900 tons, 1,700 i.h.p. Owners, Messrs. Fraissinet & Co., Marseilles, for the Mediterranean trade.

By Messrs. D. & W. Henderson & Co., Partick:—"Bellagio" (steel), 4,000 tons, 2,500 i.h.p. Engined by the builders. Owners, Messrs. Bell Brothers & M'Lelland, Glasgow, for general trade.

By Messrs. A. & J. Inglis, Pointhouse:—"Palamcotta" (steel), 4,000 tons, 3,000 i.h.p. Engined by the builders. Owners, British India Steam Navigation Co., for their Indian trade.

By Messrs. Murray Brothers, Dumbarton:—"Oakland" (steel), 400 tons. Engined by Messrs. Kincaid & Co., Greenock. Owner, Mr. T. W. Yeager, Richmond River, N.S.W., for the timber trade.

By Messrs. Russell & Co., Greenock:—"Strathesk" (steel), 2,300 tons, 1,100 i.h.p. Engined by Messrs. James Howden & Co., Glasgow. Owners, Messrs. Burrell & Sons, Glasgow, for general trade.

By Messrs. Scott & Co., Bowling:—"Cornelian" (steel), 369 tons, 445 i.h.p. Engined by Messrs. Muir & Houston, Glasgow. Owner, Mr. W. Robertson, Glasgow.

By Messrs. Scott & Co., Greenock:—"Yunnun" (steel), 1,650 tons. Engined by the builders. Owners, the China Navigation Company, London.

TWIN-SCREW STEAMERS.

By the Fairfield Shipbuilding and Engineering Company, Govan:—"Normannia" (steel), 8,500 tons, 14,000 i.h.p. Engined by the builders. Owners, the Hamburg-American Company, for their Atlantic service.

By the London and Glasgow Shipbuilding Company:—"Nau-Chang" (steel), 1,750 tons, 1,600 i.h.p. Engined by the builders. Owners, the China Steam Navigation Company, for the China coasting trade.

By Messrs. A. McMillan & Sons, Dumbarton:—"Planeta" (steel), 1,500 tons. Engined by Messrs. M. Paul & Co., Dumbarton, for English owners, and intended for the Brazil coasting trade.

By Messrs. Murdoch & Murray, Port Glasgow:—"Pilcomayo" (steel), 450 tons, 150 i.h.p. Engined by Messrs. Rankin & Blackmore, Greenock, for London owners, and intended for the South American trade.

PADDLE STEAMER.

By Messrs. Wm. Denny & Bros., Dumbarton:—"Clacton Belle" (steel), 450 tons. Engined by Messrs. Denny & Co., Dumbarton. Owners, Clacton-on-Sea Steamboat Company, for passenger service between London and Clacton.

STEAM LAUNCH.

By Messrs. Davie & McKendrick, Govan:—"Alexandra," 4 tons, 20 i.h.p. Engined by Messrs. Ross & Duncan, Govan.

SAILING VESSELS.

By Messrs. Russell & Co., Port Glasgow:—"Strathgryffe" (steel), four-masted barque, 2,200 tons. Owners, Messrs. J. & W. Stewart, Greenock.

By Messrs. Alexander Stephen & Sons, Linthouse:—"Mayhill" (steel), four-masted barque, 2,050 tons. Owners, Messrs. W. & J. Myles, Sons, & Co., Liverpool.

In addition to the above Messrs. T. B. Seath & Co., Rutherglen, constructed two galvanised steel barges, each of 100 tons, which were shipped in pieces to South America.

ANALYSIS OF LAUNCHES.

	Steamships. No.	Steamships. Tonnage.	Sailing Vessels. No.	Sailing Vessels. Tonnage.	Barges. No.	Barges. Tonnage.
Great Britain	11	20,794	2	4,250	—	—
Germany	2	11,510	—	—	—	—
France	1	900	—	—	—	—
Norway	1	650	—	—	—	—
Australia	1	400	—	—	—	—
South America	—	—	—	—	2	200
Destination withheld	1	4	—	—	—	—
	17	34,258	2	4,250	2	200

ADAMS' AUTOMATIC BOLT CUTTER.

WE illustrate on page 235 a 1½in. Adams' automatic bolt-threading and nut tapping machine, made by the Capitol Manufacturing Company, Chicago, U.S.A.

The automatic operating device consists of a cam groove on the head, a spring-seated actuating pin, and returning cams for the pin. The operating action is controlled by the adjustable collar fixed on a rod attached to the sliding carriage, and is operated to release the actuating pin during the feed of the carriage. The closing of the head is accomplished by the rear adjustable collar on the same rod operating a closing lever as the carriage is returned to position. The head is made entirely of steel and consists of four parts only. The dies are removable and easily adjusted, but as rigid when adjusted as if set in a solid die machine. The dies can be cut in a dummy head attached to any lathe, and made ready for use without occupying the cutter head. The dies, as will be seen, are clamped rigidly by means of the face screws. These screws have only to be loosened in order to remove or put in the dies. Each die is independently adjustable either way. The accurate adjustment of the die is ensured by a circle on the face of the head and completed by the arc of the same circle cut in the dies when they are hobbed or re-hobbed in the dummy head.

The carriage, which is double the length of the ordinary carriage, is gibbed to take up the wear; the vice jaws are placed in the centre of the carriage, in order to secure stability and accuracy.

All the machines are provided with an automatic force pump, which is operated by an eccentric and throws a steady and large stream of the lubricant into the head. To insure a steady stream, an air chamber is attached to the feed pipe. The base of the machine is made very heavy and all the bearings are very long. The nut taps or nut-clamping attachment is arranged to admit of from two to four nuts on the cutting edge of the tap at one time, thus increasing the product about three-fold. We are indebted to the *American Journal of Railway Appliances* for our illustration.

THE WEYMERSCH PRIMARY BATTERY.

THE Weymersch Electric Battery Syndicate have on view at No. 2, Victoria Mansions, an installation of their system for illustrating what can be done in electric lighting without a dynamo. It is, of course, only meant for use on scales too small for engines and dynamos. The installation which we recently inspected consists of eight standard batteries each fitted in a teak case measuring about 2ft. 8in. by 9½in. by 1ft. 4in. Each case contains six cells, each cell being divided into a central porous receptacle to contain one carbon element, 7½in. by 6in. by ½in., and two outer receptacles to contain two zinc elements, 7⅛in. by 7⅛in. by ¼in. The six porous cells are connected together by an ebonite pipe terminating outside the teak case in an ebonite tap and gauge glass, so arranged that on filling the porous cells with the depolarising liquid the level of solution is at once seen upon glancing at the gauge glass. The outer cells containing the zinc elements and exciting liquid are likewise connected to another ebonite pipe with its outside tap and gauge glass for a similar purpose.

The battery will work 18 consecutive hours without requiring the depolarising solution to be changed, but where the time of running is only a few hours at a time it is preferred to only fill the porous cells partially, sufficient to last the time required. Of course the oxidising liquid must be run off at the termination of the run to prevent local action on the zinc plates. The latter solution is dilute sulphuric acid one to twenty.

The general arrangement of the batteries has been designed with a view to economising labour and attention. They can be charged or emptied of their contents in five minutes by merely opening the proper taps. Barrels containing the solutions, holding from 6 to 40 gallons, are fixed at a higher level than the batteries; india-rubber tubes lead the liquids from the taps of the barrels to the cells, the filling of the whole six cells being simultaneous by reason of the connecting pipe mentioned above. A continuous trough fixed under the taps from each battery gives the necessary means of emptying without trouble and mess.

Each standard battery of six cells has a total internal resistance of 0·30 ohms, giving a maximum current of 15 amperes for 12 hours.

The oxidising solution is a secret. This seems to be the chief objection to the battery. Probably every depolarising agent is known to chemists. Battery inventors ring changes on chromates, permanganates, and nitric acid, or on lead peroxide, manganese peroxide, copper oxide, and perhaps ferric salts, or easily reducible silver and mercury salts, and nitric acid. If Mr. Weymersch has a new depolariser, why not patent it? if an old one, where is the advantage? Probably the battery is one of the best of its kind, as so much care is taken in designing it so as to be easy to work. We would have much more confidence in it if we knew what the depolariser is. A battery made up with, say, a cheap chromate, should have a large sale, as the difficulties so far have not been chemical, but have resided in the trouble of filling, cleaning, and keeping a battery in order.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

THE meeting of this Institution on the 27th ult. was occupied by the discussion on Mr. Swinburne's paper, "The Theory of Armature Reaction in Dynamos and Motors," and on Mr. Esson's paper, "Some Points in Dynamo and Motor Design."

Professor Ayrton, referring to Mr. Swinburne's method of treating the subject, deprecated the use of the term "magnetic potential" where difference of magnetic potential was meant. He also thought Mr. Esson's term "working saturation" was not to be recommended and that "working induction" would be much better. In his further remarks, Professor Ayrton said he would confine himself chiefly to three heads, which were brought out prominently in a paper on "Electromotors" by Professor Perry and himself in 1883, and about which considerable difference of opinion still existed. These were—1st, The existence of magnetic lag; 2nd, The alteration of resistance of revolving armatures by self-induction; and 3rd, Motor construction for minimum weight. As regards magnetic lag, this, he said, had often been denied, but quite recently Professor Ewing had shown that such a lag did occur, amounting in some cases to several minutes. With reference to the increased resistance of revolving armatures due to self-induction, he thought some misunderstanding existed, for Mr. Swinburne in his paper said that "power cannot be lost by self-induction." In their original paper, Professor Perry and himself had given a formula for calculating this loss when the brushes were placed at the neutral position, and this they confirmed experimentally. When, however, this condition is not fulfilled, a modification is necessary. If the brushes could be placed at an absolutely non-sparking position, the resistance of the armature would not be increased by rotation, for then a section leaves the brush and is thrown into circuit with the proper current in it, and hence no further e.m.f. is needed to bring the current up to its proper value. In fact, the energy used in starting the current is supplied by the belt whilst the coil is short-circuited. Experiments on the characteristics of a magneto Gramme, used as a generator and as a motor with equal lead and trail, show that as a dynamo the curve falls, whereas as a motor the curve rises, with increase of current. On trying the same experiments with a separately excited Gramme, the e.m.f. as a motor always increased with the current through the armature whatever the strength of exciting current used, but as a generator the e.m.f. always decreased, and with a weak field became negative when the armature current increased. In conclusion, Professor Ayrton contended that the above experiments proved conclusively that a relatively powerful armature strengthens the field of a motor and weakens that of a dynamo.

Mr. Ravenshaw said that as regards Mr. Esson's expression for the ampere turns which may be carried on an armature, he could not say that it held good in practice. He himself had experimented a good deal on the subject, and the results seemed to point to the fact that for all sizes and shapes of well-designed machines, their behaviour at the brushes would be very similar when the

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ratio between the ampere turns and the total induction in the armature was the same. This he gave, not as a law, but as a result of his own experience. This experience, however, did not agree with that of Mr. Esson. One machine made for 4,000 watts, on which he had made many experiments, had a very small distance between the pole pieces and armature core, and the pole pieces were rather close together. After testing it under these conditions up to 6,000 or 7,000 watts he tried it with the field bored much larger, and also with the poles cut off until they embraced an angle of 90°. Under all these conditions the maximum ampere turns it would carry without sparking appeared to be the same, the armature induction being kept constant. This machine was afterwards wound with a drum armature, and he had built two other types of machines with the same area of armature core, both of which carried the same ampere turns.

Mr. Kapp stated that the two papers under discussion would form very important landmarks in the development of the dynamo, and said the subjects treated in them had been brought into prominence by the use of large machines. According to Mr. Swinburne, the limiting diameter of armatures in two-pole machines was about 40 centimetres, but he (Mr. Kapp) had, by increasing the dimensions of all the parts proportionately, made dynamos with 50 c.m. armatures, and others had gone still higher. Referring to formula (2) in Mr. Swinburne's paper, he asked whether the coefficient M was correct, for, as given, the length of the armature was not taken into account. His own experience gave coefficients varying from 0·12 to 0·18 instead of from 0·08 to 0·085. As regards reversing pole pieces he said that they were brought out about five years ago by Mather. Coming to Mr. Esson's paper, Mr. Kapp wished to add one device for equalising the field in single magnet machines which had been omitted from the interesting collection. This device consists in making the upper horns rather longer than the lower ones. He cordially endorsed Mr. Esson's remarks on the small rise of temperature allowed by the Admiralty, for a rise of 11° C. meant enormous machines for their output. On the other hand, he usually allowed more cooling surface than Mr Esson, his rule being 1·5 and 2·5 square inches per watt wasted in armature and magnets respectively.

Mr. Farquharson said he thought the Admiralty rule for limiting rise of temperature had been misunderstood, and in Mr. Esson's paper it was wrongly stated, for the rise permitted was 30° F. and not 11° C. The method of testing adopted by the Admiralty was to take the temperature outside the insulation immediately the machine was stopped. This temperature was by no means the same as that within the conductor, for he had known the outside temperature to rise for 20 minutes after the machine was stopped. Keeping this fact in view, together with the long continuous runs (sometimes amounting to 24 days and nights) to which ship lighting dynamos may be subjected, he thought the Admiralty were justified in fixing the limiting temperature low enough to be safe for all machines.

Mr. A. T. Snell, speaking of machines run as dynamos and as motors, said he always found it possible to get a greater output at a given speed when running as a motor, and that the trail as a motor was always less than the lead as a dynamo. Another point in which motors differed from dynamos was the possibility of using very thick brushes with advantage in the former, whereas in the latter such a proceeding proved disastrous. These differences seemed to him to show that the magnetic distribution in generators and motors are not the same, and that in dynamos the field was more straggling and subject to greater distortion.

The discussion was then adjourned to the 13th inst.

THE NATIONAL ELECTRIC LIGHT ASSOCIATION OF AMERICA.

(*From our New York Correspondent.*)

The eleventh meeting of this Association was held at Kansas City, Missouri, on the 11th, 12th, 13th, and 14th of February. President Weeks, in his opening address, referred to the growth of a more fraternal feeling between the electric light and power engineers and the telegraph and telephone representatives since the reorganisation of the society in 1885. He also noted the example set by our British brethren of adjusting differences amicably instead of carrying litigation to the final Courts. Such a policy, he said, would have saved hundreds of thousands of dollars in America, and would have enhanced the value of electrical securities. He deprecated the policy of competing companies entering upon territory already occupied. The report of the committee on a petition to Congress for the abolition of the duty of four cents per pound on copper reported that they had performed the work assigned to them. Not a word had been said by anyone in defence of the duty, and there seemed little probability of its remaining very long. The committee on underground work, not having been able to accomplish anything, was discharged at the request of the chairman. The committee on the standardising of potentials for street railway work had received replies to their circular from 85 per cent. of the electric railway companies. About 90 per cent. of the lines operated used the Sprague and the Thomson-Houston systems. Out of about 80 in operation only nine were supplied with current from electric lighting stations. The potential now used varied from 220 to 800 volts, the greater proportion of the companies using from 450 to 550 volts. Both the Sprague and Thomson-Houston companies had agreed to a standard of 500 volts, excepting where special apparatus may be required. The committee does not recommend that it be understood that the same machinery can be used at central stations for furnishing light at night and power by day. The great saving for the Central Station Company lies in the reducing of labour and fixed charges, and also that the reserve power for one will suffice for the other. The committee on harmonising the interests of the insurance and electric lighting companies recommended that the latter appoint instructors for the term of one year to teach insurance inspectors to judge of the fire hazards of electrical installations. This recommendation had not, however, met with the favourable responses anticipated; although the underwriters appear to be willing to take some steps in the direction of more harmonious relations. A plan was also submitted for the organisation of a mutual insurance company, which would lead, not only to a reduction in the cost of insurance, but also to the construction of a better class of central stations, and their frequent inspection by experts. The report of the committee was adopted.

Papers were read by Mr. C. J. H. Woodbury, of Boston, on the "Construction of Central Stations;" by Mr. Fred. E. Sickles, on "The Steam Engine"; by Mr. George H. Babcock, on the "Economical Generation of Steam for Electric Light Stations"; by Mr. C. J. Field, on the "Development of Generating Stations for Incandescent Light and Power"; and by Mr. T. Carpenter Smith, on "A System of Station Accounts." All of these papers were thoroughly discussed, but brought out no important facts of general interest, being simply a reiteration of well-known practice in the lines of steam and electrical engineering. Mr. A. J. De Camp, of Philadelphia, addressed the meeting on the "Cost of Products to Central Stations," which was followed by a paper entitled "Nine Years with the Arc Lamp," by Mr. M. D. Law, of the same place. In a paper on "Carbon Tests," Mr. E. F. Peck pointed out that, according to tests made by himself, it was shown that in a station operating a thousand arc lamps there was a saving of sixty-five electrical horse-power per hour in using the best rather than the poorest carbons. There was also a saving of 29 per cent. in carbon consumption. A paper, under the title of "How our Paths may be made Paths of Peace," by Mr. Henry W. Pope, of Elizabeth, N.J., then followed.

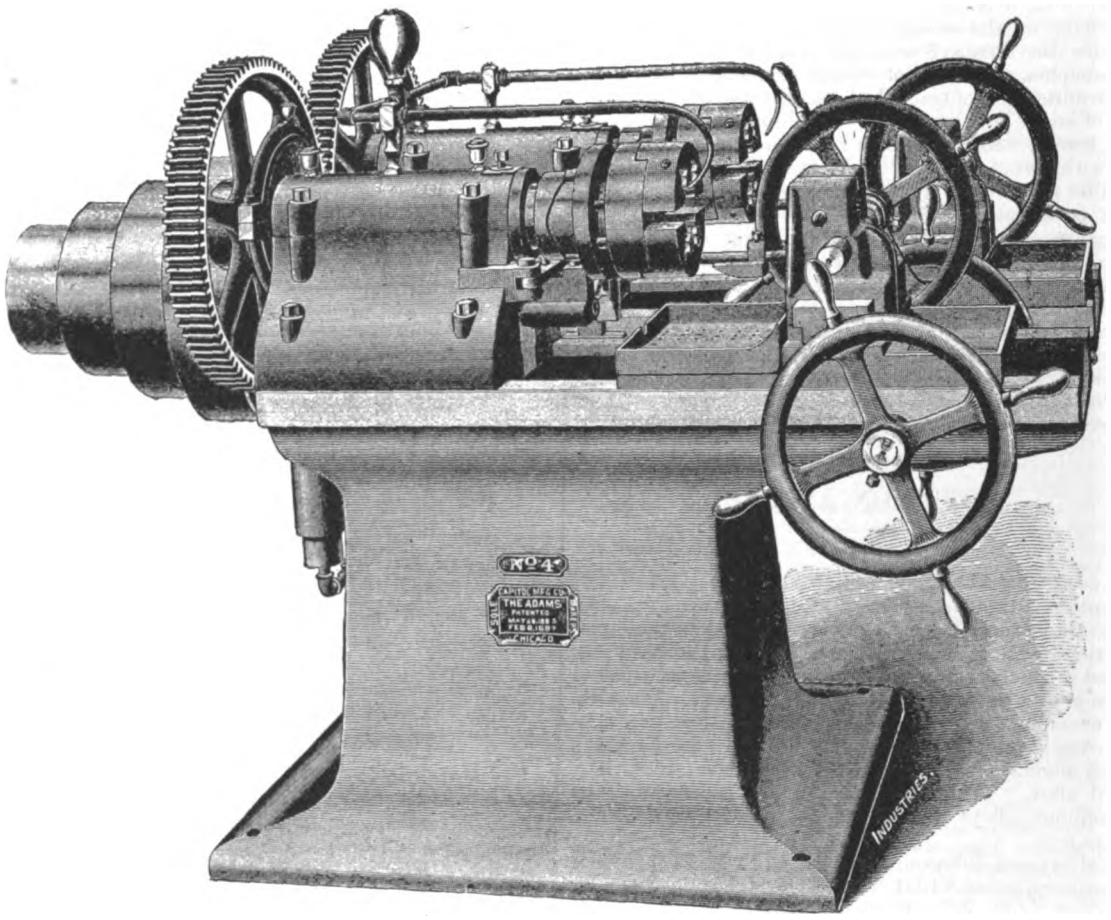
Professor Elihu Thomson, of Lynn, Mass., presented a paper on "Safety, and Safety Devices in Electric Installations." He asserted that there is more danger to life from an alternating than from a continuous current of equal pressure. He was also just as firmly convinced that the fire risk was less with alternating than with continuous currents, assuming the work of installation to be equally good. We would not be able to utilise water power for lighting without employing pressure of potential sufficient to convey the energy to a distance over a conductor at a moderate cost. If great saving of cost of fuel and other expenses in operating one large steam plant, instead of a number of separate plants, with their attendant risks, in large cities is an object worth seeking, it would be found in the conveyance in electric energy at fairly high pressures.

The paper by Mr. Frank J. Sprague, of New York, on "Electricity as Applied to Railways," was historical, and attempted to be prophetic. Two years ago, he said, the electrical railway business was in an experimental stage, and it was difficult to get a dollar for investment, while to-day it demands the best thought and the most active energies of two great corporations and a number of smaller ones. The business done this year would probably amount to $6,000,000. He stated that there were about 130 towns in the United States with one or more electric railways in operation, construction, or under contract, comprising 1,500 miles of track, equipped with about 1,700 motor cars requiring 3,000 motors of an aggregate capacity of 45,000 h.p., and a daily mileage of about 100,000, which would be doubled within three months. Reviewing the work of the past two years, that which was promised for electricity had been, in the main, entirely fulfilled. Gradients of 12½ per cent., and more recently of 14 per cent., had been ascended with loaded cars. Gradients three miles long, varying from 4 to 8 per

ADAMS' AUTOMATIC BOLT CUTTER.

CONSTRUCTED BY THE CAPITOL MANUFACTURING COMPANY, CHICAGO, U.S.A.

(*For description see opposite page.*)



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cent., had been ascended by a motor car pulling a tow car. It had done this work where it would have been impossible to have done it by horses. It had enabled the running speed of cars to be increased 50 per cent. even in crowded cities, and on suburban routes speeds of twenty miles or more had been made. The electric car had shown that it can run faster on both up and down gradients; that it can be got under way and stopped more quickly than a horse car. Mr. Sprague then devoted considerable attention to the probable utilisation of electricity on the ordinary steam railroad, taking as an example the Pennsylvania line between New York and Philadelphia, a distance of 90 miles; and, assuming that the requirements of traffic had necessitated the construction of an air line double track in addition to the present four tracks, with two copper rods, each 1in. in diameter, and with four stations, 22½ miles apart, a train service of 60 miles per hour every ten minutes would be possible at a potential of 900 volts. He believed that this system would be so far superior to that now existing as to practically revolutionise travel between the two points. He hoped that it might be a fact in the not distant future.

Papers were read by Mr. C. C. Haskins, of Chicago, on "Prodigality in Economy"; by Mr. Charles A. Harber, of Kansas City, on "Line Insulation from the Standpoint of Practical Experience"; and by Mr. J. E. Lockwood, of Detroit, on "How to Make Arc Light Circuits Safe."

NOTES ON ALLOYS.

II.

Aluminium alloys are still receiving a good deal of attention, although at present we have no accurate data as to the nature of these compounds. Before the introduction of cheap aluminium several alloys had been prepared in the laboratory, and certain characteristic points were put on record concerning their nature. Bismuth, for example, when added in small quantities, produced an exceedingly brittle alloy, while the addition of a small amount of aluminium to tin yields an elastic and hard alloy. Those interested in the earlier work on aluminium alloys will be glad of the following references:—

Calvert and Johnson, *Phil. Mag.* [4], X. 240; Tissier, *Comptes-Rendus*, XLIII. 885, XLIX. 54; Debray, *Comptes-Rendus*, XLIV. 925; Wohler, *Annalen der Chemie*, CVI. 118, CXIII. 248, CXXXVIII. 258, and *Poggendorff's Annalen*, XI. 161; and a paper by Michel, in *Annalen der Chemie*, CXV. 102.

Two or three investigators have recently re-examined the aluminium amalgam, which was first described by Cailletet (*Comptes-Rendus*, XLIV. 1250), and in our report of the British Association meeting of last year we gave an abstract of the work done by Dr. J. B. Cohen with this alloy (*Industries*, Vol. VII., p.430). The amalgam has a very energetic action on water, forming alumina and evolving pure hydrogen, and is used by the author for various chemical operations in which a powerful reducing agent is required. It reduces nitrates and nitrites to ammonia, and can be used therefore in water analysis, and rapidly converts nitrobenzene into aniline. Baille and Féry have also recently examined this aluminium amalgam, and in their paper in the *Annalen* [6], XVII. 246, they describe experiments which show that aluminium dissolves more rapidly in hot mercury than cold, but that mercury vapour does not attack the metal. They have also succeeded in obtaining the amalgam in a crystalline form, and have found that it has the composition represented by the formula Al_2Hg_3. As this is the first definite aluminium alloy described, it will be interesting to note whether the copper and other alloys contain a compound having a similar constitution. The amalgam dissolves in nitric acid, although this acid has no action upon the pure metal, which also supports the conclusion that a definite compound is produced. Another important fact brought out by these experiments of Baille and Féry seems likely to throw light on the formation of the triple aluminium alloys, such as that containing copper and iron patented by Brin. It appears that when aluminium amalgam is added to antimony amalgam, the antimony separates at the surface in small crystals, but when aluminium amalgam is added to lead amalgam, the aluminium separates from the mixture. It is also known that aluminium is expelled from its alloys with copper and tin when lead is added to the fused alloy, so that there is little chance of forming a simple or triple alloy containing aluminium and lead.

One of the numerous methods for the electrolytic preparation of aluminium also is based on the fact that aluminium and lead do not alloy together. Roger, by electrolysing fused salt and using a lead cathode, obtains a lead sodium alloy, and then uses this alloy as a cathode in the electrolysis of cryolite. The aluminium separated in the electrolysis of the cryolite, although separated on the lead cathode, will not alloy with it, and can subsequently be readily separated. The Brin patents (1888, Nos. 3547, 3548, 3549, 8746, and 8747; 1889, No. 15508) appear to show that aluminium vapour alloys readily with hot metals, although Baille and Féry have found that mercury vapour does not attack solid aluminium. In their last patent they use a flux consisting of bauxite, borax, and salt, which is fused in a specially constructed furnace, which allows of the introduction of an inert gas to carry the metallic vapours formed by the dissociation of the aluminium chloride produced into a separate chamber, where they come in contact with the metal with which it is desired to make an alloy. The furnace is an electric one, and is worked at either a high potential (50–100 volts), or a low potential of 2 or more volts. In the former plan an arc is formed at the surface of the fused flux, which considerably increases its temperature and brings about dissociation through heat, which aids the electrolytic reduction, while, when worked at a low potential, the fused mass is simply electrolysed, a button of sodium aluminium alloy gradually accumulating at the bottom of the crucible. Parsons has urged the advantages to be derived from adding aluminium to the copper alloys, which at present contain none of this metal, and thereby lessen their corrodibility, increase their fluidity, and augment their strength. In his patent (No. 187, 1889) he suggests preparing, in the first instance, ingots of an alloy containing 100 parts by weight of iron, 50–105 of tin, 5–40 of manganese, and 3–50 of aluminium. He then adds from 1 to 5 parts of this alloy to the copper, brass, bronze, or gun-metal which requires treatment. In the case of bronze or gun-metal the quantity of tin may with advantage be increased, and a greater quantity of manganese (even ferro-manganese) may be used with these alloys than with brass.

Notes.

THE SALOMONS SCHOLARSHIP.

Sir David Salomons has offered to devote £1,000 to the foundation of an electrical engineering scholarship. This will furnish a scholarship of £30 or £40 a year. The management of the matter is left in the hands of a committee of the council of the Institution of Electrical Engineers. Sir David Salomons' generosity in this matter has resulted in one of the most public spirited actions which has yet been done by electrical engineers, and there is little doubt the scheme will be as effectual as it deserves.

INDUSTRIES IN QUEENSLAND.

During the year 1889 the output of gold has increased by over 56,000oz. as compared with that of the previous year, the total being 737,800oz. Of this amount 125,500oz., 112,700oz., and 51,000oz. came from Rockhampton, Gympie, and Croydon respectively.—During the past season 39,000 tons of sugar were produced in Queensland. This is very much less than might be produced in so suitable and extensive a soil as there is in that colony, but the difficulties as regards labour are no doubt a great drawback.—In the northern districts of Queensland some of the farmers and landowners are forming themselves into a company for carrying on the manufacture of extract of beef. An extract of beef which is made in a country where there is no great supply of old cab and 'bus horses ought to be generally acceptable.

COTTON SPINNING COMPANIES.

Though the margin between yarn and cotton is at the moment very poor—in fact, little more than change for a shilling—the several cotton spinning companies which took stock last Saturday have declared large profits. Subjoined is a list:—

	Spindles.	Profit.	Dividend.
Duchess	73,012	£1,543	10 per cent.
Lower Moor	9,756	286	10 „
Central.....	50,000	1,700	10 „
Higginshaw.....	91,600	900	—
Woodstock	81,876	608	—
Star	103,536	1,890	10 „
Commercial..	62,894	1,256	—
Gladstone	84,588	1,953	—
Arkwright	73,000	2,641	15 „
Crawford.....	154 464	4,998	10 „

The above results represent the margin at the beginning of the year, when cotton was ⅛d. per lb. lower than to-day, and when also the margin was very remunerative. Since then several things have gone against spinners. Not only has cotton advanced in price, but the yarn demand has slackened—that is, the consumption of both cop-twist and weft has fallen off, for looms have stopped, owing to the prolonged deadness of the cloth markets for India. Looking forward to the March quarter, the spinning companies will show larger profits than usual. The public should, however, bear in mind that business at the moment is difficult to transact, and the encouraging prospects of Christmas are gone to the winds. The whole position of the cotton trade is abnormal. The stock of cotton in Liverpool is over a million bales, and yet with small sales daily prices do not decline.

VINE DISEASES IN AUSTRALASIA.

According to the latest reports of the Vine Diseases Board of New South Wales, it appears that the phylloxera has been almost stamped out in that colony. The board have examined nearly a thousand vineyards, and they find that the disease is confined to three districts principally—viz., Camden, Sevenhills, and Toongabbie. They have, accordingly, entirely destroyed about twenty vineyards, roots and all, at a cost of about £7,500, which is to be paid by the Governments of South Australia, Victoria, and New South Wales. There is quite a scare in New Zealand about the phylloxera, and it appears that it is decidedly in evidence. The Government, however, is doing its best to see what steps can be taken, and, if possible, the same course will be adopted as has been pursued with such success by New South Wales.

A NEW FIRM OF ELECTRICAL CONTRACTORS.

The present time is a favourable one for the commencement of a business in electrical engineering and contracting, so that the new firm, Messrs. Girdlestone, Tatham, & Co., of 16 Davies Street, Berkeley Square, London, W., has undoubtedly a promising future before it. Mr. Girdlestone has for some time been chief engineer to Messrs. B. Verity & Sons, King Street, Covent Garden, and our readers will remember that he was the joint winner with Mr. F.V. Andersen of the "*Industries* Electromotor Prize." The new firm will make a specialty of electric light and ventilating installations, and in the near future they intend to commence the manufacture of certain electrical apparatus.

LEAD POISONING BY PATENT STOPPERS.

Mr. D. Woodman has recently issued a warning against the use of the patent combination rubber and metal stopper which is now being so generally employed for closing bottles of beer, soda-water, and other carbonated beverages. It appears that a number of cases of lead poisoning in the hospitals of Newark, New Jersey, were produced through patients drinking beverages from bottles stoppered in this way. The alloy used contains 46 per cent. of lead, the other metal being tin. More tin than lead appeared to be dissolved in the liquids, but the symptoms of poisoning noticed seemed to be due to lead. From the attention called to the subject in America many of the leading manufacturers have substituted ordinary corks and rubber stoppers for the patented one complained of.

VAN STEENBERGH WATER GAS.

Professor Lewes has recently furnished a brief report on the experiments which have been in progress for some time past at Knightsbridge to demonstrate the advantages of the Van Steenbergh process of manufacture of water gas. The inventors of the process claim that by the process it is possible to make 22 candle gas by employing naphtha for carburetting the water gas at about 1s. 2d. per 1,000 cubic feet, which is considerably more economical than the results which have been obtained in America by the older water-gas systems. Prof. Lewes has found, however, that the plant erected at Knightsbridge is capable of producing 1,000 cubic feet of gas having an illuminating power of 20·5 candles from a consumption of 24·5lb. of Welsh anthracite coal and 2·75 gallons of naphtha of 70° Beaumé, which, practically, confirms the claims of the inventors. With gas coke and naphtha of 40° B. similar results have been obtained, Prof. Lewes stating that 3,900 cubic feet of gas, having an illuminating power of 22·1 candles, were produced from 250lb. of gas coke and 13·5 gallons of naphtha. The percentage of carbonic oxide in the carburetted gas is below 25 per cent., and it is comparatively free from sulphur, which makes it still more advantageous to the consumer than coal gas. Apparently gas can be manufactured on this system with much less labour and less space than that required in ordinary gas works.

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Patent Record.

(Compiled from "The Illustrated Official Journal (Patents)."

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

17th February, 1890.

2510. Cocker, B. F. ..... Drawn swell ended wires for gun parts.
2511. Fiechter, E. ..... Machinery for sifting flour (*Fiechter*).
2514. Tetlow, Tetlow, & Taylor ..... Winding yarns.
2515. Campbell, A. ..... Disengaging gear for ships' boats.
2519. Meldrum & Meldrum ... Furnaces.
2521. Elliot, J. G. ..... Pumps.
2522. Haggart, T. ..... Machine tools.
2523. Jerram, F. O. ..... Sewing machines.
2528. Toovey, A. F. ..... Low water alarms for steam boilers (*Kildoyle*).
2529. Whitley, A. A. ..... Machines for stretching woven fabrics.
2534. Oldfield, B. ..... Machines for cleaning streets.
2536. Thomerson, C. ..... Sheet metal roofing.
2537. Speight, A. G. ..... Machine for the manufacture of corrugated paper or other textile fabrics.
2540. Martin, W. H. ..... Ventilating stoke holds.
2542. Bird, F. ..... Sewer ventilation columns.
2543. Warnant-Créon, J. ..... Magazine firearms.
2544. Chenhall, J. W. ..... Smelting furnaces.
2545. Gutmann, J. ..... Tool-holding chuck.
2548. Hilditch, H. ..... Drilling tools.
2549. Morris, R. ..... Magazine firearms.

18th February, 1890.

2566. Allison, H. J. ..... Rock drills (*Rand & Githens*).
2568. Marshall, W. H. ..... Railway trucks. (28th August, 1889.)
2569. Dovey, J. ..... Tube-lined wells.
2576. Cooper, E. W. ..... Lubricating bearings.
2581. Smith, J. ..... Marine boilers.
2582. Moss & Moss ..... Looms.
2585. Hudlestone & Willans Permanent way for railways.
2587. Fielding, J. ..... Gas engines.
2589. Holgate & Holgate ..... Looms.
2607. Fraser, J. ..... Multiplying and controlling gear.
2612. Grocock, W. A. ..... Closing doors of lift wells.
2614. Brooks & Barlow ..... Ring spinning machinery.
2618. Haddan, H. J. ..... Charging furnaces (*Wellman*).
2622. Bittinger, H. ..... Apparatus for conveying pulverulent materials.
2627. Boult, A. J. ..... Sole sewing machines (*Bertrand & Bray*).
2629. Thompson, W. P. ..... Producing car wheels (*Barr*).
2632. Thompson, W. P. ..... Centrifugal filtering apparatus (*Stehlik*).
2634. Dixon, T. S. E. ..... Air brakes. (22nd July, 1889.)
2637. Heymann & Prosser ... Car couplings.
2638. Hill, T. ..... Spring pedestal bearings.
2639. Fisher, T. W. ..... Pipe wrenches.
2642. Wells, C. ..... Hot-air engines.
2644. Lake, H. H. ..... Fire alarm apparatus (*Automatic Fire Alarm and Extinguisher Company, Limited*).
2647. Lake, H. H. ..... Gas engines (*Beckfeld & Schmid*).
2648. Lake, H. H. ..... Air engines (*Schmid & Beckfeld*).
2649. Summerton, T., Jun., & Brown ..... Steam engines.
2652. Michales, M. A. ..... Mining machines.

19th February, 1890.

2657. Waddington, E. ..... Overhead travelling crane.
2663. Smith, L. H. ..... Sewing machines.
2665. Britten & Biddlecombe Uniting rods or tubes.
2667. Gray, J. G. ..... Safety cage for mines.
2670. Campbell, H. ..... Gas engines.
2675. Wilson, A. ..... Spinning yarns.
2677. Robertson, E. J. ..... Grain elevator.
2680. Parkinson & Parkinson Ventilating apparatus.
2681. Brining & Lister ..... Machinery for lasting boots.
2683. Thompson, W. P. ..... Heating and purifying feed water (*Sutcliffe*).
2686. Bown & Capewell ..... Machines for shearing wool.
2691. Brown & Sutcliffe ..... Engine governor.
2695. Haddan, H. J. ..... Ventilating (*Mossner*).
2700-1. Newton, A. V. ..... Projectiles (*Nobel*).
2703. Dales, J. H. ..... Steam engines.
2704. Cito & Funck ..... Lifting jack.
2707. Whipple, C. A. ..... Machines for the manufacture of textile fabrics.
2708. White & Hill ..... Sheet metal boats.
2709. Pitt, S. ..... Diminishing recoil of firearms (*De Nottbeck*).
2712. Horne & Whinfield ... Breechloading guns.
2715. Cooper & Wigzell ..... Apparatus for taking soundings.
2719. Behringer, A. ..... Pulverising machines.

20th February, 1890.

2722. Smith, W. E. ..... Aëronautic apparatus (*Parloff*).
2728. Murday, T. J. ..... Gas engines.
2730. Robinson & Henderson Rollers made from slag.
2733. Harrison, W. ..... Knitting machines.
2734. Fairweather, W. ..... Fringing machines.
2736. Cliffe, W. ..... Woollen condensers.
2740. Wood & Whitaker ..... Boiler furnaces.
2743. Oldershaw, H. A. ..... Sewing machines.
2744. Servus, F. ..... Type-writing machines.
2756. Thame & Sanguinetti ... Machinery for the manufacture of hollow ware.
2757. Holman, E. A. ..... Breakwaters (*Holman*).
2758. Serraillier & Armstrong ..... Self-centreing chuck.
2760. Allport, S. B. ..... Drop-down small arms.
2763. Wise, W. L ..... Apparatus for dyeing textile fibres (*Mommer*).
2765. Cail, R. ..... Projectiles.
2767. Lock, C. ..... Railway brakes.
2770. Eli, A. J. ..... Sewing machines (*Welch*).
2771. Hughes, F. ..... Double-thread sewing machines (*Welch*).
2774. Imray, J. ..... Centrifugal machines (*La Société Nouvelle des Raffineries de Sucre de St. Louis*).
2778. Pidot, H. ..... Rotary fans.

21st February, 1890.

2782. Allison, H. J. ..... Typewriting machines (*Hamilton*).
2784. Brindle, Reade, & Taylor ..... Distributing sand on railways.
2787. Seddon, E. ..... Apparatus for sand-papering wood.
2789. Wilson, H. J. ..... Economising fuel.
2791. Merington, C. ..... Shell for rifled ordnance.
2799. Young, R. ..... Railway couplers.
2800. Leeming & Wilkinson ... Looms.
2803. Smith, H. ..... Apparatus for sifting grain.
2804. Dixon & Dack ..... Water-tube steam generators.
2807. Mortimer, Mortimer, & Wright ..... Looms.
2809. Hall, J. ..... Looms (*Lockwood*).
2810. Humphrey, J. T. ..... Pipe wrenches.
2811. Prince, F. O'C. ..... Gas pumps (*Parker*).
2818. Kiefer, G. ..... Dust collector and steam trap.
2821. Crowley, R. J. ..... Night signalling apparatus.
2822. Crowley, R. J. ..... Marine signalling system (26th August, 1889).
2826. Wauters, G. ..... Propelling boats.
2830. Brighton, W. H. ..... Drop-down small arms.
2835. Vavasseur, J. ..... Mounting guns.
2837. Dyson, J. E. ..... Hank dyeing machinery.
2839. Hopkinson & Hopkinson Water gauges.

22nd February, 1890.

2848. Eyre, G. F. ..... Apparatus for packing cotton wool.
2849. Spencer, G. ..... Haulage rollers.
2850. Stott, J. H. ..... Sectional warping and beaming machines
2851. Firth, G. H. ..... Differential regulation for steam engines.
2852. Bungeroth, W. G. ..... Rotary motors.
2863. Black, J. B. ..... Scutching machines.
2866. Whitehead & Mason ... Gas and hot air engines.
2867. Gessner, E., Jun. ..... Cloth shearing machinery.
2868-9. Boult, A. J. ..... Pneumatic guns (*Eichbaum*).
2870. Thompson, W. P. ..... Apparatus for cutting sugar canes (*Maurin*).
2872. Newton, J. M. ..... Steam boilers.
2874. Lees & Jones ..... Locomotive blast.
2875. Martin & Hendrickx ... Sewing machines.
2887. Schnarrendorf, J. F. A. Feed water purifiers.
2889. Fletcher & McFarlane Rivet-making machines.
2890. Wise, W. L. ..... Tools and tool-holders for machine tools (*Berger*).
2892. Horn, W. W. ..... Tacking machines (*Dean*).
2893. Brown, A. ..... Triple-expansion steam engines.
2897. Horn, W. W. ..... Lasting machines (*Dean*).
2900. Bawden, P. ..... Machinery for the manufacture of bricks and tiles.
2901. Jones, F. J. ..... Copper tubes, cylinders, &c.
2902. Ingraham, W. W. ..... Machines for grading grain.
2904. Lake, H. H. ..... Tool-holders for machine tools (*Garnier & Weil*).

ELECTRICITY.

17th February, 1890.

2527. Cornwell, O. ..... Electric arc lamps.

18th February, 1890.

2621. Watel, H. G. ..... Electrically driven fans.
2653. De Ferranti, S. Z. ..... Electric meters.
2654. Kingsbury, J. E. ..... Electric cables (*Western Electric Company*).
2655. Kingsbury, J. E. ..... Insulating electric wires (*Western Electric Company*).

19th February, 1890.

2659. Parsons, C. A. ..... Search light projectors.
2660. Scott, R. A. ..... Incandescence electric lamps.
2687. Armstrong, A. W. ..... Producing electricity.
2688. Armstrong, A. W. ..... Electric wire running.
2716. Brewer, W. J. ..... Electrical tramcars.

20th February, 1890.

2759. Timmis, I. A. ..... Lighting trains by electricity.

21st February, 1890.

2819. Lütcke, C., Jun. ..... Solution for batteries.
2825. White, W. ..... Electrical fuses, switches, &c.
2843. Braun & Lloyd ..... Telephonic receiver.
2844. Atkinson, L. B. ..... Continuous current armatures.
2845. Mackrill, E. T. ..... Secondary batteries.

22nd February, 1890.

2876. Walter, H. E. ..... Safety apparatus for preventing danger from high tension electric currents.
2905. Horn, T. ..... Electric indicator for revolving speeds.

CHEMISTRY.

17th February, 1890.

2526. The Borax Company, Ld. Manufacture of borax. (2nd October, 1889.)
2533. Thompson, C. ..... Recovery of metal from scrap.
2547. Johnson, J. Y. ..... Gunpowder (*Pieper*).
2559. Maxim & Sedgwick ..... Carburetting gas.

18th February, 1890.

2633. Leith, J. ..... Treatment of alkali waste.

20th February, 1890.

2772. Mayer & Lorrain ..... Recovery of gold.

21st February, 1890.

2808. Noad, W. ..... White lead.

22nd February, 1890.

2864. Young, W. ..... Paraffin wax.

MISCELLANEOUS.

17th February, 1890.

2539. Dennys, N. B. ..... Anti-fouling compositions for ships' bottoms.

18th February, 1890.

2609. Rogers, C. D. ..... Screw nails.
2611. Popplewell, W. W. ..... Artificial fuel (*Conried*).
2617. Hade, T. ..... Fire escape.

19th February, 1890.

2661. Edward John Shaw & Co. Hurricane lanterns.
2682. Sloan & Bell ..... Anti-fouling compositions.
2710. Harris, I. B. ..... Indiarubber valves.
2714. Hothersall, W. ..... Shuttles.

20th February, 1890.

2732. Hewitt, F. J. ..... Fog signalling.
2746. Moseley, A. ..... Compressed block fuel.
2769. Schlund, H. A. ..... Percussion fuses.

21st February, 1890.

2827. Boult, A. J. ..... Treatment of textile fabrics.
2832. Applegarth, E. ..... Treatment of straw, esparto grass, &c.

22nd February, 1890.

2896. Joy, W. ..... Cement.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form, of such opposition.

Year 1888.

16738. Collins.

1889.

1468. Molineux.
2658. Hart.
2695. Wright.
2868. Webber.
3056. Lovelace.
3427. Oetzmann.
3544. Cowburn & Peck.
4196. Bass.
4257. Binder.
4629. Pitkin & Niblett.
4871. Seegall.
4975. Aykroyd.
5079. Willcox (*Farbenfabriken vormals Friedrich Bayer & Co.*).
5342. Haghe.
5476. Vavasseur.
5492. Knights & Capsey.
5623. Calvert.
5749. Braime.
5966. Green & Green.
5996. Phalp.
6132. Storey.
6223. Livens.
6265. Watts.
6302. James & James.
6389. Harland & Gray.
6474. Weil.
6535. Jobling.
6555. Allan.
6593. McGeorge.
6608. Brown.
6624. Farrar.
6639. Rothwell & Rothwell.
6666. Unterilp.
6676. Wright.
6686. Dalmeyer & Beauchamp.
2601. Cotterell, Cotterell, & Cotterell.
2732. Wigley.
2990. Tasker & Whitehead.
3363. Edmundson.
3465. Boulch.
3607. Childs.
4198. Ramsay & Walker
4540. Relph.
4845. Hawke.
4965. Walter.
5066. Newton (*Swan*).
5156. Wailes.
5820. Bell.
5218. Pocock.
5412. Ferguson.
5485. Morris.
5535. Blair.
5733. Page.
5869. Butlin.
5976. Leyland.
6027. Hamilton.
6159. Penfold.
6258. Lang.
6266. Brown & Pruce.
6314. Widdison.
6442. Lake (*Richter*).
6482. Dobson.
6552. Hoskins.
6577. Robertson.
6603. Serginson & Noble.
6621. Jones.
6633. Whittaker, Whittaker, & Whittaker.
6672. Shaw & Hammond.
6679. Thomas.
6693. Edwards (*Weyher*).

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6701. Wilkinson.
6717. Moulding.
6728. Kapp.
6736. Dupuy & Dupuy.
6745. Keliani.
6759. Lake (*Simonds*).
6798. Mortimer.
6820. Hutchison.
6837. Williams.
6878. Johnson (*De Latouche*).
6918. Bonne.
6932. Morton & Thomson.
6986. Mee.
7047. Jackson & Galbraith.
7065. Griffiths & Smallwood.
7199. Lord.
7401. Hampton & Partridge.
7487. Coinon.
7600. Cant.
7716. Hime & Noad.
7752. Winter & Winter.
8237. Parkinson.
8789. Crawford.
8975. Ayres & Buchanan.
9050. Jones & Jones.
9564. Noerdlinger.
10600. Lord.
10829. Van Steenbergh.
11731. Lake (*Knapp*).
12232. Olander.
13504. Smith & Colligan.
14457. Allison.
15682. Carter & Hutt.
16816. Harness.
17611. Harness.
18231. Maggs.
18483. Thompson (*Newland*).
18702. Syer.
18975. Stevens & The Remington Machine Company.
20260. Stitzel, Weinedel, Reutlinger & Schwartz, Egelhoff, & Kreiger.
20967. Lake (*Bayles*).
6706. Milligan & Briggs.
6726. Henderson.
6733. Soar.
6744. Nash & Holding.
6746. Colebrooke & Gamgee.
6760. Sizer.
6815. MacIvor, Darlington, Paul, & Allan.
6849. Okes (*Roots*).
6916. Dyer.
6927. Hawley.
6937. Lungley.
6999. Gray & Kemp.
7063. Everitt.
7091. Simmons.
7136. Friedel.
7391. Von Mering.
7402. Kendrick.
7550. Abel (*Actiengesellschaft für Anilinfabrikation*).
7717. Wright.
8193. Webber.
8343. Enzinger.
8958. Frager.
8997. Spinks.
9362. Vernon.
9565. Noerdlinger.
10756. Wilson.
10892. Penn & Penn.
12139. Millar.
13015. Westwood.
14202. Fischer.
15629. Fletcher & Hills.
15780. Lake (*Pain*).
16872. Fisher.
17808. Brazil & Johnson-Ferguson.
18638. Dickinson.
18781. Phillipson & Baker.
19167. Adams.
19875. Newman.
20227. Lake (*Wood*).
20300. Ricker.
20508. Doherty.
20647. Suchland.
20835. Stromeyer.
20989. Holmes.

1890.

189. Bray.
281. Loftie.
300. Henderson.
384. Fuhrmann.
599. Pascall.
629. Moore.
780. Emery & Brigham.
854. Manfield.
856. Kluge.
892. Chappell & Lavandeyra.
939. Williams.
946. Radford.
990. Buckley.
1005. Preiss.
1028. Thompson (*Gutmann*).
1063. Holker.
1071. Cowley.
1094. Lake (*Ewing*).
1095. Smith.
1129. King (*Kennedy*).
1171. Franck.
222. Von Faber.
299. Driggs.
351. Jones & Jones.
543. Appleyard.
622. Mayfield.
758. Wingen.
814. Allison (*Morris, Gould, Fairchild, & Roberson*).
867. Piper.
908. Thoms.
915. Norton.
941. Lineff & Bayley.
950. Thompson.
1000. Hirsch.
1027. Thompson (*Harding*).
1044. Parkin, Frear, & Davie.
1080. Elster, Young, & Knapp.
1110. Hitchcock (*Burnley*).
1149. Sterne (*Atkinson*).
1182. Stukes & Reid. (22nd June, 1889.)

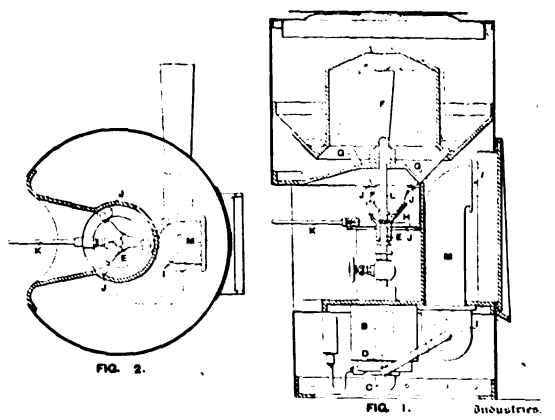
ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

Screws for Furnace Feeding.—*T. Andrews, Sheffield.*—The screws instead of being made solid as are usual is made according to the present invention hollow. In casting a screw a longitudinal hole of any desired length and diameter is made up the centre of the screw. The hole is opened at least at one end to admit a blast of air, steam, or gaseous fuel, which passes along the hole and out into the furnace and fuel through small holes or apertures. The stem of the screw may be made of increasing diameter with the helical blades decreasing proportionally to slightly disturb and break up the green coal; or, the stem may be made in sections of varying diameters for a similar purpose. The blast of air passed into the furnace through the hollow screws assists combustion over the screw case. Four claims are made. —No. 4904. March 21st, 1889. 8*d*.

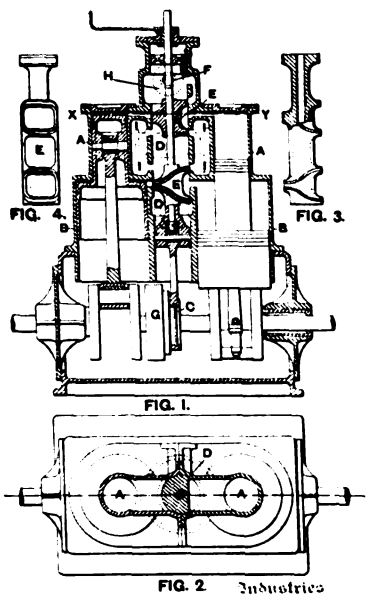
Propeller Shafts.—*C. D. Abel, London.* (*Gas Motoren Fabrik, Deutz, Germany.*)—For the purpose of reversing the rotation of the propeller shaft, the shaft is arranged in line with the motor shaft, and the two shafts are connected directly together for the forward motion by a conical friction clutch. The fixed part of the clutch is upon the driven shaft, whilst the sliding part is upon the motor shaft. A second similar clutch is arranged upon the motor shaft, the sliding part working upon a feather, whilst the other is fitted loosely upon the shaft and carries a toothed ring. A third friction clutch is arranged upon the driven shaft, with its parts arranged similarly to the second clutch upon the motor shaft and carrying also a similar gear ring. The gear rings of the second and third clutches are geared together by two wheels upon a counter shaft parallel to the propeller shaft. The whole of the clutches are worked together by a single lever, so that as the first clutch disconnects the motor shaft from the propeller shaft the second and third clutches simultaneously fix their gear rings to their respective shafts, and the motion of the motor shaft is transmitted through them and the counter shaft to the propeller shaft in a reversed direction. The cones of the first and second clutches being both upon the motor shaft may be combined into a double truncated cone shape to simplify the arrangement. One claim is made for the arrangement as described.—No. 5616. April 2nd, 1889. 8*d*.

Sand Blast Apparatus.—*J. E. Mathewson, Sheffield.*—In this apparatus a jet of steam is used to propel the cutting material. Fig. 1 is a sectional elevation of the appliance, and Fig. 2 is a plan. The steam is admitted from any convenient supply by the pipe C, and passes through helical passages D in the drying chamber B to give it a rotary motion. The rotary motion causes the steam to throw off by centrifugal force any moisture held by it. The steam passes up through the nozzle E to the pipe and funnel F, carrying with it sand, which trickles through the pipes G from the chamber above to the dish H. As the sand and


FIG. 2.
FIG. 1.
Industries.

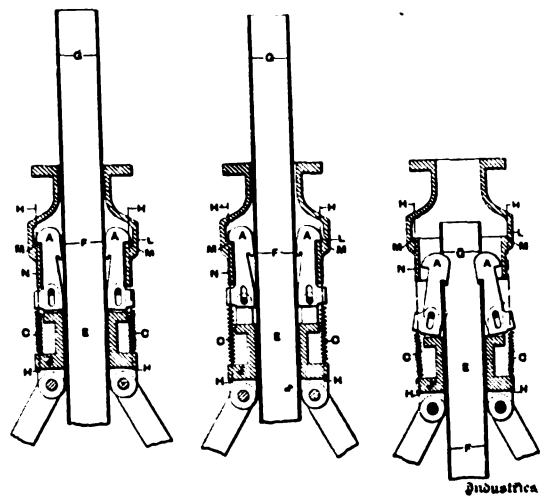
steam emerge from the funnel F the steam is drawn off by a steam jet exhauster I, and the sand passes on and strikes the glass being operated upon. A valve J is constructed to adjust or stop the supply of sand by turning the handle K from side to side. Claims: (1) In a sand blast apparatus in which steam is the motor, a blast pipe, as L, having its open lower end entering a dish-shaped hopper supported by or placed immediately above the steam jet E, such hopper being supplied with sand, in regulated quantities, by gravitation, direct from the dry sand chamber, as set forth, whereby the liability of the sand to come in contact with moisture from the condensed steam is avoided; (2) the arrangement of sand blast apparatus as described, in which the receptacle for the condensed steam, and the mud arising from the pulverisation of the sand, and of the surface under treatment, is placed below the dry sand chamber and its connections.—No. 14,923. September 21st, 1889. 8*d*.

Steam Engines.—*W. Wilson, Lowestoft.*—In the engine described in this specification the cylinders are arranged side by side, and a specially designed slide valve works in a circular chamber between them. The slide valve and its ports are so constructed that by a partial rotation of the valve the engine is reversed. Fig. 1 is a vertical section upon the engine, Fig. 2 a sectional plan upon the line X Y, and Figs. 3 and 4 a front and side elevation of the slide valve cast in one piece. The engine is constructed with high-pressure cylinders A and low-pressure cylinders B; between these cylinders is a circular chamber D for the slide valve E. The slide is connected to the crank shaft by an eccentric C and Hartnell type of governor G. In the longitudinal sections the slide valve E is of a Y form at the parts which control the admission of steam to opposite cylinders. To reverse the engine the valve is turned half round on its axis by a joint


FIG. 4.
FIG. 3.
FIG. 1.
FIG. 2
Industries.

forming the connection between the valve and eccentric rod. In working the engine, steam is admitted by the pipe F to the top chamber H, and passed alternately to the high-pressure cylinders A. From the high-pressure cylinders the steam is exhausted to the chamber I, and from there passed to the low-pressure cylinders. Claims: (1) A steam engine in which cylinders are arranged side by side or facing one another with their axes parallel, with an intervening valve chamber having oppositely arranged ports leading to the respective cylinders, and a piston valve or valves having or each having a single web on one side and double webs on the other side, the arrangement and operation of the valve or valves being substantially as described; (2) a steam engine of the kind referred to in the preceding claim wherein the reciprocating distributing valve or valves is or are made capable also of movement in a rotary sense so that the engine can be reversed by turning the valve or valves; (3) a steam engine in which cylinders are arranged side by side or facing one another with their axes parallel with an intervening valve chamber having ports leading to the respective cylinders, those leading to the cylinders at one side of the valve chamber being at different points in the length of that chamber from those leading to the cylinders at the other side, and a piston valve or valves having cavities at opposite sides thereof with working faces, the arrangement and operation being as described; (4) in an engine of the kind referred to in the preceding claim, providing between the valve or valves and the eccentric that actuates the same an adjustable connection whereby the distance between the eccentric and the valve or valves can be readily altered and the engine be thereby reversed as described. —No. 2148. February 6th, 1889. 8*d*.

Excavator Grabs.—*S. M. Cockburn, London.*—The object of this invention is to produce an automatic clip gear for grab buckets. The form of construction of the appliance preferably used is shown in the accompanying illustrations, which are sections upon the same parts in the different positions they assume whilst in use. Commencing with the grab being raised from the ground shut, the top part of the hooks A strike against the bottom corner of the suspender L; the hooks are pressed thereby into the openings F F in the frame E. When they come to the shoulder M they fly out, by the action of the springs C C, and the position of the parts in Fig. 1 are obtained. The grab is now lowered, the hooks resting on the shoulder, and on account of the action of the springs having no tendency to slip off the shoulder. Lowering continues, and the whole and every part of the grab, with the exception of the hooks, move downwards until the pins rest in the bottom of the slots, the parts at this instant assuming the positions shown in Fig. 2, in which it will be seen that the openings F have moved downwards and past the head of the hooks, which cannot now slip off the shoulder. The downward movement of the crosshead J is now arrested, and much of the weight of the grab is resting on the hooks A A; the line of action H H of this load gives the hooks a tendency to slip off the shoulder M, as the load is much greater than the force acting in the line of action of the springs, but the slipping is at


Industries.

present prevented by the frame of the grab. Lowering still continues, the frame E moving downwards and the grab opening. When the opening G in the frame passes the hooks they immediately slip from the shoulder M, and are instantly pulled downwards by the springs and are locked in gear with the frame, the part N of the suspender preventing their flying out of the openings while the hooks are falling. Fig. 3 shows this position the instant of falling from the suspender. As soon as the crane chain arrests the face of the grab, the pins will travel down the slot and rest on the bottom, and the grab will be suspended in the air open. Claims: (1) An apparatus constructed substantially as described and for the purpose set forth, whereby a hook so loaded that, when rested on a shoulder, it has no tendency to slip off, may be given a tendency to slip off by a change in the line of action of the load on the hook; (2) the combination of a hook with a limited amount of movement, with a spring or its equivalent, whereby the hook is made to engage instantly with the frame of the grab when released from a shoulder on the suspender; (3) the combination of a slot in a hook with the particular position of an opening in the frame, whereby the opening may move its position in such a manner that the hook cannot slip into it by the time it is given a tendency to slip from the shoulder on which it was resting; (4) the portion N of the suspender whereby the hooks are prevented from disengaging from the frame E until they have had time to become locked in position.—No. 3616. March 1st, 1889. 8*d*.

Nut-Locks.—*N. B. Dennys, Malay Native States, Malay Peninsula.*—The nut-lock consists of a thin disc of soft metal, preferably of copper, with a centre hole to fit the size of bolt to which it is to be applied. The periphery of the disc extends wholly or partially beyond the corners of the nut. On one surface of the "washer" thus formed a stud is riveted, or a projection punched, which enters a hole or depression of similar size in the surface to which the nut is applied. When the disc is in place and the nut screwed home a projecting part of the disc is either cut or turned up, so that the portion so treated prevents the nut from turning. Claim: The formation of an indentation in, or application of a stud to, an ordinary thin soft metal washer, or to a washer having a projecting lag, which indentation or stud is intended to enter an indentation made in the surface to which it is applied, the outer edge or lag of the said washer (as the case may be) being free to be turned up against any face of the nut screwed down over it, so as to lock the said nut rigidly in its place.—No. 1962. February 4th, 1889. 6*d*.

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FLANGING AND SHAPING METAL PLATES.—*A. C. A. Holzapfel, London.*—The machine here described is specially applicable to flanging and shaping shipbuilding plates. It consists of a powerful press whose dies are constructed of a number of metal rods of suitable length and of ¼in. to 1in. square. The ends of the rods constitute the surface of the dies. The rods are placed on end and are surrounded by a heavy steel hoop, with which the bars can be clamped in any position side by side. To give the dies the curved surface required a pattern of the plate is laid underneath the rods, the hoop slackened, and the rods allowed to fall and rest upon the pattern; the hoop surrounding them is then tightened. A similar proceeding is adopted in forming the other die. When both dies have the shape of the pattern, a thin asbestos plate is laid on the lower portion, and the plate to be shaped, after being suitably heated, is laid on the top. This is again covered with an asbestos plate, and the upper die is pressed upon the plate by mechanical means until it has assumed the shape required. Claim: The principle of using rods with roughened sides in a heavy iron band as means by which heavy iron plates can be simultaneously flanged and shaped, and which principle admits of the machine being adapted for any shape or form.—No. 2377. February 11th, 1889. *6d.*

COAL SCREENING AND BREAKING APPARATUS.—*H. Simon, Manchester.*—This invention relates to an arrangement of apparatus employed for the screening and breaking of coal preparatory to washing. The trucks conveying the crude coal are run on to a tipping stage, and are there tipped, and their contents delivered unto a slightly sloping oscillating screen. The smaller fragments fall through the meshes of the screen into the washing pit, and the larger pieces are delivered over the lower end of the screen on to a shoot, from which they pass to a stone breaker. From the stone breaker the crushed coal drops into the washing pit, and from the washing pit the washed coal is raised by an elevator to be further dealt with if necessary, or to be delivered into trucks for transport. Claim: The combination of a tipping platform, an oscillating screen and shoot and a stone breaker, as described.—No. 2699. February 15th, 1889. *6d.*

WINDING AND DRAWING MACHINES FOR SILK.—*A. Ridgway, Macclesfield.*—An improvement is here described in connection with the spindles of these machines. The spindles are surrounded by a series of springs, which are made from sheet steel or other suitable material. The sheet steel is cut or slotted to form the springs, and the ends are left intact to bend round the spindle and form ferrules. One end of the spring is fixed to the spindle, whilst the other remains loose to permit the requisite amount of play for the working of the springs. The springs by thus being made in one piece act concentrically and keep the bobbin running truly on the spindle. The springs may be made with one or more ferrules in the middle. Claims: (1) Making or forming a series of springs in one part or piece, as and for the purpose described; (2) the making or forming two or more series of springs in the length of the spindle in one piece or part, as and for the purpose described.—No. 1432 January 26th 1889. *6d.*

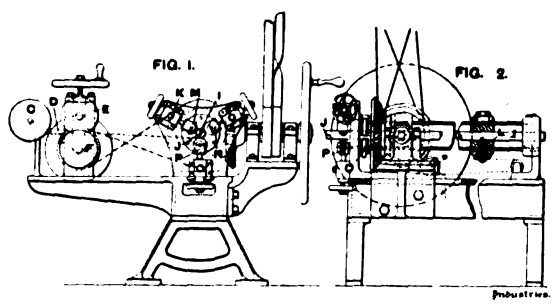
CRUSHING ORES.—*W. H. Coward, Bath.*—Improvements are here introduced into the apparatus described in a former specification, 12895 of 1888. The apparatus consists of a revolving drum, containing an edge runner rolling freely within the drum. The drum is provided with suitable means for supplying and removing the ore undergoing treatment. The improvements introduced are: First, to steady the edge runner so as to keep it central between the sides of the drum; secondly, to enable the roller to be variably weighted; thirdly, to facilitate driving the apparatus. The runner is kept central between the sides of the drum by being secured to a shaft which passes out through the opening in the side of the drum used for feeding purposes. The shaft is supported in two bearings, one of which is fixed, and the other (nearest to the runner) made to rise and fall, but weighted down by a lever and weight. The weight is made adjustable upon the lever, to permit variable pressure being brought upon the runner. The drum is partially supported by a tubular shaft concentric with the drum's axis and supported horizontally in bearings. This tubular shafting opens into the drum and constitutes the outlet for the pulverised material. To reduce the friction in the revolution of the drum, and to assist the hollow shaft in supporting the drum, the drum is made to roll upon rollers. Four claims are made for the improvements described.—No. 5286. March 27th, 1889. *6d.*

DRYING COTTON, &c.—*C. Turner, Rochdale.*—This invention refers to a method and apparatus for drying cotton, wool, and such like material when in the form of hanks, the material having undergone the process of dyeing, sizing, or similar process. Hitherto the hanks have been dried by being placed upon fixed staves or rails, as is well known, and have occupied much time in drying; with this improved apparatus motion is given to the hanks and in consequence they are more quickly dried. The apparatus has a hollow shaft supported vertically in a frame. To the top of the shaft is secured a belt pulley for the purpose of revolving the shaft upon its axis. The shaft also supports two drying frames which are arranged in a plane at right angles to the shaft. The top frame is fixed to the shaft, but the lower frame is made to slide upon it and is adjustable. The hanks are stretched from rails on the top frame to corresponding rails on the lower frame, the lower rails being adjusted to suit the lengths of the hanks. Motion is then imparted to the shaft by the belt pulley and the frames made to revolve with the hanks in the extended condition described. Claims: (1) In a machine for drying hanks of fibrous material, the employment of a spindle or shaft provided with a fixed frame and sliding frame, each carrying rails, the sliding frame acting as a means for stretching or distending the hanks. Two other claims are made for the apparatus as illustrated in the specification.—No. 4850. March 20th, 1889. *8d.*

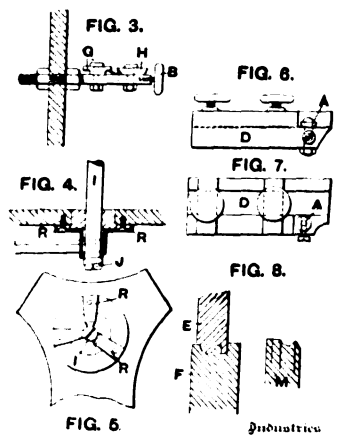
CORLISS STEAM VALVES.—*R. Middleton, Leeds.*—In this specification is described a small appliance for indicating the exact proportion of the stroke at which the steam is being cut off from the cylinder of an engine in motion. On the valve spindles, or on any suitable rocking shafts connected with them, is arranged a pointer which travels along the face of a plate. On the plate is marked a scale which represents the points of the stroke in divisions of one-hundreths. The pointer fixed to the rocking shafts travels along the plate until the steam is "cut off," when it returns quickly to its normal position. In some cases use is made of an additional registering pointer which is pushed along by the rocking pointer and stands at the maximum "cut off." The registering pointer may be made to be moved back to zero by slow driving gear or moved back by hand. Claims: (1) The application to an engine fitted with tripping gear on its steam valves of recording dials with indicating pointers—worked directly or indirectly off the steam-valve-spindles—for the purpose of showing the point of the "cut off"; (2) the apparatus in the whole or part as and for the purpose described.—No. 4067. March 8th, 1889. *8d.*

SCREW CUTTING TURRET HEADS.—*P. M. Justice, London.* (*J. M. Becher, Mishawaka, U.S.A.*).—The turret or die carrier is composed of two concentric discs placed one above the other. The dies are arranged radially around these discs in the edges of their peripheries, which face each other. The discs are made to open and close towards each other by an eccentric or cam motion operated by a hand lever. The discs are supported upon a hollow mandril, and can be revolved about their axis, so that any of the dies may be readily brought into action. The bolt to be screwed is preferably rotated, and the turret head slid up to it, but the turret head itself may be revolved and the work held stationary. Thirteen claims are made.—No. 15083. September 24th, 1889. *8d.*

MACHINERY FOR MAKING FLEXIBLE METALLIC COVERING.—*F. E. Plumb, Leeds.*—The flexible metallic covering is used for belts, bracelets, straps, dog collars, &c. The machinery produces spirally wound tubular casing from a continuous metal strip. The casing is afterwards flattened by means of suitable dies in a screw or hydraulic press. The metallic strip of metal is wound upon the bobbin C; from there it passes through a guide



D (Figs. 1, 6, and 7), which turns up one edge. From D it passes between the rollers E and F (Figs. 1 and 8), which give it a shape approximating its final shape. Having passed between the rollers E and F, the metal strip is led through another pair of dies G H, Fig. 3, which gives it its final shape, approximately that of an S, before being spirally wound. It is next attached by the slot J to the mandril I (Figs. 1, 2, and 3). The mandril I slides within a second mandril, but revolves with it, as a pin L passes through a slot in the outer mandril and is screwed into the mandril I. The outer mandril is geared by mitre wheels to the driving pulleys. The metal strip having been attached to the mandril I, the mandril is revolved, and the strip spirally wound upon it. As the strip is wound upon I, three dies, M N and P, interlock, and finally close the edge of one turn in the edge of the following. Claims: (1) In apparatus for producing spirally wound tubular casing the means of regulating and setting the finishing dies M N P; (2) in apparatus for producing spirally wound tubular casing, the employment of friction wheels O for the purpose of minimising the tensile strain upon the metal or composition strip during the finishing operation of spirally winding and closing; (3) flattening between suitable dies in a screw or hydraulic press spirally wound tubular casing to form a covering for belts, bracelets, dog and other collars, and harness ornaments; (4) in apparatus for producing spirally wound



tubular casing, the employment of the segmental collar R with internal projections to perform the office of a guiding nut to the metal strip as it passes to the dies M N and P; (5) in apparatus for producing spirally wound tubular casing, the employment of the set screw S for regulating the position of the primary shaping wheel A; (6) in apparatus for producing spirally wound tubular casing, placing the final shaping dies G H upon a bed to support the metal or composition strip and confine it within these dies which determine its final shape according to the relative position of the dies governed by the set screw B.—No. 1390. January 25th, 1889. *8d.*

RAILWAY SWITCHES.—*L. B. Stevens, London, & A. H. Johnson, New Jersey.*—The object of this invention is the better adjustment of switches in cases where more than one pair are actuated by one lever. This is done according to this invention by equalising the pressure given to each of the switches against the stock rails. The appliance for equalising the pressure is fixed in any convenient part of the rod connections between the lever locking apparatus and the switches. It consists of a cross-bar, which is pivoted at its centre to the rod leading from the operating switch. To the extremities of the arms of this cross-bar are pivoted the rods leading to the switches. With this arrangement when the switches are worked, if the tongues of one pair of switches strike the stock rails first, the lever rod, if pushed farther, continues to operate through the cross-bar the other switch rod until the pressure on the two switch rods are equal and the tongues of each switch pressed with equal force against the stock rails. If the rod leading to one switch should be a direct continuation of the rod leading from the operating lever, the end of the switch rod may be made hollow to receive the reduced end of the lever rod, and so form a lengthening and shortening joint whilst supporting the ends of the rods. The switch rod and the lever rod are in this case connected by a connecting rod. If one switch rod branches off from the direction of the lever rod, it may be connected to the lever rod by a bell crank lever and connecting rod. Instead of using a cross-bar, as described, the ends of the switch rods may be in the form of racks, and a pinion supported at the end of the lever rod to gear with the two, but free to revolve about its axis.—No. 5514. April 1st, 1889. *8d.*

CONVERTING RECIPROCAL INTO CIRCULAR MOTION.—*H. M. Lucas, Birmingham.*—Upon two parallel shafts are supported, free to revolve, two sector gear wheels with teeth around half their circumferences. Fixed to the shafts are clutches which engage with and lock the sector-geared wheels to the shaft at one point only. Two other gear wheels are also fixed to the shafts and connected by a chain which receives the continual rotary motion in one direction. Between the toothed surfaces of the gear wheels first mentioned works a double-toothed rack. The rack receives the reciprocal motion and imparts to the sector-geared wheels a backward and forward rotary motion of half a turn. As a consequence, one of the sector-geared wheels has, in the forward motion of the rack, the same direction of revolution as the other wheel has upon the backward motion of the rack. The clutches are therefore made to gear with one sector wheel in the forward movement of the rack and with the other wheel in the backward movement. Instead of using a double-toothed rack and sector-geared wheels, flexible bands may be employed and attached to smooth-surface wheels and to a bar working backwards and forwards between the two wheels. Claim: Mechanism for converting reciprocating motion into circular motion arranged and operating as described.—No. 5467. March 30th, 1889. 8d.

PURIFYING FEED WATER.—*J. Donaldson, Chiswick, London.*—According to this invention, the removal of impurities such as compounds of lime and magnesia from feed water is conducted in a steam generator as illustrated. Fig. 1 is a sectional end view, and Fig. 2 a sectional side view. The steam generator is of the type described in the specification No. 1404 of 1885. A is a horizontal cylindrical steam collector and separator fitted with a baffle

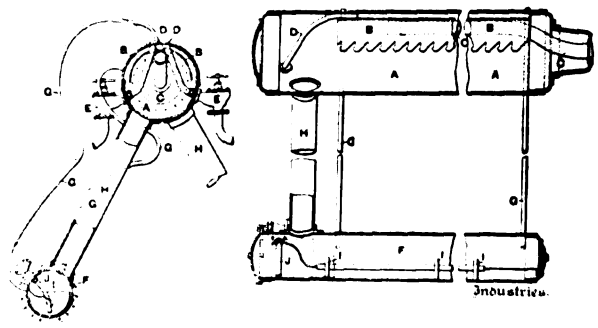


plate B, steam outlet pipe C situated under the baffle plate B, and inlet pipes D supplying feed water to be purified. The feed water supply is controlled by the valves E, and delivered on to the top of the baffle plate. The steam collector A communicates by the pipes G and H to water vessels F. With the construction described, when the feed water is turned on whilst the steam generator is under steam, the water will be directed by the inlet pipes D upon the baffle plate, where it will be intimately mixed with, and heated to a high temperature by, the steam that will also be discharged upon the baffle plate by the pipes G. The feed water, with its impurities thus rendered insoluble, will flow over the baffle plate to the bottom of the steam collector, and thence by the pipes H to the water vessels F, wherein the impurities will be deposited, whilst the steam escapes through the pipe C. The impurities may be blown off by pipes such as J, or collected in boxes placed in the water vessels under the pipes H and removed bodily. Zinc blocks I are placed in the water vessels to prevent corrosion, and assist in separating the impurities by acting as baffle plates. Claims: (1) For purifying feed water, the combination of a baffle plate, a feed water inlet or inlets arranged to discharge feed water above such baffle plate, an inlet or inlets for steam (or steam and hot water) to act upon the feed water above the baffle plate, these several parts being arranged in a suitable vessel connected with a second vessel through which the feed water that has been acted upon as aforesaid can pass and wherein any impurities rendered insoluble by the action of the steam or steam and hot water can deposit; (2) in a steam generator of the kind hereinabove referred to, admitting the feed water above the baffle plate in such a manner as to cause it to be there acted upon and purified by the entering jets or streams of steam or steam and hot water.—No. 4106. March 8th, 1889. *8d.*

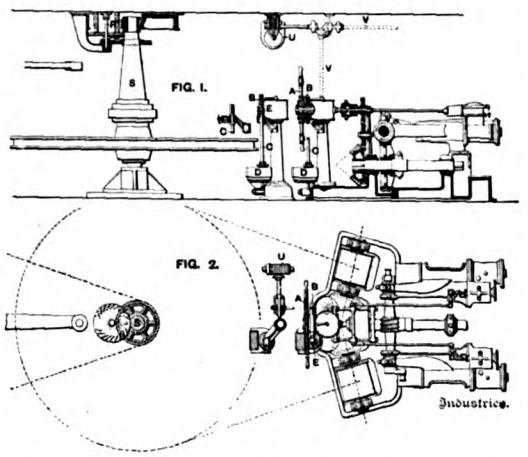
STEAM BOILERS.—*E. R. Joicey, Gateshead.*—This invention refers to the construction of the internal flues of boilers adaptable to boilers of the Lancashire and Cornish type. The flue has formed in it at intervals along its length two or more "mid-feathers" crossing at opposite angles and open at each end to the water in the boilers. These "mid-feathers" have a flattened elliptical cross-section, and are placed lengthwise in the flues. Between the flattened sides of the "mid-feathers" are inserted a number of tubes, through which the flames and gases from the furnace pass. The outside surfaces of the tubes are surrounded by water from the boiler. In order to make the flames and gases traverse the length of the flue in a serpentine or spiral direction, and to pass alternately over and under the "mid-feathers" and through the tubes, baffle bridges are provided made of refractory material. Claim: The construction of the internal flues of steam boilers with water mid-feathers at intervals along the length of flue, and crossing it in the manner of circulation tubes, said "mid-

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feathers" having between their flat sides a number of fire tubes so arranged that by "baffle bridges" the flame and gases from the furnace are compelled to take a serpentine course through the flue, and so obviate the injurious effects of the upper portion of the flue only being traversed by the flame and gases as well as to increase the strength of flues to increase the efficiency of boiler.—No. 5382. March 29th, 1889. 8*d*.

ELECTRICITY.

ELECTRICALLY CONTROLLED STEAM STEERING GEAR.—*W. Clark, London.* (*Sigmund Schuckert & Co., Nürnberg, Germany.*)—The object of the invention is to control steam steering machines by means of an electromotor, and to replace the mechanical connections heretofore employed between the captain's bridge and the steering gear. Figs. 1 and 2 show a steering engine on Macfarlane Gray's system with the present invention applied. To the hand wheel A there is attached a small worm wheel B, with which engages a worm E on the armature shaft C of an electromotor D. To enable the engine to be worked by hand when required, the worm E is made to be disconnected from the shaft C of the armature. The electromotor D, and consequently the steam steering engine, is caused to rotate in the one or other direction by the operation of a hand lever of a switch situated on the bridge, and



to which are connected wires of a dynamo machine used to light the ship. This switch is shown in Figs. 3 and 4. F and G are the leads to the ship's dynamo. H is the lever, which is held in its normal position, as shown, by springs I J. When this lever is moved, the ends of the springs K L come into contact with the fixed contacts M and N or O and M. From these contacts wires lead to the brushes of the electromotor D, so that the steering gear is operated by the movement of the lever H. An electric rudder telegraph P indicates at all times the position of the rudder. The hand of the telegraph is operated by two pairs of solenoids Q electrified by a succession of contacts made by an arm upon the spindle R (Fig. 1) which is geared to the main shaft S. A device is constructed to prevent the electromotor working any farther in

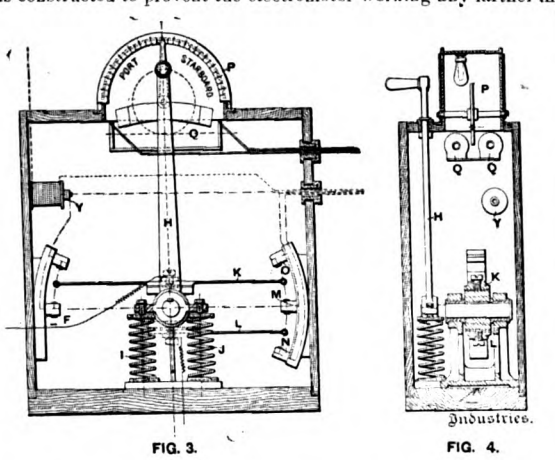


FIG. 3. FIG. 4.

the same direction when the rudder is hard over, notwithstanding that the hand lever H is kept hard over. Claims: (1) In electrically controlled steam steering gear, the arrangement of an electromotor D acting on the starting valve of the steam steering gear as described, in combination with a switch arranged on the bridge (preferably included in the electric light lead of the ship) and an electric lead connecting this switch with the said motor, which is normally without current, but by the motion of the switch lever either way from its central position receives a current flowing in the one or other direction, and is caused to rotate and effect a movement of the starting valve in the corresponding direction; (2) the substitution, in lieu of the motor D referred to in claim 1, of an electromotor U which is movably coupled with the shafting V that connects the hand steering wheel on the bridge with the apparatus on the steering engine; (3) the arrangement of a contact device Y in the lead to the armature or to the magnet coils of the electromotor D (or U as the case may be), in combination with an electromagnet (or solenoids) which when brought into circuit on the rudder reaching either of its extreme positions breaks the contact at Y and thus prevents further rotation of the electromotor.—No. 17914. November 9th, 1889. 8*d*.

CONDUITS FOR ELECTRIC CONDUCTORS.—*F. King, London.*—The conduit is constructed of earthenware troughs, made in convenient lengths and jointed together in the manner of drain pipes. The troughs may be covered by earthenware or iron lids. Holes are provided in the sides of the troughs for the connection of other troughs for carrying the leading-in wires to premises, &c. The insulated cables for the high tension charging current are carried by brackets formed upon each side of the troughs. The bare or insulated copper bars for the purpose of supplying the low tension current are carried by oil or other suitable insulators fixed to bridges spanning the bottom of the trough. These bridges are provided to permit any water that becomes condensed to pass under them and not come into contact with the insulators fixed on the top of the bridges. The water flowing through the conduits may be carried off at various points to the street drains. Claim: A conduit or support for underground electric conductors, the said conduit or support being constructed or arranged as described.—No. 5433. March 29th, 1889. 6*d*.

HARDENING STEEL TUBES.—*W. L. Wise, London.* (*M. Kramer, Berlin.*)—To overcome the difficulties usually experienced in hardening internally tubes of small diameter, the inventor makes use of electricity for heating purposes in the following method: The tube to be hardened is connected to a vessel filled with water, cold air, or carbonic acid, or other liquid or gaseous cooling substances under considerable pressure. Between the tube and the vessel is provided a cock, that enables communication with the interior of the vessel to be opened and closed as required. On the tube to be hardened, near to each of its ends, is placed a collar or clamp; each of these are in electrical connection with one pole of an electric battery or other source of electricity. The hardening is effected by passing through the tube an electric current of sufficient strength to heat the tube to the temperature suitable for hardening. The current is then quickly interrupted, and the cock opened to admit a current of cold liquid or gas to flow through the tube. In this way uniform hardening of the interior of the tube is effected. Claim: The hereinbefore described method of internally hardening steel tubes of any diameter, the said method consisting in heating the tube by the passage through it of an electric current, and then suddenly cooling it by a suitable liquid or fluid, delivered under pressure, from a reservoir to which the tube is connected, the electric current being previously broken or shunted as described.—No. 13659. August 29th, 1889. 6*d*.

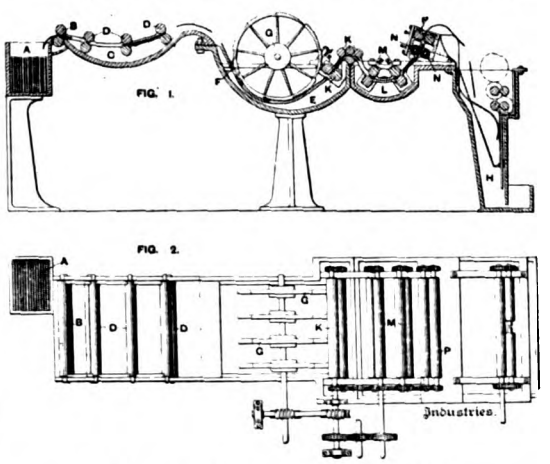
CHEMISTRY.

AMMONIUM CALCIUM PHOSPHATE.—*G. A. H. Gabet, Paris.*—The object of the invention is to manufacture a new manure—viz., ammonium calcium phosphate. For fixing the ammonia obtained by the distillation of urine or dung water, the inventor makes use of a concentrated acid solution of phosphate of lime, instead of sulphuric acid as is usual. A shallow cylindrical enamelled iron vessel is employed to receive the phosphate solution. This vessel is hermetically closed by a cover, and to its side is connected the pipe for conveying the ammoniacal gas from the distilling apparatus. The cover is provided with an agitator serving to mix the solution. Claims: (1) The employment of a solution of acid phosphate of lime for fixing ammonia to be used as manure, such application producing a product composed wholly of lime, nitrogen, and phosphoric acid, and of exceptional richness in the two latter substances; (2) the new product obtained as described in the preceding claim.—No. 5340. March 28, 1889. 6*d*.

COPPER AND ITS ALLOYS.—*G. G. Mullins, Los Angeles, U.S.A.*—The object of this invention is to refine copper and to render it more fusible. The copper is treated with a flux which is composed of purest native silica, fluor spar, carbonate of potash, and tungstate of sodium. These elements are first carefully crushed to a fine powder, and then all carefully compounded together in about the proportions of four parts of silica, three parts of fluor spar, two parts of carbonate potash, and one part of tungstate of sodium. On the bottom of the crucible, or on the bed of a reverberatory furnace, is placed from 1 to 10 per cent. of the mixture according to the character and weight of metal charged; when all is molten the bath is thoroughly stirred and allowed to remain quiet for a few moments. The scoria or dross is skimmed off, or 1 to 10 per cent. of the mixture, carried in paper bags, may be placed into the already molten metal. Claims: (1) The improvement in the process of cleaning, refining, and purifying copper and its alloys, which consists in adding to the metal a mixture of silica, fluor spar, carbonate of potash, and tungstate of sodium, in about the proportions set forth, commingling them by melting, skimming off the dross, and then proceeding in the usual manner; (2) the mixture of silica, fluor spar, carbonate of potash, and tungstate of sodium, in substantially the proportions set forth, to be used to cleanse, refine, and improve copper and its alloys.—No. 16,649. 1889. 4d.

ALUMINIUM.—*R. E. Green, London.*—This invention relates to the production of aluminium from the double fluorides of aluminium and sodium or potassium. The process is carried out in a suitable crucible which has an inlet at its extreme lowest part. Over this inlet are placed broken bits of charcoal, coke, or other refractory substance to prevent its being stopped up by the subsequent operations. Upon this charcoal is placed the fluoride of aluminium and sodium or potassium which has been mixed with silica, silicate of soda or potash, or other compound of silicon and finely powdered charcoal, and the whole is covered by a layer of newly-burnt lime. The mouth of the retort is closed with the exception of a small opening, and the retort is heated with its charge to a red heat. The retort is kept in this heated state for one hour, and during that time coal or other hydrocarbon gases are admitted through the small opening at the bottom. At the end of this time the decomposition of the fluoride is completed, and the gas is turned off and the slag removed. When the whole has been allowed to cool it will be found that the greater part of the aluminium is mixed with and absorbed by the charcoal and coke at the bottom of the retort, and can be separated therefrom by the ordinary methods. Good proportions are as follows:—Double fluoride of aluminium and sodium, 112lb.; silica (white sand), 48lb.: charcoal, finely ground, 28lb.; lime (freshly burnt), 38lb. Claims: (1) The production of aluminium in the manner as described; (2) in the production of aluminium from fluorides of aluminium and double fluorides of aluminium, and sodium or potassium, and the using of silica or silicates of soda or potash, or other compounds of silicon.—No. 5,914. April 6th, 1889. 4*d*.

COATING METAL SHEETS WITH TIN.—*E. Lones, Lydney, R. Davies, Lydbrook, J. Davies, Lydney, & B. A. Webb, Lydney, Gloucestershire.*—This machinery is designed to reduce the manual labour that is at the present time employed in the process of coating metal sheets with other metal. In the accompanying illustrations are shown (Fig. 1) a longitudinal sectional elevation and (Fig. 2) a plan of the machinery. The plate or sheet to be coated is taken from the water bath A and passed between the india-rubber covered rolls B to remove the water from it. It is next passed between a series of wooden rolls D in the



grease trough C, and led to the coating pot E. As it enters the coating pot it is held between corrugated shaped guides F, from which it is taken by the notches of the wheel G and conveyed through the pot as shown. The edge of one plate is made to overlap that of the preceding plate, to keep it in the notch. The plate is taken out of the coating pot and conveyed to the dipping pot L by a series of rollers, K and M; from these it passes between the brushes N supplied with oil. The plate is drawn through the brushes N by metal rollers P, which pass it on to the cradle O of an ordinary double grease pot H. It is afterwards finished in the usual manner. Claim: The method of and apparatus for coating metal plates or sheets with tin and other metals substantially as hereinbefore described and shown in the figures.—No. 4003. March 7th, 1889. 8*d*.

EXPLOSIVE COMPOUNDS.—*E. Liebert, Berlin.*—The inventor describes a new method of mixture for nitro-glycerine and dynamite in order to reduce their sensitiveness to blows and shocks without reducing their explosive force, and also to lower the temperature at which they congeal. Isoamylnitrate is the substance employed, and when added to nitro-glycerine presents all the advantages enumerated above. If 5 per cent. of isoamylnitrate be added to the nitro-glycerine the freezing point of the mixture is reduced to 35 degrees below zero, whilst its sensitiveness to blows or shocks is much less than that of pure nitro-glycerine. The isoamylnitrate is also completely decomposed by the explosion of the nitro-glycerine, and the gases produced scarcely differ from those produced by the explosion of pure nitro-glycerine. A suitable addition of isoamylnitrate is 3 per cent. In lieu of adding isoamylnitrate to the prepared nitro-glycerine an emulsion of glycerine and isoamylnitrate may be nitrated. Claims: (1) The improved process of preparing nitro-glycerine, which consists in adding isoamylnitrate to nitro-glycerine; (2) the improved process of preparing nitro-glycerine, which consists in nitrating a mixture of glycerine with isoamylnitrate or isoamylalcohol.—No. 5503. March 30th, 1889. 4*d*.

MISCELLANEOUS.

LINING BARRELS TO RESIST ACIDS.—*T. Bell, Lincoln.*—In order to overcome the well-known difficulties in providing acid-proof linings to barrels and other vessels used in the chlorination process of extracting metals, the following method has been devised:—The vessel is made of any suitable material, such as steel or iron, of the requisite strength, and into it is placed a lining composed of—firstly, a layer of lead, which may or may not be in metallic union with the vessel; secondly, a layer of gutta-percha, or similar substance, impervious to acids, which substance is by heat caused to unite with the lead; thirdly, a second covering of lead united to the gutta-percha by the same means as the first. As a modification, the gutta-percha may by heat be cemented directly to the barrel, and then a coating or covering of lead can be applied on or to the gutta-percha to constitute the lining. Claim: Lining barrels or other vessels with lead and gutta-percha, as above described, to resist acids for use in extracting metals by chlorination, or similar process, from their ores.—No. 2350. February 9th, 1889. 4*d*.

AIR VALVE.—*J. B. Dunlop, Belfast.*—This device consists of a short tube of caoutchouc or other elastic material, which is inserted and projects a short distance into the interior of the expansible article to be filled with compressed air. Within the inner end of this tube is placed a plug or short rod of hard india-rubber or vulcanite. The plug is cemented to part of the inner surface of the tube and constitutes the valve. The action of the device is as follows:—When air under pressure is forced into the article to be inflated, the elastic tube expands and permits the air to pass between the uncemented surfaces of the plug and india-rubber tube. When the pressure ceases, the elastic tube contracts and tightly embraces the plug or valve, the contraction being assisted by the pressure of air in the inflated article. Claim: The improved non-return air valve described.—No. 4115. March 8th, 1889. 6*d*.

Copies of the British specifications may be obtained on application to H. READER LACK, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at* ½*d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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CARRIAGE WHEEL MAKING MACHINE.

The machine which we illustrate herewith has recently been made by Messrs. John Sutcliffe & Son, wood working machinists, &c., New Bank, Halifax, for a firm of carriage makers in America. This machine is characterised by its durability and strength, and by the variety of operations which can be conducted by unskilled hands. The centre holes of the naves are bored and the spokes bored and mortised. The spoke ends are tanged for the felloes after they are driven into the nave and the felloes are bored to suit the tang. Any other boring and mortising work required in carriage building can also be done upon it.

THE RECENT GROWTH OF TECHNICAL SOCIETIES.

II.

In a recent article on the scientific work of the year 1889, the *Times* justly observed that "to examine, sift, and estimate all that science has said and done in a year would require a society of specialists in itself, working day by day, all the year round." Some such conclusion must have struck everyone who has taken the slightest trouble to inquire into the growth of scientific societies within recent years, and the work that they have accomplished. There is not, unfortunately, any exact record of the numbers, names, characteristics, and membership of the societies that are carried on outside of the United Kingdom. An attempt to formulate such a list was made in the first annual issue of the Year-Book of the Learned Societies—a most useful work, which gives particulars of all the scientific associations carried on in the United Kingdom, and the titles of the papers read at each from year to year. The work of collating the particulars relative to British societies has, however, apparently been found sufficient for one year-book, so that the foreign societies are in danger of being overlooked or neglected in any attempt to estimate the development of this great movement and its results on the intelligence, industry, and progress of the present day. Not to speak of Germany, France, Italy, Austria-Hungary, and Scandinavia, which are apparently as rich in learned societies as the United Kingdom, we find that in the United States every different State or Territory has its own series of scientific bodies, while such cities as Philadelphia compare most favourably with any similar town in England in the number, variety, and importance of the bodies that carry on the good work. So also in South and Central America. Mexico, for example, has its societies for the advancement of medicine, of geography, of natural history, of statistics, and of mineralogy. In Buenos Ayres, again, we find the Academy of Sciences, the Societies of Entomology and Palæontology, the Geographical Society, the *Sociedad Cientifica Argentina*, &c. Our Australian Colonies, including New Zealand and Tasmania, have a good and increasing show of the same kind, and neither China, Japan, nor our Indian Empire are behind, while even Java can boast of six different bodies, established with the same end in view.

A statement was compiled by the late Professor Levi which included an interesting comparison of the numbers of members of the different societies representing the different departments of science as between 1867 and 1878. The Professor found that the number of members in each group of societies showed the following extent of progress or retrogression over that period:—

	Number of Members in 1867.	1878.	Percentage of Inc.	Dec.
Royal Societies of London and Edinburgh, and Royal Irish Academy	1,359	1,305	—	3·97
Societies representing the Physical and Mathematical Societies	3,616	5,406	49	—
Societies representing Biology and Natural History	16,186	16,534	2	—
Societies representing Archæology and Geography.....	3,930	5,038	28	—
Societies representing Applied Sciences	14,506	21,949	51	—

The last-named group, which, of course, included the Institution of Civil Engineers, the Institution of Mechanical Engineers, the Iron and Steel Institute, the Institution of Naval Architects, &c., has, as might be expected, made by far the greatest progress. The fact is that while such societies as those representing biology, natural history, archæology, &c., are carried on for the pure love of science by enthusiasts who are more or less hobbyists, if not also faddists, the sociology of applied science is a necessary part of professional training and connection, with but few exceptions. And the societies that have most closely held this ideal up before them have approached most nearly to the position of becoming an almost indispensable trades union. The Institution of Civil Engineers, for example, have increased their membership from 1,698 in 1867, to 4,739 in 1888, being an increase of about 180 per cent. in about twenty-two years. It has been the same, though not to such an extent, with such societies as the Institution of Mechanical Engineers and the Iron and Steel Institute, which provide pabulum in the form of papers and discussions which are of such solid and substantial advantage to the interests that they represent that they may be almost immediately turned to commercial advantage by the discerning and capable.

The arrangements of scientific bodies differ very much in the matter of the frequency of their meetings. The famous French Academy of Sciences, for example, meets every Monday throughout the year, while our own Royal Society only meets weekly during a session of six months. The Institution of Civil Engineers holds a regular meeting every Tuesday during the winter session, and occasional students' meetings besides, but the Institution of Mechanical Engineers only meets four times in the year, and either one or two of these meetings is held in the provinces or abroad. Others, again, like the Chemical Society, which meets on the first and third Thursdays of the session between November and June, meet only fortnightly, while a hybrid society like the Society of Arts finds sufficient materials to hold usually two or three different meetings (including the sections during the week) while the session lasts. Finally, there are societies, like the Institution of Naval Architects and the Iron and Steel Institute, which meet only twice a year or so, holding, however, their meetings during several days, so that they get over almost as much ground as the societies that meet weekly or monthly. The British Association is almost the only one that holds an annual gathering only.

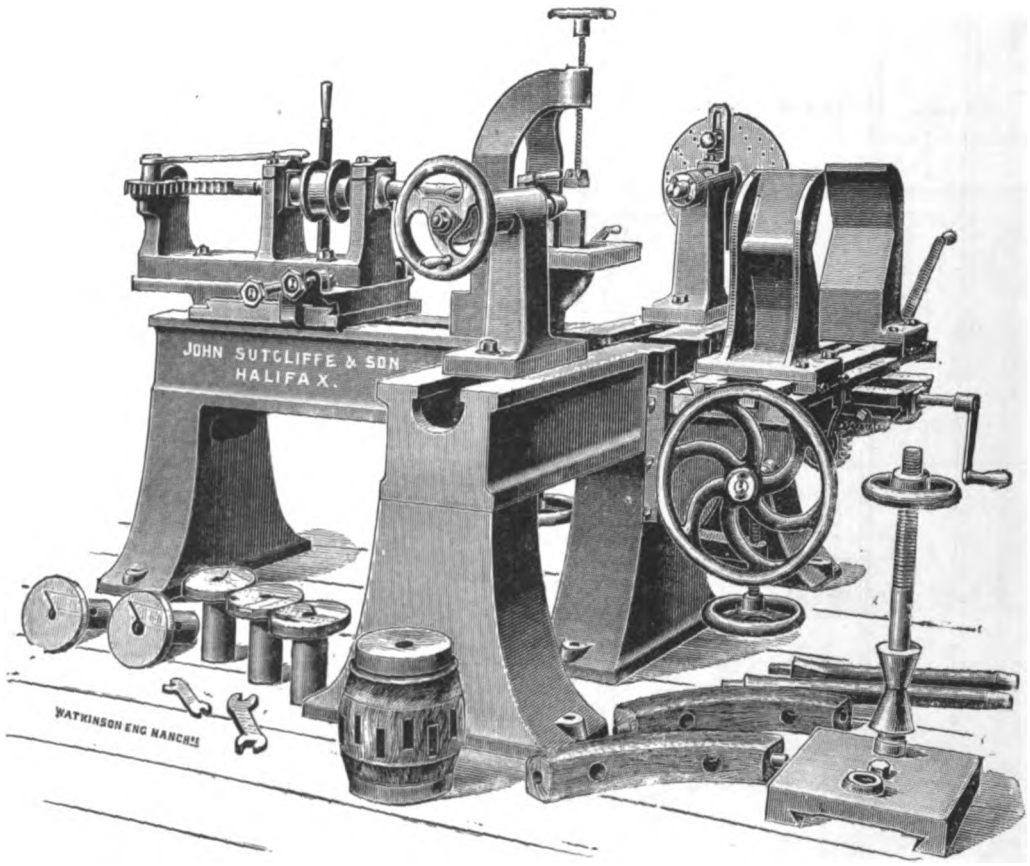
Most of the learned societies have laid themselves out for the collection and arrangement of a library representing the special branches of knowledge that they were established to cultivate. The principal, and especially the older, bodies, have in this way secured libraries of great value, that are the habitual resorts and the indispensable aids and accessories of specialists. Thus, the Royal Society has a library of about 43,000 vols.; the Royal Institution, a library of 45,000 vols.; the Royal Society of Edinburgh, a library of 15,500 vols.; the Pharmaceutical, a library of 9,000 vols.; the Geographical, a library of over 20,000 vols., the Geological, some 17,500 vols.; the Civil Engineers, more than 20,000 vols.; the Mechanical Engineers, about 4,000 vols.; and so with many other bodies. In the constitution of many learned societies, "the formation of a library" is distinctly set out as one of the principal objects of their foundation, and by the majority of them this end has been kept steadily and successfully in view. The library of his society has become to the scientific man, or to the man who follows a professional career, whether chemistry, medicine, architecture, engineering, or some other, a necessary adjunct, and often an everyday resort.

The largest and, in many respects, the most important of the various societies representing applied and mechanical science in the metropolis is the Institution of Civil Engineers. The progress of this Institution is almost unique. Unlike the Royal Society, it has owed nothing to the favour of the State, or to the influence of the great ones of the earth. It has been a purely voluntary creation, and furnishes, perhaps, as good an example as it would be possible to furnish of the successful results of combination for a useful purpose. The Institution was established in 1818, and in 1828 it was incorporated by Royal Charter. The objects of the Society are stated to be "the general advancement of mechanical science, and more particularly for promoting the acquisition of that species of knowledge which constitutes the profession of a civil (*i.e.*, civilian) engineer." The standard of membership is so high that the position of a member is prized among the profession. In order to be eligible for membership a candidate must have been "regularly educated as a civil engineer, and have had subsequent employment for at least five years in responsible situations, as resident engineer or otherwise, of adequately important works." This phraseology, although it may seem to be fairly precise, is in reality such as to leave many loopholes for the admission of members whose claims are by no means high.

The Institution of Civil Engineers took forty-four years to reach a membership of 1,000. It took sixteen years to reach a membership of 200. The last twenty years, however, have seen the ranks of the Institution more than doubled, the present number of members and associates of all classes being upwards of 5,000. These figures are fairly illustrative of the growth of the engineering profession during the same period. Up to 1860 the profession had made slow progress, but since that date it has advanced "by leaps and bounds." This, however, is not all. There were many active and prominent members of the profession in the early days of the Institution, who did not deem it necessary or desirable to join its ranks, besides which there was for a time a considerable amount of rivalry offered by another body, known as the Society of Engineers, founded in 1854, and still carried on, although long since left far

CARRIAGE WHEEL MAKING MACHINE.

CONSTRUCTED BY MESSRS. JOHN SUTCLIFFE & SON, HALIFAX.

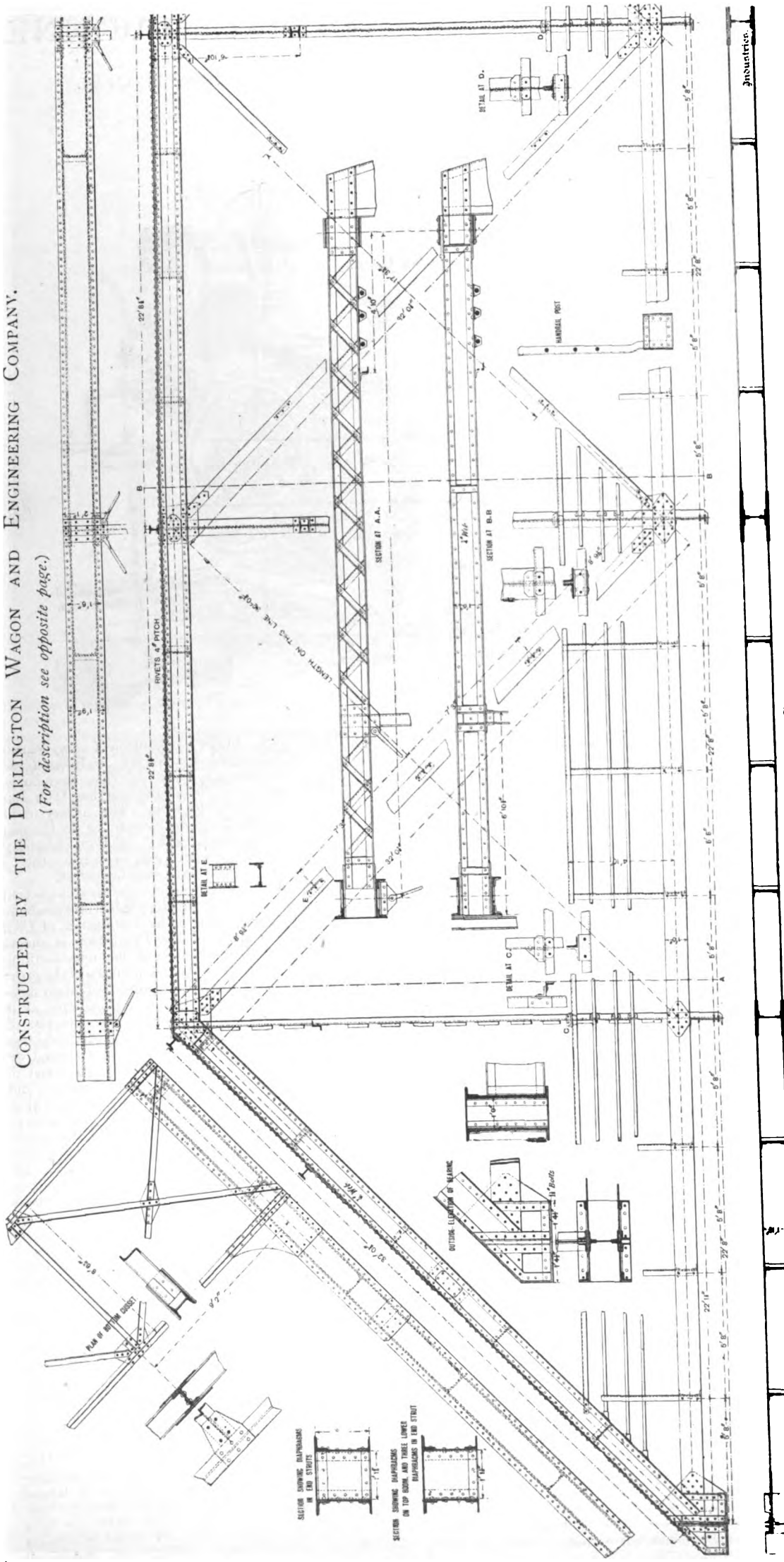


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A BRIDGE FOR CENTRAL AMERICA.

CONSTRUCTED BY THE DARLINGTON WAGON AND ENGINEERING COMPANY.

(For description see opposite page.)



behind by the parent society. The latter has by far the finest range of premises of any scientific body in the world, not even excepting the Royal Society. It has a unique engineering library; and its "Proceedings," of which four large volumes are published annually, at a cost of between £7,000 and £8,000, may be truly said to cover the whole field of applied science, either in the papers read and discussed, or in the papers accepted and selected but not read, or in the "Abstracts" from foreign sources. The annual statement of accounts presented on behalf of this Institution is so voluminous a document that it would take a much greater amount of space to summarise it than we can afford; but it may be remarked, in brief, that as "none but itself can be its parallel," this is the less necessary for purposes of comparison. The subscriptions to the Institution have increased during the last twenty years from £5,060 to £14,575, and the admission fees and life compositions from £514 to £3,841. With an income of close on £25,000 a year, the Civil Engineers have really a valuable estate to control, and, its administration is, on the whole, satisfactory.

One of the youngest of the societies representing mechanical science on the electrical side is the present Institution of Electrical Engineers, founded in 1871 by the late Sir William Siemens and others, as the Society of Telegraph Engineers and Electricians. The growth of this association, like the growth of the science that it represents, has been phenomenal. It was so much of an infant that in 1879, when Professor Levi drew up a paper on the scientific societies of the United Kingdom, it was not thought worthy, apparently, of a place among them. It was, at all events, not named by the learned Professor. The Institution has now close on 1,600 members in all parts of the world; it has a splendid collection of works relating to electricity and the allied sciences, called the Ronalds Library; it holds frequent meetings, at which all matters affecting the progress of electrical science are discussed, and it has not a few other claims to consideration and to the influence which it wields. The financial position of the society is indicated by the following statement of the income in 1878 and 1888:—

Items of Income.

	1878.	1888.
Entrance fees	£19 18 0	£165 18 0
Subscriptions	752 3 6	1,510 14 0
Life compositions	71 0 0	86 0 0
Sales of "Proceedings"	204 14 1	121 6 3
Total income	1,431 16 6	2,012 6 9

The annual subscriptions, it will be observed, have practically doubled since 1878, and this is the great test of a society's solvency and health. There has, however, been a falling off in the sales of "Proceedings," which is not easily explained, seeing that the annual volume issued by the society is more bulky and valuable than it has ever been, as it naturally would be, having regard to the much more varied applications of electricity. The expenditure of the society has kept pace with the increase of income, but not to a larger extent than the growing importance of the society would appear to justify, the chief items being as under:—

Items of Expenditure.

	1878.	1888.
Salaries	£129 7 7	£587 8 4
Rent	129 6 7	241 15 9
Printing, &c.	239 11 11	708 10 10
Meeting expenses	35 2 8	88 7 4
Total expenditure	794 1 2	2,025 14 7

The Iron and Steel Institute is a somewhat older society than the Institution of Electrical Engineers, having been constituted in the North of England in 1869, under the presidency of the Duke of Devonshire. This society has also made remarkable progress, the membership having advanced within the first ten years to nearly 1,000, and being now about 1,600. The Institute has a more cosmopolitan character than most others, having a large number of foreign members, and being in the habit of holding meetings at frequent intervals on foreign soil. The Institute publishes two large volumes of "Proceedings" annually, which contain abstracts of matters affecting the iron and steel industries from foreign sources. The income of the Institute, as between 1878 and 1888, has varied as under:—

Items of Income.

	1878.	1888.
Entrance fees	£170 2 0	£176 8 0
Subscriptions	1,850 2 0	2,648 2 0
Sales of "Proceedings"	86 6 3	194 2 3
Interest on investments	——	188 12 4

Here there seems to be progress all along the line, notably, however, in the members' subscriptions and in the sales

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of "Proceedings." Like the Electrical Engineers, the Iron and Steel Institute publish their *Journal* through Messrs. Spon, the well-known scientific booksellers, thereby differing from the Institution of Mechanical Engineers and the Institution of Naval Architects, who only publish direct from the offices, as well as from the Institution of Civil Engineers, who only sell their "Proceedings" to members, and do not offer them to the general public at all. As will be noted from the following statement of expenditure, the outlay on behalf of the Iron and Steel Institute has not increased so much as that of some of the kindred societies between 1878 and 1888: –

Items of Expenditure.

	1878.	1888.
Salaries and wages	£637 6 6	£854 0 0
Office rent	87 0 0	333 13 6
Printing and illustrations	807 10 10	890 0 5
Meeting expenses	250 1 6	191 2 4
Other expenditure	196 17 0	146 11 11
Total expenses	1,978 15 10	2,415 8 2
Balance on the year	679 15 10	791 8 5
Amount invested at end of year	——	5,995 16 2

One of the most financially successful of the societies representing applied science is the Institution of Mechanical Engineers, which was founded at Birmingham in 1847, and had George Stephenson for its first president. For a great many years this Institution had its headquarters in Birmingham, where it was originally founded, but some thirteen years ago it was decided to remove it to London. The Institution had 572 members in 1867, 1,146 members in 1878, and over 1,800 members in 1888. During the last-named period its annual income has increased from £3,801 to £6,121, as the following statement shows:—

Items of Income.

	1878.	1888.
Current subscriptions	£3,110 0 0	£4,634 0 0
Ditto in arrear and advance	——	316 0 0
Entrance fees	201 0 0	263 0 0
Sale of "Proceedings"	69 2 4	93 18 0
Interest	419 1 2	814 4 3
Donation to library	2 2 0	——
Total income	3,801 5 6	6,121 2 3
Capital	12,116 4 9	26,409 18 0

The remarkable increase of capital owned by this society between 1878 and 1888 is due in some degree to its having been the fortunate recipient of bequests and donations, the most important of which was contributed under the will of the late Sir Joseph Whitworth, one of its Past-Presidents. The Institution has now reached the point when its annual income exceeds its expenditure by about £1,000 a year, more or less. The expenditure has varied as under between 1878 and 1888, which is a period almost coincident with the life of the Institution as a metropolitan institution:—

Items of Expenditure.

	1878.	1888.
Rent	£550 0 0	£550 0 0
Salaries, &c.	1,107 3 0	1,655 8 6
Printing, &c.	1,096 17 8	1,296 15 4
Meeting expenses, including travelling	430 12 10	535 4 5
Total	3,676 14 3	5,219 5 3

The expenditure for 1888, which would otherwise appear to be abnormally larger than in 1878, was swollen by an item of £490 11s. 3d. for "research" undertaken with a view to drawing up a standard system of marine steam engine trials, and by an item of £114 17s. 5d. for "dinner guests," showing that the Institution is not only intent on hospitality, but is not afraid or ashamed, by seeking to cloak this item under some other head where it would never be traced by members, of "letting its right hand know what its left hand doeth." The expenditure for printing in 1888 was also swollen by an item of £181 17s. 2d. for the revision and reprinting of the library catalogue.

One of the most important of the societies representing mechanical science in a country like our own, which depends so much upon its shipping trade and its naval supremacy, must necessarily be the Institution of Naval Architects, which was founded in 1860, "to promote the improvement of ships and all that specially appertains to them." If the measure of the labours of this society is to be the extent to which the shipping industry of England has grown since 1860, then it must be pronounced to have been very successful indeed. The tonnage of the British Register in that year was 4,586,000, as compared with about eight millions of tons at the present time, and the steam tonnage on the British register has in the same period advanced from 452,000 to nearly 5,000,000 tons. Again, in 1860 the tonnage of new shipping built in the United Kingdom was only 226,000 tons, whereas in 1889 it was nearly five times as much. Nevertheless, the Naval Architects are a comparatively limited, and perhaps exceptionally technical body, so that neither the membership nor the income of the society have grown, like those of some other bodies with a more extended area of operations. The income has varied as under:—

Items of Income.

	1878.	1888.
Subscriptions	£1,049 10 10	£1,807 0 6
Sales of "Proceedings"	92 13 6	161 10 11
Admiralty grant	250 0 0	250 0 0
Other receipts	264 0 0	——
Totals	£1,656 4 4	£2,218 11 5
Balance in hand	£266 13 8½	£1,294 11 11

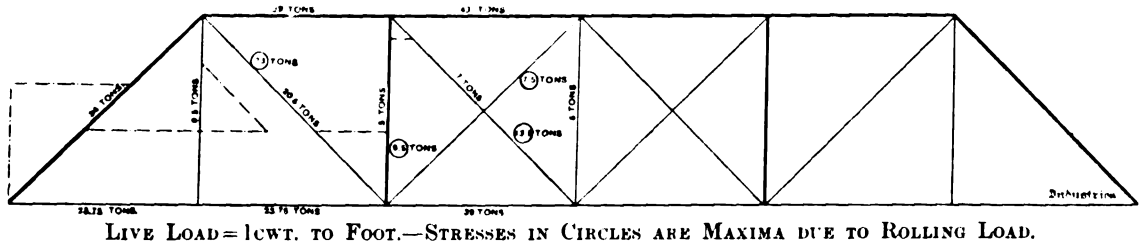
The Naval Architects have, after a long period of comparative impecuniosity and sailing near the wind, succeeded in obtaining a substantial balance to their credit. The actual income from members' subscriptions is less than that of any of the other societies occupying a leading position in mechanical science, but the membership, nevertheless, steadily increases, and now numbers between 700 and 800. As the following statement shows, the expenditure of the society has been kept within very favourable bounds, and in two items, at least, has actually diminished between 1878 and 1888:—

Items of Expenditure.

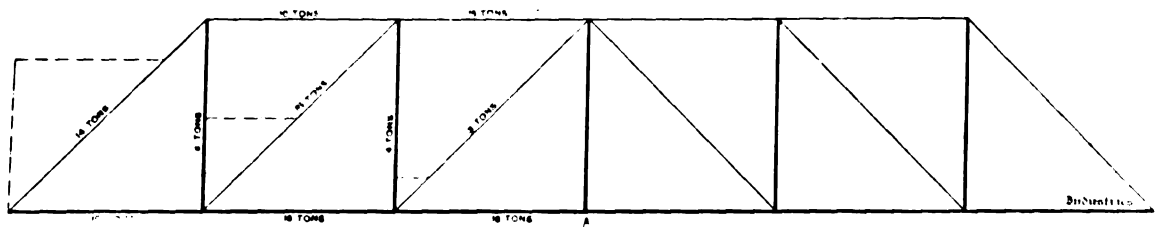
	1878.	1888.
Printing and illustrations	£652 9 10	£557 9 1
Salaries and wages	486 7 8	613 1 4
Meeting expenses	107 16 0	189 18 3
Rent	238 14 0	200 0 0
Other expenses	481 0 2	107 4 11½
Total expenditure	1,965 7 8	1,669 14 7½

A BRIDGE FOR CENTRAL AMERICA.

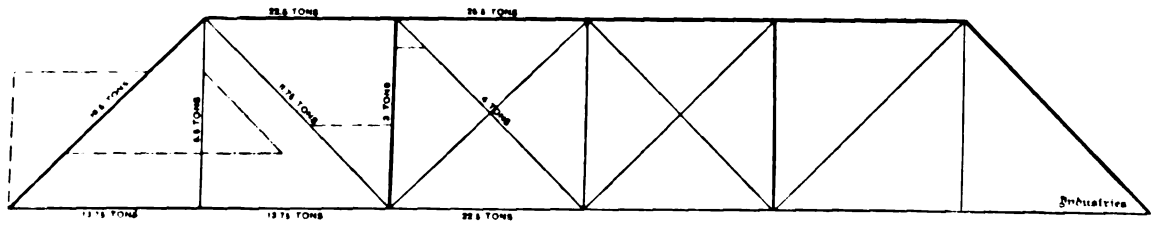
Diagrams of Stresses for 40 Metres Span.



Live Load = 1cwt. to Foot.—Stresses in Circles are Maxima due to Rolling Load.



Wind Load = 50lb. to Foot, Two Tons at Each Apex.—Diagram of Bottom Bracing.



Dead Load = 56lb. per Foot.—Superstructure and Flooring.

A BRIDGE FOR CENTRAL AMERICA.

The illustrations on pages 242 to 245 show a high-road bridge of 40 metres clear span that has recently been sent out to Central America. It has been designed by Mr. William Moore Angas, of Darlington, and built by the Darlington Wagon and Engineering Company. The general outline of the structure being different from the typical English design of bridge, a few words of explanation will be useful.

The bridge is intended to carry an ordinary high-road, and is calculated for a live load of 1 cwt. per square foot of deck area, which is certainly more than will ever come upon it. The stresses due to a live load of this density covering the entire structure are shown on the "live load" diagram above. The numbers in this same diagram in small circles are the stresses on certain members due to the most disadvantageous positions of the live load.

As the live load stresses are large in comparison with those due to the dead load, there is a considerable range of stress, and for this reason the various members are only lightly loaded. For example: The first main diagonal, consisting of two bars 8in. by $\frac{9}{16}$in., is stressed to only 4·3 tons per square inch of net area, and the other diagonals, in which the range of stress is greater, are not stressed to more than 3·8 tons per square inch.

The bottom boom is composed of two plates on edge. This member is nearly always in tension. Even when the bridge is unloaded, and when there is a wind pressure of 50lb. per square foot on the whole exposed area of both girders, there is only one panel of the bottom boom which is not in tension, and this panel is subjected to a total compression of only 2¼ tons, which is equivalent to 420lb. per square inch of gross area, on the iron plates composing the boom. These plates are, however, stiffened by diaphragms at intervals of 5ft. 8in., and are thus very efficiently stayed against compression, and may be safely relied on to transmit considerable compressive stresses. These bottom chord diaphragms carry posts for the handrail tubes as shown.

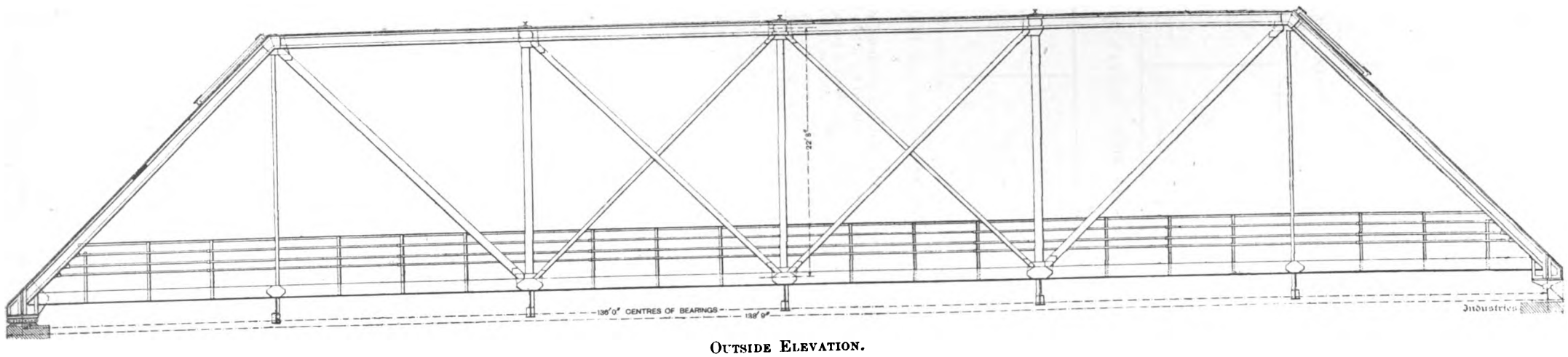
The various joints and connections to be made in the field are bolted instead of riveted. The bolts are all turned, and washers ¼in. thick are provided so as to give plenty of draw for tightening up the nuts without bringing the threaded portion of the bolts within the plates. The bolt holes were all drilled in position, whilst the complete girder was temporarily erected in the contractor's yard. All the plates through which any one bolt passes were drilled at the same operation. In this way very great accuracy is obtained, and the total load at any one joint is fairly distributed over all the bolts at that joint. Thus it is unnecessary to provide so large an excess of area in the cover plates and connections as is usual in riveted joints. The bolts are in double shear, and are stressed to not more than 3 tons per square inch; allowing nothing for their frictional grip, the iron behind them is loaded to about 6 tons per square inch of bearing area. The bottom system of wind bracing is composed of flat bars, but the upper system is of round rods tightened by right and left handed screws. Where these tension rods intersect there are small bolts in large oval holes, for the purpose of holding the two bars together and preventing rattling.

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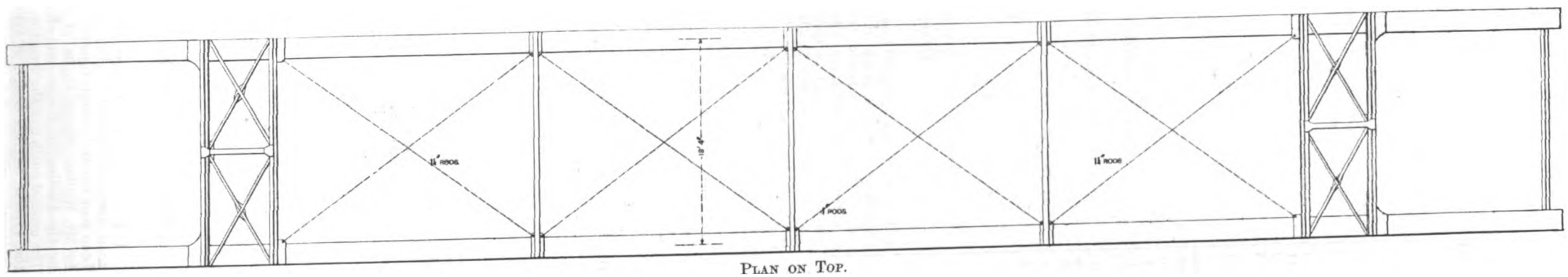
A BRIDGE FOR CENTRAL AMERICA.

CONSTRUCTED BY THE DARLINGTON WAGON AND ENGINEERING COMPANY, FROM THE DESIGNS OF MR. WILLIAM MOORE ANGAS.

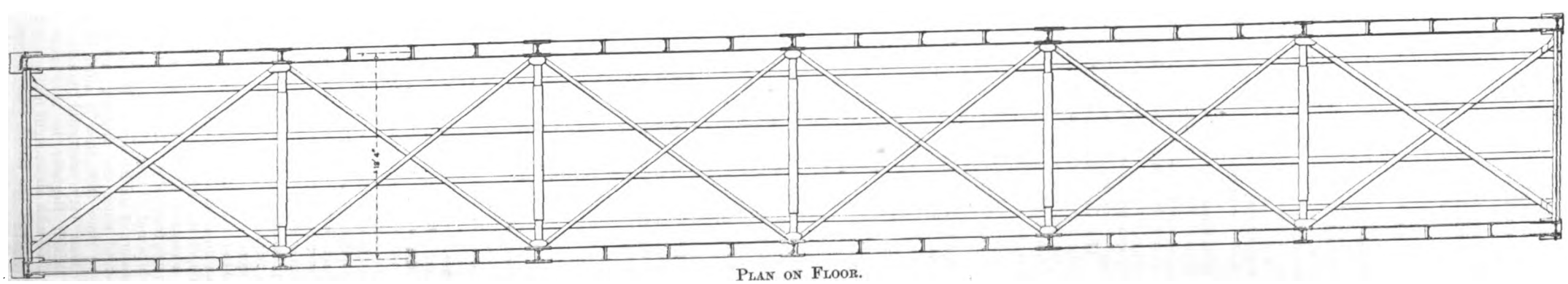
(*For description see page* 243.)



OUTSIDE ELEVATION.



PLAN ON TOP.



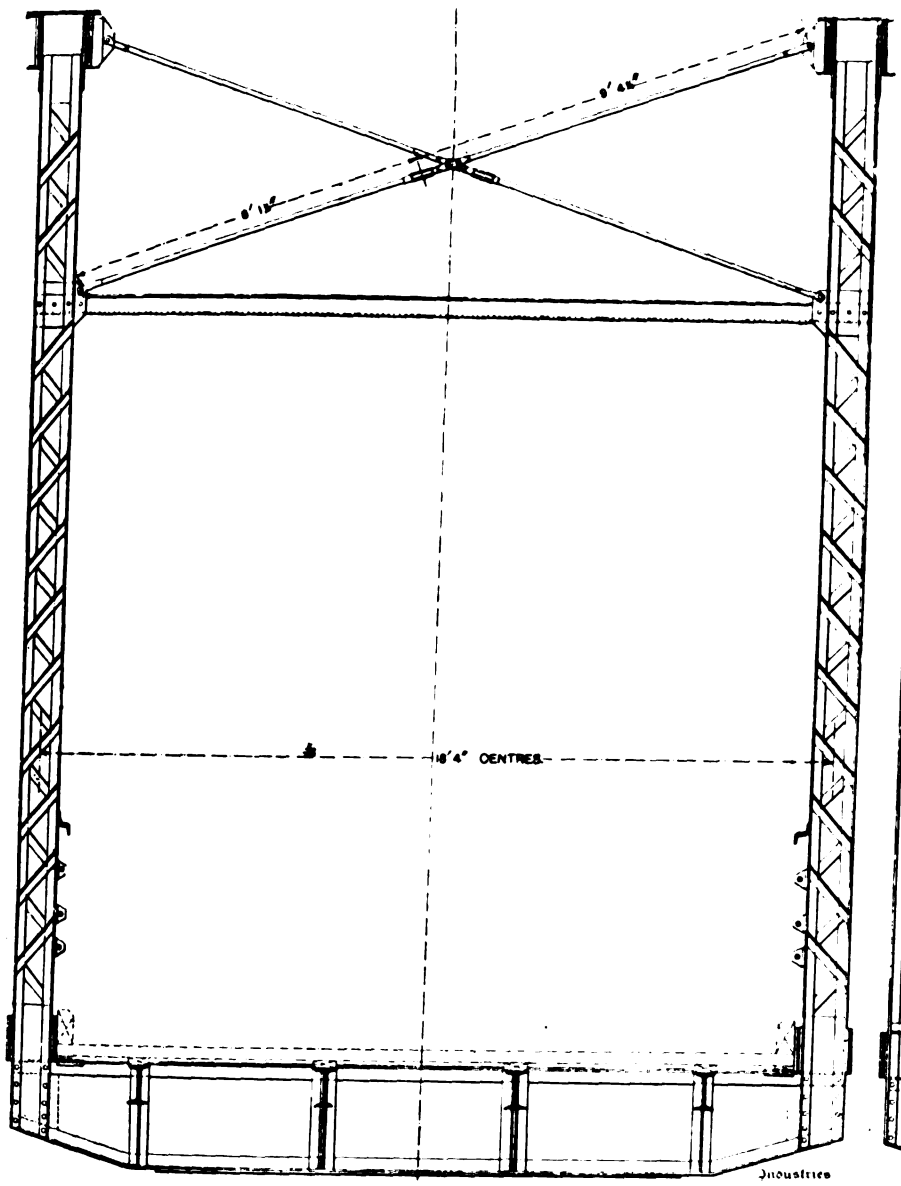
PLAN ON FLOOR.

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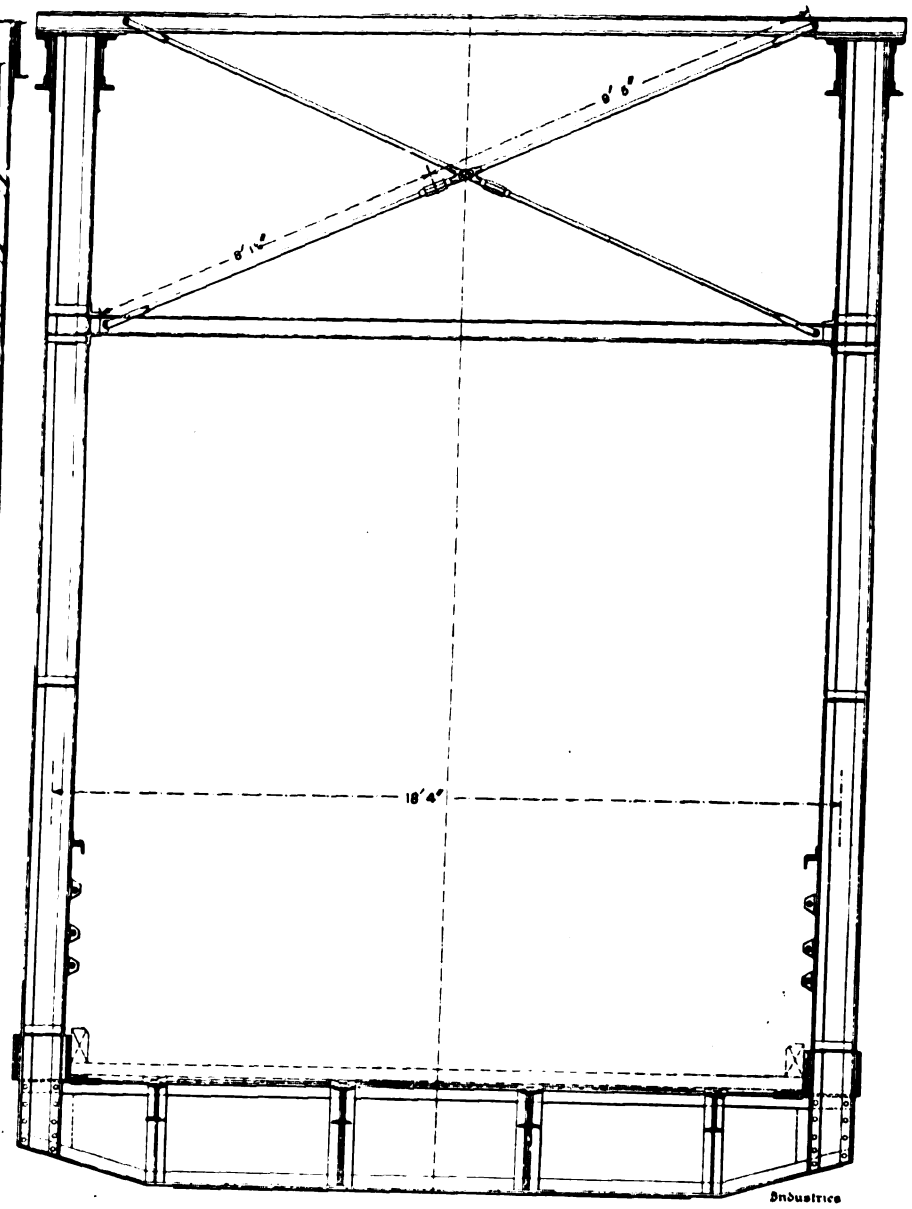
A BRIDGE FOR CENTRAL AMERICA.

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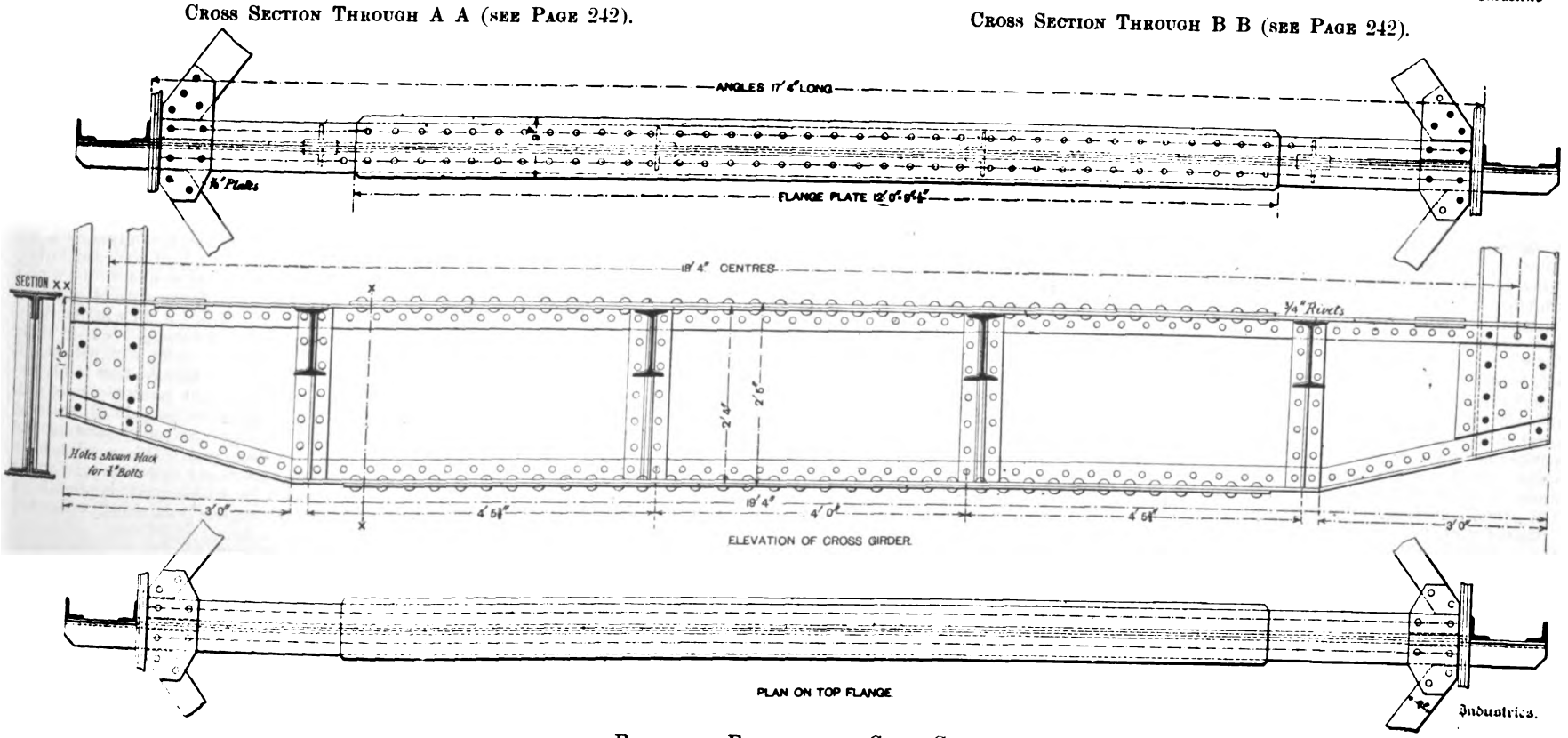
(*For description see page* 243.)



CROSS SECTION THROUGH A A (SEE PAGE 242).



CROSS SECTION THROUGH B B (SEE PAGE 242).



PLANS AND ELEVATION OF CROSS GIRDERS.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

(FOR LATEST TELEGRAPHIC DESPATCHES SEE PAGE 249.)

PARIS, 11TH MARCH, 1890.

IRON.—A slack demand and weak prices are features which distinguish the iron market of the capital from those of the provinces. The Paris merchants are utterly wanting in unity of action, and, as they seek to win customers by underselling, prices have receded to 160s. for bars and 164s. for joists. These reductions have, however, failed utterly to tempt buyers out of their reserve. In the Haute Marne business continues active. The demand is strong for wire and wire nails, and founders report plenty of orders. For ironmongery, too, the market is animated. A moderately brisk current of business is reported from the Ardennes and the Nord. In the latter district prices are less firmly maintained.

THE PORT OF DUNKIRK.—The constant expansion of the trade of the port of Dunkirk is a circumstance favourable to French industry. The number of vessels entering in 1888 was 5,242, having an aggregate tonnage of 2,392,469. Last year the number was 5,071 vessels, representing a tonnage of 2,453,931, an aggregate that would have appeared larger had not the new regulations for gauging the tonnage come into force in the later months of 1889. The harbour improvements now approaching completion will tend to still further increase the trade of this port, and to make of it a formidable competitor with Antwerp.

FOREIGN TRADE.—The cry is everywhere for more protection. Each industry is confessing itself incapable of standing against foreign competition. Scarcely a day passes without some fresh fact, some new table of statistics being brought forward to prove the truth of this confession. What this signifies for the future of French industry we will not now attempt to divine; but it is instructive to examine some of these statistics which have reference to the relative developments of the export and import trade of this country. For example, the declared value of the manufactured goods was 1,428 million francs in 1860, and 1,556 millions in 1888. Absolutely considered this might be deemed a satisfactory degree of expansion, but relatively to the growth of the import trade in such goods it leaves much to be desired, for the value of these imports has increased from 124 millions in 1860, to upwards of 600 millions in 1888. It is clear from these figures that the economic conditions have materially changed, and that French industry is not holding its own against foreign competition. In the opinion of the vast majority of Frenchmen, the only remedy for this evil is to be sought in the system of protection.

BERLIN, 10TH MARCH, 1890.

ENGLISH COAL FOR THE PRUSSIAN RAILWAYS.—Two cargoes of English coal for consumption on the Hanoverian lines of railway have recently arrived at Bremen. The price paid is said to be 20s. a ton delivered on trucks. The fact that the State railway authorities are buying foreign coal shows that the supply of home produce is insufficient to meet current requirements. The imports of foreign coal are increasing.

PIG IRON PRODUCTION IN 1889.—The production of the German blast furnaces in 1889 was, according to the official returns just published, made up of 2,047,677 tons of forge and spiegel pig, 1,402,444 tons of Thomas pig, 405,490 tons of Bessemer pig, and 531,893 tons of foundry pig; the total was 4,387,504 tons, against 4,229,484 tons in the previous year, which shows an increase of 3·7 per cent. The increase would have been considerably greater had the supply of fuel not been interrupted by the strike in the coal mining industry. The total production in 1879 amounted to only 2,226,587 tons.

GERMAN IRON ABROAD.—The effects of high prices on the export trade in iron become more distinctly visible as old contracts run out. The total quantity of iron of all sorts sent out of the country in the first month of the present year amounted to 64,334 tons, against 70,846 tons in December and 90,235 tons in January of 1889. In the following classified list the figures within parentheses are those for the same month of last year: Pig iron, 8,632 (20,116) tons; old iron and scrap, 2,048 (2,062) tons; half wrought iron and steel, 1,505 (2,290) tons; finished iron and steel (in angles, bars, and plates), 14,947 (24,304) tons; wire, 9,609 (15,259) tons; wire nails, 3,131 (4,019) tons; rails, 8,581 (8021) tons; other railway iron, 4,717 (4,192) tons; heavy castings (except ordnance), 2,122 (1,237) tons; other manufactured goods (except machinery), 9,022 (8,732) tons; total, 64,334 (90,232) tons. The falling off is especially noticeable in pig, finished iron and steel, and wire. The shipments of wire and wire nails to Great Britain in January amounted to 3,327 tons for the former and to 984 tons for the latter. Japanese customers took 963 tons of wire nails.

THE GERMAN STARCH INDUSTRY.—From the report of the general meeting of starch manufacturers held here last week we learn that, with a potato crop of 21,000,000 cwt. Germany produced last year some 460,000 cwt. of starch, and Holland, with a potato yield of 500,000 cwt., produced 160,000 cwt. of starch. Professor Delbrück spoke of the use of potato starch mixed with rye or wheat meal for the manufacture of bread, and strongly recommended the practice, which he said was rapidly growing in public favour. A resolution was passed to make an appeal to the Government for a reduction of the railway rates of carriage for wet as well as for dry starch, to enable the German manufacturers to meet Dutch competition. The total exports of starch and potato meal in the first month of the current year amounted to 66,226 cwt., against 44,924 cwt. in the same month of last year. The principal customers are Great Britain and Spain. To the former the month's shipments amounted to 20,146 cwt., and to the latter 20,518 cwt.

NEW DOCKS ON THE RHINE.—It is proposed to build four large docks on the Hessian Rhine. One is to be built at Worms, and another at Bingen, a third near Oppenheim, and a fourth between Castel and Kostheim, in connection with the Main Canal.

THE INTERNATIONAL LABOUR CONFERENCE.—The following is the programme of the deliberations of the International Conference respecting the regulation of work in industrial establishments and mines:—I. *Regulation of Work in Mines.*—1. Shall the underground employment be prohibited: (*a*) of children below a certain age? (*b*) of females? 2. Shall a limitation of the hours of labour be provided for in mines wherein the work is particularly prejudicial to health? 3. Is it possible in the general interest to submit to an international regulation the work in collieries, so as to assure regularity in the output of coal? II. *Regulation of Sunday Work.*—1. Shall work on Sunday as a rule, and save in cases of necessity, be prohibited? 2. What exceptions may be allowed should such a prohibition be issued? 3. Shall such exceptions be determined by international convention, by Act of Parliament, or administratively? III. *Regulation of Child Labour.*—1. Shall children up to a certain age be excluded from industrial labour? 2. How is the age to be determined up to which the exclusion shall operate? The same in all branches of industries or differently? 3. What restrictions in the hours of labour and the kind of employment are to be provided in the case of children admissible for industrial labour? IV. *Regulation of the Work of Young Persons.*—1. Shall the industrial labour of youthful persons who have passed the age of childhood (12) be subject to restrictions?—2. Up to what age shall the restrictions take effect?—3. What restrictions are to be prescribed? 4. Shall exceptions to the general provisions be provided for in individual branches of industry? V. *Regulation of Female Labour.*—1. Shall the day or night work of married women be restricted? 2. Shall the industrial labour of all females (women and girls) be subjected to certain restrictions? 3. What restrictions are desirable? 4. Shall exceptions to the general provisions be provided for in individual branches of industry, and which? VI. *Execution of the Provisions that may be Agreed Upon.*—1. Shall measures be taken for the carrying out and supervision of the provisions to be agreed upon? 2. Shall repeated conferences be held of the representatives of the Governments taking part, and what tasks shall be assigned to them?

VIENNA, 10TH MARCH, 1890.

THE COAL MARKET.—The wintry weather which recommenced during the first days of this month has caused such a strong demand for coals in Vienna, that the Northern Railway will have its work set to supply all its customers. Special trains are fitted out to bring coals from the Ostrau district to Vienna. As the consumption is steadily increasing for both household and industrial sorts, the use of Bohemian brown coals will largely increase. The general manager of the State Railways has already commenced the calculation of special tariffs for the transport of Dux coals to the Vienna market. It is a question, however, whether the Bohemian works will be able to deliver all the necessary quantities, because the traffic in Bohemia is extraordinarily brisk. Last month the receipts of the Dux-Bodenbach Railway increased by 115,000fl., and those of the Prague-Dux Railway by 12,000fl., as compared with the same period of the last year. The Salgo-Tarjau coal works have issued the report for the last business year; it shows a clear profit of 432,000fl., and the company will pay a dividend of 16 per cent. At five of the Wolfsegg collieries near to Linz in Upper Austria a strike has broken out. Labourers demand an increase of wages and a reduction of the working time. Owners, however, are not willing to meet the claims of the labourers, and so the end of the strike is not to be expected.

THE IRON MARKET.—The iron market continues in the usual condition. The building season has already begun, and was followed at first by an increase of the demand for girders and rolled iron. Already the works have plenty of orders on hand. Bar iron has been raised 5fl. per ton in Bohemia. Machine makers cannot receive any further orders, and an import is being made from England in consequence. The Erste Brünner Maschinenfabriks-Actiengesellschaft of Brünn is enlarging its establishments, and a new machine manufactory is to be erected in the neighbourhood of that town. The Schick'sche foundry and machine manufactory of Budapest made a profit of 115,000fl. last year, and is paying a dividend of 12 per cent.

BRUSSELS, 11TH MARCH, 1890.

THE COAL MARKET.—The state of the coal market is becoming more regular. It will be remembered that at the commencement of the year the market experienced a succession of severe shocks, and ever since then the prices have been uncertain, and have depended entirely on momentary circumstances. In consequence all the large consumers refrained from entering into contracts, and confined themselves to hand-to-mouth transactions. Now, however, these feverish symptoms are passing away, and the prices may be fixed with some feeling of security for a considerable period ahead, and long contracts are again being entered into. Coke is steady at 35fr., and coking coal at 20fr. to 21fr. In *fines demi-grasses* 16fr. and 19fr. are maintained as the extreme prices. Close burning coal is very firm at 15fr., and screened and nuts are at 20fr. to 21fr. Briquettes are sold at 23fr., 24fr., and 25fr. Contrary to the hopes of most of the coal producers the special tariffs of 1886 for the carriage of coal by the State railways were abolished on the first of the month, and since then the Grand Central Railway has followed the example. The carriage of goods by the State railways has increased very much during the week ending the 2nd inst., as compared with the similar week in 1889. Most of the increase is due to the greater business in coal and coke.

THE IRON MARKET.—The most important event of the past week in the iron market has been the decision of the ironmasters' syndicate to maintain the present prices of bars and sheets. For some considerable time the demand for finished iron has been flagging, and it was thought by some that the prices should be reduced in consequence. On the other hand, it would be suicidal to lower the prices on account of the cost of labour and raw material. The difficulty of the position is all the worse on account of the fact that the foreign producers are ready to step in at any moment. Owners of rolling mills are considering the advisability of limiting their output. All the machine shops have sufficient work to keep themselves going for the present, but forward orders are not so plentiful as might be desired.

THE LINEN TRADE.—The sales of Russian flax and tow have been less important than those of a few weeks back; prices are weak, though no actual lowering has taken place. The Ghent market, on the other hand, has been well supplied, and the demand was bright; prices were raised all round, and the current sales in threads were satisfactory. The demand for cloths is good, but most of the houses have no stock.

DÜSSELDORF, 11TH MARCH, 1890.

COAL.—The demand for coal continues unabated, and production is being pushed to the utmost. The merchants are profiting largely by the recent rise in prices, which are fully 35 per cent. above those at which the contracts were made under which the colliery owners are now working. The situation is for the latter much less favourable than the general public are taught by the agents of the working men to believe. The trade with Hamburg and its neighbourhood continues to increase, the consignments to that district in the month of February being 55,780 tons against 52,680 tons in the same month of last year. Fresh orders are coming in freely.

IRON.—That the iron market has lost much of its life and vigour is a fact now reluctantly admitted. The action of the coal miners in disturbing the basis of trade has weakened the confidence, and interrupted the development of the business in the home markets. This slackening of the home demand has made the loss in the export trade more keenly felt, and, together, these influences have operated to change the aspect of the markets. Pig iron is now but little inquired after, and prices, in so far as they are made by the middlemen, are giving way. Manufacturers still maintain their rates. The Rhenish-Westphalian pig iron makers' syndicate has announced a production of 111,656 tons in February, against 117,778 tons in January of the current year, and 110,666 tons in February of 1889. The syndicate of rolled iron manufacturers has been prolonged till December 31st of the year 1893. Business in the market for finished iron is less active, and no transactions are now recorded above the syndicate minimum. Merchants have in some instances undersold this minimum. The tone of affairs generally is somewhat weak.

THE LABOUR QUESTION.—The agitation among the working men for an increase of wages and shorter hours of labour is extending to all classes, and is everywhere increasing in intensity. The movement has acquired such force that a general rise of wages may be regarded as inevitable. There is hardly a trade in which the operatives have not already agreed to demand better terms of their employers, and to enforce their claims by strikes as soon as the winter is wholly past. Before the end of the current year the cost of production in Germany will, for all manufactures, have been materially increased. A correspondent in Halle describes a state of things which is to be met with in all the industrial towns of Germany. He says that in his district the carpenters are asking for an average rate of 4¾d. an hour; the bricklayers demand to be paid 6d. an hour, against 4¾d. last year; the paperhangers, painters, and house decorators claim a maximum of 18s. a week for a nine hours day; and the tailors are agitating for a 20 per cent. rise. In some trades, in which work is plentiful, a considerable advance in wages has been already conceded.

LILLE, 11TH MARCH, 1890.

IRON.—The situation is not materially changed from what it was a week ago. There is a steady flow of fresh orders to the forges; but the market has lost something in strength of late. The bulk of the business transacted takes place on the basis of 160s. for bars; but some bargains have been recorded at 156s. Work is now carried on

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more regularly, the supply of fuel being more abundant. Some of our manufacturers are sending iron to Germany, where the high prices now prevailing render it possible for the products of this district to be offered at rates considerably below those current there.

TEXTILE MANUFACTURES.—Business in linen goods at Armentières is considerably more active this week. Buying orders are coming to hand plentifully, and there is a prospect of continued activity for some time to come. The statistics of trade in February show that the turnover for that month was above the average. The Roubaix woollen trade is slack, but the tone of the market is good. It appears from the statistics of the trade of the Port of Dunkirk that the quantity of raw wool imported in 1889 amounted to 1,722,672 cwt. against 1,280,750 cwt. in the previous year.

FLAX AND YARNS.—There is an active market for home-grown flax, with prices tending in favour of buyers. Russian is a little more inquired after, and prices are somewhat weak. Such have been the distinguishing features of the flax trade in the week last past. Business in tows is restricted to the needs of the moment. Prices are a little lower. Tow yarns, too, have receded a point. The market is quiet for linen yarns. For jute yarns there is still a brisk demand—at least, for the fine and medium sorts. The commoner qualities are less inquired after. Prices remain practically unchanged.

AMSTERDAM, 10TH MARCH, 1890.

ACCIDENTS IN FACTORIES.—The new Association of Employers for the prevention and minimising of accidents in Dutch factories is now duly constituted, and its rules and regulations already framed and approved by a committee consisting of seven members.

RAILWAYS IN HOLLAND.—Among the new projects there is a line from Hellevoetsluis, the port of the German Ocean where William III. took sail in 1688 to Rotterdam, and a direct railway between the latter city and Amsterdam. Hellevoetsluis is well known among sailors as a splendid harbour, accessible at all times to all ships, and it would no doubt be used much more than at present if it could be easily reached by rail. As soon as the acquisition of the Dutch-Rhenish Railway by the State is an accomplished fact, and the States-General shall have passed the proposed agreements with the Holland Railway Company and the State Railways Company, the different stations at Utrecht are to be pulled down and replaced by one large central station, which will accommodate the large exchange traffic between the north and the south, the west and the east. Utrecht, being in the middle of the kingdom, will become its most important railway centre. Recently the giving way of the foundations of the Central Railway Station at Amsterdam has been referred to. Now a similar phenomenon is engaging the attention of the railway department at Feyenoord, on the other side of the Maas, at Rotterdam. The large railway embankment there shows signs of subsidence, and the Government, in conjunction with the town authorities of Rotterdam and the directors of the State Railways Company, has appointed a technical committee to inquire into the probable causes.

TOLLS ON CANALS AND ROADS.—The Government Bill for the abolition of the dues on the Amsterdam ship canal will shortly come on for debate in the Lower Chamber of the States-General. As soon as it is passed by both Chambers the Minister of the Means of Communication will take in hand the more comprehensive scheme of abolishing tolls on Dutch canals and highways generally. The Minister is in favour of such a measure, but the question is whether it may be feasible at the present moment. In order to ascertain this his Excellency intends to appoint a small committee of inquiry, with power of hearing evidence and preparing a scheme for acceptance. The chief difficulty to be met is, no doubt, to find the means of replacing the source of revenue to be sacrificed.

FRENCH ENGINEERS IN HOLLAND.—The Royal Institute of Civil Engineers of Holland will meet shortly to settle the programme of the next summer conferences. It is proposed to invite to these and Holland generally the leading members of the French Société des Ingénieurs Civils in Paris, particularly Messrs. Eiffel and Decauville.

CO-OPERATION AT DELFT.—The Co-operative Society of Delft, whose 309 members chiefly beiong to the artisan class, has done well in 1889, and a dividend of 5½ per cent. is available for distribution among the shareholders.

TIN IN THE DUTCH EAST INDIES.—The success of the Singkeb Tin Company has stirred the ambition of explorers and promoters in other directions. There is little doubt but that numerous other islands of the Archipelago, besides Banca, Blitong, and Singkeb, contain either tin ores or alluvial tin, and small syndicates are being formed to explore several of them, of course with a view of bringing out companies if the trial borings and washings should prove successful. The Dutch-Indian Government is encouraging these efforts of private enterprise as much as possible by sending out its own engineers for the purpose of assisting in the work of exploration. That such work is not always without its dangers was shown the other day on the large island of Flores, mainly a dense jungle inhabited by savages, over whom the Dutch hold a merely nominal sway. A party, formed by the Government engineer, Van Schelle, was attacked by a large number of Malays armed with klewangs, or swords. Many were shot down by musketry fire, but Mr. Van Schelle and his assistant received dangerous klewang wounds in the back. The Government is sending a small expedition to punish the islanders for this outrage upon its officials.

COPENHAGEN, 8TH MARCH, 1890.

A RAILWAY FOR RUGEN.—The island of Rügen in the Baltic is to have a railway, which will, naturally, be of modest proportions. Its length will be only a little over 8 kilometres, and the whole cost is calculated at £3,000. It will connect the two seaside places, Ahlbeck and Heringsdorf, with Swinemünde. It is expected to be a great boon to the fishing people, but it may, however, obtain its greatest importance through its possibly becoming a link in a new connection between Sweden and the Continent, which is under contemplation.

FISHING IN NORWAY AND SWEDEN.—Great efforts are being made in both Sweden and Norway to advance this important and lucrative industry. A number of fishing smacks have been purchased in England, new steamer and railway communications are being opened out, the construction of boats, carriages, and utensils is being improved, ice depôts are being erected, &c. All along the Norwegian coast the cod fishing is going on; the results are satisfactory and the prospects are hopeful. The fish are mostly large and the livers good. Last season's herring fishing in Sweden has not been quite so good as the previous one. The quality of the salted herrings is, however, generally excellent. The following figures will show the increase of the Swedish export of fish during the last few years:—

	1886.	1887.	1888.	1889.
Fresh fish ... kilogs.	22,131,000	34,098,000	38,251,000	55,783,000
Salted, dried, smoked, &c.:				
Herrings... ,,	1,192,000	2,598,000	5,526,000	20,507,000
Other fish. ,,	488,000	325,000	877,000	664,000

THE INTERNATIONAL EXHIBITION AT STOCKHOLM, 1892.—In two years' time the Swedish capital is going to hold a large Exhibition, which is sure to attract considerable attention.

NEW PETROLEUM STEAMER.—A new petroleum tank steamer was launched on the 27th ult., from the Kockum Engineering and Shipbuilding Company, Malmö, Sweden. Its capacity is 600 tons. The building of tank steamers has of late been a very important specialty in Swedish shipyards, and orders continue to be forthcoming, especially from Russia.

MADRID, 10TH MARCH, 1890.

ACCUMULATORS IN SPAIN.—Accumulator works have lately been established in this country, though on a very moderate scale. It is surprising, however, that the accumulator works at Madrid have to pay much heavier prices for lead, sulphur, &c., than in London, and as coals are also dearer, the accumulators made in this locality are as dear as those which are imported. The central telegraph station at Madrid has adopted accumulators. These accumulators have a great future before them at Madrid on the tramways.

TAR DISTILLING IN SPAIN.—The well-known house of Messrs. Burt, Boulton, & Haywood have established a branch house with riverside front at Bilbao for carrying out the business of tar distilling. They supply already by far the largest quantity of pitch used in Spain for patent fuel, and their Bilbao establishment will be a great aid to coke making.

SPANISH PIG IRON.—Some English papers have been questioning whether it can pay to ship to England pig iron instead of iron ores. If the Asturian mines could give coals in proportion to the demand, and if good coke ovens were in existence at Bilbao, hematite pigs could be made for less than 42s.

DEATH OF THE MARQUIS OF MUDELA.—The second Marquis of Mudela, Don Francisco de las Rivas, died on the 5th inst. at a comparatively early age. He inherited only eight or nine years ago one of the largest fortunes of this country. He owned the largest wine business in Spain or in any country in the world, and was also interested in four blast furnaces at Bilbao. His usual crop of vines yielded 12,000,000 bottles every year, and his make of hematite pig iron came up to 80,000 tons.

NEW YORK, 1ST MARCH, 1890.

THE COAL MARKET.—The anthracite coal trade remains dull and depressed. The production of coal even at 2,000,000 tons per month is probably greater than the consumption, and but little more than that was used in January. The demand for pea and buckwheat coal is very large, and prices are a shade higher, and are now better than for two years back. Furnace sizes are well taken, but the domestic sizes are very dull. Up to date the amount of coal sent to market is about 360,000 tons less than in 1889. The present restrictive process is costly, and a large part of the trade is still in favour of the entire closing down of the mines. The powers in the trade believe that the present and future restriction which will be ordered will, before the end of the spring months, put the trade in fair condition. The cutting of rates has caused three of the largest shippers of anthracite to cut down the nominal rates of all sizes above pea from 10 cents to 25 cents per ton. There is considerable coal to be had, however, at even lower rates.

AMERICAN TIN ORE.—The Sioux Reservation having been at last opened for settlement, the famous tin mines in the Black Hills will be worked to their fullest extent. Besides the railroad lines, which have already been surveyed and will be laid as soon as possible, to cross the reservation, there are a number of important additions to the roads in the Black Hills district which will open up the richest of the mines. The railroads and miners of the Hills have determined to turn their first attention to the tin. None of the gold mines are to be abandoned, but, with the proposed tariff to give them a start, they will, within a few months, be prepared to furnish all the tin needed in the United States.

AN INLAND SHIP CANAL.—A delegation from Delaware and Maryland have appeared before the River and Harbour Committee of the House to advocate the construction of a ship canal between Chircoteague and Delaware Bay. This is an old project, but is to be pressed with renewed vigour during the present House. The breakwater at Lewes, Delaware, is an altogether insufficient protection during severe weather, many vessels being lost there every year. The ship canal can be constructed, it is estimated, at a cost of only $300,000, and Congress is asked to appropriate one-third of it this year to begin the work. This canal, when finished, will afford shelter for vessels in the harbour of Lewes, and will also be of great commercial value as a waterway. It would also be of immense strategic value in time of war as one of the chain of inland water communications along the Atlantic Coast. Plans for the canal have been approved, and the appropriation is recommended by the Chief of Engineers.

THE SEAL FISHERIES.—The Secretary of the Treasury has opened the bids for the Alaska fisheries. There were twelve altogether, and they were all put in on the last day. Any one of these bids more than trebled the amount the Alaska Commercial Company is now paying. This company pays now $65,000 per year, and $2·61¼ per skin taken, and the same company bids $50,000 per year and $6·74 for each skin taken, besides doing the other work required by the Government. In the old contract there was a clause requiring the payment of 55c. per gallon for all the oil extracted from the seals, but on the representation that this oil was valueless the payment was, by some authority unknown, remitted. That the oil is worth a great deal the bids just opened show, as amounts varying from 25c. to 55c. per gallon are offered. The following are the principal bids:—The American Fishing and Trading Company of San Francisco, $305,000 per year rental, $4·12 for each skin, and 25c. per gallon of oil; Alaska Commercial Company, $50,000 per year, $6·75 for each skin taken, or to pay the United States any larger amount offered in good faith, besides establishing dwelling-houses, schools, hospital, regular mail service, &c. The North American Commercial Company of San Francisco offers $55,200 per annum, and $10·75 for each skin, with the express understanding that the catch shall not be limited to less than 100,000 after the first year; or they will give the Government 45 per cent. of the gross receipts for the sale of the seals; or they will pay 10 per cent. more than offered by any other company. The contract will not be made until sufficient time has been given to thoroughly study the different bids.

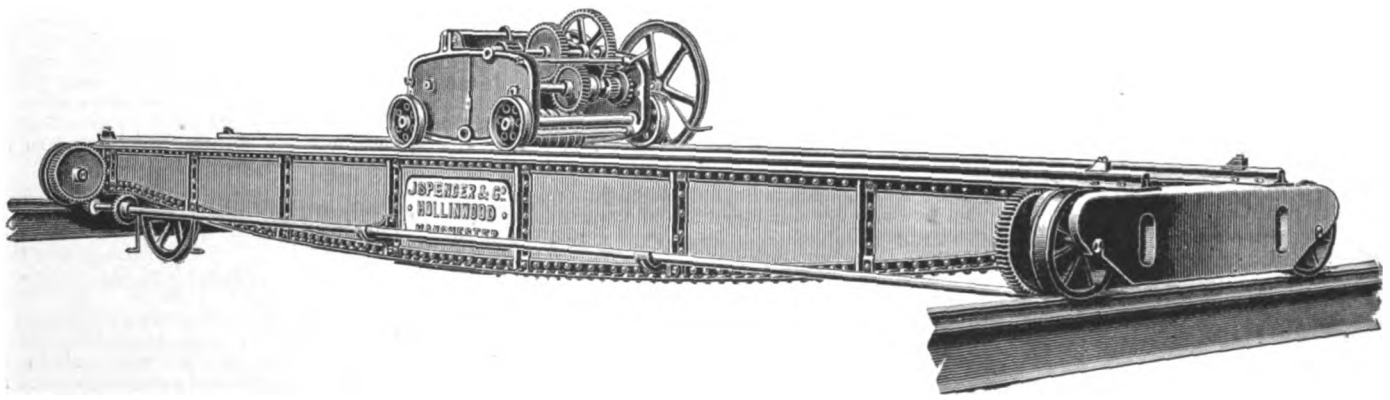
RAILROAD PROSPERITY.—The railroads of the country were never earning more money than at present. In January the increase in gross earnings over last year was more than $4,000,000. It is likely that the net earnings will also be very large, as, except on a few Western roads, the weather has been such as to make expenses light for the season of the year. In January, 1889, returns from 154 roads, operating 82,040 miles, showed $30,289,211 gross earnings, while from the same number of roads in 1890, operating 83,983 miles, the gross earnings were $34,292,250. The increase—over 13 per cent.—is the largest ever made in January, and is the fourth successive January increase. The business of railroads is not only heavy, but, in the opinion of railroad men, it will continue heavy during the entire year.

THE IRON AND STEEL TRADE.—There is nothing new in the iron market. Consumption is still heavy, but there are no attempts to make new contracts. Buyers are holding off until forced to come in, and sellers are equally slow in making any concessions in prices. In pig iron there is little change. The entire output is absorbed generally in small lots, but there is no disposition to buy large quantities at ruling rates. The Western markets are weaker because of the increased competition of Southern iron, which will be shortly increased by the blowing in of several of the larger furnaces. This will, probably, affect the entire market, unless consumption increases again shortly. No. 1 foundry is selling at $20 to $20·50 per ton, No. 2 at $18·50 to $19, and grey forge from $17·50 to $18 delivered. The market for manufactured iron scarcely holds its own. Prices are nominally unchanged, but the trade is dull, and the week's sales are only sufficient to cover the week's production. Mills are still busy on old orders. Steel rails are quiet. Prices are firm at $35 per ton at mill. Although there is not much demand at present, there are some fair-sized orders in prospect, and it is likely that a good deal of business will be placed during the next month. Steel in other forms is dull and unsettled.

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IMPROVED TRAVELLING CRANE.

CONSTRUCTED BY MESSRS. J. SPENCER & CO., ENGINEERS, HOLLINWOOD, NEAR MANCHESTER.



IMPROVED TRAVELLING CRANE.

THE above illustration shows an improved travelling crane made by Messrs. J. Spencer & Co., engineers, Hollinwood. It is specially designed to give the quickest speed of lifting with a minimum expenditure of power. The weight of the various parts is reduced as far as possible consistent with the provision of the necessary margin of strength. The cross girders are bow-shaped riveted plate girders, sustained at the ends by cast-iron carriages. The crab is provided with single and double spur gearing, the change being made by a claw-clutch. In order to avoid overlapping of the chain the barrel is grooved, and is sufficiently large in diameter to wind on the entire length of the chain. All the motions are controlled by hand chains from below, but crank handles are also fitted to permit of control being obtained from a platform. In the smaller sizes—that is, up to 10 tons lift and 30ft. span—the main girders are made of rolled iron.

INSTITUTE OF MARINE ENGINEERS.

A MEETING of the Institute of Marine Engineers was held on the 4th inst., when Mr. W. J. Nowers Brett read a paper on the "Friction of Screw Propelling Engines." The paper dealt with the losses due to friction in various parts of the marine engine and shafting from the pistons to the propeller blades. The question of rough surfaces and lubrication was first referred to, also the small bearing surfaces sometimes found in engine shafting and the consequent trouble. The forms of steam admission valves in use and the rejection of the slide for piston valves in more recent types of engine were noted, and the advantages of the piston valve pointed out. Reference was made to the different kinds of material used for bearing bushes—*e.g.*, lignum vitæ for the propeller shaft in the stern tube; brass, white metal, or phosphor bronze for the various other bearings. It was suggested that it would be an advantage to use roller bearings for some of the shaft journals, and a model of roller bearings suitable for tunnel and other shafting, made and patented by Mr. Leslie, one of the members, was exhibited.

A passing reference was made to shafting being out of alignment, and the advantage of having flexible couplings fitted to the tunnel shafting to obviate the trouble frequently experienced, whether due to original lining off or to the alterations which take place from time to time in the hulls, due to the loading of varying cargoes or to structural weakness. The best material to use for propeller blades was considered, and reference was made to the extensive corrosion or pitting found to take place at the points of the blades in both cast iron and steel after a few months' running.

In the discussion the question of the most suitable form of packing rings for pistons was considered, and several members expressed opinions favourable to a series of narrow cast-iron rings as being economical and least liable to cause excessive friction. The once common practice of giving packing rings too much compression was commented upon strongly, as this led frequently to a system of packing being unjustly condemned on account of undue compression being placed on the rings.

The great unbalanced weight of the slide valves fitted to many engines—especially the high pressure valve of compound engines—was remarked upon as obviated to a certain extent in more recent types of engines by the piston form of valve, which cannot, however, be looked upon as perfect, as regards keeping steam tight for a long period. The arrangement of a balanced or equilibrium slide valve patented by Mr. Church was highly commended by several present who were acquainted with its merits. The introduction of phosphor or manganese bronze and Delta metal for propeller blades was considered by those who had had experience of them to be a very great improvement as compared with cast iron or steel, although expensive in first cost. The improved speed of the ship, the reduced drag on the engines, and the fact that the action of the water at the periphery of the propeller does not cause any pitting action such as is found in the cases of iron, and especially steel blades, involving frequent renewal, all tended to the view that in the end the new alloys were the more economical.

The principles of friction on moving surfaces were discussed, and an interesting series of remarks on this subject, with data gained from experiments, were given by Mr. McFarlane Gray.

The proceedings were brought to a close by votes of thanks to the author of the paper and the Chairman. It was decided to continue the discussion at a future meeting early in April.

The annual general meeting will be held on the 28th March, when the financial and other reports for the first year of the history of the Institute will be submitted and the result of the voting papers for the election of the new Council declared. We hope, now that the Institute has gained confidence and is fairly established, the time is not far distant when it will have premises of its own, and rooms for educational and other purposes worthy of the name.

LONDON ASSOCIATION OF FOREMEN ENGINEERS.

UNDER the presidency of Mr. J. E. Bartle, Professor W. C. Unwin, F.R.S., gave on Saturday, the 1st inst., at the Cannon Street Hotel, before the London Association of Foremen Engineers, a very interesting lecture on the "Objects and Methods of Steam Engine Trials." In the course of his remarks the Professor said that it was to engine tests having for their object the investigation of the thermodynamic actions which went on in the engine that they owed every real improvement in the steam engine. In such tests—tests that went beyond the simple testing of the feed water and coal—some theoretical calculations of a somewhat recondite character were necessary, and it was by that means that they were able not only to know how much coal was burned, and how much power was developed, but also to measure how much heat was developed in the furnace, how much got into the steam, and where the loss occurred, and thus to ascertain what losses were important enough to be worth trying to diminish. Beyond the immediate commercial advantage of a thorough engine test, it was an addition to the sum of knowledge available for further improvement of the steam engine. And, in connection with the question that was agitating the engineering world at the present moment, as to whether jackets were useful or useless, he ventured to say that if a few complete marine engine tests had been made there would have been no room for doubt at all, and a considerable sum annually would have been saved. The prime object of an engine test was usually to determine the cost of power, and for that purpose a combined engine and boiler trial must be made. But such a trial always left an element of uncertainty, as they might have a good engine and a bad boiler, or a good boiler and a bad engine, and they were therefore unable to tell how much credit or discredit attached to the engine maker and how much to the boiler maker. For a single boiler trial the most accurate plan was to draw the fires and weigh them at the beginning and the end of the trial. Steam was got up and the fires got into average condition, the test being taken to begin the moment the fire was put back and the steam valve opened. At the end the fire was again drawn and cooled down; it was then separated by sifting into ash, cinders, and clinkers, the cinders which did not pass through a $\frac{1}{2}$in. sieve being treated as unburned coal and the ash and clinkers as incombustible refuse. Such trials, however, were unsatisfactory if they were not continued for twelve, and, if possible, for twenty-four hours. The lecturer usually noted the water level at the beginning and brought the water to the same level at the end. The amount of air used was the next important measurement, and this he generally accomplished with the aid of anemometers at the mouth or openings in a wooden box in front of the furnaces. Perhaps a better way, however, was to analyse the furnace gases. Knowing how much carbon had gone in the furnace gases it was easy to find how much air had gone into the chimney. A very few ounces of gas, however, had to be taken as sampling a very large quantity—perhaps 50 tons of furnace gas. The measurement of the temperature of the furnace gases presented also some difficulty, and in this connection he had used Murrie's pyrometer, and had found it satisfactory so far as he had had opportunities of testing it. A calorimeter for estimating the carbon value of the fuel would be very useful if there was a reliable one, but they could to a great extent get over the difficulty of not having a quite satisfactory fuel calorimeter by using a standard coal such as Nixon's navigation in all boiler trials. An engine test, when tolerably complete, was more difficult and required more preparation than a boiler test. In the first place it was necessary to cut and blank flange as far as possible every connection through which leakage could occur. The principal measurements to be made were the measurement either of the feed or condensed steam, or both, and from this the weight of the steam used was determined. Next came the measurement of the indicated power; then the heat rejected must be determined by measuring the volume and rise of temperature of condensing water; and lastly, the amount of jacket drainage must be measured as a means of determining the heat given to the cylinder from the jackets. The lecturer concluded his address by exhaustively describing the measuring arrangements adopted at the Central Institution.

In the discussion that followed the lecturer was asked his opinion about steam jackets. Professor Unwin, in reply, said that a jacket was always, in every case, useful. He had taken the trouble to go through fifty experiments of a parallel character with and without the jackets, and in only one case did he find that there was not a very distinct economy gained by the use of the jacket, and that he attributed rather to an experimental error.

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NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.

Mr. C. Furness, Mr. Henry Withy, and Mr. R. W. Vick, the principal members of the firm of Edward Withy & Co., West Hartlepool, have recently given a sum of money to this Institution for the founding of a Gold Medal Fund, so that a valuable gold medal, with a certificate, may be given each year for the best paper on Engineering and for the best paper on Shipbuilding. It is hoped that the giving of these medals will very greatly stimulate the advancement of engineering and shipbuilding in the North-East Coast ports. We understand that all members are eligible to compete for these medals with the exception of the Executive Council, who have the awarding of the medals. The above-named Institution is in a flourishing condition, having nearly 1,000 members, who are nearly all heads of departments. The result is that the papers read are generally of great practical value to shipowners, engineers, and shipbuilders. The Institution has also the election of two members upon the Expert Committee of Lloyd's for the consideration of all plans, new designs, &c. The Institution has extensive offices in Newcastle-on-Tyne, which contain a good library, but although the offices are in Newcastle the Institution does not restrict the reading of papers to that town alone, but arranges for some to be read at Sunderland and Hartlepool.

Notices of Meetings.

THIS WEEK.

South Staffordshire Institute of Iron and Steel Works Managers.—Saturday, March 15th. Mr. Herbert Pilkington, F.C.S., M.Inst.M.E.. "On the Manufacture of Basic Pig Iron."

NEXT WEEK.

Institution of Civil Engineers.—Ordinary meeting, Tuesday, March 18th, at 8 p.m. Paper to be read: "Lough Erne Drainage," by James Price, Jun., B.E., M.Inst.C.E. Students' meeting, Friday, March 21st, at 7.30 p.m. "Economy Trials of a Compound Mill Engine and Lancashire Boilers," by L. A. Legros, Stud.Inst.C.E.

Society of Arts.—Wednesday, March 19th, at 8 p.m. Fifteenth ordinary meeting. "Commercial Geography," by J. S. Keltie. Sir Frederick Abel, C.B., F.R.S., will preside. Saturday, March 22nd, at 3 p.m. "The Atmosphere," by Professor Vivian Lewes.

Chemical Society.—Thursday, March 20th, at 8 p.m. Lecture by Professor Judd, F.R.S., on "The Evidence Afforded by Petrographical Research of the Occurrence of Chemical Change under Great Pressures."

The Institution of Electrical Engineers.—Thursday, March 20th, at 8 p.m. "Alternating *v.* Continuous Currents in Relation to the Human Body," by H. Newman Lawrence and Arthur Harries, M.D. (if discussion on previous papers allow).

Physical Society.—March 21st, 1890. Papers to be read: 1, "On the Villari Critical Point of Nickel," by Herbert Tomlinson, F.R.S.; 2, "On Bertrand's Idiocyclophanous Prism," by Professor Silvanus Thompson.

Royal Institution.—Friday, March 21st, at 9 p.m. Professor G. F. Fitzgerald, M.A., F.R.S., on "Electromagnetic Radiation." Saturday, March 22nd, at 3 p.m. Lord Rayleigh, on "Electricity and Magnetism."

PRICES CURRENT, 12th March, 1890.

Quotations at per ton, unless otherwise specified.

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	77/-	66/6

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

METALS.

Spelter:	Ordinary	£23	10	0	to	£23	15	0
Copper:	British Cakes and Ingots	54	0	0	„	55	0	0
„	Chili Bars, G.O.B.'s	46	17	6	„	47	2	6
„	Other sorts, G.M.B.'s (equal to Chili Bars)	46	17	6	„	47	2	6
„	Manufactured (strong)	62	0	0	„	.....		
Lead:	Common Pig	13	12	6	„	13	15	0
„	English Sheet	14	2	6	„	14	5	0
Tin:	Straits	90	17	6	„	91	5	0
„	Australian	90	17	6	„	91	7	6
„	English Ingots	95	10	0	„	.....		

PIG IRON.

Middlesbro' Warrants, No. 3	50/-	Cash	
Scotch Warrants, m/n	50/4	„	
Hematite Warrants, m/n	63/-	„	
Stocks in Stores { Scotch	855,195.—Dec. for week,	10,553	Tons
Middlesbro'	171,677.—Dec. „	5118	
Hematite	375,135.—Dec. „	495	„

Exclusive of stocks in makers' yards.

	No. 1.	No. 3.		
Coltness	73/-	66/-	f.o.t.	Glasgow.
Gartsherrie	70/-	64/-	„	„
Langloan	73/-	66/-	„	„
Summerlee	70/-	65/-	„	„
Glengarnock	73/-	67/-	„	„
G.M.B. ex Store	51/-	50/9	„	„

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	7 5 0	.....	7 15 0	f.o.t. wks.
„ Angles	7 0 0	.....	7 10 0	„
„ Plates	7 5 0	.....	7 15 0	„
Staffordshire Bars (cheaper makes)	8 17 6	.....	9 7 6	London.
„ Angles	8 17 6	.....	9 7 6	„
Crown Sheets	8 15 0	.....	9 5 0	„
„ Hoops	8 2 6	.....	8 12 6	„
"Siemens-Martin" Steel Boiler Plates			9 15 0	„
„ Ship and Girder			8 15 0	„

Market quiet.

Messrs. Carrick & Brocklank, Manchester, report as follows:—

Copper: The fluctuations in Chili bars during the past week have been but small, quotations to-day being slightly lower. The market is still inactive, consequent on the continued depression in pig iron, and but a very limited business is being done. The demand for manufactured continues slack, and prices to-day are £62 sheets, £65 bottoms.

Tin: A steadier feeling has been noticeable during the week, and prices of foreign have advanced about £1 per ton. To-day's quotations are £90 17s. 6d. to £91 5s., with moderate business doing.

Lead continues very quiet, although values are a shade higher.

Spelter is lower, the demand being very slack. At the same time there is no pressure to sell, the stocks everywhere being small.

CHEMICALS.

		£	s.	d.		£	s.	d.
Acid:	Carbolic Crystals lb.	0	0	10½	to	0	1	0
„	„ Liquid gal.	0	1	2	—	.....		
„	Citric lb.	0	1	7	—	.....		
„	Oxalic „	0	0	3¼	—	.....		
„	Sulphuric ton	1	12	0	—	.....		
„	Tartaric lb.	0	1	4	—	.....		
Alum:	Lump (powder 10/- ex.) ton	4	17	6	—	.....		
Ammonia:	Carbonate lb.	0	0	3½	—	.....		
„	Muriate (Grey) ton	22	15	0	—	.....		
„	„ (White) „	26	10	0	—	.....		
„	Sulphate „	11	17	6	—	.....		
„	Liquor lb.	0	0	3⅜	—	.....		
Antimony	ton	.....			—	.....		
Bleaching Powder	„	5	5	0	—	.....		
Bisulphide of Carbon	„	13	10	0	—	.....		
Borax	„	30	0	0	—	.....		
Benzole (90 %)	gal.	0	4	0	—	.....		
„ (50/90 %)	„	0	3	1	—	.....		
Copper Sulphate	ton	26	10	0	—	.....		
Copperas	„	2	0	0	—	.....		
Kieserit	„	.....			—	.....		
Lead:	Nitrate „	22	10	0	—	.....		
„	White Sugar „	24	0	0	—	.....		
„	Brown „ „	19	0	0	—	.....		
Potash:	Bichromate lb.	0	0	4	—	.....		
„	Caustic ton	22	0	0	—	.....		
„	Carbonate „	19	10	0	—	.....		
„	Chlorate lb.	0	0	4¾	—	.....		
„	Prussiate (Yellow) „	0	0	10¼	—	.....		
„	Sulphate (Basis 90 %) ton	9	10	0	—	.....		
Precipitate:	Red lb.	0	3	1	—	.....		
„	White „	0	3	2	—	.....		
Salts: Epsom	Bags ton	3	0	0	—	.....		
	Casks „	3	15	0	—	.....		
„	Glauber „	1	10	0	—	.....		
Sulphur:	Sublimed Flowers „	9	0	0	—	.....		
„	Recovered „	4	10	0	—	.....		
Soda:	Ash deg.	0	0	1⅜	—	.....		
„	Caustic (White 70%) ton	8	17	6	—	.....		
„	„ „ 60%) „	7	17	6	—	.....		
„	„ (Cream 60%) „	7	7	6	—	.....		
„	Crystals „	2	12	6	—	.....		
„	Bicarbonate „	5	15	0	—	.....		
„	Hyposulphite „	6	5	0	—	.....		
Solvent Naphtha	gal.	0	3	6	—	.....		
Tartar, Cream of	cwt.	5	12	6	—	.....		
Zinc Sulphate	ton	7	10	0	—	.....		

Messrs. S. W. Royse & Co., Manchester, report as follows:—

Chemicals.—The course of business in chemicals continues quiet. In alkalies especially there is little being done, and only for spot delivery, the labour troubles making the position forward very uncertain. Crystals and crude carbolic are very dull, but liquid carbolic is in rather better demand. Sulphate of copper is somewhat firmer for both present and forward delivery. Foreign white sugar of lead has been advanced, though it is difficult to see any reason for this.

OILS.

		£	s.	d.
Cocoanut:	Cochin per ton	26	10	0
„	Ceylon „	24	10	0
Cottonseed	„	22	7	6
Cod	„	21	0	0
Lard	„	26	10	0
Linseed	„	22	10	0
Palm, Lagos	„	24	10	0
Rapeseed:	English „	33	10	0
Seal:	Pale „	28	0	0
„	Brown „	22	0	0
Sperm	„	46	0	0
Whale	„	24	0	0
Turpentine	per cwt.	1	10	6
Coal	per gal.			
Petroleum	(Refined) „	0	0	5⅜
„	Spirit „			

FOREIGN TELEGRAPHIC ADVICES

(From our own Correspondents.)

Paris, March 13.—*Iron.*—Market hesitating. Buyers hold aloof in expectation of lower prices. Merchants quote bars at 160s. and joists at 164s., but concessions are easily obtained on orders of some importance. Prices are maintained in the markets of the provinces, but the current of business is slackening. In the Nord especially the market is quieter.

Metals.—The metal markets are dull and depressed. Copper is still quoted at the prices current a week ago; but the amount of business done is very small, so that prices are little more than nominal. These remarks apply also to tin. The supply of lead exceeds the demand, but the rates are too low to allow of any further decline. Spelter has lost the advance reported last week.

Berlin, March 13.—*Bourse.*—The market for industrial securities has recovered briskly from the extreme depression which characterised it a week ago. The recovery is in part due to the closing of "bear" accounts; but in part also it is real. Confidence has in some measure been restored, and as weak holders have been shaken out, the market is steadily regaining strength. The rise in colliery shares is from 6 to 7 per cent. There were some fluctuations yesterday; but to-day the market opened with an advance.

Iron.—The market is quiet, but there is a better tone due to greater confidence. More favourable accounts from the Westphalian coal-mining districts have raised hopes of a peaceful settlement of the wages dispute. Prices are moderately firm at 205s. a ton for Silesian bars. Founders report business brisk. Foundry coke in strong demand at 41s. 6d. to 42s. 6d. a ton delivered in Berlin.

Metals.—Business in metals is very slack. There is not much doing in copper, but Mansfeld refined maintains its position firmly at from £59 to £60. English brands a little weaker at £56 to £57. Tin dull at last week's prices: Banca, £100 to £101. Lead is less inquired after, but prices are firm: Clausthol refined, £15 10s. to £16. The market is stronger for spelter: Silesian, W.H. brand, £25 15s. to £26 10s.; ordinary, £25 to £25 10s. Antimony regulus unaltered.

Breslau, March 13.—*Coal.*—The merchants have again advanced the prices of coal 4d. to 5d. a ton, and 6d. to 8d. has been added by the retail dealers. The demand continues very brisk. The requirements of the iron manufacturers are not yet fully satisfied.

Iron.—The market is active both for crude and for finished iron. Grey pig, 85s. to 90s.; English foundry pig offered at 83s. to 84s. Demand brisk for joists, both for home consumption and for export. Hoops are much inquired after. Good business in plates, wire, and wire-nails. Prices are firm at 210s. for bars, 230s. for common plates, 250s. to 260s. for boiler plates, and 265s. for thin sheets, manufacturers' base prices; merchants' rates from 15s. to 20s. more.

Metals.—The market for zinc is still flat. Good ordinary Silesian brands are offered at £22 7s 6d. to £22 10s. There is but little stock in second hands, so that a further relapse is not to be apprehended. The tone of the market has somewhat improved. Lead is in fairly brisk demand.

Düsseldorf, March 13.—*Coal.*—The coal market is extremely animated, the demand continuing unabated, but prices remain steady. There is disunion among the colliers relative to the threatened strike; hence hopes are entertained that the conflict may be averted.

Iron.—The market for pig iron is very quiet. Both buyers and sellers are waiting for clearer indications of the course of events. Prices, which have receded a little from their highest point, are firm at the present rates. The demand for finished iron and steel has fallen off a little, wire having suffered most. The foreign demand for wire is very slack. Joists are more inquired after. Prices unaltered.

Ghent, March 13.—*Flax and Yarns.*—The market has further improved for home-grown flax; the demand being very brisk and the quantity on offer not large, prices are very firm. In Russian flax there is but little doing. There is a fairly strong current of business in yarns, the demand being chiefly for the finer numbers. Prices remain unchanged. Coarse tow yarns are utterly neglected.

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HOME INDUSTRIES.

LONDON 13TH MARCH, 1890.

THE MONEY MARKET.—The money market has now assumed an aspect of ease, with money in plentiful supply and lendable at about 3 per cent. The fear of gold withdrawals to New York is not altogether over, seeing that the bullion stock of the Associated Banks in New York has been steadily increasing; but the rate of exchange between the two countries renders the export of gold from London to the States improbable for the present. The stock markets, after a fit of depression, have improved greatly in tone this week. The Stock Exchange is disposed to take a hopeful view of the outcome of the wages dispute in the coal districts, and consequently home railway stocks fairly maintain their prices. North-Easterns, which are always most sensitive to influences of the kind, are as strong as any railway security in the list. Among American railways there is no striking feature, but London is inclined to be steadier and more "bullish" in tendency than New York. Foreign stocks are firm on the whole. Argentine securities fluctuate considerably in sympathy with the rise and fall of the premium on gold at Buenos Ayres, and confidence in them has been greatly shaken. Gold mining shares have been in greater favour than for some time past. The more substantial of the Transvaal mines are showing improved prices, and the shares of the Indian mines have also been freely bought. There has been no movement of significance in industrial shares, save a drooping inclination among the securities of the electrical companies. The nitrate group has not yet returned to favour in the market.

COMPANIES.—The following companies have been registered since our last report:—Thomas & J. S. Turner, Ld., with a capital of £20,000, to carry on the business of gunmakers, &c.; The Newcastle Breweries, Ld., with a capital of £400,000; The Jersey Mill Co., Ld., with a capital of £2,000, to carry on the business of spinners, bleachers, &c.; R. & W. Wilson & Sons, Ld, with a capital of £25,000, to carry on the business of iron and tinplate workers, japanners, &c.; The Jersey Tinplate Co., Ld., with a capital of £20,000; The British Standard Manufacturing Co., Ld., with a capital of £5,000, to carry on the business of rubber stamp pad manufacturers; The Liverpool and Galway Steamship Co., Ld., with a capital of £10,000; Smith Patent Engineering Co., Ld., with a capital of £7,000, to carry on the business of engineers; The Morgan Crucible Co., Ld., with a capital of £300,000, to carry on business as crucible manufacturers, &c.; The Saline Syndicate, Ld, with a capital of £10,000, to carry on business as brine owners, salt manufacturers, &c.; The Trevennick Mining Syndicate, Ld., with a capital of £3,525; The British Mexican Exploration Syndicate, Ld., with a capital of £25,000, to carry on mining operations in Mexico; The Chorley Colliery Co., Ld., with a capital of £15,000; The Tewkesbury Brewery Co., Ld., with a capital of £100,000; The London Graving Dock Co., Ld., with a capital of £40,000; The Watts Steel and Iron Co., Ld., with a capital of £250,000; The Oxford Mill Co. (Rochdale), Ld., with a capital of £60,000, to carry on the business of cotton manufacturers; Varley, Bros Ld., with a capital of £8,400, to carry on the business of dyers and finishers.

BOARD OF TRADE RETURNS.—The prominent feature of the Board of Trade returns for February is the general decrease in the imports, which amounted in value to £31,018,842 for the month as compared with £32,340,096 in February, 1889, being a falling off of £1,321,254. The decrease is largely due to smaller importations of cotton from Egypt and of wool from Australia. The exports are again very satisfactory, amounting to £21,084,228 as compared with £18,670,352 in February, 1889, an increase of £2,413,876. Machinery and millwork were exported to the value of £1,179,616 as against £981,378 in the same month last year; hardware and cutlery to the value of £212,430 against £237,328; implements and tools, to the value of £106,737 against £74,946; and telegraph wires and apparatus connected therewith, to the value of £201,594 against £32,086. The exports of yarns and textile fabrics amounted to £9,553,871 against £9,063,994 last year, and chemicals to £725,887 against £603,427.

LONDON CONCILIATION BOARD.—We have already dealt very fully with the scheme which has been proposed by the London Chamber of Commerce for arbitrating upon labour disputes. They are now issuing circulars to all the labour organisations in London with a view to these associations sending delegates to represent them at a meeting to be held on the 16th proximo. Twelve representatives of labour will then be elected to sit on the London Conciliation Board. It is also proposed to form separate committees for the various trades.

THE GRINNELL SPRINKLER.—Messrs. Dowson, Taylor, & Co. have just published two circulars relative to the performances of the Grinnell Sprinkler. It appears from them that up to the end of last year 593 fires were extinguished by the sprinklers, and that the average loss as stated by insurance companies has been £49. These facts show the great utility of these extinguishers.

FIRE ENGINES ON THE THAMES.—The London County Council, having dealt with Captain Shaw's request for more escapes and more men, is now giving its attention to the fire engines, and it has been decided to accept Messrs. Shand, Mason, & Co.'s tender to supply two powerful steam fire engines for use on steel rafts on the river. The joint capacity of the new engines will be 2,700 gallons per minute.

THE ROYAL METEOROLOGICAL SOCIETY.—At the ordinary meeting of the Society, to be held at the Institution of Civil Engineers, 25, Great George Street, Westminster, on Wednesday, the 19th inst., at 7 p.m., the following papers will be read:—"A Brief Notice respecting Photography, in relation to Meteorological Work," by G. M. Whipple, B.Sc., F.R.Met.Soc.; "Application of Photography to Meteorological Phenomena," by William Marriott, F.R.Met.Soc. After the reading of these papers the meeting will be adjourned, in order to afford the fellows and their friends an opportunity of inspecting the Exhibition of Instruments illustrating the application of Photography to Meteorology, and of such new instruments as have been invented and first constructed since the last Exhibition. The Exhibition will, at the request of the Secretary of the Institution of Civil Engineers, be open in readiness for the meeting of that Institution on Tuesday evening, the 18th inst., and will remain open till Friday, the 21st inst.

THE ROYAL INSTITUTION.—The following are the lecture arrangements after Easter:—The Hon. George C. Brodrick, three lectures on The Place of Oxford University in English History; Mr. Louis Fagan, three lectures on the Art of Engraving; Mr. Andrew Lang, three lectures on the Natural History of Society; Professor C. V. Boys, three lectures on the Heat of the Moon and Stars; Professor Dewar, six lectures on Flame and Explosives; Captain Abney, three lectures on Colour and its Chemical Action; Dr. Charles Waldstein, three lectures on Excavating in Greece; the Rev. S. Baring-Gould, three lectures on the Ballad Music of the West of England (with musical illustrations). The Friday evening meetings will be resumed on April 19th, when a discourse will be given by Sir Frederick Bramwell, Bart., on Electric Welding; succeeding discourses will probably be given by Sir John Lubbock, Bart., M.P., Mr. R. Brudenell Carter, Professor Raphael Meldola, Professor A. C. Haddon, Professor Boyd Dawkins, and other gentlemen.

MANCHESTER, 13TH MARCH, 1890.

THE ENGINEERING TRADES.—There is hardly so much new work coming forward as was the case a few weeks ago. The drooping condition of the iron market is probably keeping back a large number of orders. Generally there is a feeling that lower rates are likely to be obtained shortly. At the same time, engineers are generally so occupied with work on old contracts that they are rather indifferent about accepting new business except at full rates. There is also a probability of a movement for an advance of wages throughout the trade—in fact, the moulders have already struck work in Bolton for an advance. Thus, unless there is a considerable falling off in demand, the position of engineers will be such as to compel them to resist any reductions of price. Millwright work is generally good, and boiler makers are as full of orders as they can be. Locomotive engineers are also busy, and in this department there is plenty of work in hand. Machine tool makers have not as yet found any diminution in the demand, and are still working at the highest pressure. Some heavy tools are being made for marine work, and a number of special tools for railway purposes. Among the latter may be mentioned a lathe for a railway repairing shop, just constructed by Messrs. Hetherington & Co. It can be used as an ordinary sliding and screw-cutting lathe, and may, by the removal of the rests and the substitution of a special chuck fitted to the saddle, be also employed for boring out axle boxes. In textile machinery there is a full tide of prosperity, and everyone is employed to his greatest capacity. Ring spinning and mule spinning machinery appear to be in about equal demand, and preparation machinery of all classes is also sold in large quantities. No sign of any falling-off is to be seen in the call for spinning machinery, and makers are disposed rather to discourage than to encourage new business, except where a long term is given for delivery. Loom makers are generally well employed. Coppersmiths and brassfounders are a little quieter generally, and there is scarcely so brisk a demand existing.

THE COAL TRADE. There is some excitement in the market in consequence of the threatened general strike of miners, but it is by no means certain that this will actually take place. For all classes of manufacturing coals there is a strong demand, and the output is not more than sufficient to meet it. Indeed, in some cases manufacturers are finding it difficult to obtain supplies, while others are making strenuous efforts to lay up stocks, so as to tide them over the period during which the strike may last.

THE MANCHESTER LINEN AND JUTE TRADES.—Considerable inconvenience has been caused of late in dry goods circles here, owing to the prevalence of the malady which it has become customary to misname "influenza." Many large houses, such as that of Messrs. S. & J. Watts & Co., have had a section of their employés laid up owing to the ailment. Shipments of textiles from Lancashire centres to foreign ports have been delayed in consequence of the Liverpool dock strike, which affects a much wealthier and more important district than that which suffered when the dockers of the metropolis were struggling for their "tanner." The linen trade, notwithstanding these drawbacks, however, has been fairly brisk in the home trade sections, although, as far as export business is concerned, little of interest can be recorded. Fine linens, such as fronting varieties, are slightly dearer in certain quarters, but the tendency for general descriptions of such goods is steady. Lower qualities are unchanged. In jute goods there is a steady trade.

NEW SALT DEPOSIT.—A large deposit of salt and brine has been found at Middlewich, a small town on the borders of the Cheshire salt field. It is of good quality, and the depth of the shaft is about 100 yards.

GLASGOW, 13TH MARCH, 1890.

PIG IRON.—The pig iron market was further depressed last week by realising sales on a large scale, and as low as 50s. cash was accepted on the 6th inst. The downward course, however, seems to have been arrested for the time being, all the business done since then having been in the neighbourhood of 50s. 6d. cash. Although the cry still is that there is no business doing, the deliveries from store are going on at a great rate, with no corresponding increase of stock, as far as can be ascertained, in makers' hands. Cumberland seems to be the district most immediately affected by the very great cost of coke and raw material and wages; and at a conference of makers there a few days ago arrangements were entered into for blowing out or damping a number of furnaces.

MANUFACTURED IRON AND STEEL.—The lower prices have been attracting orders from abroad, and it is understood that during the past few days considerable contracts have been made for malleable iron for the Colonies.

THE COAL TRADE.—The uncertainty as to the action of the miners is unsettling the market to a certain extent, but there is rather more business doing, prices being firm. Export trade has been good, and the home demand for domestic and also for steam purposes has been very steady.

STRIKES. The surfacemen on the North British Railway are out on strike. They demand 2s. per week of an increase in their wages.—A strike has taken place in the shipbuilding yard of Messrs. Scott & Co., Greenock. The fitters' helpers have left work owing to a demand for an advance of wages not having been complied with.

THE FORTH BRIDGE. The inhabitants of North Queensferry are very indignant that, by the erection of the bridge, with its approach line high above the level of the town, they have been deprived of their railway accommodation. There is no station on the new line, and the old station is to be shut up. The townspeople base their claim for a station upon the terms of transfer of the old Queensferry and Dunfermline line to the North British Railway Company. At an indignation meeting held there to protest against being deprived of railway accommodation while the crowning triumph of railway engineering was at their very doors, though high above them, one speaker said that he had travelled from North Queensferry to Edinburgh in the old coaching days in a coach-and-four in an hour and twenty minutes, at a cost of 2s. 6d. He had travelled third-class, by the new route by the Forth Bridge over the same journey in an hour and three-quarters, and at a cost of 2s. 6d. This is an amusing comment upon the march of science.

EDINBURGH ELECTRICAL EXHIBITION.—The tender of Messrs. A. Macleod & Co., 98, Mitchell Street, Glasgow, for supplying the main driving and other pulleys required in the Exhibition has been accepted by the Executive Committee.

(From our own Correspondents.)

LIVERPOOL, 12TH MARCH, 1890.

THE DOCK LABOURERS' STRIKE.—This strike has unfortunately assumed large proportions, and over 20,000 men are now affected. The dispute now is not so much the amount of wages as the terms dictated by the Union men, which the steamship owners stoutly resist. Large numbers of men have been drafted from other towns, and the ships are being discharged, but there is now undoubtedly a delay, and serious inconvenience is being felt by the shippers. They are now advising their customers abroad not to ship their goods to Liverpool, but to London, Cardiff, and other ports. The men are thus practically driving the trade from the port.

THE MERSEY BAR.—The Mersey Docks and Harbour Board have instructed the well-known manufacturers of dredging plant, Messrs. Simons & Co., of Renfrew, on the Clyde, to design and construct powerful sand pumping appliances to be fitted to one of the steam hopper barges constructed by them some time ago for the Board. When completed the apparatus will be employed to cut a deep channel through the outer bar of the Mersey.

LEEDS, 12TH MARCH, 1890.

THE IRON AND STEEL TRADES.—There is hardly so much firmness in the finished iron and steel trades as was the case a few weeks ago, and the reason of this change may be found in the declining state of the warrant market, and in the agitation on the part of the miners for a 10 per cent. advance of wages. Inquiries from consumers of iron are fewer, and though, with regard to the steel trade, much business is being done in plates, there is a falling off in the demand for ingots and forgings. The demand for marine work has also fallen off somewhat lately, but it is antici-

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pated that the decision of the Government to add to the fleet will give a large amount of employment in Leeds during the year. Railway material of all descriptions is wanted on a large scale for home and foreign customers, and patent steel frames for rolling stock have been ordered by several important railway companies. Although inquiries are not so numerous as at the beginning of the year, the branches of the engineering trade interested in the production of locomotives and materials used in the construction of engines and electric lighting plant, are very busy. General engineering tool makers are actively engaged, but agricultural implement makers are quieter just now. A good deal of hydraulic machinery is being got out of the shops, both for home and abroad. Leading firms have conceded an advance to moulders and boiler makers.

THE COAL TRADE.—The threatened crisis in the coal trade monopolises a vast amount of attention in commercial circles and among the public. All along the masters have contended that the prices realised for coal do not justify the granting of the 10 per cent. demanded, and last Friday they expressed a readiness to have the dispute settled by arbitration. The suggestion, however, has not met with support from the miners' leaders, and a strike on an extensive scale is imminent. The West Yorkshire coalowners, like those in the southern part of the county, are firm in the attitude which they have taken up since arbitration was suggested at the Coalowners' Federation. The bulk of the men's notices terminate this week. Meanwhile, coal is advancing in price, and manufacturers are trying to add to their stock of fuel. The Yorkshire Miners' Union, at the end of September last, had a banking account to the amount of £11,082 12s. 6d.

SHEFFIELD, 12TH MARCH, 1890.

CRISIS IN THE COAL TRADE. A meeting of the coalowners of Yorkshire was held on Monday afternoon at Sheffield, and after a long discussion on the wages question no decision was arrived at. On the whole colliery owners are decidedly against giving an advance of wages, and unless some compromise is made between owners and miners there is every likelihood of a lock-out. House coal was advanced on Monday by 1s. 6d. per ton. In the export trade, viâ Hull, the well-known Denaby Main Colliery heads the list with 12,064 tons. All local manufacturers are stocking coal to the fullest possible extent with a view to contingencies.

IRON AND STEEL TRADES. A much quieter tone has prevailed here during the past week. Few new orders have been placed on the books, and unless orders come in soon quotations must be lowered. At present there is plenty of work for all, and never at any time have Sheffield manufacturers done better work.

THE SHEFFIELD TECHNICAL SCHOOL.—The Sheffield Corporation have granted £3,800 in aid of the Technical School, where it is proposed to erect a small Siemens furnace in addition to the crucible furnace, which is almost ready. A new 50-ton Buckton testing machine of latest pattern is almost ready for erection at the school.

NORTH STAFFORDSHIRE, 12TH MARCH, 1890.

THE IRON TRADE.—There is great diversity of opinion amongst business men as to the immediate prospects of trade. Some think that the lull is but a temporary one and that prices will become firm again, and others have theories of a pessimist character. Certain it is that the demand for local brands of iron is quiet, and that as a result some concessions are being made to consumers in the matter of price. This applies to both the crude metal and the finished material.

THE COAL TRADE.—Notices have been handed in at all the collieries of the district, which terminate on Saturday next. The final result of the negotiations between the Coalowners' and the Miners' Federations is being awaited before any definite local decision is arrived at. It is hoped and believed that a strike will be avoided.

CARDIFF, 12TH MARCH, 1890.

COAL AND COKE.—The colliers' usual monthly holiday last week had the effect of reducing the total shipments, but there seems no abatement in the demand, which, in view of possible labour difficulties in the Northern districts, is exceedingly strong. Prices are firm, with, if anything, a slight advance on last week's figures. First quality is quoted at 15s. 9d. to 16s. 6d.; second, 15s. 3d. to 15s. 6d.; inferior, from 14s. 6d. No. 3 small for smiths and coking is very scarce, and for house coal the demand is still large, so much of this quality being used for bunkers.

IRON AND STEEL.—The pig iron trade continues flat, with no prospect of an improvement until the warrant market recovers itself. Steel bars show a sign of weakness, and although nominal quotations are about £7 10s., it is said that £7 has been accepted. The inquiry for rails is moderately brisk, but quotations are lower.

TINPLATES.—The tinplate trade is in a very unsatisfactory condition, and arrangements are almost complete for a week's general stoppage. The production seems to be excessive, and makers are unable to produce without loss. Iron ore continues in poor demand, but as sellers in Spain are well sold no lower prices have been accepted.

BATH AND WEST AND SOUTHERN COUNTIES SOCIETY.—This old-established Society will this year hold its annual exhibition at Rochester on June 5, 6, 7, 9, and 10, and money prizes amounting to nearly £3,000 are offered for horses, cattle, sheep, pigs, poultry, cheese, butter, cream, hops, wool, preserved fruits, &c., in addition to several gold and silver medals and plate. The display of implements, machinery, and articles of general utility is always a very large one, and among other attractive features will be exhibitions of manufactures, paintings, fruit-packing appliances, &c. The butter-making contests, which have been such interesting features of the Society's recent shows, will be again carried out, together with other interesting demonstrations of dairy practice. The regulations, &c., can be obtained of the secretary (Mr. Thos. F. Plowman, Bath), and further particulars will be found in the Society's advertisement. The Society's gold medal is offered for the best appliance for determining the amount of butter fat in milk, and also for the best method for testing the acidity in milk.

BARROW-IN-FURNESS, 12TH MARCH, 1890.

RESTRICTION OF HEMATITE OUTPUT.—The decision of the makers of hematite pig iron to blow out five or six furnaces with a view to checking speculative influences has been carried out, but there has not yet been any marked improvement in prices. Warrants are only 1s. per ton above last week's prices, but the stocks have been sensibly reduced, not only in makers' yards but in the warrant stores. The latter have been reduced to the extent of 5,302 tons during the past week, and they are now 6,512 tons less than they were in the beginning of the year. One furnace at Carnforth, one at Millom, one at Lowther, one at Harrington, and one at Maryport will be blown out before the end of the month, and it is quite possible that a sixth furnace will be put out of blast. The output will thus be reduced by 4,000 tons, and only 50 of the 79 furnaces in the district will be left in blast. Prices are difficult to quote, as makers cannot do business with the price of warrants so much below the actual cost of production.

STEEL.—The steel trade is busy industrially both in the Bessemer and the Siemens-Martin departments, but the orders coming to hand are comparatively small, and buyers of rails, ship qualities of steel, tinplate bars, and other products are evidently holding back for cheaper prices. Rails have gone down to £6 per ton, ship-plates to £8 5s., angles to £7 15s., and tinplate bars to £6 10s., but local makers are not doing business at these prices, as they have several months' work in hand.

CHEMICAL WOOD PULP. Although the new Kellner-Partington Pulp Company have not yet got their works at Barrow into full operation, they are beginning to make large deliveries of the manufactured pulp, which is in brisk demand at good prices. The sample manufactured is highly spoken of, and as a material for papermaking purposes it is in growing demand. There are indications of a very large trade in this class of material, and the success of the new works at Barrow is an already assured fact.

MIDDLESBROUGH, 12TH MARCH, 1890.

PIG IRON.—After considerable fluctuation the market has settled down at lower prices than last week. Yesterday No. 3 G.M.B. was offered by merchants at 50s. 6d. per ton, but more than 50s. 3s. could not be obtained for delivery this month. At present there is no business done for future delivery. Makers will not break their price, and are content to hold on for a better price, which they anticipate will come with the opening of the shipping season. Buyers prefer warrants, and thus it happens that, whilst makers' stocks are accumulating, the warrant stocks are decreasing. The stocks in Connal's stores on Monday, the 10th, amounted to 171,914 tons, against 176,866 tons a week ago.

SHIPMENTS OF PIG IRON.—The shipments are very poor indeed, being only about half of what they were at the same time last year. For the current month up to Monday, the 10th instant, they amounted to 12,943 tons, as against 23,824 tons for the first ten days of March last year. The shipments have fallen off all round.

MANUFACTURED IRON AND STEEL.—Finished products are flatter than last week, and the prices have fallen. There are few inquiries and no new orders. Iron ship plates are at £7; angles, £6 15s.; common bars, £7 per ton, less 2½ per cent. on trucks at works. Steel ship plates, £8 5s.; angles, £8 2s. 6d.; rails, £6 12s. 6d. per ton f.o.t. at works.

SUNDERLAND, 12TH MARCH, 1890.

SHIPBUILDING AND ENGINEERING.—The dispute between the employers and workmen in the engineering establishments has come to a crisis. The original demand of the employés was for a second shilling advance and one hour less work on Saturdays. Notices to cease work, unless the latter point was conceded, expired on the 8th inst. Fortunately, at a conference between the representatives of the two parties, on the 7th inst., it was decided that the notices should be extended to the 15th inst. A ballot is to be taken among the workmen as to whether they would accept the shilling per week increase; as to whether in such establishments where the men desired particularly to cease work at twelve o'clock on Saturdays this arrangement be conceded provided the hour was worked up during the week; and as to whether they would forego the rise of wages, and insist merely on the fifty-three hours week, stopping work at midday on the last day of the week. The Tyne, Wear, and Tees districts are all intended to be placed on the same basis, but only the decision of the Wear workmen has as yet been arrived at; it was as follows: 1,582 voted for the twelve o'clock Saturday; 18 for the employers' modified offer; spoiled votes, 3. There can scarcely, it is anticipated, be a strike now, but, in any event, it is doubtful whether it would be general, as the lesson learnt by the engineers' employés during the last strike on the apprentice question has left permanent effects.

SHIPPING.—The freight market has been unchanged during the last week or ten days. American rates, hitherto favourable to shipowners, have eased somewhat, owing to a rise in the prices of wheat in the United States and to forward fixing. The Baltic and White Sea trades are opening on less favourable terms than last year, and the Black Sea market still keeps low. Outward coal rates to the Mediterranean have slightly improved. Local coal shipments are by no means steady: during the last week, 65,231 tons were shipped, as against 78,647 tons, 56,962 tons, 75,402 tons, and 60,961 tons in the immediately preceding weeks; 38,667 tons went coastwise, and 26,564 tons to foreign ports. Coastwise shipments included 450 tons of patent fuel, 9,000 dozen bottles, 200 loads of timber, 223 tons of iron plates, 56 tons of steel plates, and 95 tons of lime.

NEWCASTLE, 12TH MARCH, 1890.

SHIPBUILDING.—The announcement has been made that a firm of shipbuilders have, through Messrs. Snowball & Co., Side, Newcastle, acquired possession of the shipbuilding yard at Scotswood, which was formerly occupied by Messrs. Campbell, McIntosh, & Bowstead, and that they intend re-starting the establishment at an early date. The yard is a very spacious one, and is fully fitted up with first-class modern machinery. We hope to be in a position to give fuller particulars respecting this very important undertaking in the course of a week or two.

DISPUTES IN OTHER TRADES. A section of the quay labourers are on strike against what they term a reduction of wages, but which is described by the employers' representatives as a rearrangement of the rates on a more liberal scale than that which existed six or seven months ago. The strike is causing some inconvenience, but this is daily being lessened by the starting of new hands. In the building trade considerable inconvenience is also felt, through a strike of the same class of workmen, for an advance of one halfpenny per hour.

THE COAL TRADE.—The shipments of coal and coke from Tyne Dock for the week ending March 8th amounted to 104,836 tons, being an increase of 9,936 tons as compared with the shipments for the corresponding week last year.

CHEMICALS.—The chemical manufacturers are actively employed in shipping goods, but stocks, with the exception of crystals of soda, are being rapidly cleared out. The lading of the steamers for Dantzig and Stettin, together with the shipment orders which have come here in consequence of the dock labourers' strike at Liverpool, are the causes of the increased activity. There is a considerable amount of inquiry going on respecting future deliveries of bleaching powder and soda ash, but manufacturers are exceedingly careful about committing themselves while so many labour difficulties appear in the way.

IRON AND STEEL.—In the pig iron trade quietude continues to prevail, holders being somewhat reluctant to sell at the rates now current. In the manufactured iron trade a fairly active business is being done, but prices have declined to the extent of nearly 20s. per ton from the highest point attained during the recent period of exceptionally brisk demand. In the steel trade values have also decreased, with the result that orders are said to be coming in more freely.

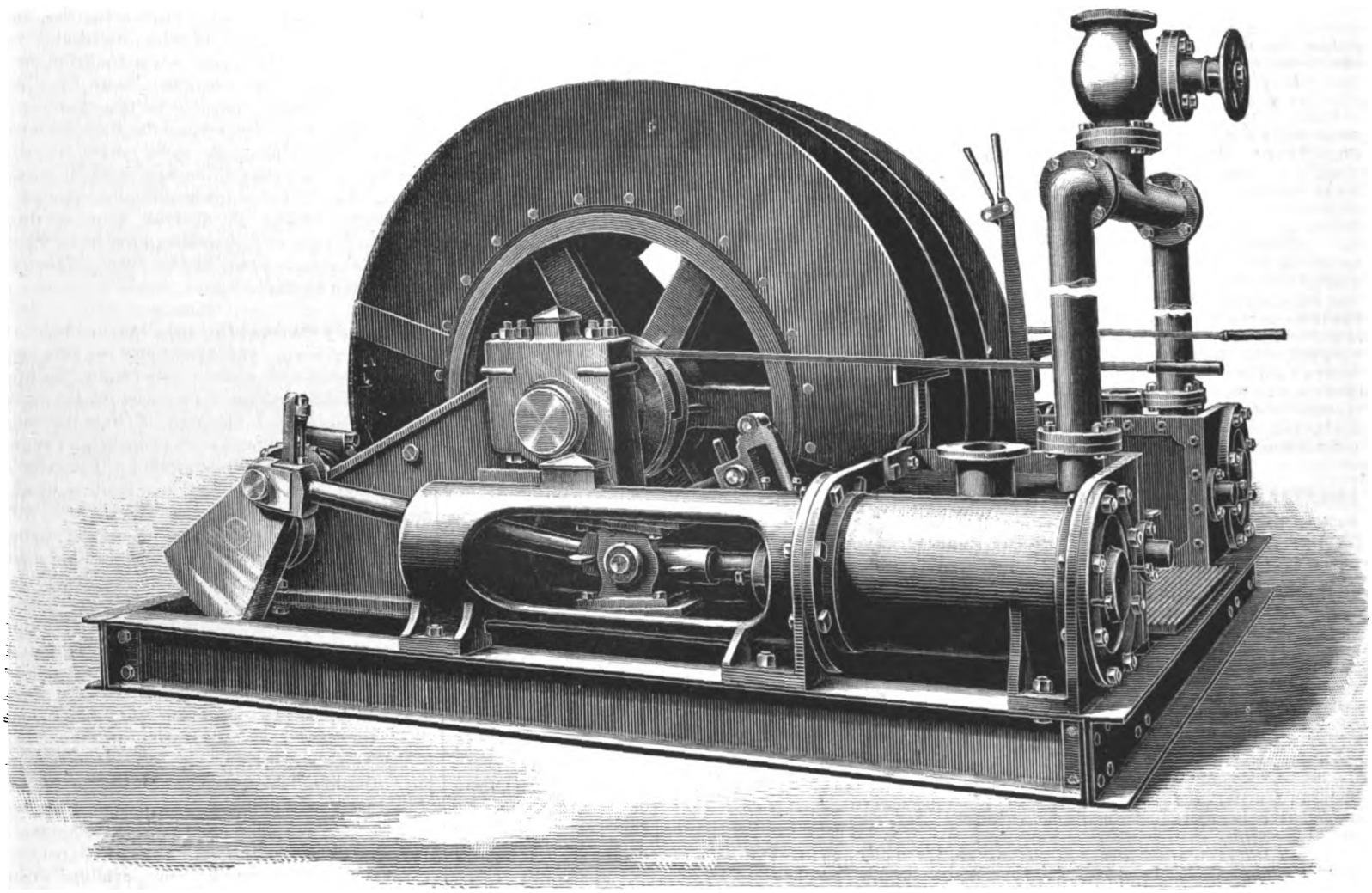
DUNDEE, 12TH MARCH, 1890.

FLAX AND JUTE TRADES.—The trade here in both branches continues quiet. Business in flax is limited both for spot goods and on contract. There is a demand of a hand-to-mouth character for flax yarns. Transactions have been carried through at low prices, but it is thought that quotations have now touched their lowest point. Manufacturers of linens are well employed, and orders are coming in with satisfactory steadiness. The finer goods are most in demand. Prices are steady. There is a steady inquiry for sailcloth at late rates. Jute of good quality is meeting with a satisfactory sale, but coarser kinds are not at present much inquired after. The demand for jute yarns has, if anything, improved during the fortnight, and prices are a shade firmer. Orders for Hessians are coming in pretty freely. The New York market is steady, and 40in. 10½oz. burlaps are quoted at 5¼c. per yard. The jute crop of 1890, it is now estimated, will exceed 2,500,000 bales. Statistics have been published giving particulars of the export of flax from St Petersburg in 1889. It appears that there was a decrease of 15,000 tons flax and 4,000 tons of codilla, compared with the exports of the previous year. The totals for the year were:—Flax, 12,723 tons, and tow and codilla, 6,829 tons. Dundee was the largest importer, taking 2,863 tons flax and 1,234 codilla. Dunkirk came next with 5,946 tons of flax and 925 tons of codilla. Montrose imported 1,458 tons flax and 738 tons codilla; Lubeck, 1,147 tons flax and 289 codilla; and Antwerp, 170 tons flax and 2,312 codilla.—It is reported that one of the largest firms in this district, that of Messrs. Cox Bros., is about to be converted into a limited liability company. The capital, it is said, will be three-quarters of a million.

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SEMI-PORTABLE HAULING ENGINES.

CONSTRUCTED BY MESSRS. JOHN WILD & CO., ENGINEERS, FALCON IRONWORKS, OLDHAM.



SEMI-PORTABLE HAULING ENGINES FOR COLLIERIES.

WE illustrate above a pair of semi-portable hauling engines which have been made by Messrs. John Wild & Co., Falcon Ironworks, Oldham.

These engines have been specially designed for underground work, and are the outcome of a long practical experience with mechanical engineering work in collieries. The larger sizes of this type of engine are intended for main roads and inclines, whilst the smaller sizes are more especially intended for hauling from the workings to the main roads. The engines are mounted on a strong framework composed of wrought-iron girders and channels, whilst the drums are fitted with wrought-iron cheeks which are secured to the body of the drum by bolts. The brake consists of a cast-iron ring turned and fitted into a prepared recess in the drum. When pressure is applied to the brake lever the cast-iron ring is expanded so as to come in close contact with the drum.

In the engine illustrated above the cylinders are 12in. diameter, and have an 18in. stroke. The pistons are of the "Mather & Platt" type, 4¼in. wide. The piston rods are of the best mild steel, 2in. diameter. The stroke of the slide valve is 3¼in. The slide-valve spindles are of the best mild steel, and the outer end is carried by an adjustable slide to receive the strain due to the angularity of eccentric rod. The connecting rods are of the best hammered iron, 3ft. 9in. long, 2in. diameter at their small ends, 2⅝in. diameter at their large ends, and 2⅝in. diameter in the centre. The crank shaft is of the best mild steel, 4½in. diameter; and the cranks are of good cast iron and of the balanced type. The crank pins are of the best mild steel, 2⅝in. diameter, and 4¼in. long between collars. The drum shaft is of mild steel, 6½in. in diameter, and the bottom step of its bearings is of gun metal. The drums are 4ft. in diameter, and 12in. wide between the cheeks. The cheeks are 9in. deep, and are made of wrought-iron plates 2in. thick. The body of each drum consists of one casting. The brakes consist of cast-iron expansion rings fitting inside the drum, and they can be operated without the engineman leaving his place. All materials used are of good quality, and are adapted to their several requirements. The workmanship is of the best class throughout.

LLOYD'S COMMITTEE OF SHIP-BUILDING.

OWING, doubtless, to the continued pressure of public opinion, Lloyd's Committee have agreed to the very necessary reform of admitting representative members of the scientific societies concerned in shipbuilding and marine engineering to assist them in their deliberations. Such help will be very valuable in connection with the numerous points that arise in connection with the framing of the rules of the Society. By this recent decision the whole question of the way in which the technical department has hitherto been administered comes, therefore, prominently to the front. Up till now the Committee have necessarily been largely in the hands of their permanent employés upon professional matters. The system has worked fairly well, but not without complaints on several occasions, which the efforts of the staff have not always quite allayed. By the adoption of the change the Committee will be competent to act for themselves as regards engineering details, independently of the officials. This is a considerable gain, and one which will be much appreciated. It is a curious feature that, with the vast amount of work to be got through by the Society's surveyors, and the great interests at stake in the formation of rules to guide the building of the country's mercantile marine, the staff has been permitted to compete for essentially outside work. The primary object for which the register exists is to class ships therein so that they may pass readily from hand to hand, the class being a certificate of value. It would have been thought that the task of keeping abreast of the engineering science of the day and taking account of new developments was a sufficiently arduous one. In the course of time the original purpose for which the Society was established seems to have been somewhat overlooked. It has now come to be recognised that a person who wishes to buy a ship may call in one of the Society's surveyors to pronounce a special opinion upon her, the fees therefor going, presumably, to the Society. Surely such duties and others undertaken by the staff were never contemplated at the outset. In a competition with a public body like Lloyd's, the mass of shipbuilders and engineers must suffer. Individual experts cannot hold their own in the open market against a Society that makes the laws which govern ship construction. It has, practically, the monopoly as regards the classification of ships. The position of Lloyd's, as far as the general public is concerned, remains unique, and their certificates are invaluable. Our point just now is that the Committee ought to take a different stand and confine themselves to their proper sphere of action. We should suppose that for a powerful society to take fees, as they do, below those required by independent members of the profession, is of doubtful advantage. There has hitherto been no appeal from this state of things, the Society being a ring within itself. Now, however, that extra-professional members are to be included on the Committee, we may reasonably anticipate that they will exercise their powers to do away with any anomalies that may exist. If we take the Board of Trade, or Admiralty, which, though Government Departments, have each technical staffs, we find there is a rigid rule in each case against the employment of any of the officials on outside duties. Were it otherwise, a "leakage" of information acquired in regular hours might follow, and the Departments represented become a byeword in the country. The same objection applies to a body having functions of the nature of Lloyd's Register. To the previous want of an engineering section on Lloyd's Committee we must ascribe the state of affairs that has supervened. Now that weakness on the technical side has been admitted, any errors that have crept in will probably be soon put right and undue latitude will be partly restrained. The Society has frequently been at open war with the prominent builders of the country, the latter from their power and number never really bowing to decisions in which they had no voice. It may now be reasonably expected, with the concessions made, that the Society's action will be brought up more to the latest requirements in all the minutiæ of their very important work.

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

Contents.

	PAGE
Carriage Wheel Making Machine (*Illus.*)	241
The Recent Growth of Technical Societies—II.	241
A Bridge for Central America (*Illus.*)	243
Foreign Industries (Corres.)	246-247
Improved Travelling Crane (*Illus.*)	248
Institute of Marine Engineers	248
London Association of Foremen Engineers	248
North-East Coast Institution of Engineers and Shipbuilders	249
Notices of Meetings	249
Prices Current	249
Foreign Telegraphic Advices (Corres.)	249
Home Industries (Corres.)	250-251
Semi-portable Hauling Engines for Collieries (*Illus.*)	252
Lloyd's Committee of Shipbuilding	252
The Industrial Outlook	253
American and English Practice in Electrical Engineering	254
The Opening of Western China	255
Words as Trade Marks	255
The Late Sir Peter Coats	255
The Late Mr. Alan Brebner	255
The Late William Henry Snell	256
Letters to the Editor:—	
Blasting Gelatine Patents	256
Then and Now	256
Locomotive Practice	256
The Steel of the Forth Bridge	256
Legal Proceedings	256
Shipbuilding Notes	256
Sayer's Patent Air Propellers and Blowers (*Illus.*)	257
The Institution of Civil Engineers	257
Safety in Electrical Distribution—I.	258
Practical Working of the Electrical Subways in New York (Corres.)	259
Society of Chemical Industry	259
Notes	260
"Industries" Patent Record:—	
Applications and Acceptances	261-262
Illustrated Abridgments	262-264

To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

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Industries:

FRIDAY, 14TH MARCH, 1890.

THE INDUSTRIAL OUTLOOK.

THE falling off in business announced in reports from many districts in England and Scotland is not to be accounted for on any very simple grounds. The wave of good trade which arose in the late autumn of 1887, and which increased in volume all through 1888 and 1889, seems to have reached its culminating point about the close of the past year; for since 1890 began there have been in many of the leading districts distinct evidences of decline. The falling off in the placing of shipbuilding orders, though not immediately affecting the shipbuilding districts, owing to the large amount of work booked during the period of strong demand for ships, must ere long begin to tell upon shipbuilders. This diminution in shipbuilding orders is due, no doubt, to the excess of tonnage in the market seeking employment, and to the serious depression of freights in consequence. In some instances freights have fallen to about 50 per cent. of their amount a year ago. This decrease in earning power has unquestionably led to hesitancy in placing orders for new ships; but since this cause has hardly yet begun to operate upon industry directly, the causes of the depression, such as it is, must be sought elsewhere. It may be suggested that these causes may be found to exist in part in the mode in which the capital saved during the past two or three years has been invested. A very large portion of that capital has been invested in undertakings many of which are not yet, and some of which may never be, productive. A reasonable time at least must elapse before a new industry or a new company can be expected to become a good dividend-paying concern, and thus for a year or more after the foundation of a company its shareholders do not receive any income. More than this, not a few of the companies registered are conducted, within two years after promotion, with due formal solemnity through the Court of Bankruptcy, their promotion money having been in many cases squandered in a circle of unsound undertakings. Some of the companies formed within the past two years are even now exhibiting symptoms of non-productivity, to say the least. This non-fulfilment of expectations must have led to the restriction of expenditure among certain classes, and must thus have tended to depression. But perhaps a more potent influence in the alleged decrease in the volume of trade is to be found in the investment of so much of the capital in permanent and practically unrealisable forms. Should the investment result in increased production, all may come out right in the long run; but meanwhile the cost of the unrealisable investment must be met out of the produce of the year, and this may only be effected by disturbing the economic balance. Again, during the past three years there has been a steady advance in high class securities, and thus a falling off in the rate of return to capital. Some of the railway stocks have advanced from 98 and 100 to 120 and 130. Consols also are at a high price. Thus the interest payable to shareholders has been low, and their income has been to some extent reduced, while during the same period prices of many of the commodities ordinarily used in consumption have risen. The fund holder and interest receiver benefited largely by the fall in prices during the years of depression which expired in 1886, and they are now simply compelled to return the advantage they gained then. This, however, causes them to restrict their expenditure, and thus to depress demand and influence business adversely. Again, as regards the wages of labour, the rise of wages affecting the prices of certain articles, by placing a drag upon production, has been accompanied or followed by an increase in the cost of living owing to the advance in the prices of some at all events of the articles of common consumption. Thus the working class have been prevented from doing more than temporarily adding to the demand for commodities. In accounting for an apparent downward tendency in trade, there is another element in the case whose influence is so obvious that it is apt to be overestimated. This it the element of speculation. All businesses where buying forward is the rule must be more or less speculative. The temptations in a rising market, with a favourable outlook, and no apparent insurmountable labour troubles, are very strong, but a faint breath of suspicion that things are not what they seem is sufficient to kill speculation for the rise and to transform it into speculation for the fall. Although the mere gambling in foreign and home speculative stocks has comparatively little influence outside a narrow circle, saving when a new "lamb" is drawn in and fleeced, and his business, whatever it may have been, perhaps destroyed, speculation in such a commodity as pig iron, indulged in so largely at certain times by outsiders, does unquestionably affect, often seriously, the course of ordinary industry. It is clear that some portion of the downward tendency of the curve of trade is due to speculation in metals, not so much owing to the actual increase in prices brought about by speculation, as to the violent fluctuations and uncertainties of a market so influenced. It is an experience which has been met with in the recent history of the iron trade, that, contemporaneously with alterations in supply and demand for industrial purposes, which would have had the effect of raising or lowering prices as the case might be, speculative transactions entirely reversed what may be called the natural order, and caused price movements of a precisely opposite character to take place. In addition, however, to temporarily or permanently disadvantageous investments, to the element of speculation, to the checking of consumption of the bulk of the people by the rise in prices, and to the diminution in the return to capital resulting in a check to luxurious consumption, there is another element which at this time is thrusting itself very prominently forward. This element is the disturbance caused to industry and the actual loss inflicted by what are alleged to be excessive demands by labourers, and their result—strikes. That this is a real and widely influential cause of the decline in the wave may be held as proved. Waste of time, waste of resources, carried to an extent so enormous as was the case in the London dockers' strike, cannot but find economic retribution. Never before in the history of industry in this country had the labourer so much actual power as he has now, and he is roundly charged with using that power in a short-sighted and intensely selfish manner. There can be no question that there have been pretty ample grounds for such charges. The anathemas that, on the part of labour, have been hurled against the

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capitalist and employing classes, even if they had been justified, might now simply be returned with interest. But of what avail would be a mere bandying of words? The main point is to arrive at a *modus vivendi*. Admitted that the practice of combination among labourers—simply a fair counterpart to combination among owners of capital—has acquired a footing so secure that any attempt on the part of Parliament to define its limits more than they are now defined by law would inevitably fail, what is to be done to prevent the occurrence of fluctuations in trade due to labour disputes and strikes is really the crying question of the moment.

If disputes between employers and employed cannot be prevented, how can they be settled so as to prevent the culmination of a strike? There can be no doubt that some of the newer trades unions, especially those which are attempting to consolidate the lower grades of labour, are managed in as selfish and short-sighted a manner as it is possible to conceive. Yet even they must be dealt with wisely, if firmly. Some patience must be exercised during their transition from wild inexperience and tutelage under professional agitators, whose influence over the men is often in inverse proportion to its wisdom. Hitherto the men have been incohesive, and frequently have suffered from being at the mercy of those who bought their labour at the lowest rate, and cared not whether they lived or died by their earnings. Thus, when one comes forward, even though he be a self-seeking charlatan, to champion them, his profession of the potency of combination and action under his guidance is easily believed, and, so long as the benefits he secures are substantial, he is caressed; when benefits cease to be secured, he is kicked. This is the history of nearly every labour combination in its early stages. Until men learn that their wages and the mode in which they spend them are integral parts in a cycle, and that alteration unwisely effected is fatal to themselves as well as to those whom they seek to strike, there can be little hope for trades unions, left to themselves, to regulate industry and commerce with advantage to society. Looking at the matter from as impartial a standpoint as one may pretend to assume, it is quite obvious that the egotism of the working class is no whit less worthy of condemnation than the egotism of the classes above it. If, as some politicians say, the industrial safety of the country cannot wisely be left to the class of landed proprietors, or, as others say, it cannot wisely be left to employers or capitalists alone, the idea which seems to be held in some quarters, that the lower ranks of labour may, by combining together and dictating terms to the rest of society, efficiently and wisely manage the terms of industrial distribution, is surely as slenderly based as any of those. As an actual practical step towards a solution of the problem of how to tide over the transition stage which must intervene before we have reason to hope that a less selfish and more reasonable spirit may pervade all classes, it is surely advisable, ere we sink into another well of depression like that from which we have so recently escaped, to try a series of experiments in arbitration. Let the dock strikers in Liverpool and the shipping companies involved submit their dispute to arbitration, rather than disorganise the trade of the port, and in effect inflict a fine upon almost everybody in the city. It is conceivable that a few days' bombardment would inflict less serious damage upon Liverpool than such a strike. With a fall in prices probably imminent, without indulging in too gloomy forebodings, there is strong reason to believe that strikes will become more and more frequent, since employés are necessarily unwilling to realise the necessity of a reduction. It is to be pointed out that strikes against a reduction of wages very rarely succeed; because a movement for reduction of wages on the part of the employers is generally dictated by the imperious necessity of a falling market. It is in the interests alike of workmen, employers, and society generally, to settle disputes which have such wide-reaching influences by reference to independent parties rather than by recourse to a war in which the onlookers are hardly the least sufferers.

AMERICAN AND ENGLISH PRACTICE IN ELECTRICAL ENGINEERING.

American practice radically differs from English in several points, and sometimes our electrical engineers are a little apt to condemn without examination anything which does not chime in with their preconceived notions. Let us, however, examine some of the more important differences, not with the view of showing that the Americans are wrong, but to see whether we are always right ourselves.

Everyone condemns the rough-and-ready way in which work is frequently put up in the United States; but it is not really a question of whether the work should be put up in a temporary way at a moderate cost or in a manner calculated to withstand the wear and tear of a century or more, but whether it is to be put up roughly or not put up at all. In our permanent work do we not spend a great deal too much in making it far more permanent than there is any need? To make anything too strong is only a less fault than making it too weak. If it is too weak it may break some day and do some damage, and money will be spent repairing it; if made too strong, capital has been foolishly sunk, and extra interest and depreciation have to be paid. If anyone proposed to lay tram lines on a macadamised road in England, and to run electric tramcars over them at twenty miles an hour, he might be laughed at; but in America they do this. There is, therefore, no room for laughing at such a plan, as it works, and what is still more important it pays, and pays well. In England, promoters would ask for capital to do the work in what would be called a permanent, solid, engineering manner, but, as we have pointed out, part of the capital may be wasted, or sunk foolishly, and it will then be more difficult to pay a good dividend. In many cases the larger capital necessary is not forthcoming at all, and so, because we cannot get the work done according to our British prejudices, it is not done at all.

The most remarkable difference is in the system of supply. In this country a maker of dynamos, for instance, does not turn out hundreds of the same size and type; he makes them of all sizes, to go at all speeds, and give all sorts of outputs. This is not because the makers like this mode of manufacture, but because the customers demand it. The maker may perhaps charge an extra price, and thus make a little more on each machine, but the price is increased, and increased price means decreased total profits to the business, though the profits per machine may be greater. Why, it may be asked, is the customer not content with the stock sizes? The customer is a small contractor, in all probability, and suffers from a weakness which seems almost universal in the electrical industry. Every electrical engineer thinks he is an inventor. Even if he does not want the plant to be made so as to work in some invention of his own, he may have a lot of little fads which have to be considered. He probably likes the dynamo to run absurdly slow or ridiculously fast, or he likes it coupled direct to some favourite engine, which, he thinks, is superior to all other engines. If the installation is large, the engineer insists on pushing in some product of his own brain, and the whole thing is called his "system." This evil becomes greater the more important the station. In the whole of the United Kingdom there are, probably, no two installations alike. In America the contractors supply the machinery of the type found by them, after considerable experience, to be good, and that machinery is put up in exactly the same way as exactly similar machinery for exactly similar purposes has been put down before, and it works without a hitch just as it worked before. The people who put it down do not settle what machinery to use, or interfere with the design in any way; they merely carry out the designs of experienced engineers, who have, under a very perfect system of division of labour, perfected every detail. Of course, the difference is that in America the plant is supplied by large contractors, and the engineers who erect it are practically the contractors themselves. The American arrangement of business tends to the development of enormous companies, and these absorb all the engineers, and the man who in England would be a small contractor is a member of the staff of a large concern. It would be exceedingly difficult for an electrical firm to begin business on this principle in England now. We believe the Westinghouse Company are going to try, and we wish them every success, and hope they will not only help to develop the electrical industry here, but that they will also show us how to do business on the wholesale interchangeable principle.

The consulting engineer seems to be non-existent in America, and we believe this is a point of great importance. In lighting a town here, for instance, the contractor, or the various contractors, are naturally at the mercy of the consulting engineer. The consulting engineer may be in a position to keep the contractor in order through his superior knowledge, but in many cases he is a drawback. Very often he has never had any practical experience, and has simply pushed himself forward by a judicious form of advertising. If electric work were more centralised, so that there were only a few large companies, those of the present consulting engineers who are really men of practical knowledge and experience would be employed by the companies, and the rest would perhaps be able to find some work they could do to advantage. The consulting engineer is now in an anomalous position: he has power to control the contractor, but if the installation does not work properly the blame is somehow or other generally thrown on the contractor. If it goes well the consulting engineer probably reads a paper on it, and is retained by the next town requiring lighting plant.

The American attitude towards science is radically different from ours. In this country we have too much respect for what is called "pure science." The measure of value of science is its immediate or probable future applicability to useful purposes. It must be distinctly understood that by pure science we do not mean what many people loosely term theoretical knowledge. Theoretical knowledge has a value that cannot be underrated. It is not merely useful, it is indispensable. If a man investigates the composition of Sirius his results are of no practical value. His work may be extremely engrossing, and the account of his researches may be very interesting reading, but it cannot well be regarded as work of practical value. An investigation of the tides, on the other hand, is a different matter; it is immediately useful. Now if a man spent a large portion of his time in studying the composition of Sirius, and evolved a number of speculative theories about it, he would be made a member of a number of learned societies and would become a distinguished authority at once. If another man of equal ability spent the same time in examining the properties of various insulating materials under various practical conditions, and found out enough to help electrical engineers out of all the difficulties that are dimly seen in the future, he would remain a nobody unless he chanced to procure a patent; and a section of the public would infinitely prefer to intrust the care of the lighting of a town to the astronomer than to the insulation inventor, because the former would be considered a distinguished scientific man. The Americans perhaps go a little too far the other way in their idea of what an electrical engineer ought to be, but they judge a man by his practical success.

There is still another important difference between American and English practice. In America they really understand the subdivision of labour. In England the same man has often to design machinery, manage shops, look after correspondence, superintend outside installations, canvass for orders, and work up the business generally. This evil partly arises, of course, from our system of comparatively small companies. In America there is a staff for each of these departments. Here we do not experiment in a systematic way. Every maker of any importance should have a special experimental department with a special experimental staff. At present most people would regard all that as reckless extravagance. We think quite the reverse, as the experiments must be done some time or other, and they are done, but they are done on machinery which is already on order, and this is the most expensive way of making experiments.

The last point is that there seems to be some difference in the matter of "push." If the electrical business was carried out more on American lines, is it not likely that such branches as mining work, electrical tramways and railways, and motor work generally, would be farther forward than they are?

THE OPENING OF WESTERN CHINA.

The Chinese Government has just given another illustration of its way of looking at things, and of doing things, which to Western minds, which will not take the trouble to study all the circumstances, may seem strange and possibly stupid. When fully considered, however, it will be seen that this way is possibly, on the whole, the best which the conditions of things will admit. Some time ago we mentioned the arrangements which had been come to with Mr. Little about the navigation of the Upper Yang-tse, and we pointed out that these in no way lessened the rights of British subjects generally under the Chefoo Convention, and that probably some would take advantage of these rights. The Chinese Government evidently recognised this, and now they have proposed to Lord Salisbury to modify the terms of the Convention. As originally drawn up, it was provided that Chung-King, the principal commercial city in the province of Szechuen, was to be constituted a

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treaty port, and thrown open to the residence of foreign merchants so soon as a foreign vessel should have succeeded in reaching it. Yet when Mr. Little and his company made arrangements for doing this, they bought up his vessel and stipulated that he should not make another attempt for at least ten years. They now propose to open Chung-King, which is the great emporium of the trade of Western China, at once to foreign trade and to the residence of foreign merchants, but still subject to the restriction that the navigation of the river by foreign vessels be not attempted for the same time as arranged with Mr. Little. This may seem a piece of fooling, for all goods will require to be carried by junks from Tchang, taking in many cases months to go up, and costing much for insurance, for the dangers of navigation are very considerable. No doubt, people in this part of the world will say, if the Chinese are really in earnest about the matter they ought at once to get steamers suited for the navigation of the rapids, but they forget that in this country vested interest and narrow prejudices hinder for a very long time many needed reforms. Let them therefore put themselves in the place of the Chinese Government, and they will see how necessary it is to have a transition period, in which the changes may be carried out gradually. During that time foreign merchants will have the right of residing in Chung-King, and they will have opportunities for studying the requirements of the wealthy province of Szechnen, with its population of about 70,000,000, and no doubt, notwithstanding the impediments to transport, will be able to do a considerable amount of trade. At the same time the various vested interests will be able to adapt themselves to the changed conditions, and especially the provincial governments to the very serious loss of revenue from *likin* duties which would arise if direct and easy communication could be established in British vessels between Tchang and Chung-King. The junk-owners and haulers who make their livelihood out of the present system of navigation would also be able to turn to other work, although in any case we do not anticipate that the change would be so rapid as to dispossess these for a considerable time, and many of them would no doubt find occupation in the steamers. We trust that Lord Salisbury will agree to what seem to us to be reasonable proposals, and that opportunities will be afforded to our merchants of making themselves acquainted with the requirements of an immense population. If good use be made of their opportunities, we doubt not but that at the end of the transition period proper arrangements will be made for improved transport, and thus an immense outlet be afforded to British goods.

WORDS AS TRADE MARKS.

There is an increasing desire in the commercial world to have words instead of devices as trade marks. There are strong reasons for this departure. Words are more easily brought to the notice of the public and more easily recollected by them than devices, and some newspapers and periodicals object to advertisements containing anything beyond type.

The Patents and Trade Marks Acts, 1883 and 1888, point out what are the essential particulars of a trade mark, and particularly mention, sec. 64:—"(*d*) An invented word or words, or (*e*) A word or words having no reference to the character or quality of the goods and not being a geographical name."

This section has no reference to marks in use before August, 1875, technically known as "old marks." Old marks consisting of words are not rendered invalid because they transgress the above definition. The real object of a trade mark is to identify the goods of a particular manufacturer.

Words as trade marks possess certain disadvantages. The trade mark may have some connection with a patent, in which case the trade mark is of little or no avail after the expiration of the patent. The courts will not sanction the use of a trade mark which in any way tends to lengthen the monopoly of Letters Patent. To show the length to which the courts, here and also in the United States of America, have gone, we need only refer to the cases of the Wheeler and Wilson sewing machine and the Singer sewing machine. It was held in each case that, where a machine has acquired a name, other persons can, after the patent has expired, construct the machine and call it by that name; but such other persons may not place on such machines any mark which would lead the public to suppose that they were made by the original manufacturers. Independently of patents, we can state another objection to words as trade marks. The word may not be descriptive of the article at the date of registration, but it may subsequently become so. There has been no decision on this point, but any rights in the word will be very limited. To illustrate our meaning, a chemical manufacturer brings out a new compound (not protected by a patent), and for which the true chemical name is (say) methyl-diphenylamine, $C_6H_5NCH_3,C_6H_5$. He christens this "roslyn," registers the word "roslyn" as a trade mark, and then introduces the article into the market. It will be seen that this is a perfectly good trade mark. It is an invented word, and, at the date of registration, not descriptive. It would, of course, have been impossible for him to register the word "methyl-diphenylamine," as that is descriptive. In the ordinary course of events the manufacturer advertises the existence of the article, and after a few years the word "roslyn" becomes the popular equivalent of the more technical word "methyl-diphenylamine." Under these circumstances can it be supposed that the chemical manufacturer has the exclusive right to the word "roslyn," which word he has invented? In all probability it will be found that in his advertisements and trade lists he has used the word "roslyn" to describe the article, and not as a trade mark to identify his make from that of other manufacturers.

On this will depend the extent of his rights. If, as a fact, the word "roslyn" represents his manufacture, and his manufacture only, no other person will be allowed to make use of the word in advertisements or price lists. If, on the other hand, the word has, since registration, become descriptive of the article itself, other manufacturers would be entitled to make use of the word to describe the article; such other manufacturers could not, however, use the word as a trade mark. In this latter case the owner of the trade mark has very narrow rights. In another column will be found a report of a case of Barlow and Jones *v.* Johnson & Co. The case had reference to the word "Osman," which the defendants contended was descriptive of the particular article, and that there was no other word than "Osman" to represent that article.

Mr. Justice Chitty, however, held that the word "Osman" was not descriptive of a new article, and that it represented the plaintiffs' manufacture only; and he thereby deprived the public of a legal decision on a subject of great importance to the commercial world. If words as trade marks lead to inconsistent results, the time will not be far distant when words will no longer be available for registration except in the case of a firm's name.

THE LATE WILLIAM HENRY SNELL.

It is with great regret that we have to announce the death of Mr. William Henry Snell, the editor of the *Electrician*, which took place on the 5th inst., in the thirty-second year of his age. Mr. Snell was born at Tiverton, in Devonshire, on the 6th of November, 1858, and commenced life as a science teacher in his native town. He afterwards studied at the School of Electrical Engineering, Hanover Square, London, and from there he went to be chief electrician to the Cunard Steamship Company. He was subsequently a sub-editor on this journal, and his services were most valuable. In 1886 he joined the staff of the *Electrician*, and in the following year became editor of that journal. He was a man of great abilities and an incessant worker, and his minute knowledge of the various branches of science that he had to deal with was extraordinary. Those who knew him privately have lost a friend such as can ill be spared, and a man who was otherwise worth knowing on account of his general ability and information. He was one of the first to discuss alternating currents so as to make his work intelligible to non-mathematical readers, and had also written papers on distribution and other matters. He was also well known as one of the co-patentees of the Kapp and Snell transformers. An editor, however, is better known as a sort of embodiment of his paper, and all readers of the *Electrician*, whether they knew him personally or not, will feel the loss of his individuality.

THE LATE SIR PETER COATS.

By the death of Sir Peter Coats, which occurred at Algiers on Sunday last, in his eighty-second year, Paisley has lost one of its most esteemed citizens.

Sir Peter was born in Paisley on the 18th of July, 1808. His father, Mr. James Coats, was the founder of the great thread firm of Messrs. J. & P. Coats. When the firm was first established it engaged in the production of textile goods, but in the year 1824 its attention was turned to the manufacture of thread, which ultimately became its sole business. The sons of James Coats served their apprenticeships as engineers, and no doubt this laid the foundation of the success which attended their work, as they were thus able to take advantage of all the improvements which were made in machinery. The three sons—James, Peter, and Thomas—were all partners, and the business very soon became largely developed. On the death of their father, in 1857, the management fell upon Peter and Thomas, and the trade rapidly became almost world wide. Addition after addition had to be made to the works, until at the present time they form a group of buildings in which employment is found for 6,000 people. But even the immense works at Paisley were soon found insufficient to meet the demands of the firm's trade, and equally large works were started in America, so as to leave the Scotch works free to supply the home and continental trade. So much has the thread trade been concentrated that it may be said that a very few firms practically have a monopoly of it.

Sir Peter and his firm took a high view of their social duties, and devoted large sums to the improvement of the town of Paisley and the elevation of its inhabitants. The work with which Sir Peter's name is most likely to be connected was his gift of the Free Library and Museum Buildings, costing, with the site, about £18,000. In April, 1871, the library and museum were formally opened, and since that time they have been of the greatest possible advantage to the people of Paisley. Mr. Coats received the honour of knighthood in 1869. About twelve years ago Sir Peter bought the estate of Auchendrane, in Ayrshire, and his last years have been chiefly spent there and in Algiers.

THE LATE MR. ALAN BREBNER.

Our readers will regret to hear of the death of Mr. Alan Brebner, C.E., of the firm of Messrs. D. & T. Stevenson, civil engineers, Edinburgh, whose name has come before the public rather prominently recently in connection with the proposed Forth and Clyde Canal. Mr. Brebner had been connected with the firm of Messrs. Stevenson for a long time, first as a pupil, then as resident engineer on works, and latterly as a member of the firm. Before beginning work as a civil engineer he had served his apprenticeship as a mason, and thus laid a good practical foundation for his after work. In early life Mr. Brebner had considerable experience on railway work, chiefly in Fifeshire. Thereafter he returned to Messrs. Stevenson's employment, and was connected with the design and construction of many important works, especially those relating to harbour and lighthouse construction, and river improvement. He paid special attention to lighthouse apparatus, and devised several important improvements, and on the subject of lighthouses generally he was considered one of the foremost authorities. As a Parliamentary and legal witness he always gave his evidence in a clear and concise manner, and he spared no pains in making himself acquainted with the details of the case in hand. He was not much given to writing on professional topics, but the few papers he has left show a thorough grasp of the subject under discussion, and a clear method of expressing his views. He was gifted with a most retentive memory, and was an expert in all engineering calculations. Mr. Brebner was in his usual health until about a month ago, when he was attacked with hemorrhage, and he died somewhat suddenly on the 5th inst. He was in his sixty-fourth year, and leaves a widow and family. Of a quiet and reserved disposition he seldom came prominently before the public, but he made a large number of personal and professional friends to whom his death will be a matter of deep regret.

Letters to the Editor.

THEN AND NOW.

To the Editor of "Industries."

Sir,—Your special account of the Forth Bridge affords a most excellent idea of this enterprise from an engineering point of view, but its advantages to the ordinary traveller have not been made so evident. Though now resident in London I used formerly to live in Edinburgh, and the journey to and from Dundee and Aberdeen almost baffles description under the old state of affairs. There were two ferries to cross, one between Granton and Burntisland, and the other between Tayport and Broughty Ferry. The first, I think, is about three miles, and the second about one mile, but the delays occasioned were vexing to the soul. On one day, some six years ago, after the old Tay Bridge had broken down, and before the new Tay Bridge had been erected, I started from Aberdeen early in the morning to keep an important engagement in Edinburgh. The train kept very good time till we got to Broughty Ferry. On reaching that spot it was discovered that one of the ferry boats was laid up for repairs, and that the other had burst one of the steam pipes leading to the boiler. The result was that none of the passengers could progress on their journey. They wired to Dundee for a tug, but would or could not inform us when it would arrive, and we had to shiver in a bitter east wind on the pier in the month of February for, I think, some two hours. When we had crossed Fife the connection was, of course, lost at the Burntisland Ferry.

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Altogether the run from Aberdeen to Edinburgh took about as long as the express train between Edinburgh and London.

All the trains from Fife to Edinburgh used to be as notoriously late as are those of the South-Eastern here. All this is now done away with, and local travellers have reason to congratulate themselves on the engineering enterprise of the present century.

I am also well acquainted with the usual Queensferry passage, which seems to have but slightly altered for many a long day, with the exception that a steamer took passengers across instead of a pinnace. The first chapter of Scott's "Antiquary" gives an account of how Lovel and Mr. Oldbuck had, firstly, difficulties with the coach from Edinburgh to South Queensferry, and how they had to dine at the Hawes Inn, which still exists, mainly depending upon cyclists. The date of the story is 1816, but it applies very considerably to the routine of a dozen years ago, only that then the coach was put bodily on board the ferry boat on its way to Dunfermline.

The new way of getting north will prove a boon, more to the Scotch on the North British lines, than to those who are going from London to Aberdeen, who have hitherto gone by Perth.

Yours, &c.,

A Scot in London.

London, 10th March, 1890.

BLASTING GELATINE PATENTS.

To the Editor of "Industries."

Sir,—Some statements made by Mr. MacRoberts in a paper read the other day before the Glasgow Section of the Society of Chemical Industry are instructive, as indicating that the fact of a patent having been granted has a deterring effect upon would-be imitators even after its expiration. He said the only firm making blasting gelatine was the Nobel's Explosives, and, though the patents expired last year, any competition was unlikely. He gave as a reason that the difficulty of obtaining a suitable site, the difficulties with the local authorities, with the Home Office, and, lastly, the difficulty of obtaining suitable technical management, made it improbable that the monopoly would be disturbed. The reasons adduced are weighty, but they are not conclusive. The obstacles referred to have been overcome by the Nobel Company, and, that being so, they could also be surmounted by any other company. If, therefore, Mr. MacRoberts' opinion that there will be no competition proves to be correct, the cause is rather to be found in the fact that the protection afforded by the patent has allowed the company to obtain such a firm hold of the market that a newcomer could not venture to oppose them. This should prove encouraging to other owners of patents about to expire.

Yours, &c.,

Patentee.

Newcastle-on-Tyne, 8th March, 1890.

LOCOMOTIVE PRACTICE.

To the Editor of "Industries."

Sir,—I find in your American contemporary, the *National Locomotive and Car Builder*, a statement the object of which is to show that English locomotives are far more expensive than those made in America. It is asserted that "a British locomotive building company, noted for the fine equipment of tools used and the advanced system of production followed, built two hundred locomotives last year, while employing on an average 2,500 workmen; a well-known American firm in the same time built three hundred locomotives while employing 1,400 workmen." It would have been far more satisfactory if we had been told the names of the firms, so that the figures given might be tested, but accepting them without question, it appears on the face of it that the American paper has not discovered the proper application of the facts. Dearness is purely a relative term, and a locomotive at a certain price may in the long run be more expensive than one of which the prime cost is 50 per cent. higher. The true deduction to be made from the foregoing statement is, that the English locomotive, upon which far more work has been expended, is the superior article.

Yours, &c.,

Loco.

Glasgow, 10th March, 1890.

THE STEEL OF THE FORTH BRIDGE.

To the Editor of "Industries."

Sir,—As some few thousand tons of that part of the steel that Sir John Fowler told the assembled guests at the recent inaugural ceremony, "had come from dear little Wales," were manufactured under my management, you will perhaps kindly allow me to make a few observations on the nature of the material that the inspecting engineers call throughout their final report just presented to Parliament "Siemens-Martin" steel.

In a general sense it matters little what name is given to a material that has amply proved its excellence by successfully undergoing the most searching and rigorous tests, and it is besides quite a common thing to designate open-hearth steel of any kind as "Siemens-Martin." Still, in these days, when a mere change in the position of the tuyeres in the Bessemer converter has been found so to modify the conditions of manufacture as to constitute a new process, it will not be thought hypercritical to distinguish between "Siemens-Martin" steel properly so called and "Siemens" steel pure and simple, which, as a matter of fact, is what Sir John Fowler referred to.

In the earlier, or "Siemens-Martin" process, malleable iron, wrought scrap, or scrap steel is melted in a bath of pig iron, from which the impurities are eliminated solely by the action of the flame and the addition of spiegel or ferro-manganese. Wrought metal, or steel scrap, is an essential element of the process, and no ore is used. In the "Siemens" process, on the other hand, a much larger relative quantity of pig iron is employed, and, although scrap is also generally worked up, the process can very well go on without it. Then, again, the impurities are driven out from the pig iron by the addition to the bath of a properly selected iron ore, which becomes reduced, whilst its oxygen carries away the carbon and assists in the formation of a siliceous slag. Both processes require Mushet's addition of ferro-manganese at the end, a common need of most steel-making operations. It will require little further explanation to show that the "Siemens" process lends itself more readily than the "Siemens-Martin" does to the continued production of large quantities of a high-class material of uniform nature, as pig iron and iron ore of the necessary quality can readily be obtained in any quantity, whereas wrought iron scrap and scrap steel are always difficult to procure when the amount needed is large.

At a time when not Britain alone, but the entire world, rejoices over the accomplishment of one of the greatest feats of engineering skill that dignifies the human race, it may not be inopportune to call to mind that it was at the Landore Steel Works that those methods were perfected which have furnished 51,000 tons of suitable material to build the giant structure that now spans the Forth. May its endurance for many centuries keep the name of Sir William Siemens in grateful memory, even as the design and construction of the bridge already ensure this meed of fame for the names of Fowler, Baker, and Arrol.

Yours, &c.,

F. J. R. Carulla.

Derby, 8th March, 1890.

Legal Proceedings.

BARLOW AND JONES (LIMITED) *v.* JOHNSON AND CO.

This case related to a trade mark, and occupied seven days before Mr. Justice Chitty. The plaintiffs and defendants were manufacturers and sellers, at Manchester, of Turkish towels. The plaintiffs claimed the exclusive user of the term "Osman" in connection with such towels. The defendants contended that the word was descriptive of a new article, that it was common to the trade, and that the plaintiffs could have no exclusive monopoly in the word.

Mr. Justice Chitty said that it appeared that the plaintiffs in 1879 commenced to make a superior quality of Turkish towels possessing a greater power of absorption than any hitherto introduced, and that in 1886 they registered their label as a trade mark under the Patents, &c., Act, 1883, bearing upon it the term "Osman," and also the head of Osman Pasha. The label thus registered had been from the commencement used by the plaintiffs for the special goods sold under it. To go through the voluminous evidence produced upon this trial would be an impossibility. He should therefore merely state the result of such evidence, and that was that the name "Osman" in reference to Turkish towels denoted in the market goods of the plaintiffs' manufacture, and had no other meaning. The defendants, however, said that the plaintiffs' title to the name "Osman" must depend on their right as existing at the date of registration (as was admitted), and that the plaintiffs had no right to the name, because the law was that if a man produced or invented a new article of manufacture, and gave it a new name by which it became known in the market, the name became *publici juris* and could not afterwards be recaptured and appropriated for exclusive use. The defendants said that where an article for which a patent was obtained became known by a name connected with the patent, exclusive property in the name was not permitted because there was no other designation for the article, and to hold otherwise would operate as an elongation of the patentee's term of monopoly under the patent. In support of this view the defendants relied on the Wheeler & Wilson sewing machine case and the "Gem" gun case. These authorities were not applicable to the present case. The plaintiffs never had any monopoly. It was open to the whole trade to make precisely similar goods and call them by any name they pleased. The defendants, however, also urged that where a new article was produced not under a patent and given a new name by which it became known, and which, when examined, was descriptive of the article, the name could not be appropriated by means of registration or by any other means. Cases were cited in support of that proposition, but the *ratio decidendi* of these cases was that the word in question was or had become descriptive of the new article with which it was connected. He, however, found upon the facts that the Turkish towels manufactured by the plaintiffs were not "new articles" in the sense contended for. All that the plaintiffs had done was to make certain improvements in the quality of the towels, and to this superior quality of towels they gave the name "Osman" by means of labels affixed to the goods. The name denoted nothing more than that the articles were of a particular quality and that the plaintiffs were the makers. The question whether the name denoted the article or the particular manufacture was a question of fact. In the present case he held upon the evidence that the term denoted the manufacture. Therefore the questions of law contended for by the defendants did not arise. His Lordship then dealt at length with the other arguments of the defendants, and gave judgment for the plaintiffs, and granted a perpetual injunction restraining the defendants from using the word "Osman" in connection with Turkish towels.

SHIPBUILDING NOTES.

On the 6th inst. Messrs. Short Bros., Pallion, launched the steel screw steamer "Enchantress," built to the order of Messrs. Taylor & Sanderson, Sunderland. The vessel is of the spar-deck type, with cellular double bottom and six water-tight bulkheads. The principal dimensions are: Length between perpendiculars, 292ft.; breadth, moulded, 40ft.; depth of hold, 27ft. 6in. The deck machinery is specially complete, and is provided with steam from a large multitubular boiler placed on deck. The vessel will be provided with quadruple expansion engines by Messrs. Allan & Co., Scotia Engine Works, Sunderland.

On the 6th inst. Messrs. J. L. Thompson & Sons, of North Sands, Sunderland, launched the steel steamer "Poh Ling," which has been built to the order of the China Shippers' Mutual Steam Navigation Company. The principal dimensions are: Length between perpendiculars, 378ft.; breadth, moulded, 41ft. 6in.; depth of hold, 25ft. 3in.; and measurement capacity about 5,000 tons. In every respect the vessel is most completely fitted and finished for the tea trade. At each hatch double derricks are fitted, and the cargo arrangements generally are specially designed for rapid handling of cargo. The engines are of the triple expansion type and indicate 2,800 h.p. The cylinders are 32in., 49in. and 77in. diameter, by 48in. stroke. The engines and boilers have been constructed by Mr. John Dickinson, Palmer's Hill Engine Works.

On the 7th inst. Messrs. Richardson, Duck, & Co. launched from their yard at Stockton-on-Tees a steel screw steamer named the "Montebello," of the following dimensions:—Length over all, 287ft.; breadth, extreme, 35ft.; depth, moulded to awning deck, 25ft. 9in. This steamer has been built to the order of Messrs. Thos. Wilson, Sons, & Co., of Hull, and is intended for their passenger trade between Hull and Norway. The awning deck extends fore and aft, and on it a large deck-house has been erected amidships containing dining saloon for 70 first-class passengers, &c. She will be engined by Messrs. Amos & Smith, of Hull.

On the 7th inst. Messrs. Bartram, Haswell, & Co., South Dock, Sunderland, launched the steel screw steamer "Benedick," built to the order of Messrs. C. Howard & Son, London. The vessel has a raised quarter-deck, partial awning deck forward of engine-room, full poop aft, cellular double bottom, and web frames and intercostals. The principal dimensions are: Length between perpendiculars, 300ft.; breadth, moulded, 39ft.; depth of hold, 21ft. 7¼in.; and gross register, 2,460 tons. The deck machinery includes six steam winches, Davis's hand and steam steering gear, Hastie's steering gear aft, &c. The vessel will be schooner rigged, with telescopic masts to suit the bridges of the Manchester Ship Canal. The engines and boilers have been contributed by Mr. John Dickinson, Palmer's Hill Engine Works, Sunderland.

On the 8th inst. the Strand Shipbuilding Company, North Sands, Sunderland, launched the steel screw steamer "Oxus," built to the order of the Oxus Steamship Company, of London. The principal dimensions are: Length between perpendiculars, 216ft.; breadth, moulded, 28ft. 3in.; depth of hold, 18ft; and tonnage, about 910 tons gross register.

On the 8th inst. Messrs. William Doxford & Sons launched from their yard at Pallion a steel steamer, built to the order of Messrs. William Ross & Co., of East India Avenue, London. Its dimensions are: Length, 365ft.; breath, extreme, 44ft.; depth, moulded, 30ft. The engines are of the triple expansion three-crank type, by Messrs. Doxford; the cylinders are 27in., 44in., and 72in. in diameter, by 48in. stroke. They are supplied with high-pressure steam from two double-ended boilers. She is fitted throughout with electric light by Messrs. J. H. Holmes & Co., Newcastle; steering gear amidships by Messrs. Bow McLachlan & Co., Paisley; screw gear aft by Crawford Brothers, Monkwearmouth; steam windlass, by Messrs. Emerson Walker & Thompson Brothers, Gateshead; and five 7in. by 12in. winches, by Welford Brothers, of Pallion.

On the 8th inst. Messrs. Laird Brothers, Birkenhead, launched from their works the torpedo gunboat "Almirante Condel" for the Chilian Government, a sister vessel in every respect to the "Almirante Lynch," which was launched from the same yard on the 10th ult. These vessels are an enlarged form of the well-known "Rattlesnake" of our own navy. They have a length over all of 240ft., with 27ft. 6in. beam, and a maximum draught of 9ft. to 10ft. They will be fitted with two pairs of triple expansion surface condensing engines, with four boilers of the locomotive type, and when working under forced draught will be capable of exerting 4,500 h.p., with which a speed of 21 knots is expected.

On the 8th inst. there was launched from the yard of the Tyne Iron Shipbuilding Company, Limited, of Willington-Quay-on-Tyne, a steel screw steamer, which has been built to the order of Messrs. Kinghorn Brothers, of Liverpool, agents for the owners, Messrs. Wm. Howard Smith & Sons, Limited, of Melbourne. The vessel is of the following dimensions, viz.:—Length, 300ft.; breadth, 41ft.; and depth, 23ft. She has water ballast right fore and aft on the cellular system, and will be fitted with all modern improvements for the rapid loading and discharging of cargo. The engines are to be supplied by Messrs. Wigham Richardson & Co., and are of the triple expansion type; the cylinders are 23in., 37in., and 62in. in diameter, by 42in. stroke. Steam is supplied by two large boilers constructed throughout of steel. On leaving the ways the vessel was named the "Time."

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SAYER'S PATENT AIR PROPELLERS AND BLOWERS.

CONSTRUCTED BY MESSRS. BENNETT & SAYER, ENGINEERS, DERBY.

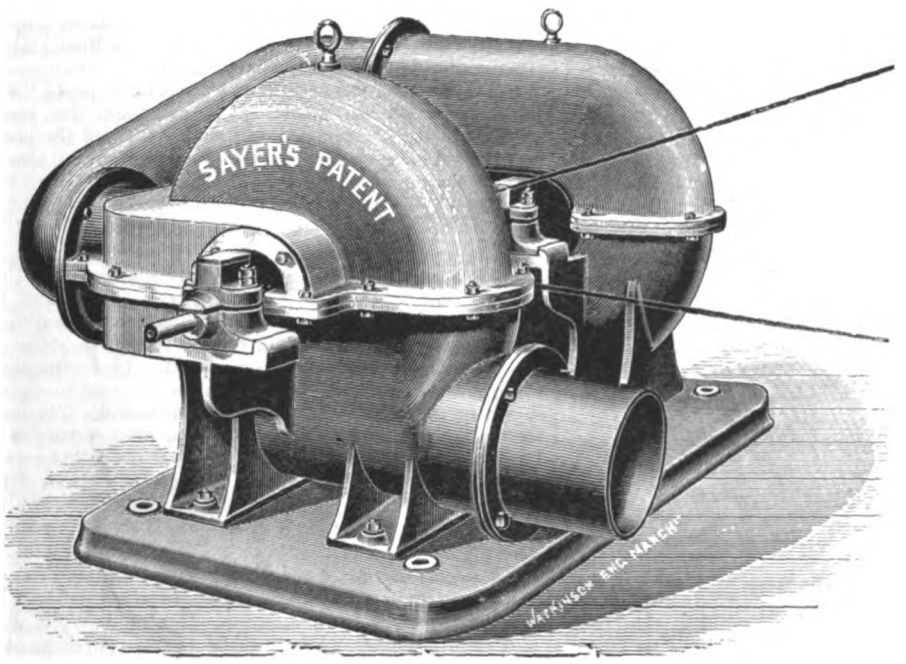


FIG. 1.—COMPOUND HIGH-PRESSURE FAN.

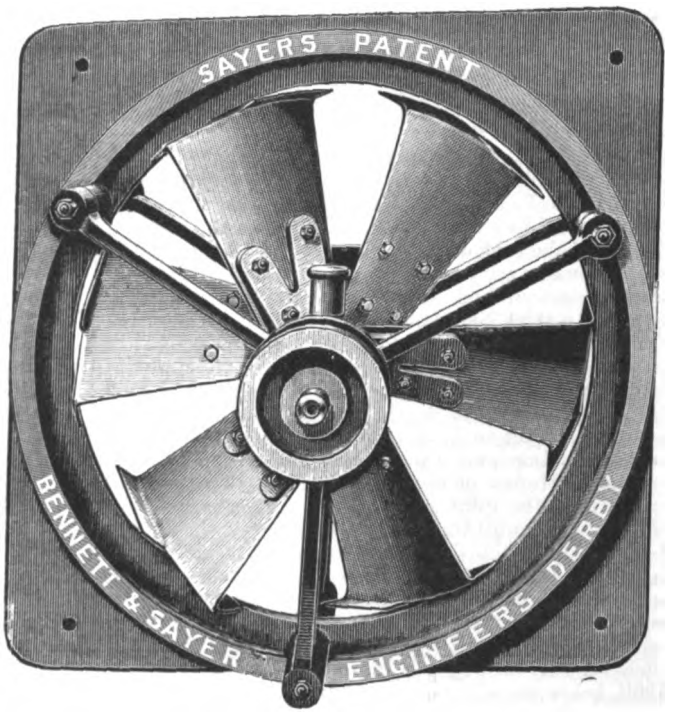


FIG. 2.—REVERSIBLE AIR PROPELLER.

SAYER'S PATENT AIR PROPELLERS AND BLOWERS.

IN Fig. 1 we show Sayer's patent compound high pressure fan, which is intended for use in iron foundries. In addition to its use for the foundry cupola, it is found efficient for sand-blast machines, pneumatic despatch, and for forcing air through long distances in pipes. These fans give 25in. water pressure at very moderate speeds.

In Fig. 2 we illustrate Sayer's patent reversible air propeller. The special point of the construction of this fan is that it can be used for forcing air in either direction with equal efficiency without any rearrangement of parts.

Fig. 3 shows one of the smaller sizes of Sayer's patent blast wheels, with one steel side plate removed to show its construction. A blast wheel similar to the one illustrated, 30in. in diameter, will pass, through a 15in. outlet, 15,000 cubic feet of air per minute, at a speed of only 1,000 revolutions per minute.

The makers of these various types of blowers are Messrs. Bennett and Sayer, engineers, Derby.

THE INSTITUTION OF CIVIL ENGINEERS.

AT the fourteenth ordinary meeting of the Session, on Tuesday, the 4th inst., Mr. Berkley, Vice-President, in the chair, three papers were read on Railway Bridges:—

I.—THE HAWKESBURY BRIDGE, NEW SOUTH WALES, by Mr. C. O. Burge, M.Inst.C.E.

The railway system of New South Wales had hitherto consisted of two separated divisions—the one starting from Sydney and branching thence in a westerly, southerly, and south-westerly direction, while the other originated at Newcastle, on the sea coast, about 100 miles north of Sydney, and communicated with the northern part of the Colony and with Queensland. The Hawkesbury Bridge was situated upon the connecting link of railway which was designed to unite these two systems. It crossed the main channel of the Hawkesbury between Long Island and Mullet Head, at a point where the channel had a width of about 2,800ft., and a maximum depth of 77ft., while its bed consisted of a deposit of mud extending to a depth varying from 60ft. to 170ft. below high-water mark, and overlying the sand. For the construction of this difficult work, the Colonial Government invited tenders accompanied by competitive designs, and took steps to make the competition world-wide. A committee, consisting of Mr. W. H. Barlow, Past President Inst.C.E., Mr. G. Berkley, Vice-President Inst.C.E., and Captain Douglas Galton, R.E., Assoc.Inst.C.E., was appointed to adjudicate on the tenders; and when the report of this committee had been supplemented by others from Sir John Fowler, Past President Inst.C.E., and Mr. John Whitton, M.Inst.C.E., Engineer-in-Chief for Railways, New South Wales, it was finally decided to accept the tender of the Union Bridge Company, of New York, who undertook to complete the bridge within two years and a half, for the sum of £327,000. The accepted design consisted of seven spans of 415ft. (from centre to centre of the piers), the foundations being carried down in steel caissons filled with concrete, while the upper portions of the piers and the whole of the abutments were of masonry. The girders were formed of built steel compression members, and solid steel eye-bar tension-rods, all the connections being made by steel pins. The cross-girders and rail-bearers were of riveted steel plate. The two main girders of each span were 410ft. long from end pin to end pin, and 58ft. deep at the centre, and were placed 28ft. apart from centre to centre, the bridge carrying two lines of railway. In the execution of the foundations, it was found very difficult to sink the caissons in a truly vertical position through the great depth of mud that had to be penetrated before the sand could be reached. The tendency of the caisson to assume an inclined position, and to draw away from its true place during the process of sinking, gave rise to a great deal of trouble and delay, and in some cases could not be entirely overcome; and the author was of opinion that this difficulty was in great measure due to the form in which the caissons were constructed. In plan, the caisson formed a rectangle with rounded ends, its length, transversely to the bridge, being 48ft., while its outside width was 20ft. The outer shell of the caisson, having this contour, formed a vertical prism for the greater portion of its height; but in the lowest 20ft., the walls were splayed 2ft. outwards at the base by inclining them at a batter of one in ten at the sides, and also at the rounded ends. Each caisson contained three circular dredging wells, 8ft. in diameter, placed along its axis at distances of 14ft. from centre to centre, the wells being splayed outward at the base in conical form, so as to meet the outer shell, and to come to a cutting edge at the periphery of the caisson and also between the wells. The lower part of the caisson was built on shore, and, being temporarily fitted with a false bottom, was floated out and sunk to the bed of the river. The space between the wells and the outer skin was then loaded with concrete, and the caisson was sunk through the mud by dredging the material from the bottom of the three wells. If the caisson showed any tendency to cant transversely to the bridge, it could be righted by dredging one or the other of the wells in advance of the remainder; but when it canted transversely to the axis of the caisson, the central position of the well precluded the use of any such means of righting it. It was also believed that the

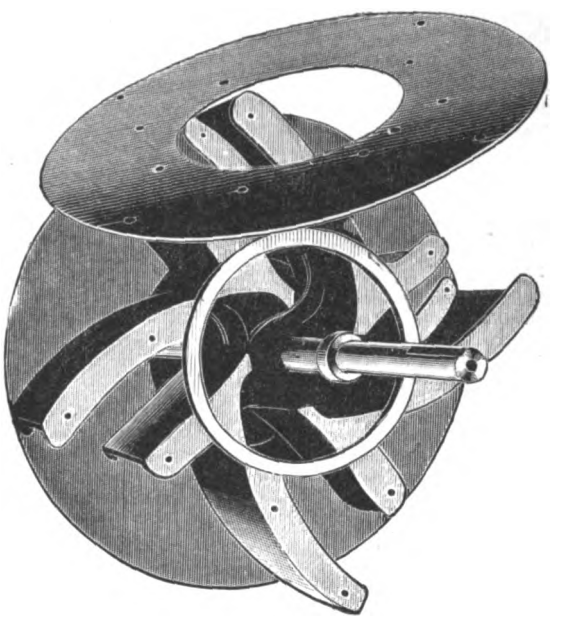


FIG. 3.—BLAST WHEEL.

splayed form given to the base of the caisson enhanced the tendency to cant over, as the sinking of the splayed shoe would leave around the walls of the upper portion an empty space, which would afterwards become filled up in an irregular manner, depending upon the consistency of the mud. For the work of erecting the main-girders, a pontoon was constructed of sufficient size and stability to carry a complete span of the superstructure elevated above the deck upon staging high enough to command the piers, whose summit was 40ft. above high-water, the range of tide being 7ft. At a convenient point on the shore, a gridiron was built at a distance of about half a mile from the bridge, and on this gridiron the pontoon was scuttled and allowed to remain, while the steelwork of a complete span was put together upon the top of the elevated staging above the deck. For the voyage of this craft out to the bridge, a favourable conjunction of tide and weather was selected, and, the scuttling valves of the pontoon having been closed at low-water, the vessel floated off the gridiron at the rise of the tide, and was warped out to the bridge by 6in. hawsers worked by steam windlasses, the operation being facilitated by the assistance of steam-tugs and by the flow of the tide. At the top of the tide, the pontoon was in place between the piers, the ends of the main-girders being then a few inches above the bearings on the piers, and the vessel, being moored in this position, was allowed to fall with the ebbing tide until it left the

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girders supported upon the piers. In some cases the process was hastened by partially scuttling the pontoon. The author described the numerous vicissitudes of the voyage, which was repeated in similar manner for each span, and also the endeavours that were made to correct or to remedy the canting of the caissons. It was worthy of remark that although the successful tender was made by an American firm, yet the whole of the steel and ironwork was provided and manufactured in the United Kingdom, excepting only the swelled heads of the eye-bars.

II.—The Construction of the Dufferin Bridge over the Ganges at Benares, by Mr. F. T. G. Walton, C.I.E., M.Inst.C.E.

The Dufferin Bridge was constructed by the Oude and Rohilkund Railway Company, in order to connect their line with the East Indian Railway, and was the fourth bridge erected by the same company across the Ganges. The site of the bridge was immediately below the ancient city of Benares, where the river was confined in a comparatively narrow and deep channel, the left bank being formed of a thick bed of clay which resisted the abrasion of the stream, and which extended below the river bed as far as the middle of the channel, while the remainder of the bed and the right bank were formed entirely of sand extending to a great depth. In the rainy season the river was subject to floods rising 50ft. above lowest river level, and submerging the district on the right bank for a distance of five or six miles inland. But from the cessation of the rains in October the stream generally fell gradually, until the recommencement of the rains in June. During the dry season the current lessened by degrees, until its velocity was not more than one mile an hour, and the channel then silted up considerably; but during the rains the velocity of the current was occasionally fifteen miles an hour, and the bed was sometimes scoured to a depth of 70ft. below low-water, or 120ft. below flood-level. The bridge consisted of seven spans of 356ft., and nine of 114ft. (from centre to centre), and was built for a single line of 5ft. 6in. gauge. The railway was carried between the main girders of the large spans, and on the top of the girders of the smaller spans. The height from low-water to rail level was 79ft., and the clearance under the main spans at highest flood was 25ft. A metalled road, 22ft. in width, was provided at rail-level, and was used for cart traffic between the passage of the trains. A footway, 5ft. wide, was carried on cantilevers outside the main-girders on each side. Both abutments were built as block-houses to contain troops for the military defence of the bridge. The river piers carrying the 356ft. spans were each founded on a single well of elliptical shape, 65ft. across the major axis, and 28ft. across the minor axis. For each well an iron caisson, of similar elliptical form, was provided, the height of the caisson varying from 10ft. to 50ft., according to the depth of water in which the pier had to be built. The caissons were constructed with three internal excavating chambers divided by cross walls 5ft. in thickness, and surrounded by the elliptical wall of caisson which was also 5ft. in thickness. The outer shell was vertical throughout, while the inner skin inclined inwards from the base at an angle of 45°, thus forming a cutting-edge which was strengthened by a cast-steel shoe 1½in. thick. Three of the piers were situated on, or very near to, the dry bank of the river, and these wells were sunk to a depth varying from 48ft. to 133ft. below low-water. The remaining four caissons were built on pontoons and lowered to the bed of the river; and were sunk by means of Bruce and Batho's dredgers worked from staging erected on the pontoons, the depth of these foundations varying from 62ft. to 141ft. below low-water. The wedge-shaped portion of each caisson, above the cutting-edge, was filled in with cement concrete; and above that height the space between the inner and the outer shells was filled with brickwork in mortar. Above the top of the caisson, the brick well and cross walls were carried up in similar elliptical form, and the work was bonded with the brickwork below by an iron crate of angle-bars contained within the thickness of the walls. In sinking through the great depths above mentioned, it was frequently found that the well exhibited a tendency to cant over in one direction or another; but this tendency was corrected without any great difficulty, and the wells were successfully got down in their true positions with no greater divergence than 6in. in any case. Two of the wells, when passing through a hard stratum, canted over considerably from the vertical. No. 6 was 4ft. 9in. out of perpendicular when 109ft. in the ground, and No. 7 was 5ft. 3in. out when 135ft. in the ground. To right these wells a weight of about 1,000 tons, in rails, was first brought on so as to cause the greatest pressure on the high side. The earth outside the well was then excavated, on the side towards which the well was leaning, leaving the slope of the excavation at 1 to 1. This slope was covered with wooden sleepers, on which rails were laid in the direction of the slope 6ft. apart. Again, on these rails were laid cross-sleepers close together, and the whole excavation was then filled in with bricks, forming a wedge-shaped mass which pressed continuously against the side of the well as it sank. In this way No. 6 was brought upright while sinking only 5ft. 8in., and No. 7 was righted in sinking 20ft. The main-girders were entirely of steel, the allowed working stress being 6½ tons per square inch. They were 355ft. 6in. in length, with a uniform depth of 35ft. 4¼in. The lattice-web consisted of vertical posts and inclined ties crossing three bays at an angle of 45°. The weight of a pair of main-girders was 491 tons, and of the complete span 746 tons. For the erection of these girders, the smaller girders for the 114ft. spans were used to form a temporary bridge of three spans extending across each opening, and carried upon two temporary piers consisting of twelve iron screw-piles driven into the bed of the river. The piles were braced together above water-level; but in some cases they were situated in 65ft. depth of water, and to ensure the stability of the temporary pier the group of piles was embedded in a raised mound of sand contained between walls of sand-bags. The cost of erecting one of the large spans was Rs. 57 per ton. The execution of the works gave employment to a large number of natives, as many as seven thousand having been employed at one time. The bridge was the joint design of Mr. Hederstedt, the Company's Chief Engineer, and Mr. Batho, their Consulting Engineer in England, Mr. W. H. Barlow, Past President Inst. C.E., having been consulted in the first discussion and arrangement of the design.

III.—The New Bridge of the London, Chatham, and Dover Railway Company over the Thames at Blackfriars, by Mr. G. E. W. Cruttwell, M.Inst.C.E.

The new bridge, which had been erected by the London, Chatham, and Dover Railway Company, across the Thames at Blackfriars, immediately alongside their older bridge, together with the new station in Queen Victoria Street, formed an important extension, which was long needed for the increasing traffic of the railway. The bridge was designed to carry, in all, seven lines of railway, and had a clear width of 81ft. between the parapets; but this width was increased to 123ft. at the northernmost span, where it was necessary to provide space for the platforms as well as for the lines of way. In consequence of the great width, and the occurrence of numerous cross-over roads upon the bridge, it was impossible to adhere to a construction like that of the older bridge, consisting of main girders rising above the rail-level; and it was considered preferable to adopt a series of arched ribs placed entirely beneath the rails. The bridge had five spans: the shore span on the Surrey side being 183ft.; the centre span and the Middlesex shore span, 185ft. each; and the second and fourth spans, 175ft. each; the lengths of the three middle spans being fixed so as to correspond with those of the old bridge alongside. The foundations of the abutments were carried down to a depth of about 25ft. below Trinity high-water, the work being executed within cofferdams composed of a single row of sheet-piles of sawn pitch-pine. The foundations of the river piers were all carried down to 46ft. below Trinity high-water, and were laid in the London clay, the depth below the river bed varying from 16½ft. to 23½ft. Piers Nos. 1, 2, and 3 were each founded upon three rectangular caissons spaced 6ft. apart; whilst for the long pier on the Middlesex side four caissons were required. Immediately above low-water level arches were turned across the 6ft. openings, and above these the piers were carried up solid. The caissons were about 30ft. by 30ft., and consisted of a single skin of wrought-iron varying from ½in. to $\frac{5}{16}$in. in thickness, stiffened by vertical angle- and tee-bars spaced at intervals of about 7ft., and also by temporary horizontal stiffeners. In each case the lower portion, or permanent caisson, was 21ft. in height, and above this a temporary caisson was carried up to a further height of 28ft., this portion being bolted to the permanent caisson and removed after the building of the pier was sufficiently advanced. For sinking the caissons a staging was erected around the side of each pier, and to regulate the descent each caisson was suspended from the staging at the four corners by wrought-iron rods 2¼in. in diameter. The rods were in lengths coupled together by pins, and the top length of each rod was cut with a square screw thread 2½in. in diameter, by which the caisson was lowered uniformly at the four corners, the nuts being simultaneously turned by four spanners coupled together. The silt and ballast were excavated down to the clay by Priestman's grabs worked by movable jib-cranes; and, as soon as the caissons had been sunk well into the clay, the water was pumped out, and the digging was continued in the dry. At first, this could only be done during low-water, and, as the tide rose, the water was admitted into the caisson; but as the caisson penetrated to a safer depth into the clay the time of working was extended, until, on reaching the full depth, the tide was kept out altogether, and the concrete work was then commenced. The permanent caissons were filled with concrete to within 4ft. of the top, and above this level the brickwork and granite facings of the piers were carried up for a few feet inside the temporary caisson. The latter was then removed, and the masonry of the piers was continued by tide work. The superstructure of the bridge consisted of a series of arched ribs of segmental form, having a rise of 18ft. 6in., and a depth of 4ft. 6in. At each end the bearing of the ribs was taken upon a cylindrical pin of wrought iron, 8in. in diameter, which rested in a semi-cylindrical socket formed in the bed-plate. The arched ribs had sufficient transverse stiffness in themselves, and there were no braced spandrels between them and the upper longitudinal girders carrying the floor of the bridge, which were simply supported upon the arched ribs by vertical posts. The longitudinal girders were fitted between the cross-girders which were riveted upon the tops of the posts, the joints being connected by cover-plates and also by the flat floor-plates, $\frac{11}{32}$in. in thickness, which were laid over the whole surface. The longitudinal member might therefore be considered as continuous, and was made so in order to counteract the effect of unequal loading of the various spans upon the piers and foundations of the bridge. The continuity was unbroken throughout the entire length of 987ft., the member being contained between abutments of sufficient stability to withstand the thrust due to any probable rise of temperature, while it was also tied back at each end to anchorages of sufficient stability to withstand contraction. The longitudinal member was riveted up at a temperature of 50° Fahr.; and before it was finally closed, observations were taken of its actual contraction when the thermometer stood at 26° Fahr. The contraction resulting from this fall of 24° was 2in., which corresponded nearly with the amount by which a length of 987ft. of iron should contract according to calculation. The joint engineers for the works were Mr. William Mills, of the London, Chatham, and Dover Company, and Messrs. J. Wolfe Barry and H. M. Brunel. The author of the paper was their resident engineer.

SAFETY IN ELECTRICAL DISTRIBUTION.

By James Swinburne.

I.

In these articles it is proposed to discuss the merits of various automatic safety devices, and to mention and suggest a few more, of which some are new.

By safety is meant safety from personal injury and safety from fire. And it is the intention to show that with reasonable precautions it is possible to render the electric light almost perfectly safe

Series Arc Circuits.—Take first the case of high tension series arc lighting. There have been numerous accidents in the States through arc circuits being badly insulated. Of course we may reasonably assume that the circuits are well insulated, at least, to begin with; but for a circuit to be safe it is not enough that the wires should be perfectly insulated; the public and the companies' servants should be protected against any accidents which might occur through the insulation breaking down anywhere.

Almost every arc lamp in the market has its framework in contact with the circuit. This is a reprehensible practice, and has been the cause of one or two accidents. It must be remembered, however, that the frame of an arc lamp will always tend to be at the same potential as its carbons, for the series and shunt circuits, as well as the rods, must be in connection with the circuit. It would add little to the expense of construction to insulate the frame with low insulations; but it would be exceedingly difficult to insulate the frame up to, say, a million megohms, so that the insulation might rank as part of the main circuit. By low insulation, in this article, I mean insulation suitable for low pressures of, say, 50 to 150 volts; by high insulation, I mean insulation fit for standing from 1,000 volts upwards. With the best insulation available in an arc lamp, the frame might be earthed, so that there would be no danger; but it is probable that the arc lamp insulations would always be giving out. It would, therefore, seem best to insulate the frame from the circuit with low insulation, such as strips and washers of insulating materials, which will, as a matter of fact, sooner or later, become dirty; but not to trust to the insulation. It is easier to highly insulate the frame of the lamp from the post, as there are fewer contacts to protect. The lamps themselves must still be regarded as weak points in the circuit.

Another weak point in the circuit is the dynamo itself. Minute leaks to earth in the dynamo may easily occur. Considerable care is generally taken in insulating the armature; but there is little reason why the field magnets should be series wound. Series wound arc light machines, each working on its own circuit, are survivals of the old ideas. Where one machine is used

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alone it is difficult to find anything better, but in a station it is simpler to work all the arc lamps from one or two large machines in parallel. Electromotive forces of 2,000 to 4,000 volts are generally quite unnecessary, as 1,000 would be practically as economical in copper, and would give much less trouble by break-downs. In considering cost of leads, people are apt to forget the extra cost of insulation for higher pressures.

The large machines, being separately excited, need high insulation in their armatures only. As this method of arc lighting is not in use, it is not necessary to discuss it farther. Even if a number of high tension machines are used, each feeding its own series circuit, it is better to excite them separately, not only because it is easier to insulate the high tension circuits, but also because greater steadiness can be obtained, and a more perfect type of machine may be used. This arrangement has been adopted at Tilbury Docks by Messrs. Crompton & Co.

Returning to the question of safety of life. If the circuit is fully insulated throughout, a man touching the circuit cannot get an appreciable shock, as there is no complete circuit. To be dangerous, a circuit must be grounded somewhere else to make a circuit through a man. Thus even if the frames of the arc lamps form part of the circuits, an attendant, or a linesman belonging to another company, should feel nothing if he touches one. The accidents in the States could never occur without the greatest carelessness. Probably the circuits were never tested, but were taken as all right until a breakdown occurred—that is to say, as long as there was only one ground on each circuit, nothing was done in the way of repairing it. The result of such criminal carelessness would be that in a short time nine circuits out of ten would be earthed at one place each, and would be ready to kill anyone who touched an arc lamp.

As it needs an earth elsewhere to injure the man who touches an arc circuit, it can be made safe by arranging something to give the alarm, or to cut the circuit as soon as one leak occurs. The circuit is artificially earthed at the middle. Of course the actual middle of the circuit may be some miles off, so two high resistances are put across the circuit, and the middle is earthed. The earth connection is made through an electromagnet, and if any current passes, the electromagnet either puts out all the lights on the circuit instantly, or breaks the earth connection and rings an alarm. Suppose a man now touches the circuit somewhere, a current passes through him and back by the electromagnet. The electromagnet circuit is made with such a high resistance that only a harmless current can pass through the main, even under the 1,000 volts or so that represent half the electromotive force of the machine.

I have tried some experiments, which I hope soon to publish, on the current a man can take without serious discomfort. He can easily take a direct current of from a hundredth to a fiftieth of an ampere. In a 2,000 volt circuit, therefore, a safety cut-out with 20,000 ohms in its magnet circuit, and 40,000 ohms in the pair of resistances in shunt to the whole circuit, render it impossible for a man to get a serious shock. An automatic cut-out of low resistance might kill a man, even though it acted almost instantly. Condenser methods have been proposed, but they are no safer than high resistances, and do not act unless the earth contact is made suddenly, and are therefore not to be depended upon. The electromagnet may be arranged in several different ways. These will be more fully discussed in connection with incandescent distribution.

Danger from fire need not be separately considered in the case of arc circuits, as a system which is safe as to life is safe as to fire, for it takes two earths to cause a fire.

In places where overhead wires are used many troubles have arisen from telephone, telegraph, or other wires falling across electric light circuits. If the electric light circuit has been sufficiently insulated a wire falling across it should not come into metallic contact with it. On the other hand, if the insulation has been so bad as to have perished spontaneously, and to have left the wire bare, no automatic tell-tale will give warning till an earth is made. Immediately a telephone or other wire touches it, however, the electromagnet will prevent any damage.

A great many accidents have been reported in which the arc circuit broke and fell over other wires, making contact and doing damage. This seems impossible, for if an arc wire broke the machine would almost instantly lose its field, and there would be very little electromotive force available. Some arc machines will, however, give 120 volts on open circuit, due to the residual magnetism of their fields. Moreover, if the wires were insulated they might rest on other wires without necessarily short circuiting. If bare overhead wires or wires with only an apology for insulation are used in connection with separately excited dynamos, of course they will remain alive, even after breaking.

(*To be continued.*)

PRACTICAL WORKING OF THE ELECTRICAL SUBWAYS IN NEW YORK.

(*From our New York Correspondent.*)

At the meeting of the American Institution of Electrical Engineers, held in New York, on February 18th, Mr. Wm. Maver, Jun., electrician of the Subway Company, gave a description of the various systems adopted, with the results of the experience of the past year. The ideal system, as generally understood, he said, was a commodious tunnel, which would also provide for gas, water, and steam service. This had been dismissed as too expensive, the estimated cost being $430,000 per mile, or $30,000,000 for the entire city. Eight different systems of conduits had been adopted, experimentally or permanently.

Firstly, there is the Dorsett conduit, of asphalt concrete: the blocks are about 4ft. long, being moulded with 2½in. ducts. This is in a fair state of preservation. Then there are the zinc tube conduits, in which the tube is surrounded by hydraulic cement. It was expected that the zinc would corrode, leaving the cement tubes intact. Owing to the frail tube collapsing under slight pressure in construction, this plan has been abandoned. The sheet iron cement-lined pipe conduits are made in single or multiple tubes of two, four, six, or more ducts in 8ft. lengths. The tubes are connected with ball and socket joints. About 113 miles of these ducts have been laid, and it is expected more will be laid this year. About fifteen miles of creosoted wooden ducts have been laid, known as the Wyckoff conduit, and are made of logs bored out. Lead-covered telephone cables are placed in these, and the action of the creosote upon the lead is being carefully watched. After three years' use no apparent deterioration has taken place. The lead is alloyed with 3 per cent. of tin. The bulk of the subway conduits consists of wrought-iron pipe laid in hydraulic cement concrete. These pipes are 20ft. in length, and vary in diameter from 2in. to 3in. The thickness of the iron is ·217 of an inch. In laying these pipe conduits, the bottom of the trench is first levelled to the gradient; planks are then set against the side of the trench to sustain it. A layer of concrete is then laid and rammed in the bottom of the trench. On this is placed a row of iron pipes, next a layer of concrete, then another row of pipes, and so on, until the desired number of layers is attained. The number of pipes in a row depends upon the topography of the street and the location of existing gas and water pipes which it is desired to avoid; and the number of rows, upon the total number of pipes desired to be laid in a given subway. In order to add strength to the mass, and to protect the ducts from mechanical injury, the concrete is applied more thickly on the bottom, top, and sides of the subway than between the pipes. There is placed over all a 2in. yellow pine planking, heavily creosoted, to further protect the conduits against injury from picks, crowbars, &c., in the event of future excavations in the streets. The wrought-iron pipes are joined end to end by a coupling screw-joint with a tapering or vanishing thread. By the use of this form of thread, the rate of laying this pipe is increased 50 per cent. These tubes are delivered free from burrs, and have a smooth inner surface. The pipes are sometimes asphalted to prevent rusting, but should they in course of time rust, it is expected, as in the case of the zinc tubes, that the concrete will preserve the shape of the duct intact. There are close upon 550 miles of wrought-iron piping in the subways. The facility with which a pipe conduit conforms to the varying condition of the crowded streets of large cities, as found in the process of trenching, is one of its chief advantages. The main reasons which have led to the extensive use of wrought-iron piping in the subways are its great strength, its adaptability to varying conditions of the street, and the rapidity with which it can be laid. The Edison system consists of wrought-iron pipe, in which are placed the copper conductors or rods. These conductors are wound with rope, and the pipe is filled with an insulating compound of Trinidad asphaltum, rosin, paraffin, and linseed oil. These iron pipes are laid directly in the earth. There are about fifty miles of this pipe now laid in New York City.

The subways are in many cases on both sides of a street, and, as a rule, the telegraph and telephone wires are assigned to ducts on one side of the street, and the electric light wires to ducts on the opposite side; but in numerous instances the electric light wires are operated in distributing ducts on the same side of the street as the telegraph and telephone wires, and without detriment to the latter.

Access is had to the conduits of the subways by means of man-holes, placed at an average distance of about $\frac{1}{25}$th of a mile apart. The man-holes are, with a few exceptions, built of brick laid up in concrete cement, with hydraulic concrete bottom. The outside of the walls is coated with cement to prevent moisture and gas from penetrating. Access to the man-holes from the street is had through the cast-iron head which is set on the brickwork, and which is provided with double covers. The upper or street cover weighs about 350lb.; the lower cover is provided with a rubber gasket to prevent ingress of street water into the man-holes. This cover is funnel-shaped, in order that any water which may enter through the upper cover may be drained away from the gasket. The lower cover is screwed down upon the gasket by a gun-metal bolt and cross-bar. The upper cover is loose upon its bearings. The ducts enter the man-holes at a point easily accessible to the workmen while standing on the bottom of the man-hole. The average width of the man-holes is about 5ft., and varies from 5ft. to 10ft. in depth.

The foregoing mentioned conduits may be considered as belonging to the regular subway system of New York city. There are, however, several other conduits in operation, namely, the Brooks, the Western Union, and about five miles of telephone cable laid in wooden boxes filled with sand. The Brooks system has been repeatedly described. The Western Union subway consists of an iron pipe about 6in. in diameter, into which wires have been drawn.

All the electrical subways of New York, with the exception of the Edison system, are on the drawing-in-and-out systems. As many as six electric light cables, No. 6 B.W.G. conductors, have been repeatedly drawn at once into a 3in. duct. It is not deemed advisable to draw cables into or out of ducts over cables already laid, but in case of necessity it has been done without injury to the cables. As the weight of a No. 6 B.W.G. lead-covered cable is for 300ft.—say, 250lb.—an idea may be obtained of the force required to draw in six such cables. Cables weighing in the aggregate 5,510lb. have been drawn at one time into one duct.

It is a comparatively easy problem to arrange an electrical subway for trunk line circuits. The difficulty arises when the question of distribution of the current from the main conduits is to be considered, as when, in the case of the telegraph and telephone service, it is desired to furnish city customers with circuits; and in the case of electric light service, when it is required to make house-to-house or street lamp connections. In the case of telegraph and telephone distribution, subsidiary pipes or ducts are generally led from an adjacent man-hole to the front or side of buildings, whence the cables are continued to the roof of the building or to the back yards, from which latter points the circuits are radiated as required. The cable of the telephone company is generally made up into fifty pairs. When this number of circuits is not required in one block or series of blocks, the cable is forked in the man-hole, one portion of the conductors being led in a smaller cable in one direction, another portion elsewhere as may be required. This method of distribution has been found convenient and satisfactory. Distribution of the electric light current is effected in several different ways in the New York subways. For street arc lamps the circuit is usually looped from the man-hole to the lamp post through a subsidiary iron pipe. For easy access to houses and to lamps in the middle of blocks, distributing ducts are laid over the trunk ducts as near the surface of the street as practicable, the average distance from the surface of the street being, perhaps, 18in.

(*To be continued.*)

SOCIETY OF CHEMICAL INDUSTRY.

MANCHESTER SECTION.

On the 5th inst. a discussion on the Technical Instruction Act took place. The Chairman, Mr. I. Levinstein, in opening the proceedings, read a letter from Mr. W. Mather, M.P., which explained the working of the Act

In the letter Mr. Mather said that the apprehension that the Science and Art Department would become master of the situation wherever the Act was adopted was utterly groundless. The object of the Act was to decentralise, by enabling local authorities to establish or aid schools of science and art with special branches of instruction adapted to the requirements of their respective districts, and the local control of such schools was as safely guarded under the Act against interference by the Department as municipal control was guarded against interference of the Local Government Board. The only possible control of the Department would be that of rejecting any subject in the list which did not come within the scope of the Act.

The power to give an authoritative interpretation of the scope of the Act must naturally rest with the Department, but beyond this it had no special power to dictate what subjects should be taught or to control the teaching. From every point of view the most complete control would rest with the local authorities over any schools

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of technical instruction which were assisted by the local rate levied under the Act.

Mr. Levinstein, in a few remarks on the letter, said that manufacturers now seemed convinced that there was need for more extended and thorough teaching of technical subjects and the scientific principles involved. Technical schools were not, and should not be, self-supporting, because the fees would then be too high for the class of students they sought to benefit. He thought that Mr. Mather's letter would clear up the doubts of the members with respect to South Kensington's control over the Act.

In the discussion which ensued, Mr. Forbes Carpenter addressed the meeting at some length, going into the history and development of the Act. He reminded them that before the Act was passed Manchester had petitioned against its being made compulsory, and said they would notice as a feature of the Act the words, "a local authority *may*"—not *must*—"adopt the Act." He next referred to the School Board's objections to the Act, and said that, with respect to technical education, the School Board of Manchester was far behind that of Birmingham.

Dr. G. H. Bailey said that, after hearing Mr. Mather's letter, he was able to move his proposed memorial to the City Council to adopt the Act. He went on to contend that the classes of the Department did not fulfil the requirements of technical education, and said that of the 50,000 people connected with the manufacturing industries in Manchester, not 5 per cent. attended any classes bearing upon their manufactures. This state of affairs was quite different in Germany. The co-operation of the manufacturers and the City Council was needed in this matter.

Mr. H. Grimshaw said they could only speak for the chemical trades, and it was desirable to know how far the Act, which a circular of the National Education Association had described as an obscure one, was capable of being carried out. It certainly should not be done under the present examination system of South Kensington. More inspection and less examination was wanted. After referring to the inability of the greater part of the House of Commons to deal with this subject, and to the lack of professors of technological chemistry in this country, he declared strongly in favour of home rule in technical education.

Mr. Reynolds (secretary of the Manchester Technical School) said that it was proposed to ask the City Council for a ½d. rate, which would be shared by other educational bodies in the city. The Act would put technical schools on quite a new and improved basis. A committee of the City Council, assisted by the Manchester Section, would be much more fitted for carrying out the Act than such a body as the School Board.

GLASGOW SECTION.

On the 4th inst. a paper on the "Manufacture of Blasting Gelatine" was read by Mr. George MacRoberts, late manager of Messrs. Nobel's Works, Ardeer. The blasting gelatine patented by Nobel, the inventor of dynamite, in 1875, consists of a mixture of nitro-glycerine and nitro-cotton. When perfectly made it is a clear, semi-transparent substance of specific gravity 1·5 to 1·55, slightly elastic, and somewhat resembling india-rubber. It usually consisted of 92 per cent. to 93 per cent. of nitro-glycerine, and 7 per cent. to 8 per cent. of nitro-cotton. After giving, in the words of the inventor, a short account of the compound, Mr. MacRoberts described the gelatine-making machine used at Ardeer. He then pointed out that, in consequence of the stringent regulations of the Home Office Explosives Department, the buildings wherein the manufacture was done required to be well separated from each other, so that in case of an explosion the destruction might be confined to as small an area as possible. In carrying out the making of blasting gelatine, therefore, the following routine was observed:—The nitro-cotton required was first brought from the nitro-cotton drying stove, weighed off in the quantity required for each charge, and put into gutta-percha or brass-lined wooden boxes capable of holding enough of nitro-glycerine and gun-cotton together for the charge of a gelatine making machine. A number of these boxes, containing a quantity not exceeding the total allowed by the regulations, was then taken to the nitro-glycerine washing-house, and the proportion of nitro-glycerine required was weighed off and added to each box. The boxes were then conveyed to the gelatine-making house and the contents transferred to the pans of the respective gelatine machines. As each pan was charged, it was put under the stirrers, screwed up, and the machine started, and in the course of about an hour the gelatinisation was complete, and the pan ready to be cleaned out for another charge.

Of all the nitro-glycerine explosives, blasting gelatine was the strongest. It was specially suited for blasting in water. The manufacture of the article in this country was confined to one firm—Nobel's Explosives Company. Although the patent expired last year, yet the manufacture was surrounded with so many difficulties that it was very improbable the monopoly would be disturbed for a long time.

A paper on the "MacArthur-Forrest Process of Gold Extraction," by Mr. J. S. MacArthur, was also read He gave a very full detail of the process (which might be called the cyanide process), and expressed the opinion that it would take a front rank among all the processes for gold extraction.

LIVERPOOL SECTION.

The fifth meeting of the Session was held at University College, on the 5th inst., when Mr. T. S. Rigby, F.C.S., read a paper on "Sulphate of Lime in Cement, and a Direct Process of Calcination." In referring to the introduction of Chance's sulphur recovery process, the author of the paper pointed out that many were of the opinion that the residual lime mud obtained in the process contained too much sulphate of lime to be of use in the manufacture of cement. He had, however, prepared cement from this source, and the product had shown itself quite equal in quality to London cement. The tensile strength of the freshly prepared cement is somewhat low, but it stands the test of time effectually. In fact, the setting properties of cement can be restrained to an almost unlimited extent by the addition of plaster of Paris; hence the presence of the calcium sulphate in cement interferes with the testing very materially. Cements with more than 4½ per cent. of sulphate of calcium have a decided tendency to crack and break up. The author assigns 3 per cent. as a limit for the sulphate of lime that can exist in cement without prejudicial effects.

Notes.

THE SUEZ CANAL TRAFFIC.

THE following table shows the traffic through the Suez Canal during the years 1887, 1888, and 1889, and at the same time shows the leading position occupied by British shipping in the traffic :—

	1887.	1888.	1889.
Total vessels	3,137 ...	3,440 ...	3,425
British vessels.....	2,330 ...	2,625 ...	2,611
Total tonnage	5,903,024 ...	6,640,834 ...	6,783,187
British tonnage	4,516,773 ...	5,223,255 ...	5,352,886
Revenue (francs)	57,862,371 ...	64,832,273 ...	66,167,579

THE SIBERIAN RAILWAY.

THE Russian Government seems to be seriously contemplating the construction of the great Siberian railway entirely on its own account, thus carrying out its policy of having all the railways directly under State control. The committee appointed to report on the matter has concluded its work, although the scheme may yet undergo some modification. The question of funds, however, is still to be arranged, and we are afraid that this will cause more difficulty than the actual construction. The development of the trade will be gradual, and the line is not likely to pay a dividend for some time, and even if the Government pledged its credit, that does not stand sufficiently high to make it likely that the money would be forthcoming on easy terms. The line will be fully 4,300 miles long, and the preliminary estimate is about 28 millions sterling. The cost of construction per mile ought not to be very great, as the country traversed is mostly flat and well timbered, and there are few broad rivers to cross.

UNFENCED MACHINERY.

A CASE of interest to employers of labour who employ young persons with unfenced machinery has been decided by the Queen's Bench Division. The Employers' Liability Act holds the employers liable for accidents which occur through defects of the machinery, and the presiding judges have decided that the absence of fencing constituted a "defect" in a machine rendered dangerous by such absence. The plaintiff, a boy under sixteen, had his hand crushed in the cogs of a leather pressing machine which he had been employed in feeding, and a jury awarded him damages; but in an application to set aside the verdict it was argued that danger is not a defect in a machine if the machine is not defective in anything required for its object—in this case, of rolling leather. Lord Coleridge, while admitting that it was difficult to define a "defect," held that in the case under dispute such existed, for the injury was caused by the condition of the machine at the time—that is, in the manner and circumstances under which it was used. The machine could not work by itself, but required to be fed by boys, and that could not be done without danger if the machine were unfenced. Although the machine was not defective with reference to its purpose, it was so with reference to the danger arising from its use. Lord Esher concurred, saying that any other view would render the Act valueless to workmen. Leave to appeal was refused.

DETECTION OF WOOD IN PAPER.

MM. R. GODEFFROY AND M. COULON have worked out a method for estimating the amount of woody tissue in paper, based on the fact that cellulose which has been extracted with water, alcohol, and ether does not reduce a solution of gold chloride, whereas wood pulp quickly reduces such a solution on warming to metallic gold. They find that 100grms. of well-dried sawdust are capable of separating 14·285grms. of gold from its solution. In examining paper by this method they remove size by treating the material with cold and hot water, and then extract alumina by washing with an alcoholic solution of tartaric acid. The paper after this treatment is tried and extracted with alcohol and ether, and then treated with the gold solution.

THE FOREIGN OUTPUT OF COAL.

ONE thing which must be kept in mind when considering the price of coal in this country, is the effect which high prices will have on the output of coal in foreign countries and the Colonies. In Japan, for instance, the output has increased to a very large extent, and considerable quantities are now exported to several parts of China and the East. Then, again, in New Zealand, California, and British Columbia the coal trade has received large development, and as the resources in these countries are large, a much greater increase is likely to take place. Even in France the production has increased to a considerable extent, a good part of which has been used in supplanting that supplied from England. The Mines Department of the French Ministry of Public Works has published particulars of the production of coal for last year, showing that the total output was 24,588,880 tons, being an increase of nearly 2,000,000 tons over 1888, and 3,000,000 tons over 1887. The increase would have been still larger if it had not been for the strikes which occurred during the past year in the basins of the Pas-de-Calais and the Nord. The southern companies especially have made great efforts to increase their sphere of action, and supply the Mediterranean ports, which have hitherto been provided chiefly with English coal. These facts should be carefully borne in mind when the question of a strike in the coal trade is seriously contemplated.

THE LAW OF LIMITED LIABILITY COMPANIES.

WE have often pointed out the necessity for an improvement in the law relating to Limited Liability Companies, and we are glad to find that at least one effort is to be put forth in that direction during the present Session of Parliament in the way of bringing home to the directors of a company and others the responsibility for the statements in their prospectuses. A Bill has been introduced by Mr. Warmington, Q.C., which provides that every prospectus of a company, and every notice inviting persons to subscribe for shares or debentures is to be deemed to contain a "warranty" of certain things by every person who is a director at the time of the issue of the document, or who is named in it as a director, or as having agreed to become one, and also by every other person who has authorised its issue. The warranty is to be that every statement of fact in the document is true, and also that every statement of or extract from any report of any engineer, valuer, accountant, or other expert contained in it is a true and fair statement of or extract from the report, and that the report was made by the person whose name it bears. Moreover, it is to be regarded as warranted that the directors, &c., have reasonable ground for believing, and do believe, that the report was made in good faith, and that the person making it was competent to report on the subject. The right of action of successful applicants for shares against the directors, &c., is to be the same as if the warranty were included in a contract for sale. This should make directors or organisers very careful of the statements which they make in their prospectuses.

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Patent Record.

(Compiled from "The Illustrated Official Journal (Patents).")

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

24th February, 1890.

2907. Williams, N. ..... Rope haulage.
2910. Gregson, S. ..... Washing machines.
2911. Kirkbride, L ..... Looms.
2917. Lewis, W. ..... Tramway joints.
2919. Grob, Schultze, & Niemczik ..... Petroleum engines.
2924. Brett & Hazlewood ..... Steam stamps.
2925. Ryson, J. ..... Boiler furnaces.
2927. Petrie, J. ..... Steam boilers.
2930. Eccles, R. ..... Looms.
2932. Duxbury & Hargreaves Paper making machinery.
2935. Vojacek, L ..... Propelling and measuring fluids.
2936. Seed, J. ..... Looms.
2938. Lumb, F. L ..... Twisting and doubling frames.
2941. Appiani, G. ..... Continuous acting kiln.
2947. Presgrave, D. K. ..... Torpedoes.
2950. Laird, R. ..... Fuel economiser.
2954. Roots, J. ..... Gas engines.

25th February, 1890.

2964. Clifford, W. ..... Hoists for mines.
2968. Loughridge, J. E. ..... Brakes for railway cars.
2973. King, A. W. ..... High pressure valve.
2976. Tompkins & Tomkins ... Rotary motor.
2977. Lomas, T. P. ..... An improved rivet.
2981. Coombs & Hyde ..... Manufacture of steel.
2992. Boult, A. J. ..... Button setting machines (*American Button Fastener Company*).
2994. Thompson, W. P. ..... Safety valves (*Hildebrandt*).
2995. Brady, J. ..... Numbering and perforating machines.
2999. Wanecek, F. ..... Looms.
3000. Bonne, C. R. ..... Machine for drying grain.
3003. Höfel, E. ..... Weaving loom tackle.
3007. Beck, R. McC. ..... Compound steam engines.
3010. Barth, F. A. ..... Chair for rails.
3014. Eldredge, E. F. ..... Wheel tires.
3015. Goad, E. V. ..... Automatic laundry water dyer and starcher.
3017. Sergeant, H. C. ..... Compressors.
3018. Howard & Geddes ..... Machines for clipping wool.
3019. Lake, H. H. ..... Cigar bunching machines (*Williams*).
3020. Van Steenbergh, B. ... Steam boilers.
3021. O'Brien & Carew ..... Machines for the manufacture of stone-cutting chisels.
3022. Lake, H. H. ..... Railway vehicles (*Sisum*).
3029. Herbert, M. E. ..... Boiler furnaces.

26th February, 1890.

3031. Wallis, A. H. ..... Compound engines.
3035. Perrna & Theoharescu Magazine rifles.
3041. Wilson, M. ..... Valve gear.
3043. Bell & Bell ..... Boiler furnaces.
3048. Dale, T. ..... Steam boilers.
3051. Dalman & Blincoe ..... Adjustable bearings.
3052. Brogden, H. ..... Cigar-making machines.
3053. Smith, M. ..... Matrices for stereotyping.
3056. Murrie, J. ..... Steam boiler feeding, regulating, and indicating apparatus.
3061. Collet & Merichenski Tagging machine.
3063. Clark, W. A. ..... Steam traps.
3074. Elliot, J. G. ..... Pumping engines.
3084-5. Mills, B. J. B. ..... Governors (*Honeywill & Linnemann*).
3086. Oncken, G. A. ..... Machinery for cutting veneers.
3088. Haddan, H. J. ..... Water level indicator for boilers (*Haut*).
3089. Seckendorf, S. ..... Apparatus for drying granular materials (*Rouland*).
3091. Bloomer, B. ..... Casting metal.
3092. Bloomer, B. ..... Moulds for casting in metal.
3093. Lake, H. H. ..... Machines for pressing and steaming textile materials (*Gessner*).
3099. Hurrell, M. H. ..... Directing guns and torpedoes.
3101. Parker, C. E. S. ..... Breechloading ordnance.

27th February, 1890.

3105. Glover, T. S. ..... Heating railway cars.
3106. Bradford, T. ..... Washing machines.
3110. Cocker, B. F. ..... Magazine small arms.
3113. Berggren, R. ..... Couplings for propeller shafts.
3114. Crosland, W. ..... Machinery for grinding and polishing stones.
3116. Keyworth, W. ..... Boiler tubes.
3121. Rylands, D. ..... Machinery for manufacture of hollow glass ware.
3124. Peirce, J. W. ..... Stopping and starting tramcars.
3125. Turnor, M. ..... Machinery for the production of spring hooks.
3127. Hedley, J. T. ..... Metallic packing for piston rods.
3128. Munden, W. J. ..... Speed-varying gear.
3139. Boult, A. J. ..... Brakes for vehicles (*Kretzschmar*).
3145. The Lucigen Light Company, Ld., & Jarmain Portable oil gas furnace.
3149. Thomson & Hampshire Looms.
3151. Grove & Lewis ..... Steam boilers.
3156. Butler & Kendrick ..... Lubricators.
3159. Cresswell & Heslop ... Feeding printing machines.
3170. Griffith, R. ..... Multiple drilling machine.

28th February, 1890.

3173. Murphy, G. R. ..... Torpedoes.
3174. Wrigley, T. ..... Ring frame spindles.
3178. Casey, G. ..... Grinding carding flats.
3186. Proctor, J. ..... Mechanical stokers.
3191. Muir, A. ..... Machine tools.
3192. Baxter & Macdougald Centrifugal machines.
3194. Hattersley & Hill ..... Looms.
3196. Walker & Mills ..... Alarm valves.
3197. Bott, J. E. ..... Circular saws.
3198. Norris, W. ..... Pneumatic drawback for rams or plungers operated by explosive gases.
3199. Harper, J. ..... Screw propellers.
3201. Jackson, C. L. ..... Cloth-stretching machines.
3209. Hope, G. F. W. ..... Separation of sand from water.
3210. Fenwick, W. ..... Cotton gins.
3211. Duncan, R. B. U. H. J. ... Screw bolts.
3213. Challis, C. E. ..... Rotary engine.
3214. Wagner, K. ..... Machinery for the manufacture of buttons.
3217. Spurr, C. W. ..... Apparatus for cutting veneers.
3219. Gold, R. ..... Obtaining motive power.
3232. Fiddian, W. ..... Machinery for the manufacture of chains.
3233. Faulkner & Lloyd ..... Iron and steel tubes.
3234 Kohn, M. ..... Direct acting steam pumps.
3239. English, T. ..... Ordnance.
3241. English, T. ..... Field gun carriages.
3243. Sanders, H. C. ..... Metal tubes.
3244. Beetham, W. ..... Bottle-washing apparatus.

1st March, 1890.

3251. Masson & Scott ..... Steam pipes.
3257. Cooper & Holdsworth Detaching boats.
3259. Norman, G. ..... Crushing machines.
3261. Lake, H. H. ..... Apparatus for filtering water (*Jewell*).
3262. Cooper & Holdsworth .. Lowering boats.
3265. Ormerod, Davies, & Haythornthwaite ... Humidifying apparatus.
3266. Townson & Dixon ..... Sawing machines.
3269. Crowe & Massam ..... Three-way valves.
3273. Fletcher, G. E. ..... Lighting of railway trains.
3277. Patterson, E. ..... Gas governors.
3279. Skinner, W. H. ..... Heating water.
3285. Sayer, W. ..... Machinery for making bricks.
3287. Anderson, A. ..... Marine boilers.
3289. Robinson, A. M. ..... Roller mills.
3292. Schneider, A. ..... Heating feed water.
3301. Samuel & Samuel (trading as La Société Samuel Cousins) ..... Machinery for printing fabrics.
3302. McDougall, McDougall, & Sugden ..... Steam generators.
3305. Stark, J. ..... Starting and stopping tramcars.
3313. Hill, E. J. ..... Boat detaching apparatus.
3316. Walker, H. C. ..... Lifts and hoists.
3318. Müller, A. ..... Boiler pumps.

ELECTRICITY.

24th February, 1890.

2945. Laurent-Cély & Timmis Secondary cells.
2957. Aubert, J. J. A. ..... Electric meters.

25th February, 1890.

2963. Sayer, R. C. ..... Electric railways.
2986. Wollin & Werline ..... Electric lamp sockets.
2996. Mostyn, R. J. F. ..... Electric meters.
3008. Hollingshead, W. B. ... Storage batteries.
3013. Hartmann, C. J. ..... Storage batteries.
3024. Lake, H. H. ..... Electric motors (*Parkhurst*).
3028. Reignier, A. C. ..... Dynamo-electric machines.

26th February, 1890.

3071. Barber Starkey, W. J. S. Electric meter.
3078. Wadén, D. J. ..... Microphone.
3082. Langhans, R. ..... Incandescent lamps.
3094. The Mining and General Electric Lamp Company, Ld., Fitz-Gerald, & Hough ..... Portable electric lamps.
3096-7. De Ferranti. S. Z. ... Electric meters.

27th February, 1890.

3133. Boardman, F. R. ..... Electric lamps.
3152. Thoms, W. A. ..... Electrical conductors.
3153. Thoms, W. A. ..... Manufacturing electrical conductors.
3163. Alexander, P. P. ..... Electric switches.
3169. Carpenter, C. E. ..... Electro-heating apparatus. (6th August, 1889.)

28th February, 1890.

3193. Swinburne, J. ..... Transformers, electrical measuring instruments, and insulation.
3231. Shipp, J. ..... Regulating electromotive force.

1st March, 1890.

3271. Russell & Scott ..... Dynamo electric machines.
3272. Fletcher, G. E. ..... Switches.
3276. Whalley, A. ..... Telephonic apparatus.

CHEMISTRY.

24th February, 1890.

2955. Proffe, H. ..... Continuous distillation of tars.
2958. Stevenson, J. ..... Alcohol (*Riglet*).

25th February, 1890.

2960. Borland, W. D. ..... Nitro-compound powders.
2990. Stephenson, H. S. G. ... Carbonic acid gas.

26th February, 1890.

3062. Danchell, F. L. H. ..... Treatment of sewage.
3081. Kingsford, C. ..... Gas retorts.
3087. Lawrance, E G. ..... Evaporating liquors (*Pick*).
3095. Leigh, H. H. ..... Colouring matters (*Williams*).
3098. Lake, H. H. ..... Colouring matters (*Leonhardt & Co.*).

27th February, 1890.

3154. Thoms, W. A. ..... Alloys.
3160. Von Steenbergh, B. ..... Water-gas.

28th February, 1890.

3220. Greenwood, J. ..... Sodium and chlorine.
3240. Brehier & Talbot ..... Tartaric acid.
3245. Bohm, W. D. ..... Gold and silver.
3246. Bohm, W. D. ..... Apparatus for the separation of gold and silver.

1st March, 1890.

3275. Simonin, G. ..... Reduction of metallic ores.
3295. Houston & Beakbane ... Tanning liquors.
3303. Willcox, B. ..... Dye stuffs (*Farbenfabriken vormals Friedrich Bayer & Co.*).
3312. Adeney & Parry ..... Purification of sewage.

MISCELLANEOUS.

24th February, 1890.

2920. Campbell, H. ..... Flash lamps.
2940. Benjamin, H. ..... Asphalte.
2943. Douse, T. R. ..... Fire extinguisher.

25th February, 1890.

2967. Fleming & Hilder ..... Range finders.
2978. Mowll, C. H. ..... Artificial fuel.
2985. Frankal & Majorkiewicz ..... Fire extinguisher.
2993. Beswick, J. ..... Blasting operations.
3009. Keene, S. D. ..... Bleaching and dyeing.

26th February, 1890.

3060. Brampton, C. H. ..... Driving chains.
3079. Etherington, J. ..... Safety lamp.

27th February, 1890.

3107. Knight & Ashworth ... Shuttles.
3146. Wood & Davies ..... Steadying the index finger of registering dials.

28th February, 1890.

3236. Siemens, F. ..... Hot air gas lamps.

1st March, 1890.

3286. Sowerby, J. G. ..... Manufacture of glass.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form, of such opposition.

Year 1888.

17163. Rawson & White.

1889.

1217. Thomas.
2084. Plant.
3376. Becker & Winslor.
3424. Swinburne.
3442. Sanderson & Reed.
3591. Blandy.
3671. Boult (*Pouchard*).
3806. St. George.
3965. Ross.
3984. O'Brien (*Underwood*).
4136. Burton.
4335. Everitt.
4539. Eisenmann & Archr.
4749. Bailey.
4935. McDougall.
5049. Sparrow.
5175. Wintour.
5216. Smith.
5363. Rhodes.
5483. Bergmann.
5496. Household.
5497. Household.
5590. Bentz, Edmeston, Edmeston, & Grether.
5702. Lindley.
5981. Reininghaus.
1273. Cunningham.
3172. Sonstadt.
3386. Webb.
3433. Prince.
3545. Weldon.
3646. Hosack.
3782. Bohnen & Kleber.
3809. Key.
3972. Roots.
4040. Stacey.
4237. Schmidt.
4497. Ellmore.
4696. Dear & Catterson.
4846. Falkenstein, Rousseau, & Falkenstein.
5085. Brining & Lister.
5187. Walker.
5269. Cavill.
5420. MacIlwraith, Gilchrist, & MacIlwraith.
5579. Melvin.
5624. Taylor & Challen.
5631. Luther & Cockburn.
5919. Lea & Lynam.
6003. Steidl.

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6075. Gregory & Gregory, Jun.
6331. Dunnachie.
6434. Imray (*Farbwerke vormals Meister Lucius & Brüning*).
6607. Holland (*Wood*).
6688. Comings.
6747. Bliss, Bradbury, & Gibson.
6800. Reuter.
6819. Jacquemin & Segrestan.
6838. Jones.
6866. Killick.
6874. Tata & Lyon.
6898. Barwell.
6905. Brimelow.
6917. Flesch.
6945. Lennox.
6976. Eddleston.
7017. Verity & Verity.
7024. Isitt.
7039. Van Kervel.
7059. Ruggles (*Jamieson*).
7067. Pitt (*L. Cassella & Co.*).
7071. Bühler.
7096. Wotherspoon.
7107. Chapman.
7127. Vaughan (*Trott*).
7141. Grundy.
7155. Miller.
7157. Goudie.
7197. Goslin.
7212. Cooke.
7248. Moller.
7254. Harrison.
7276. De Ferranti.
7324. Rigg.
7378. Abbott.
7481. Hookham.
7651. Tonks & Burn.
7671. Kilsby.
7905. Martin.
7947. Farquharson.
8153. Oates, Oates, & Earnshaw.
8201. Allenby.
8342. Olberg.
8591. Devis.
8985. Embleton.
9442. Williams & Ascough.
10317. Marston.
10387. Keil.
10864. Smith, Smith, & Rowling.
11464. Douglas.
11909. Avery.
12411. Thomas John Sweeney.
12773. Wheeler. (14th January, 1889.)
14533. Floor & Bolt.
15486. Boult (*Hermann Steinbeck, successor to Louis Walther*).
16333. Le Poidevin.
16608. Jackson.
16818. Hull.
17361. Bacon & Morgan.
17716. Bond.
18022. Thompson (*Williams*).
18346. Haimes & Haimes.
18771. Adair.
19042. Fairlie.
19411. Thompson (*Nelson*).
19622. Dennes & Rose.
19801. Burges.
19862. Hyatt.
20288. Tatham & Tatham.
20669. Libbey.
20744. Reimann.
20789. Burridge.
6177. Taylor & Taylor.
6262. Jarvis.
6400. Pinnington.
6476. Jones.
6563. Haslam.
6585. Brunton.
6646. Allenby.
6702. Richmond.
6778. Bedford.
6790. Smith.
6818. Bramish.
6828. Dixon & Dack.
6839. Wood & Wood.
6872. Munzinger.
6896. Gillies.
6904. Holland & Lightowler.
6922. Challis.
6963. Drummond.
6978. Bäx.
7021. Hunter.
7029. Denny & Brown.
7055. Latham.
7062. Sandiford & Diggle.
7069. Tavernier & Casper.
7081. Goaring.
7099. Brining & Lister.
7123. Dodd.
7128. Winder.
7143. De Laval.
7156. Macfarlane.
7194. Franks.
7198. Adeney & Saunderson.
7214. Wood & Wood.
7251. Newton & Quiggin.
7262. Imray (*Mannesmann*).
7289. Phillipson.
7328. Jagger.
7399. Hartley.
7613. Price & Soderberg.
7659. Quaglio.
7821. Crosland.
7944. Lones, Vernon, Holden, & Bennett.
8154. Oates, Oates, & Earnshaw.
8267. Beaumont.
8459. Willson.
8845. Procter, Middleton, Fraser, & Carter.
9545. Cole.
10318. Marston.
10769. Horn.
11245. Thompson (*Hurdle & Manypenny*).
11866. Engelfred.
12040. Kelly.
12412. Barry.
13872. Parsons.
14409. Bland.
14869. Sporton & White.
15730. Bullivant.
15964. Coward.
16163. Orloff.
16577. Burgess.
16676. Weber.
17031. Jackson.
17479. Western.
17829. Johnson.
18206. Bullivant.
18447. Hudson.
18978. Laemmerhirt.
19366. Blacker.
19449. Hargreaves, Scranton, & Porter.
19851. Cox.
20248. Gardner.
20325. Clegg.
20719. Hänisch.
20770. Eckford.
20943. Schaeffer.

20957. Haddan (*Mayo*).

1890.

15. Davey.
361. Thompson (*Henshaw*).
412. Spear.
686. Mewburn (*Low*).
790. Moore & Love. (15th June, 1889.)
1106. Carpenter.
1135. Fairweather.
1183. McCaffrey. (26th June, 1889.)
1205. Fellows.
1277. Bowen.
1299. Knapp.
1327. McQuiston.
1342. Hubner.
1348. Steinmüller & Steinmüller.
1411. Kuhse.
1438. Handwerg.
1453. Knight.
1482. Thompson (*Hermann*).
1493. Rossney & Cutter.
1496. Lake (*Evans*).
1514. Alkier.
1517. Keys.
1622. De Jordan.
1640. Wolfermann.
1659. Plisson.
1682. Heathfield.
1752. Riedler.
1762. Hirschberg (*Hagarty*).
173. Kitto.
370. Grenier.
616. Abel (*Newton*).
706. Scaife.
888. Stanêk.
1103. Lässor.
1112. Connolly, Altman, Altman, & Altman.
1200. Moore.
1204. Carter.
1271. Butler & Parrock.
1282. Abel (*Pfeifer & Langen*).
1326. Schmidt-Mulheim.
1329. Bonne (*Thompson*).
1345. Boss.
1375. Holroyd.
1403. Hewitt.
1436. Turner.
1446. Maddox.
1476. Boult (*Schweickhart*).
1488. Müller & Bach.
1495. Lake (*Johnson*).
1509. Hardingham (*McCormick*).
1533. Horn (*Redwood*).
1634. Burton.
1641. Dähne.
1681. Newman.
1697. Ziegler & Menz.
1761. Smidth.
1798. Heyer.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

Turn-Tables and Cranes.—*W. Williams, St. Ives, Cornwall.*—To reduce the friction in turning turn-tables and cranes and to simplify their construction the inventor supports them upon ball bearings. The balls are arranged in a horizontal and circular groove situated under the table. A corresponding groove is attached to the underside of the table, and the balls revolve between the two when the table is turned. The grooves are situated near to the edge of the table. Claims: (1) The use of turn-tables with circular grooves to turn round on ball bearings; (2) the construction of turn-tables as herein described with ball bearings in circular grooves on which the tables turn round and the balls move freely in endless succession; (3) the use and construction of turn-tables (for any purpose) with ball bearings placed in grooves to run freely round in endless succession.—No. 4847. March 20th, 1889. 6*d*.

Rotary Engines.—*D. Williamson, Brooklyn, U.S.A.*—The engine is constructed to be worked by a fluid such as water under pressure, but may be used for pumping and other purposes. It consists of an annular chamber, in which work feathering vanes. The continuity of the annular chamber is broken by an abutment, which receives the back pressure of the working fluid, whilst the vanes receive the forward pressure and cause the shaft to revolve. The abutment is formed with a slot, which is of sufficient width to allow the passage of the vanes when they are feathered or turned round at right angles to the position they assume at the time of receiving the working pressure. In the illustrations, Fig. 1 represents a side elevation of the motor,

FIG. 1.

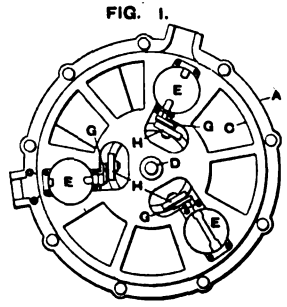


FIG. 2.

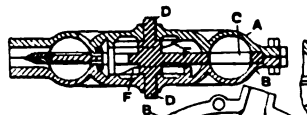


FIG. 3.

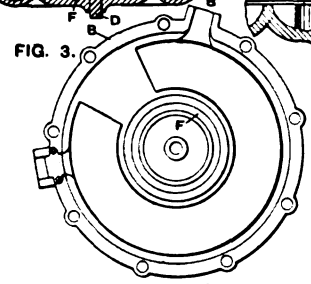


FIG. 4.

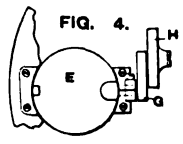


FIG. 5.

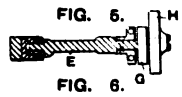
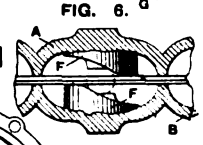


FIG. 6.



Industries

with one half of its casing removed; Fig. 2 is a central section, taken in the plane of the shaft; Fig. 3 shows one of the casing halves, Figs. 4 and 5 details of a vane, and Fig. 6 a sectional view showing the cam for feathering the vane. Between the two halves A B of the casing is a thin plate C, which is fixed to the shaft D and carries the vanes E. The vanes are supported in the plate C by pivots, and to these pivots are connected the cranks G (Figs. 4 and 5), which carry the friction wheels H. In the central part of the casing is a chamber containing the cam F, which, by guiding the friction wheels H, feathers the vanes as they pass the slot in the abutment. Seven claims are made for the engine described and certain modifications.—No. 18956. November 26th, 1889. 8*d*.

Lock-Nut.—*J. W. Smallman, Nuneaton, Warwick.*—The nut has a base lying in a plane which cuts the axis of the bolt otherwise than at right angles—that is, a nut a portion of whose base only has contact with its seat when screwed home. The effect of screwing such a nut down is to gradually bend the bolt to one side, and so lock the parts in position. The tendency of the nut to unscrew is prevented, for to do so it would have to straighten or bend the end of the bolt in an opposite direction. Claims: (1) The improved lock-nut formed or operating as described; (2) a lock-nut in which the locking effect is produced by reason of the nut, when screwed home, being unable to rotate without varying the extent to which the bolt has been previously bent, as described.—No. 2633. February 14th, 1889. 6*d*.

Duplex Pumps.—*C. E. Owens, London.*—In duplex pumps worked by steam as hitherto constructed, the cylinders of the two pumps have both been supplied with high pressure steam. In some cases these duplex pumps have been compounded, that is to say each pump has had a high and low pressure cylinder. By this last arrangement a waste of power is avoided which takes place in the first. To prevent the waste of power as in the last arrangement and to simplify the parts the inventor works one pump with a high pressure cylinder and the other with a low, passing the steam from the high to the low. The cylinders are placed side by side and operate upon the pumps in precisely the same way as the two high pressure cylinders, and the piston rod of each cylinder actuates the slide valve of the other cylinder in the manner usual in duplex pumps. In order to start the pump, steam is admitted to the high pressure cylinder at full pressure and simultaneously to the low pressure cylinder at a reduced pressure, the reduced pressure being obtained by means of an ordinary reducing valve. Claims: (1) A duplex compound fluid pressure pump constructed substantially as hereinbefore described, with a high pressure cylinder and a low pressure cylinder, these two cylinders being placed side by side and operating the pumps in the same way as two high pressure cylinders hitherto used side by side in duplex fluid pressure pumps, and the piston rod of each cylinder actuating the valve of the other cylinder in the manner which is usual in duplex pumps; (2) the duplex compound fluid pressure pump constructed and working as described; and (3) referring to the pump as illustrated in the specification of patent.—No. 4112. March 8th, 1889. 8*d*.

Boiler Furnaces.—*P. McGregor, Jun., Birkenhead.*—Means are here described by which the circulation of water about or near the furnaces of steam generators may be more vigorous and effective. In the interior of the furnace are hollow rings or portions of rings having preferably one flat side, the other being semi-cylindrical. The flat side is arranged to lie against and be connected to the inside of the furnace. In the flat side of the rings and in the furnace at corresponding points are formed apertures, one or more being at the bottom and one or more at the top. The rings are secured to the furnaces at parts where the apertures are made, either by rivets surrounding the apertures or by nipples screwed through the ring and furnace plates. These apertures form the communication between the boiler and the semi-circular rings, and the circulation of the water is caused by the water within the ring becoming heated, rising to the top, and escaping by the top apertures. As the rings project into the furnace they become consequently more heated than the sides of the furnace, and circulation of water is very rapid. Claims: (1) The combination with a furnace of a steam generator of a hollow ring or rings placed within or outside the furnace and arranged with one of its or their surfaces bearing upon the same; (2) a ring for furnaces of steam generators of semicircular or analogous form in cross section, the flat surface being, on the outside, adapted to bear upon the inner surface as described; (3) the combination with a circular furnace of a steam generator of a ring or rings placed within or outside the furnace, as described, and connected thereto and having apertures therein, by which the water is free to pass in at or near the lower part thereof and leave at or near the top as and for the purposes described; and claims (4) and (5) referring particularly to the furnaces illustrated by the drawings in the specification.—No. 4990. March 22nd, 1889. 8*d*.

Steam Traps.—*W. Watson, Bradford.*—The water is collected in a small closed tank carried by one arm of a lever, the opposite arm of the lever being weighted. The fulcrum of the lever is the plug of a cock, and the arm of the lever supporting the vessel is hollow. The vessel communicates with the plug of the cock by two channels in its supporting arm. One of these channels is in communication through the cock to the pipe from which the water is to be run off, and the other through the cock to the outlet for the discharge of the water from the vessel. The counterweight upon the lever is sufficient to balance the collecting vessel and a certain quantity of water, so that when the vessel is empty it is held up by the counter-weight and the discharging channel is closed. After a quantity of water has collected, however, the weight causes the vessel to drop, and the discharge valve becomes opened and the water discharged. Claims: (1) The construction of a steam trap in such a manner that the letting off of condensed water is controlled by a tap which, when sufficient water has collected, is opened by the weight of the water, and is again closed by the action of a counterbalance weight when the collected water has been discharged; (2) the construction of steam traps as described.—No. 5500. March 30th, 1889. 8*d*.

Spinning and other Machinery.—*J. Boyd, Glasgow.*—The invention comprises an improved combination of mechanism for lifting and lowering the building or traversing rails of spinning, roving, twisting, and analogous machines. The mechanism is shown in the accompanying illustrations, Fig. 1 being a side elevation, Fig. 2 an end elevation, Fig. 3 a horizontal section, and Figs. 4 and 5 details. The mechanism shown in the drawings is in part carried by a casting A bolted to a transverse frame B of a spinning or other machine. The building or traversing

FIG. 1.

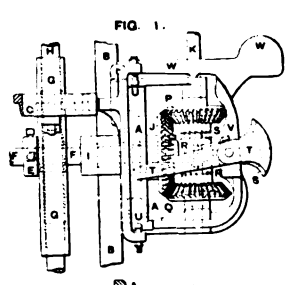


FIG. 2.

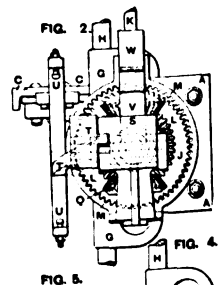


FIG. 3

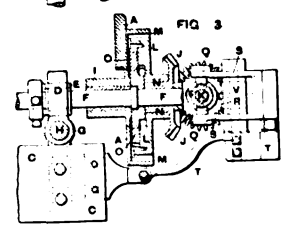


FIG. 4.

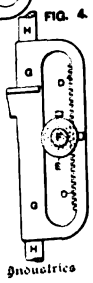
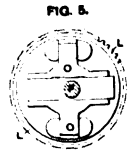


FIG. 5.



Industries

rails, of which a part C is shown, are lifted and lowered by means of vertical racks D (shown in detail Fig. 4) geared to pinions E on a longitudinal shaft F. The racks are formed on or fixed to tubular guides G sliding upon the rods H. The shaft F extends through a bearing I and supports a mitre wheel J which is in gear with two others upon the driving shaft K. The mitre wheel J is mounted loosely upon the shaft F and has a long eccentric boss N which supports the outer toothed wheel L gearing with the inner toothed annulus M. The inner toothed annulus M is stationary, and constitutes with the outer toothed wheel L

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mounted upon the eccentric boss N a well-known form of differential gear, used in this case to reduce the speed of the shaft F. The outer toothed wheel L is connected, by pins working in slots, to the collar O fixed to the shaft F, which consequently receives a reverse motion to that of the mitre wheel J. To reverse the motion of the shaft F necessary for the up and down action of the rack, the two mitre wheels P and Q are alternately connected to the driving shaft by the coupling R. The coupling R is alternately locked with the mitre wheels by the forked lever S and the tappet lever T connected to each other and worked by the tappets U attached to the traversing rail C. To hasten the action of the clutch at each end of its stroke, a lever V is connected to the other two and works upon the inclined surfaces of a weighted lever W. As the tappet lever T shifts the clutch from one position to the other the lever V gradually raises the weighted lever W until it passes the extreme point, and the weight of the lever W then presses the lever V over to its extreme position, and so throws the clutch into gear. Claims: (1) The combination of parts constituting my improved mechanism for lifting and lowering the building or traversing rails of spinning, roving, twisting and analogous machines, substantially as hereinbefore described and as shown in the accompanying drawings; (2) in mechanism for working building or traversing rails of spinning, roving, twisting and analogous machines, combining differential gear to reduce speed, with a three-bevel wheel arrangement having a reversing clutch moved by adjustable tappets traversing with the rails and combined with a heavy tumbler lever, the parts being constructed, arranged, and operating substantially as hereinbefore described.—No. 4593. March 16th, 1889. 8*d*.

HACKLING MACHINES.—*A. Combe, Belfast.*—These improvements in hackling machines are applied to the appliances for raising and lowering the channel which carries the holders, and also for sliding the holders from over one tool to over another. Figs. 1 and 2 give views of a hackling machine, with the improvements attached. The novelty of the invention for raising and lowering the channel C, which carries the holders H, consists in the peculiar form of the lifting lever A. The lever A is made in the form of a loop, and is rocked upon the stud J by a runner I upon the main wheel B. To the upper side of the loop is attached a connecting rod D, which imparts a rocking motion

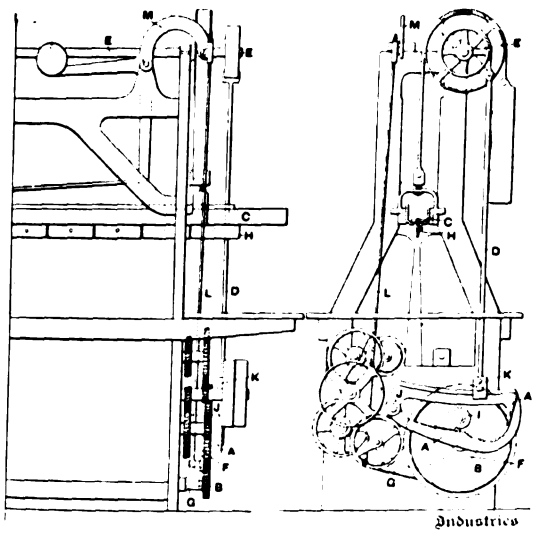


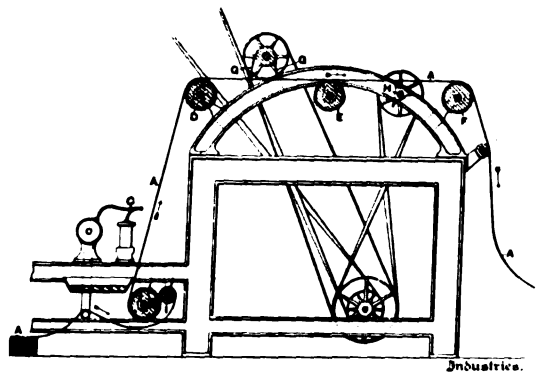
FIG. 1. FIG. 2.

to the lifting shaft E at the top of the machine. The rod D is attached to the loop by an adjustable joint K. The surface of the looped lever upon which the runner I travels is formed so that the desired differing rates of speed are given to the channel C which carries the holder H. The novelty in sliding the holders H from over one tool to over another consists in using a cam F, fixed to the main wheel B, and actuating a lever G connected by the rod L to the weighted lever M. The cam F raises the ordinary weighted lever M, while the holders H are stationary in the channel C, and liberates it when the channel C is at rest at its highest position in order to enable the weighted lever M to slide the holders H from over one tool to over another. Claims: (1) The looped lever A, and adjustable clip attachment K, and a runner such as I all in combination, for giving the lifting motion in hackling machines, and as herein described, and substantially as illustrated by drawings; (2) the sliding cam F on the opposite side of the wheel B to runner K and lever G in combination as and for the purposes herein set forth, and substantially as illustrated by drawings.—No. 4834. March 28th, 1889. 6*d*.

LOOMS.—*H. Hartley, Nelson, Lancashire.*—This invention relates to the construction of picking bowls and studs for looms. The picking stud is constructed of cast iron, and in it is formed a hole for the admission of the picking shaft. The stud is slid upon the picking shaft and secured at any point by a set screw. The part of stud on which the picking bowl or cone works is conical to fit a conically shaped hole in the bowl or cone. Claim: A picking bowl or cone and stud, constructed as described.—No. 5569. April 2nd, 1889.

CHUCKS FOR LATHES.—*J. Barlow, Coventry.*—The body of the chuck is disc-shaped, similar to the ordinary face plate of a lathe. Upon the face of this plate, and upon opposite sides of the centre, are two sliding jaws, movable in the same straight line. One jaw has a V-shaped recessed gripping face, and the other sharp edges with which to hold the work. The work when held by the chuck rests upon the two faces of the V-shaped jaw, and is held firmly against them by the other jaw. The V-shaped jaw may be attached to the plate by two bolts working in parallel slots, diametrically opposite to the slot in which the other jaw slides. By this connection of the block it may be adjusted as required to or from the centre of the lathe, and its faces inclined equally or unequally to the direction of its sliding motion. If the faces of the V-shaped jaw should be unequally inclined to the direction of the motion of the jaws, circular work will be held in the chuck eccentrically to the lathe centre. The V-shaped chuck when adjusted for work may be fixed, and similar work removed or placed in the chuck by moving the other jaw. One claim is made for the chuck described.—No. 5662. April 2nd, 1889. 6*d*.

APPARATUS FOR TREATING CLOTH.—*A. & R. Brearley, Batley.*—By this improved machine the cloth is damped and passed in a stretched state to be operated upon by a winged beater, to raise the nap or pile. It next passes by an ordinary revolving beater operating upon its underside, and proceeding forward is passed to the tentering machine. By these means the pile is raised and kept erect until it arrives at the tentering machine. In the illustration, which is a sectional side elevation of the machine, A is



the cloth being treated. The cloth is first taken over the break roller B covered with cards, resistance to the roller's rotary motion being caused by a friction strap and weight, not shown. The cloth is next damped or dewed by means of a series of tubes or nozzles C as it passes upwards over the guide rollers D, E, and F. In travelling over the guide rollers it is beaten by the flexible winged beaters G to raise the pile, and further along it is beaten again by the ordinary beater H. In the tentering machine the front rollers are dispensed with and in place a round-faced wheel is employed near each set of hooks to take off the drag of the piece from the hooks and to keep the pile from becoming flattened. Claims: (1) The combination of break roller B, guide roller I, dewing or damping apparatus C, guide rollers D, E, F, and winged beaters G and H, operated as and for the purposes substantially as shown and described; (2) the use and employment of the winged beater G operating upon the face of the cloth substantially as shown and described; (3) the general arrangement and construction of apparatus substantially as shown and described; (4) in tentering machines, the use and employment of a round-faced wheel or disc at or near each set of hooks for the purposes described.—No. 3764. March 4th, 1889. 8*d*.

FLY WHEELS.—*D. Halpin & I. A. Timmis, London.*—This description of fly wheel is constructed so that it may be readily and economically made, and yet shall have sufficient strength to resist centrifugal breaking strains when driven at a high velocity. The boss and arms of the wheel are made in any convenient or known manner. On the arms is fitted a rim in the shape of a channel or groove. In this groove is wound a sufficient number of layers of metal wire to give the weight required to the fly wheel. Existing fly wheels may be strengthened by attaching discs or rings to their rims to form troughs and filling these with wire coils. Claims: (1) The making or forming a groove or grooves in the periphery of wheels which are used as fly wheels or otherwise, for the purpose of putting a coil or coils of wire or tap in the manner and for the purpose described; (2) the coiling or winding of wire or tape on the periphery of fly or other wheels, as and for the purposes described.—No. 5755. April 4th, 1889. 6*d*.

HIGH-SPEED ENGINES.—*A. Sneath, London.*—The engines referred to in this specification are of the duplex type, with cylinders arranged in the same axial line. The piston rods are connected to a link whose slot is straight and placed vertically and at right angles to the piston rods. In this slot the crank or crank pin of the engine works upwards and downwards as the pistons make their strokes. The two cylinders may be operated by high pressure steam, or one with high and the other low. Two or more sets of cylinders may also be connected to the same crank shaft. Claims: A high-speed engine, the cylinders of which are placed in pairs, each pair being adapted to operate upon a single crank without the employment of connecting rods as described; (2) the manufacture and use of the improved engine hereinbefore described.—No. 5859. April 5th, 1889.

DIES FOR ROLLED FORGINGS.—*H. H. Lake, London. (The Gould Rolling Machine Co., Leominster, U.S.A.)*—These dies are specially applicable for use with rolled forging machines having a vertical, rotary, or reciprocating movement. The parts of the machine to which the dies are attached have longitudinally concave and convex surfaces which are arcs of a circle described from the centre of rotation. The concave surface of the one part is opposite to the convex surface of the other. Upon these surfaces dies of novel design are placed, having their longitudinal sections to correspond with the surface to which they are attached; thus, one is concave and the other convex. The dies gradually taper from the ends they commence work to the rear ends, so that the rear ends are of the finished form of the work. In dies for rolling globular forms the working surfaces of the dies are formed at one end with a small arc of a circle corresponding to the surface of the globe, and gradually increasing towards the other end in its cross section to a semi-circular shape. Both dies are similar in cross section, and as they revolve in contrary directions a similar cross section of one corresponds to a similar cross section of the other, so that when the full parts of the dies pass each other their combined surfaces form a complete circle. The edges of the dies are bevelled and are punctured or indented, to prevent the dies slipping upon the work instead of rolling it. Claims: (1) A die for making rolled forgings having a concave working face comprising a longitudinally arranged groove semi-circular in cross section and formed between diverging cutting and spreading bosses having outwardly inclined indented faces; (2) companion dies for making rolled forgings having their working surfaces respectively concave and convex in longitudinal section and provided with cutting bosses having indentations in their spreading faces; (3) a die for making rolled forgings having a working face convex in longitudinal section, said face comprising a cross sectional semi-circular groove formed between diverging cutting bosses having outwardly inclined spreading surfaces provided with indentations; (4) dies for making rolled forgings having indentations in the spreading faces as described.—No. 20966. December 31st, 1889. 6*d*.

SELF-ACTING MULES.—*W. Bryden & H. Stansfield, Leeds.*—These improvements in self-acting mules are for the purpose of simplifying and more readily reversing the motion of the spindles for producing different twists of the warp and weft threads. The spindles are driven by cords or bands from one cylinder or "tin-roller," extending the full length of the machine. In the present form of machines, to change the twist of the thread from a right to left hand twist, the whole of the cords or bands driving the spindles had to be changed from cross bands to straight bands, or *vice versâ*. In the present improvements this change is made by reversing the motion of the "tin roller." This is effected by gearing the roller by tooth wheels to one end of a counter shaft. To the other end of the shaft is attached a second toothed wheel, which gears by an intermediate wheel with a toothed wheel upon the driving shaft. When the machine is required to be reversed the intermediate wheel is removed, and the wheel upon the driving shaft moved to gear directly with the wheel upon the counter shaft. Claim: The means employed for reversing the action of the cylinder or "tin-roller," and consequently the motion of the spindles, without the necessity of removing or altering the position of the driving cords or bands, as and for the purposes described.—No. 346. January 8th, 1890. 6*d*.

CALCINING FURNACES.—*E. B. Parnell, London.*—This invention relates to calcining furnaces, and refers principally to that class of muffle calcining furnaces which are horizontal. According to this invention, these furnaces are caused to rotate, whilst in use, on rollers or the like, to avoid the injurious effects of unequal expansion and contraction. In the accompanying illustrations Fig. 1 is an elevation partly in section; Fig. 2 a transverse section on the line X X, Fig. 1; Fig. 3 a transverse section on the line Y Y, Fig. 1; and Fig. 4 a detail. A is the shell or body of the furnace, built up of cast-iron plates and mounted upon the bearing rollers F, which are revolved by the mechanism

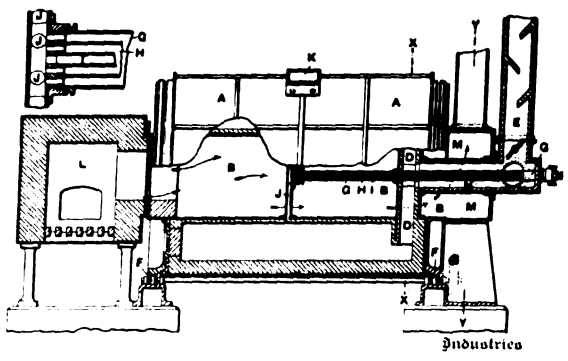


FIG. 1.

shown in Fig. 3. A tube B occupies the central part of the shell A, and the remaining part is divided by plates into six chambers C. A discharge pipe E communicates with the chambers C by the branch pipes D, and concentric pipes G, H, and I, by the branch pipes F, to convey respectively air, gas, and steam to the chambers. The method of working the apparatus is as follows:—The calcining chambers C are charged with material through doors K, and the whole furnace revolved slowly upon the rolls. A fire is raised in L, and the products of combustion conducted through the central tube B into the uptake M. Steam, air, and gas are admitted as required to the calcining

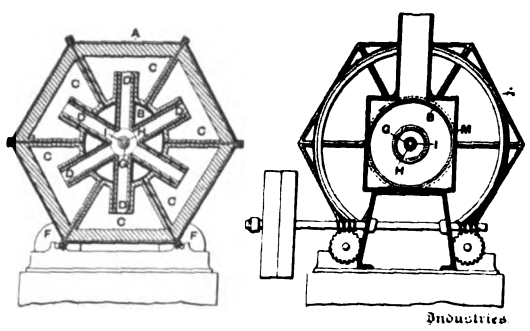


FIG. 2. FIG. 3.

chambers, and the fumes given off by the material are conducted away by the pipes D, as already mentioned. Claims: (1) In a calcining furnace a rotating body or shell, such as A, the interior of which is divided into a number of longitudinal chambers substantially as herein described and illustrated in the accompanying drawings; (2) in a calcining furnace the arrangement of the pipes H, G, I one within the other, so that the innermost pipe is protected against the surrounding high temperature, so as to ensure that the steam which is passed through it to the calcining chambers will be delivered in a saturated condition; (3) in a calcining furnace a horizontal shell or body, such as A, mounted on frictional driving rollers, to which rotary motion is imparted by worm or equivalent gearing substantially as herein described and illustrated in the accompanying drawings; (4) in a calcining furnace the combination with a central stationary outlet pipe, such as N, of a number of rotating branches, such as D, connecting it with the calcining chambers; (5) the general combination and arrangement of parts constituting the complete calcining furnace substantially as herein described and illustrated in the accompanying drawings.—No. 4354. March 12th, 1889. 8*d*.

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ANTI-FRICTION RINGS.—*A. M. Clarke, London.* (*J. J. Ladd, Callao, Peru, South America.*)—The anti-friction ring is designed to be placed upon axles and shafts between the collars or boxes of wheels and journal boxes. It consists of a split ring enclosed by a collar, which is divided for convenience in applying the ring to a shaft or axle, and a lubricating device formed on or attached to the collar for maintaining a constant lubrication. The split ring is made in halves, whose ends naturally interlock with each other. In the one part is formed a key seat which fits a key fitted to the shaft upon which the ring is placed. The split ring is made of hardened steel. A collar of iron is fitted to the ring, and is provided with a removable section of sufficient width to permit the placing of the collar upon the ring. The collar is formed with a block on its edge, in which are made oil chambers which communicate with each other and with a passage leading to the interior of the collar, the oil, which is gradually supplied through the said passage to the interior of the collar, maintaining a perfect lubrication of the collar without depending upon the oil supplied to the journal box. Two claims are made for the anti-friction collar described.—No. 19797. December 9th, 1889. 6*d.*

ELECTRICITY.

GENERATION OF ELECTRICITY ON RAILWAY TRAINS.—*I. A. Timmis, London.*—The electricity is generated by a dynamo, for the purpose of lighting lamps, working brakes, charging accumulators, or for other similar purposes. The dynamo is fixed in any convenient vehicle, for instance a guard's van, and driven by a steam engine, which may either take steam from the locomotive or from a special boiler. If a special boiler is used, it is preferably placed with the dynamo and engine in the same vehicle. When a quantity of water is required to cool parts of the engine, the water used for the purpose may be circulated through the train to warm the compartments. The heat in the fire-box of the special boiler may be used to heat a system of pipes or tanks containing chemicals, such for instance as the Arctos system or the Harden Star system, for the purpose of cooling the compartments of the train. Claim: The combined arrangement hereinbefore described for driving an engine, and also providing means for heating or cooling railway vehicles, as and for the purposes described.—No. 5615. April 2nd, 1889. 6*d.*

REGULATOR FOR ELECTRIC CURRENTS.—*W. R. Michl, Wettr-on-the-Ruhr, Germany.*—The regulator is self-acting, and is operated by weights, which are controlled by a system of electric magnets and solenoids. Fig. 1 is a front elevation, and Fig. 2 a side elevation of the appliance. A are contact plates arranged in an arc and connected to resistances. B is a spring contact arm for putting the different resistances in circuit. The arm B is attached to a wheel C^1, which may be revolved in either direction by the

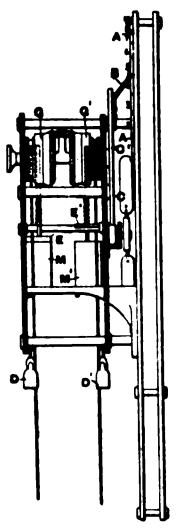


FIG. 2.

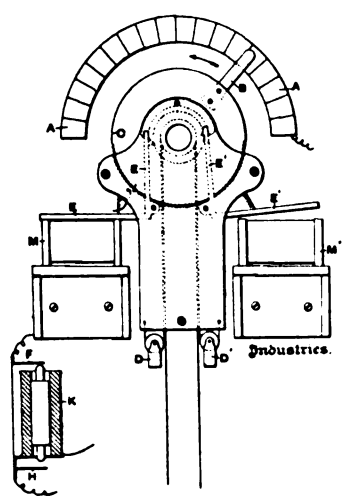
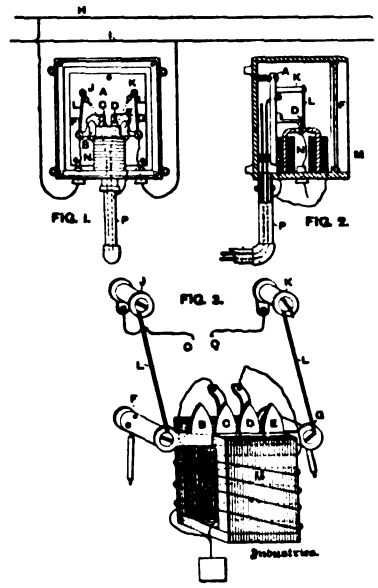


FIG. 1.

weights D D^1. The weights are suspended by chains passing round the drums G G^1. In the drums G G^1 fall the pawls E E^1 to prevent the weights turning the wheel C^1. The wheel C^1 is geared to a fly-wheel C to make its motion slow. The pawls E E^1 are situated above electromagnets M M^1, which are vitalised as required by a controlling solenoid K. The pawls E E^1 are held away from the magnets M M^1 by springs, but should the current exceed the normal the core of the solenoid K is raised and makes contact with F, and puts the electromagnet M in circuit. The arm E is then drawn down and the wheel G permitted to revolve, turning the wheel C^1, and so shifting the contact arm B to put in more resistance. When the current has become normal the arm E is released, and the contact arm remains stationary. If the current falls below the normal the core makes contact with the plate H and puts the magnet M^1 in circuit when the arm B is moved in a contrary direction. Claims: An improved regulator for electric currents arranged substantially as described and shown in the drawings.—No. 18,979. November 26th, 1889. 6*d.*

SAFETY DEVICES FOR ELECTRIC CIRCUITS.—*H. H. Lake, London (E. Thomson, Lynn, U.S.A.)*—The invention relates to lightning arresters for use in connection with lines which carry currents of considerable potential. In the accompanying illustrations Fig. 1 shows a front view of the lightning arrester. Fig. 2 a side view in section, and Fig. 3 the essential electrical elements of the invention separated for clearness. A slab of non-conductive material A is fixed in a casing of metal, and supports the lightning arrester plates B C D E. The plates B E are supported by the standards F G_1 which are electrically connected to the main leads H I, whose difference of potential is great at those parts. The standards F G are further connected with terminals J K by fuses F. From the terminals J K connection is made by insulated wires passing downward through the pipe P to any suitable device, such as a motor or induction coil. The plates C D are connected to earth by wires which form the coils of the magnets M N. On the occurrence of a lightning discharge which induces or produces an instantaneous flow of high potential current in either one or both of the mains H I, such flow or discharge finds its way to earth by springing across the space between the plates B C or D E. To prevent a circuit forming between H and I by an arc across the arrester plates, the magnets M N develop magnetism in the poles between which the arrester plates are placed to rupture or blow out by magnetic action any electric arc so formed. Should a short circuit occur in the lines O Q leading from J K to the induction coil the fuses L become melted and the current for the time discharged to earth. Claims: (1) The double pole lightning arrester hereinbefore described having lightning arrester points connected to both poles of the circuit,



and mounted together as a single structure, in combination with an arc rupturing magnet; (2) the combination with the double pole lightning arrester connected to the two mains or wires of an electromagnet whose magnetic poles embrace or act upon the spaces between both sets of arrester plates or poles, and a coil or coils for said magnet in a circuit from one main to the other through the arrester; (3) the combination with the branch wires of a lightning arrester, and fuses between the local translating device and said branch wires; and (4) and (5) a modification.—No. 6063. April 9th, 1889. 8*d.*

ELECTRIC SIGNALLING LAMPS.—*J. P. Rees, London.*—A portable electric lamp for signalling by flashes is here described. Fig. 1 is a side elevation partly in section, and Fig. 2 a front elevation of the lamp. The battery is enclosed in the case A upon whose lid B is mounted the lamp C and its fittings. The leading-in wires of the lamp are connected to the poles of the battery, one by the metal strip D, and the other by the metal strip E, the contact piece F, and the spring G, which is connected to the pole. The lamp C is enclosed in a case H provided with lenses I, and separated by a diaphragm into two compartments. In the diaphragm is a small aperture K closed at will by a system of levers M, N, O, and L. When it is desired to transmit a message the spring G is depressed until it bears upon the contact-piece F and is held in this position to complete the circuit through the lamp C during the working. The disc or shutter over the aperture K is then operated by pressing the lever L so as to open and close it in such a manner as to produce the desired signals. Claims: (1) A portable electrical apparatus for signalling by means of flashes of light; (2) the combination with an electric battery and an electric lamp connected therewith of a device for closing and interrupting the circuit, and a casing enclosing the said lamp and provided with one or more lenses; (3) in an electric signalling apparatus such as hereinbefore described a tube provided with

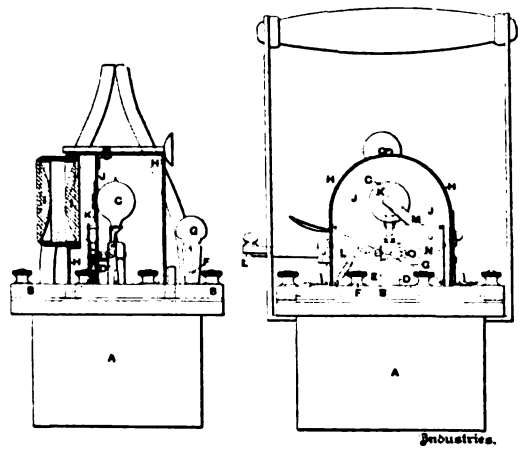


FIG. 1. FIG. 2.

one or more lenses and so fitted in a casing enclosing the lamp that it can be adjusted towards and away from the said lamp; (4) in an electrical signalling apparatus such as hereinbefore described, the employment between the lamp and the lens of a partition or diaphragm provided with a suitable aperture, and a disc or shutter provided with means for operating it to open and close the said aperture; (5) the improved apparatus constructed as described.—No. 1038. January 18th, 1889. 8*d.*

CHEMISTRY.

WATER GAS.—*S. Fox & E. Blass, Leeds.*—This apparatus is designed to generate the gas directly from water without the use of a boiler. This is effected by heating up a regenerator by gases produced during the time of blowing up the fuel in the generator. Water is then admitted under pressure into the heated regenerator, and is converted into steam. This passes through the incandescent fuel and makes the water gas. The regenerator is formed of a metal case lined with refractory material, and partially divided in two or more compartments by walls of the same material. In one of these compartments is constructed the furnace, and in the other are placed bricks or other pieces of refractory material crossed to form passages for the products of combustion proceeding from the furnaces. These bricks and the walls become heated, and the spray of water is directed upon them to form steam at the proper time as already described. The passage of the steam in the course of being converted into gas passes through the regenerator in a contrary direction to the products of combustion. Claim: In apparatus for and in the manufacture of water gas, the producing without the use of a steam boiler of steam necessary for the manufacture of such gas as described.—No. 6131. April 10th, 1889. 6*d.*

POTASSIC AND SODIC HYDRATES.—*G. A. H. Gabet, Paris.*—The above hydrates are manufactured according to this invention by the following method:—A solution of acid phosphate of lime is placed in an enamelled iron boiler, 15 per cent. of acid phosphate being a suitable strength. This solution is brought to and maintained at nearly the boiling point, and an equivalent quantity of either sulphate of potash or sulphate of soda added. Soluble phosphate of potash or phosphate of soda and insoluble sulphate of lime are thus formed. The sulphate of lime is separated by filtration. The phosphoric acid is precipitated by milk of lime and then separated. The solution of potash or soda left is concentrated to any desired degree in an iron vessel. With a very slight increase of cost precipitated phosphate free from iron and alumina and caustic soda of great purity may be obtained. For this purpose it is necessary to divide the precipitation of the phosphoric acid into two parts. First lime is added to the solution of acid phosphate of soda until a neutral or slight alkaline reaction takes place; half the phosphoric acid is precipitated in the form of phosphate of lime and di-sodic phosphate remains in solution. The precipitate of phosphate of lime is separated. In cooling the di-sodic phosphate remaining in solution crystallises, and it is separated from the water of crystallisation, and after being dissolved in warm water the phosphoric acid it contains is precipitated by the addition of the necessary quantity of lime. This second precipitate of phosphate of lime is free from iron and alumina, and the soda remaining in solution is of great purity. This process of manufacture of soda and of potash has the advantage of permitting of the employment of the double sulphates of potash, soda, and magnesia. By treating these salts with an equivalent solution of acid phosphate of lime, on one hand acid phosphate of magnesia and acid phosphates of potash and of soda—all of them soluble—are obtained, and on the other hand sulphate of lime, which precipitates and can be separated, is obtained. Claim: The manufacture of caustic potassic and sodic alkalies by the aid of phosphate of lime and the sulphates or bisulphates of potash and of soda, such process enabling phosphate of magnesia to be obtained as a bye-product when double salts which contain magnesia as one of the bases are employed.—No. 5341. March 28th, 1889. 6*d.*

WASTE SULPHURIC ACID PICKLE.—*S. Daw, Llanelly, Carmarthen.*—This invention relates to the treatment of sulphuric acid pickle to produce useful products. The liquor treated is derived from works in which tin, terne, and black plate are manufactured, it being necessary at certain stages to immerse the iron or steel plates in dilute sulphuric acid. The spent or residual liquor from this process is mixed with any suitable material containing available oxide of magnesium. The available oxide of magnesium is added in the proportion of forty pounds weight to thirty-two pounds weight of sulphur found in combination with the constituents of the waste pickle. The addition of the material containing oxide of magnesium causes by chemical action the production of oxide of iron and sulphate of magnesia. Claim: The method of treating the material usually known as spent sulphuric acid pickle with or without preliminary treatment consisting in adding thereto material containing available oxide of magnesium so that sulphate of magnesia and oxide of iron are produced.—No. 4701. March 18th, 1889. 4*d.*

MISCELLANEOUS.

INDICATOR FOR RAILWAYS.—*C. C. Hearsey, Chiswick.*—The use of this invention is to enable passengers in railway vehicles to ascertain during a journey the names of stations as the train passes through them. In each compartment there are arranged a series of plates or discs attached to an endless band passing over rollers. One of these plates is exposed at a time to the passengers in the compartment. On these plates are marked the stations in the order they are situated upon the railway track. At the stations are fixed parallel with the metal track, and by its side, a plate of metal having an edge which slopes upward from either direction. A sliding rod is affixed perpendicularly to the side of each carriage connected at its top to the spindles of the rollers over which passes the endless band carrying the station indicating plates. By thrusting this rod upwards vertically the rollers in each compartment of the vehicle are turned sufficiently to indicate a fresh station. The rod is thrust upwards by its lower end travelling up and over the edge of the plate of metal fixed by the side of the rail at each station. Thus, as the train passes through a station its name is indicated. Claim: The automatic system comprising the double incline plate, and the gear and mechanism for the purpose of turning the endless band containing the names of the station and the combination in the manner described.—No. 1984. February 4th, 1889. 8*d.*

Copies of the British specifications may be obtained on application to H. READER LACK, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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MESSRS. ARBEY'S TOOLS AT THE LATE PARIS EXHIBITION.

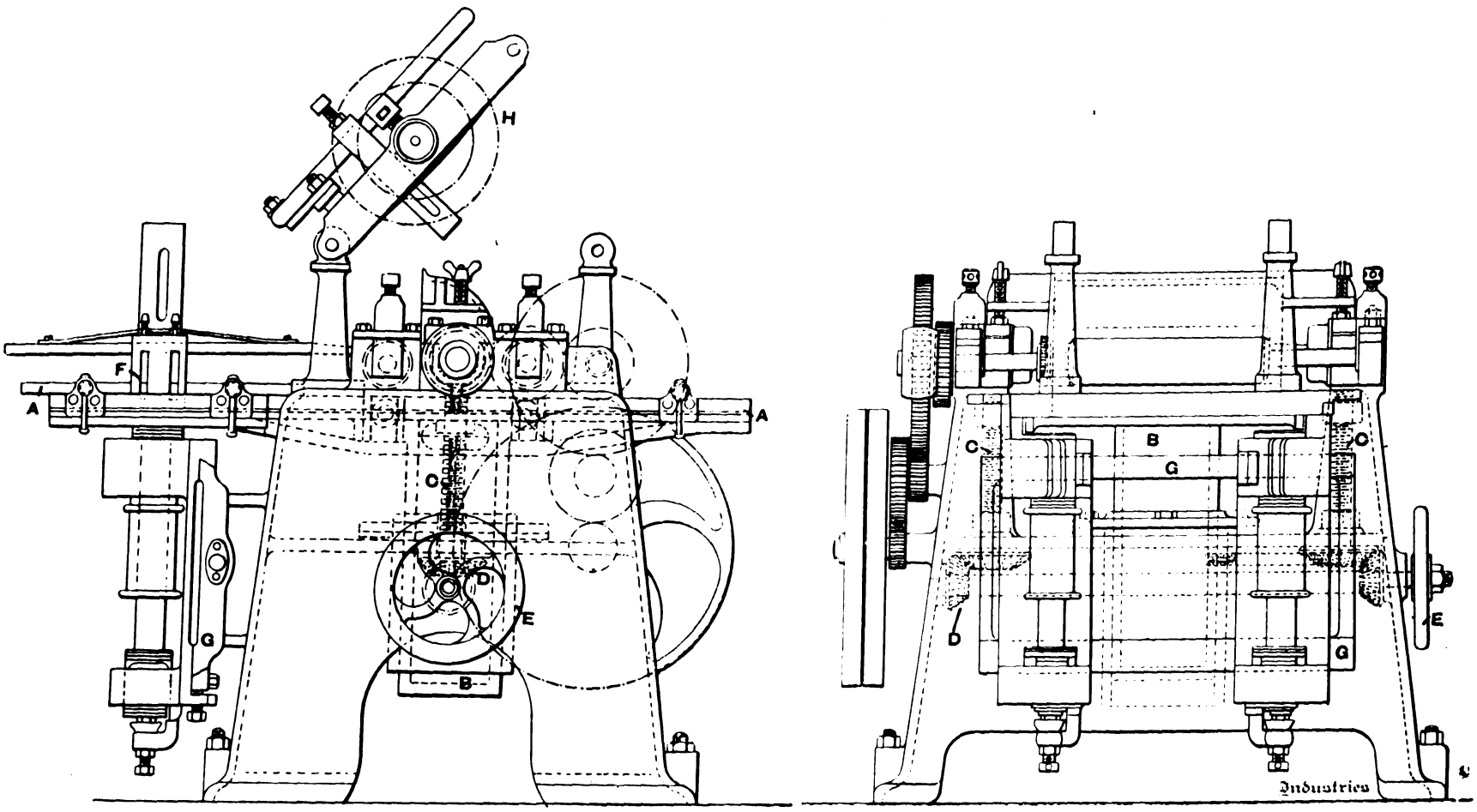


FIG. 1.

MESSRS. ARBEY'S TOOLS AT THE LATE PARIS EXHIBITION.

WE illustrate herewith a parquet machine, exhibited by Messrs. Arbey. Figs. 1 and 2 show front and end elevations, from which it will be seen that the table A is supported by a cylinder B, and can be raised or lowered by means of two screws C, which are caused to revolve by bevel wheels D, actuated by the hand wheel E. The vertical cutters F are driven by half-crossed belts, and may be moved transversely along the slide G, so as to suit different widths of timber. They may also be raised or lowered to suit the varying heights of the table. The horizontal cutters, which are helicoidal and very thin, are a special feature of the machine, and a special automatic apparatus for sharpening the cutters in position without removing them is supplied. This avoids the necessity for setting the cutters after sharpening. The apparatus is shown at H, and may be swivelled into a vertical position, and held there so as to be out of the way when the machine is working. Fig. 3 shows the mode of applying the sharpening apparatus, and is intelligible without further description. Fig. 4 shows the construction of the helicoidal knife, which is made specially by Messrs. Arbey. The machine is very compact, and occupies only a very small floor space. The pressure against the side of the timber is produced by a weighted lever, and this arrangement, whilst giving sufficient pressure, is not so unyielding as the screw arrangement usually employed.

The same firm exhibited in the machinery hall several excellent machines for wood working, but as these present no novel features we shall only mention them here. These included a copying machine for making gunstocks, wooden shoes, and lasts, which will copy four at one operation: it is similar to the machines made by Messrs. Arbey for making gunstocks, and now worked by the French Government in their arsenals at Chatellerault and St. Etienne; two moulding machines, one for straight mouldings and the other for carved mouldings, a type of machine first made by this firm; a large band saw; a copying lathe, for copying objects such as chair or table legs or the handles for coffee-pots; a machine for making wood wool, which we described in *Industries* some time ago (see Vol. V., page 74); boring and mortising machinery, tenoning machinery, and grinding apparatus.

FIG. 2.

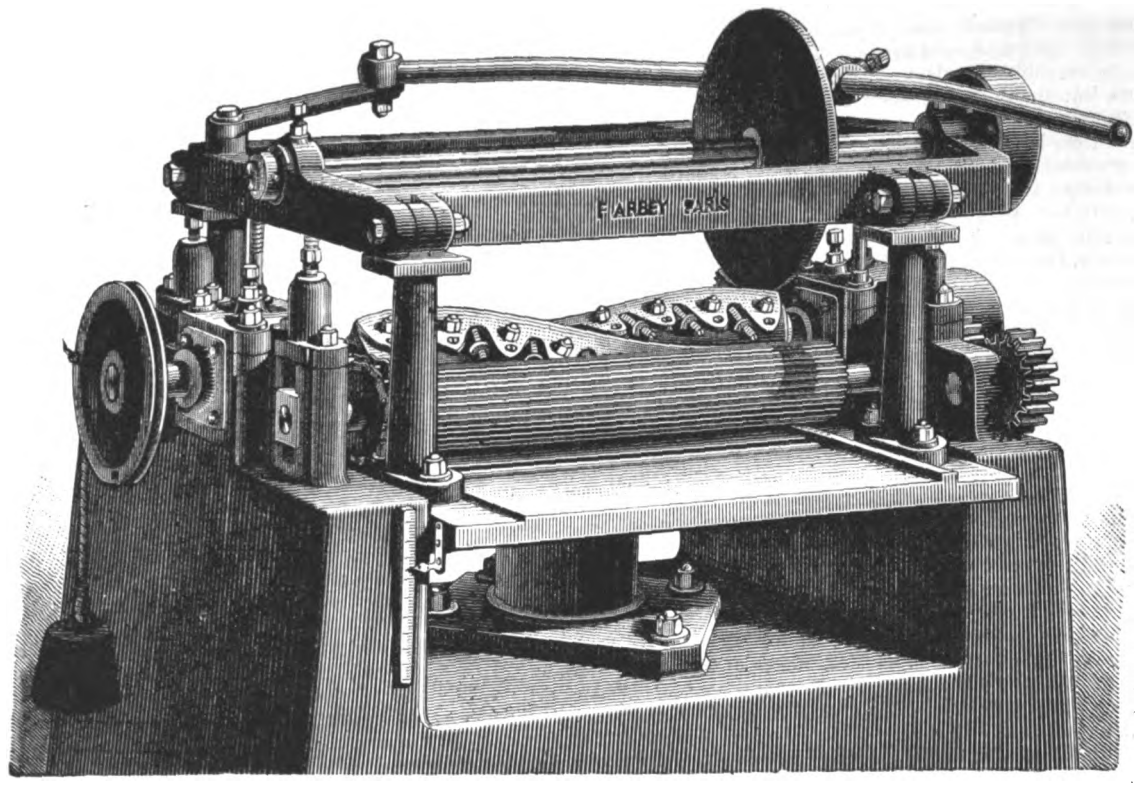


FIG. 3.

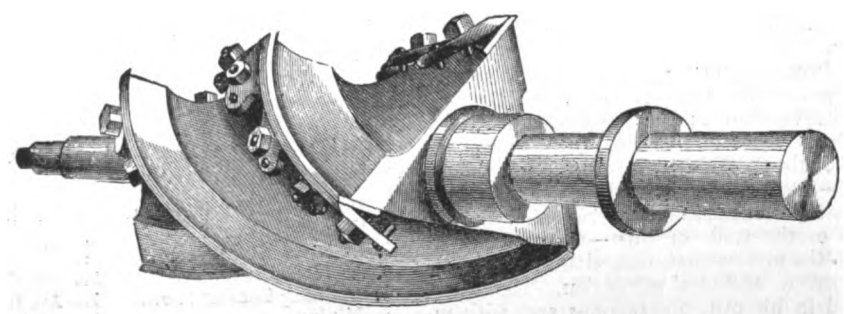


FIG. 4.

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LOW-PRESSURE COMPRESSED AIR TRAMCAR.

CONSTRUCTED BY MESSRS. HUGHES & LANCASTER, ENGINEERS, CHESTER.

(*For description see opposite page.*)

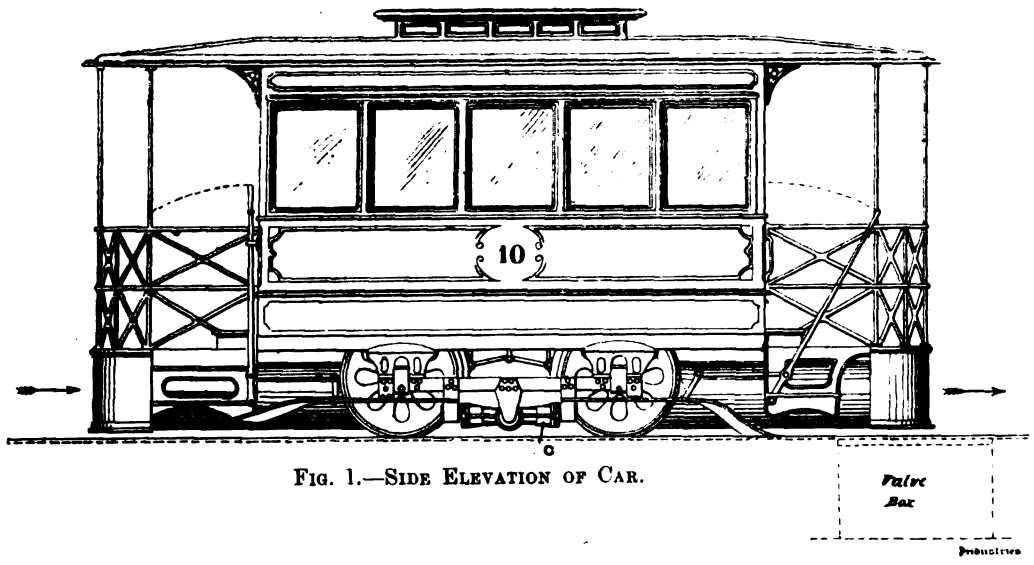


FIG. 1.—SIDE ELEVATION OF CAR.

TRAINING FOR TRADES AND CRAFTS.

BY HENRY DYER, C.E., M.A.

(*Continued from page 195.*)

III.

FOR those who wished to be ranked as tradesmen or craftsmen, there ought to be three grades of examination when they had attained at least the age of twenty-one. The first for those who had been in the workshops for at least five years, and who had attended a few elementary classes in general subjects and in the theory of their special departments. The examination need not be very difficult, either in the theoretical or practical sides, but should be sufficient to test whether the candidates were able to do an average day's work, and at the same time knew the elements of the principles involved. The second grade should have a higher standard in the theoretical subjects, and those who passed it should get off with four years in the workshop as apprentices; while the third should be higher still, and only require three years in the workshop. These two latter examinations would be taken up by those who aimed at being foremen and managers, and who had had special advantages at school or college.

By whom should these examinations be conducted, or, at least, superintended? In my opinion it should be by joint committees of the employers and the employed in the different trades and crafts. For the examinations of the first class a committee of workmen and masters, of the second of foremen and masters, and of the third of special examiners and masters, should be appointed, and thus not only would the entrance to each trade be properly guarded, but, what is of more importance, the work in our technical schools would be kept up to date, and prevented from running to seed among the fads of the teachers. Where the committees found examinations already in existence which met their requirements they should accept certificates from those who had passed them, and not cause new ones to be instituted. Moreover, when a man had been in receipt of at least the minimum standard wage for, say a year after the completion of his apprenticeship, that should be accepted as sufficient proof of his ability as a workman. The work of the committee would therefore be, to a large extent, the testing of credentials, and the influencing of teaching rather than the direct superintendence of examinations. The greatest danger to technical education arises from the fact that instruction is apt to become stereotyped, or the teachers take up a little bit of a subject and exhaust it, and the work is of as little use to the pupils as doses of Greek or Latin grammar. There can be no doubt that, if once we obtained the right men as teachers—men who could really teach, and who had at the same time considerable theoretical and practical experience of the trade or craft—we would have overcome one of the most serious difficulties in the way of the development of technical education. The scientific man, buried in his own abstractions and with no enthusiasm for the teaching of youth, the skilled workman, ignorant of the methods of education, and the artful crammer, who with a minimum of knowledge *passes* a maximum of students, are types of men who have brought technical education into disrepute.

The tendency of some of our modern legislation and custom is to range employers and employed on opposite sides, and questions affecting them are decided, not on their merits, but by a measurement of the force which each can bring into the struggle. This is a barbarous system, and the sooner it is changed the better for all concerned. Instead of having unions of masters to squeeze all they can out of the men, and trades unions to exact all they can from the masters, we ought to have an organisation in which the interests of both employers and employed would be fairly considered. In short, we want a modification and development of the trades guilds of the middle ages, and in this, as in many other things, we find that true liberalism is a return to the customs of our forefathers. The study of the constitution and duties of these modern guilds is beyond my present purpose, but one very obvious function would be the regulation of the admission of members, and the conditions under which the different trades and crafts are to be taught. The trades unions have often been blamed for enforcing their arbitrary rules regarding the number of apprentices to be employed in the different trades, but if they agreed to limit that number by a test of skill and knowledge, and insisted on the employers doing their duty to their apprentices, they would be supported in their position by the public. This arrangement has already been carried out in a few trades, and it has been applauded by all concerned, and been productive of the greatest possible good. It must be distinctly understood, if technical education falls into the hands of paid public officials, and separated from those who are actively engaged in the trades and crafts connected with it, it will become a snare and a delusion; the machinery may be improved, but the true spirit which should be at the bottom of all real developments will be utterly awanting. I have no doubt it will be said that my suggestions are contrary to the accepted doctrines of political economy and the principles of Free Trade. With these I am not specially concerned, and, when they interfere with the development of humanity, I have no hesitation in putting them aside.

In order to give some idea of the amount of theoretical knowledge which I consider necessary in the different grades which I have mentioned, a brief outline may be given of the arrangements which have been made in the Glasgow and West of Scotland Technical College. The evening classes have been arranged to lead up from the ordinary classes of a Board school, and complete courses of instruction, at very low fees, have been instituted in the following departments:—

1. Mechanical Engineering.
2. Naval Architecture.
3. Electrical Engineering.
4. Architecture.
5. Building Construction.
6. Mining.
7. Metallurgy.
8. Agriculture.
9. Chemical Industries.
10. Textile Industries.
11. Art Industries.
12. Commerce.

In each of these departments there are two grades of instruction and of certificates, the junior being within the reach of all ordinary apprentices, and the senior being intended for those who have had better opportunities or have greater abilities. The standard of the junior certificate would, in my opinion, be very suitable for the admission standard to the trades guild, on the theoretical side. On the practical side it would be determined from time to time by the committees of the different trades and crafts.

There is a considerable number of bursaries in the College to assist those who are attending the evening classes, and a few scholarships to take some of the best students from the evening to the day classes, and the governors have also power to remit in whole or in part the fees of artisans and others who are desirous of attending the day classes and require aid for obtaining the education therein provided. In the day classes a course of instruction extending over three years has been arranged in the following departments:—

1. Civil Engineering.
2. Mechanical Engineering.
3. Naval Architecture.
4. Electrical Engineering.
5. Architecture.
6. Chemical Engineering.
7. Metallurgy.
8. Mining Engineering.
9. Agriculture.

and those who complete the course and pass the necessary examinations obtain a diploma and become Associates of the College. The diploma can also be got by those who hold the senior certificate after an attendance of one year at the day classes. Negotiations are now being carried on with the authorities of Glasgow University for the recognition of attendance at the College as qualifying in great part for the degree of Bachelor of Science. When these have been completed we will have an educational ladder which will reach from the lowest class in a Board school to the highest class in the University, and only requiring ability, perseverance, and energy to enable the poorest student to mount to its topmost rung.

The progress of technical education has been very much impeded by the extravagant demands of enthusiasts, and by vague ideas about the necessity of educating the British working men. In my opinion there is far more necessity for educating the British manufacturers, not only as regards the value of improved scientific knowledge, but also in their social duties, and especially those they owe to their workmen. If they clearly recognised the worth of education and encouraged it, the working men would soon take to it, and if they took a friendly interest in the welfare of their workmen we would hear little of strikes, lock-outs, and other labour difficulties. As a matter of fact the extension of labour-saving appliances in those industries in which goods are manufactured on a large scale has in very many cases reduced the workmen to parts of the machines, or to labourers who do unskilled work. For these men, what is wanted, is not so much technical education, which they have no opportunities of applying, but general education which will enable them to escape from the drudgery of their daily lives. This is true to a very considerable extent even with skilled workmen, and therefore the pass examinations which I have suggested should be comparatively easy, and their technical knowledge should be simply intended to enable them to go about their work in an intelligent manner. Their general knowledge should, however, fit them to act the part of good citizens—a matter of greater importance than mere skill in a trade. Opportunities should, however, be afforded to the most intelligent and persevering for passing to the higher grades by means of bursaries and scholarships, but no artificial system should be pursued which took good workmen from the workshop and unfitted them for any other useful work. Our elementary education has produced a large number of men who would not condescend to a good day's hard work, and has overstocked the market with clerks; and, if we do not take care, technical education, so called, will do the same for the more genteel parts of the trades. The majority of those who at present attend science and technical classes do so, not that they may become better workmen, but that they may be relieved from working with their hands almost altogether, and I very much doubt if those who pass the greatest number of science and art examinations are the most expert in the workshop or the most useful in the management of business. The really successful technical education of the future will not be a mere smattering of science combined with a certain amount of practice, but will consist of the highest possible knowledge in special departments, which will enable its possessors to revolutionise old industries or to introduce new ones; and, however much manufacturers may wish to have workmen with a fair amount of scientific training, it is of much more importance to them, at least from their ordinary point of view, to have a few highly skilled engineers, or chemists, or artistic designers, as the case may be. I make these remarks for the purpose of indicating that in my opinion, the future happiness and welfare of the

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LOW-PRESSURE COMPRESSED AIR TRAMCAR.

CONSTRUCTED BY MESSRS. HUGHES & LANCASTER, ENGINEERS, CHESTER.

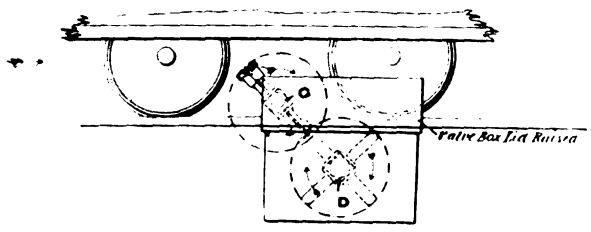


FIG. 2.

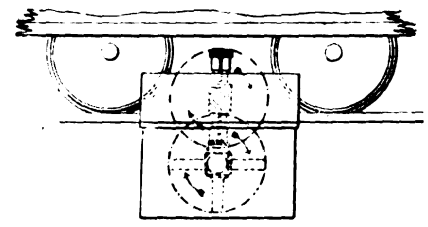


FIG. 3.

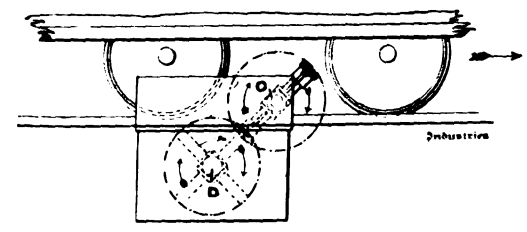


FIG. 4.

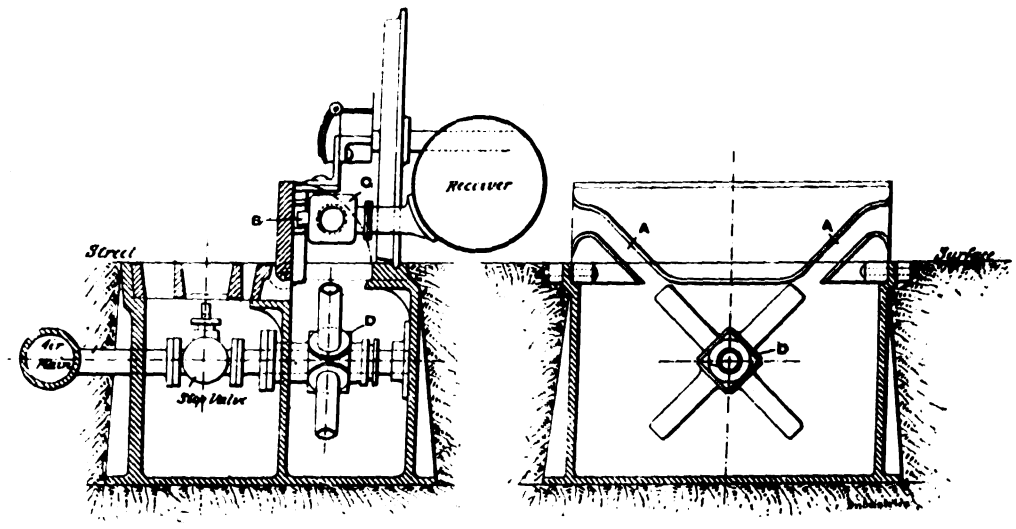


FIG. 5.

FIG. 6.

great majority of the working classes will depend much more on a good general, than on a narrow technical, education; because then, not only will they be able to rise above the mechanical drudgery of their daily work, but what is of more importance, they will, as educated free men, have the determination to withstand the attempts of unscrupulous capitalists to use them as machines for grinding out dividends apart from the consequences either to themselves or to society. It is, therefore, highly necessary that tradesmen and craftsmen should make themselves acquainted with the history of economic ideas, and of industrial and commercial institutions, so that in making arrangements for the future they may be guided by the experience of the past, and be able to rise above the merely selfish class feeling which is too apt to be engendered when only present wants and conditions are considered. They would, among other things, do what they could to assist in the terrible problem of unskilled labour, with its long hours of monotonous, soul-destroying work, or its body-destroying slavery; for if this be not done, the whole movement for the improvement of the position of tradesmen and craftsmen would lead to the establishment of a select body in comparative comfort, and a great mass in the deepest degradation. All real social reform must permeate the whole community, and not create a caste system which, in many cases, would be more heartless than the present.

For some time past some of the trades have been agitating for Acts of Parliament to be passed, requiring that examinations be held to test the fitness of persons holding special positions for the duties they have to perform. For instance, the shipwrights are anxious that a competent professional examination should be required of those in their trade before they are allowed to proceed to sea. A resolution to this effect was adopted at the last Trades Union Congress, as was also another, expressing the opinion that no person should be placed in charge of steam engines or boilers (sea or land) who has not undergone an examination to prove his practical fitness for such employment. Already the Board of Trade has such examinations for navigating officers and engineers of vessels, and no doubt in some respects they have been the cause of considerable improvement. But in this matter, as in almost every other connected with education, the British public has been compelled to worship the fetish "examination." Examinations by themselves generally lead to pure cram; and I am very much misinformed if these Board of Trade examinations are not examples of the most unmitigated cram in existence. They have reared up a class of men who have no object in educating those who come under them, and who are content with simply stuffing them with material which can be conveniently placed on the examination paper. Now such a system not only does comparatively little good, but it also does a large amount of positive harm. It would be rendered quite unnecessary if the arrangements I have suggested were adopted, as each trade would then be directly responsible for the efficiency of its members, and if an Act of Parliament were required at all it would be to compel shipowners and others only to engage those who were able to show that they were recognised members of the trade. Responsibility would thus be thrown on the proper parties, and a more thorough training, both in the theory and practice of their work, insured on the part of all candidates for such positions as I have named, and as a result we would not only have better tradesmen, but also, as a rule, better men.

I have held and expressed these opinions about modern trades guilds for a considerable time, and I am pleased to find that similar ones are held and expressed by those who are intimately acquainted with the organisation of trades unions. Mr. John Burnett, formerly Secretary of the Amalgamated Society of Engineers, now Labour Correspondent of the Board of Trade, says: "Everything is being sacrificed to the cry of 'more work,' and even the character of the workers will suffer as long as this is made the first object. A modern trade guild might therefore fitly consider if the old apprenticeship system might not be revived with interest and advantage to all concerned. The division of labour is now carried out to such an extent that the good all-round workman of the old-fashioned stamp is more and more difficult to meet with. Employers frequently complain that they cannot obtain such men, oblivious of the fact that their method of using boy labour is entirely to blame for the evil. The boy is not now trained that he may become a generally skilful workman, but that he may produce as much profit as possible to his employer. To make the boy a master of his trade is no part of the bargain. Such guilds might also take up the kindred subject of technical education, so closely allied with that of the workshop training of the young. Even apart from the employers, it would be to the advantage of the unions to assist the spread of technical knowledge among their members, by raising scholarships and establishing classes to develop among their members the scientific knowledge of their trades. To give to them the brains as well as the manual skill of their industry, will not only do much to keep down the number of their unemployed and increase their membership, but solidly impress upon the minds of employers that unionists are indeed the pick of British artisans. This may be deemed a somewhat Utopian idea, but in an age when the increasing severity of competition for the work of the world makes absolute co-operation between capital and labour more and more a national necessity, I hope to see the practical accomplishment of this ideal."*

The first step necessary for the carrying out of the proposals I have made is for a joint committee of the employers and the employed in each trade or craft to meet and arrange the conditions under which it shall be learned, both as regards its theory and its practice. These being settled both parties must be bound to do their best to enforce them. The masters would insist on their employés, and the trades unions on their members, conforming to them. Of course it would take some little time before they could be put into full operation, but when once they were we would, with slight modifications and extensions in our present educational arrangements, have all we require in the way of training for trades and crafts, and that without the aids of special Acts of Parliament and of institutions and machinery which would involve an immense expense to the country. If the work were properly carried out we would also have, what is of more importance from every point of view, a manly enthusiasm and pride in the welfare of all connected with trades and crafts, and a healthy social spirit, which never allowed selfish or class interests to interfere with those of the community and the State.

* "Claims of Labour," Lectures, p. 37.

LOW-PRESSURE COMPRESSED AIR TRAMCAR.

THOUGH we are well familiarised with the iron roads in our streets, and look on the constant service of tramcars in our main thoroughfares as a necessary part of everyday life, yet after its introduction the system has remained practically what it was at the outset. Nothing has been generally adopted to supersede horse-flesh for traction, though the field is such a good one. It can only be surmised, therefore, that the tramway companies have found some practical defects in whatever has hitherto been brought to their notice. A new form of mechanical plant for the purpose is now bidding for a share of patronage. It is connected with the use of a low-pressure air tramcar, of which Messrs. Hughes & Lancaster, of Chester, are the makers. A few days ago this firm gave a demonstration of the system, which appears to possess many valuable features.

It may be premised that the use of compressed air is not new in street car traction; but previous attempts have always been in the direction of high pressures. If they have failed, it has not been for mechanical, but economical, reasons. On Colonel Beaumont's plan it was sought to use a pressure of about 1,200lb. on the square inch, and carry a store for a complete journey out and home to the depôt. Such a high pressure necessitated a considerable receiver thickness to withstand it, and this signified deadweight to be transported at all times. The receivers, too, had to be large enough to provide sufficient air for a long journey. To extract as much advantage from the system as possible heating apparatus was employed. To satisfy all these conditions a separate car became compulsory, and this had to be made heavy enough to give the required adhesion to the rails and draw a fully loaded car up the steepest incline. Thus we come to the same drawbacks as the ordinary street locomotive, with the expensive permanent way to support it. Moreover, as there is a certain loss of energy in compressing air, in practice, this loss becomes intensified as we reach higher pressures. When, however, a little above 10lb. pressure in the receivers is sufficient to propel a car, a great weakness in the system becomes apparent—enough, in short, to make all the difference between success and the reverse. Much the same may be said of the Mekarski plan, in which a pressure about half that named is used. On the low-pressure system, which has been established by Messrs. Hughes & Lancaster, a maximum of 170lb. on the square inch is all that is employed to do the work. Instead of carrying on the car the air wanted for a whole run, the receivers are only charged for a very short distance, the average being about a mile. A fresh

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supply is picked up *en route* from a main pipe laid under the roadway with branches in boxes alongside the line. The lids of these boxes are level with the road, and present no obstruction to ordinary traffic. For some distance on each side of them the rail is double grooved. A driver, on approaching one of these charging stations—slowing down somewhat as a matter of course—uses a lever standing on each car platform to drop a plough into the second groove. The box lid is lifted on its hinges, and kept up by the car body. There are two slots A (Fig. 6) on the under side of this lid, into the entering one of which a pin B on the double-ended car valve C engages. The valve arm, by the movement of the car, is brought directly opposite one branch of the four which radiate from the centre supply valve D in the box. It clasps bodily the branch presented to it, and in the vertical position (Fig. 3) full feed takes place, both valves being then open. A few seconds suffice for a moderate charge, but generally a stop will be made, and boxes will be fixed conveniently for so doing. As the car passes onwards communication ceases, the two arms of the car valve C become horizontal again but at opposite points, while the valve D on the main has passed through 90° only. Both are then shut, and left so that a similar operation may be repeated, and the lid falls into its place again. The series of operations after the first are therefore quite automatic.

Our illustration, Fig. 1, represents the car with which the experimental trials have been made. Figs. 2, 3, and 4 show the entering, full open, and leaving positions of the car and supply valves C and D. Fig. 5 shows a transverse section of the supply-main culvert and valve box, and Fig. 6 shows a sectional elevation of the valve box with the lid open. The car is self-contained, the motor being attached direct to the axle and with all the air receivers out of sight. It moves without any visible agency whatever. We had on the occasion referred to an opportunity of a short trip of half a mile on an incline of 1 in 45. The car appeared to behave very well and be easily under control. As, however, the usual traffic had to be contended with, we are compelled to refer to the extended report made by Professor Unwin for complete results.

First, however, we may inquire what leads to a saving over anything of the kind to which we are accustomed. What is the cause of the greater efficiency claimed? It will be observed that there is a minimum of deadweight in the apparatus employed. The air reservoirs have only a thickness of ⅛in., owing to the low pressure contained in them. The weights are:—Car, 1 ton 19 cwt.; machinery, 1 ton 15 cwt.; passengers, 1 ton 15 cwt.; total, 5 ton 9 cwt. This gives a proportion of machinery to the total of only one-third, whereas with steam trams the locomotive alone may weigh probably 12 tons, giving a dead load out of all proportion to that of the car and passengers—say, of four tons. Again, there is more economy in employing one central source of power and distributing it through several machines not all making the largest demand at any one time, than in keeping each one up to its full capacity whether it is requiring the same or not. It is to such causes as these, then, that we must look for the successful results put forward, viz., that only one-third to one-sixth the usual haulage work is done on this system. Opposed to this gain there is the thermal loss due to compression of the air to be taken into account, and the friction and leakage being spread over a range of pipes, but the advantages appear to much more than counterbalance the drawbacks.

The trials have all been conducted with an experimental car, which was not built for the purpose. A certain leakage, therefore, occurred, which will no doubt be greatly minimised when the receivers are built in the car itself, and the motor improved, as a result of the experiments. It has been found by Professor Unwin that a fall of only 7° in temperature was evident in the receivers after a run, heat being supposed to be abstracted from the atmosphere through the thin casings. The professor's results are therefore calculated on the assumption that the expansion of air in the receivers is isothermal, and the curve showing the work done hyperbolic. He assumes the car resistance at 27lb. per ton, and from his experiments deduces 12,000 foot lb. of work for every pound of air used. We give his results:—

Gradient.	Resistance in lbs. of six-ton car.	Initial pressure above atm. lbs. per sq. in.	Final pressure above atm. lbs. per sq. in.	Pounds of air used in run.	Work in traction per lb. of air used, ft. lbs.	Distance run before stopping, in feet.
Level	·162	170	18	78·77	14,510	7,055
1 in 150	252	170	28	73·60	13,790	4,028
1 in 75	342	170	38	68·42	13,010	2,603
1 in 50	430	170	48	63·24	12,340	1,814
1 in 25	698	170	76	48·72	11,020	769

PUMPING MACHINERY FOR JAPAN.

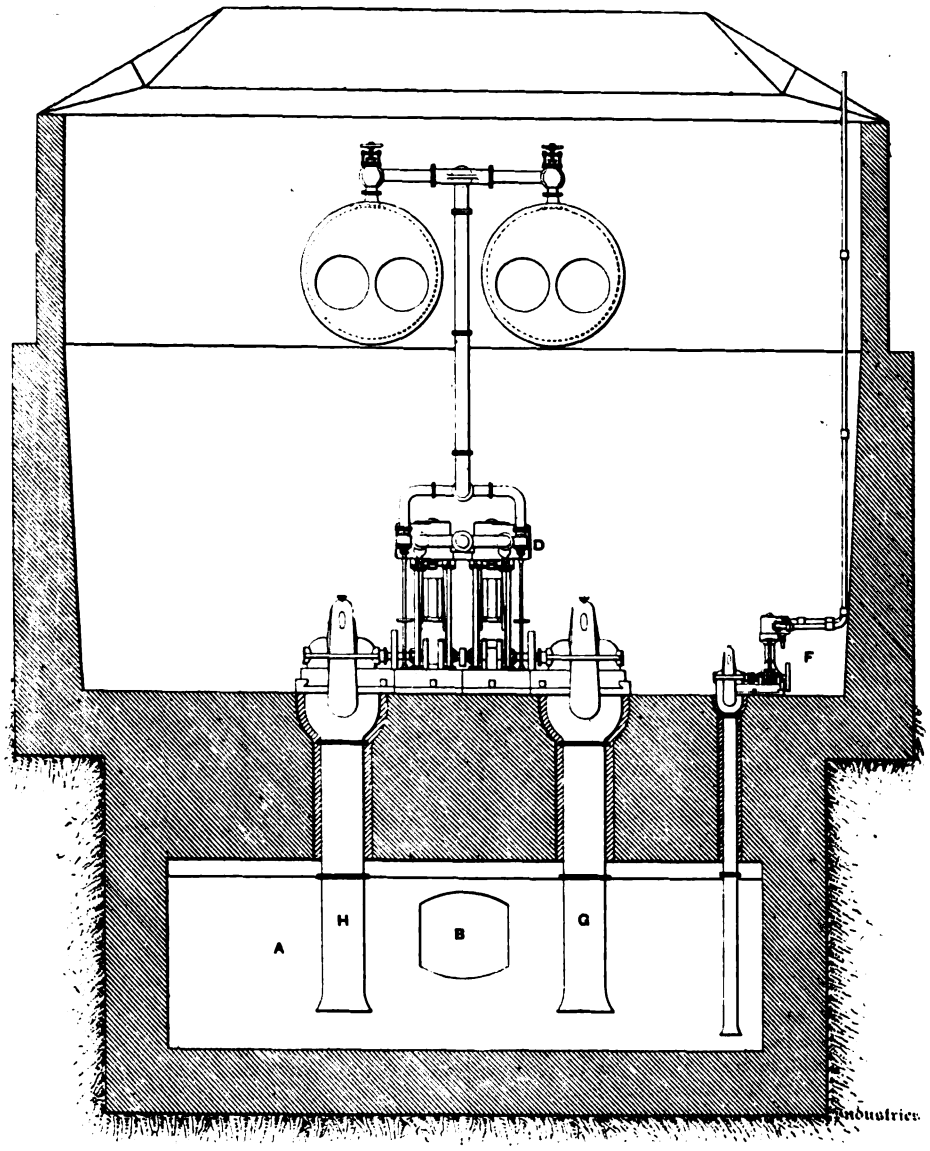


FIG. 1.—TRANSVERSE SECTION OF ENGINE AND BOILER HOUSE.

These are for level or rising gradients. On the falling gradients the air may be shut off, or the motor reversed, so as to partially recharge the reservoirs and give a brake action. It may be added that the air cylinders have a capacity of 52ft., the average speed of the car being 9 miles per hour. As much, however, as 15 miles an hour has been recorded.

Messrs. Hughes & Lancaster themselves compute that, with coal at 10s. per ton, on a line like that at Chester, the cost of fuel would be ¾d. per car mile, or even less. It will be gathered, therefore, that there is every likelihood of this low-pressure system being introduced to the public notice in a manner to test it thoroughly. Its advent will be watched with much interest.

PUMPING MACHINERY FOR THE JAPANESE GOVERNMENT.

WE have on numerous occasions set forth before our readers information relating to the astonishing progress made by Japan. Notwithstanding the great strides made by the Japanese Government and people in various directions, with the view of making their interesting country the "Britain of the East," progress is still being continued, though probably in a more guarded and careful way than heretofore. As an example of recent progress in Japan, we illustrate above and on pages 269 and 276 a dock pumping plant which has been recently constructed for the Japanese Government, and is intended for a new dock now being built at Hiogo. This dock is of large size, and will be capable of taking in steamers of the largest tonnage ever likely to require accommodation in that port. The dock is being erected and will be worked under the supervision of Mr. Miyabara, a Japanese engineer of considerable experience, who was for some time engaged in this country in surveying steamers built for his Government. The dock is being constructed of stone of the usual form, and the pumping machinery we are about to describe is arranged to empty it in from two and a half to three hours. The whole of this machinery has been designed and constructed by Messrs. W. H. Allen & Co., engineers, York Street Works, Lambeth, London, and is capable of discharging 7,000 tons of water per hour when both pumps are at work Referring to our illustrations, Fig. 1 (above) and Figs. 2 and 3 (on the opposite page) represent a transverse section, a sectional elevation, and a sectional plan respectively of the engine and boiler house, while Fig. 4 (page 276) shows a general view of the engines and pumps. It will be seen from the illustrations that a pair of centrifugal pumps and a pair of inverted vertical engines are neatly arranged and affixed to a continuous and massive bed-plate. The pumps are arranged on the outside, right and left, and the engine crank shaft is extended on either side to carry the pump discs. The joints of the pump casings are in a horizontal plane, and therefore the discs can easily be examined. The lower parts of the pump casings, together with the suction and delivery pipe orifices, are made to form part of the bed-plate, and the number of joints are thus reduced to a minimum. The pump discs are each 5ft. diameter, and the suction and delivery pipes 2ft. 3in. diameter. The engines have cylinders 18in. in diameter, with a stroke of 16in., and are fitted with variable expansion gear. The starting gear is specially arranged so that the engines can be operated from above or below. The makers have had a very large experience in this class of work, and the engines and pumps embody all their latest improvements, and are constructed with all their usual care and finish. The steam for the engines is derived from two Lancashire boilers, 6ft. 6in. diameter and 28ft. long. As above stated, the whole of the machinery, including the small pumping engine for draining the dock from any slight leakage, has been supplied by Messrs. W. H. Allen & Co., and we have no doubt, from our knowledge of the work done by this firm, that the plant will give satisfactory results.

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PUMPING MACHINERY FOR THE JAPANESE GOVERNMENT.

CONSTRUCTED BY MESSRS. W. H. ALLEN & CO., ENGINEERS, LAMBETH.

(*For description see opposite page.*)

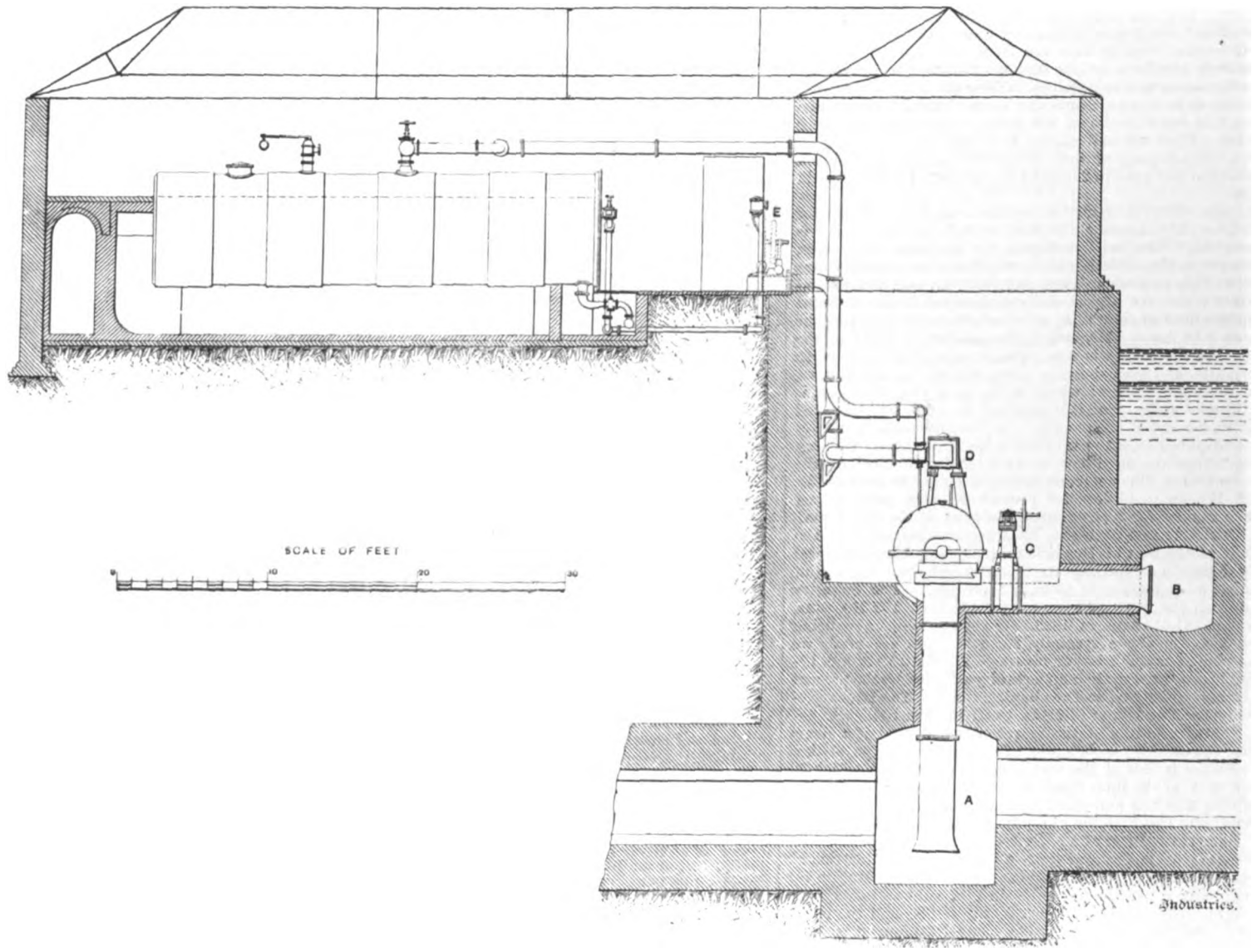


FIG. 2.—SECTIONAL ELEVATION OF ENGINE AND BOILER HOUSE.

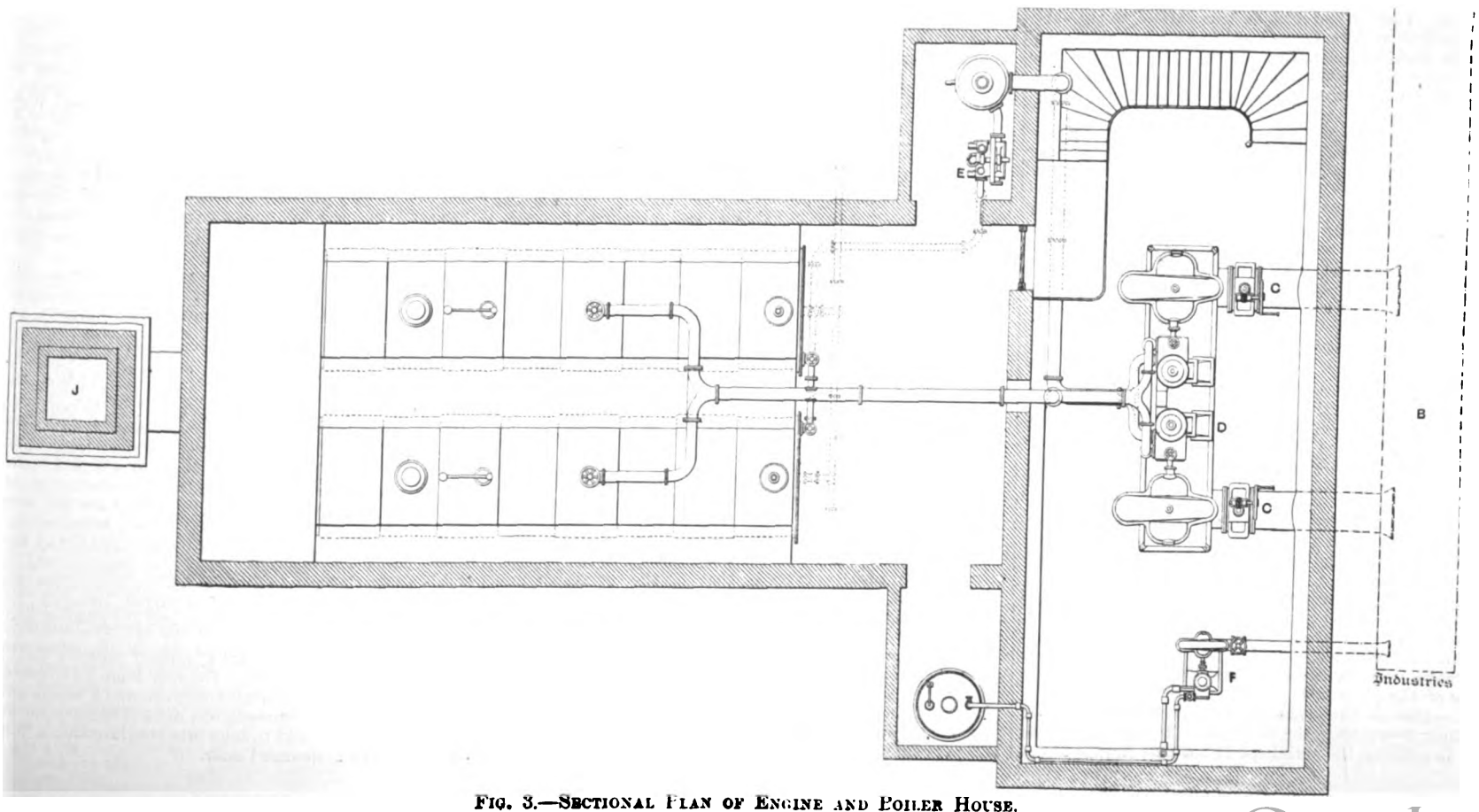


FIG. 3.—SECTIONAL PLAN OF ENGINE AND BOILER HOUSE.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

(FOR LATEST TELEGRAPHIC DESPATCHES SEE PAGE 273.)

PARIS, 18th March, 1890.

IRON.—Business in iron has certainly not improved in the last week. Here in Paris there is hardly anything doing, and there are no signs of a better trade in the near future. That the merchants have but little confidence in the situation is shown by the fact that in three weeks they have let the price of bars fall from 172s. to 156s. a ton. The state of affairs is less discouraging in the provinces, but the demand is everywhere fallen off. For the present, and for at least two months to come, manufacturers have plenty of work in hand, but fresh orders are becoming scarce. Were the coal market less firm prices would give way. The imports of Spanish ores by the port of Dunkirk amounted last year to 249,857 tons against 173,956 tons in 1888.

COAL.—The coal question continues to afford cause for much anxiety, inasmuch as the attitude of the miners is uncertain. The conflict begun in England has given strength to the agitation which the Socialist organisations are striving to keep up among the colliers, and the partial strikes which are almost daily announced from the Saint Etienne district show that not much is needed to fan the spark into flame. Meanwhile the market, in spite of the fact that the supply is now equal to the demand, remains very firm, and even shows a rising tendency. Thus coke, the minimum price of which is, in the North, 28s. a ton, is being sold at 29s., and it is expected that 30s. will be asked before the end of the month. Coal for industrial purposes has advanced 1s. a ton within the last few days. Colliery proprietors are unwilling to contract far forward at the current rates. One company, which is selling its coal at 16s. and 17s. in small lots for prompt delivery, refused last week an offer for 20,000 tons at the price of 15s. 2½d. a ton.

THE NITRATE OF SODA TRADE.—The statistics of the trade of the port of Dunkirk in 1889 show continued and rapid growth of the imports of nitrate of soda, the use of which as a manure is steadily increasing. The quantity entering the port last year amounted to 159,310 tons, against 141,514 tons in 1888. When the ships now being built on the Clyde specially for this trade are ready we may look for much larger returns. Agriculturists are beginning to perceive their opportunity afforded by the present depressed markets, and are buying freely. The latest quotations at Dunkirk are £7 12s. to £7 15s. per ton.

STRIKES.—From statistics recently collected it appears that the industry most subject to disturbance from strikes in France is that of the textile manufacturers, in which 39 per cent. of the total number occur. Next follow the coal mining and iron and steel making industries with 17 per cent., and the building and joinery trade with 15 per cent.

ELECTRIC LIGHT AT ST. OUEN LES DOCKS.—"La Société pour la Transmission de la Force par l'Electricité" has installed at St. Ouen, near Paris, a large station for supplying a portion of Paris and the sub-stations of the neighbouring villages, Asnières, St. Denis, and St. Ouen, with electricity. This station comprises four groups of two Roser boilers giving 16,000 kilogs. of steam per hour, four groups of coupled cylinder Corliss engines of 300 h.p. each, seven Marcel-Deprez dynamos giving 2,400 volts and 30 amperes. This current will be transmitted to the sub-stations, and there transformed to be distributed at 100 volts. The necessary electrical energy for exciting the high-pressure dynamos for lighting the works will be furnished by four Hillairet dynamos of 250 amperes, 110 volts, one Marcel-Deprez dynamo of 500 amperes. A battery of Laurent Cély accumulators of 500 kilogs., constructed by "La Société du Travail Electrique des Métaux," will complete the installation now in progress, and on which we shall have more to say when working.

INTERNATIONAL TELEGRAPHIC CONFERENCE.—It is proposed to hold an international telegraphic conference in Paris this year, and invitations have been sent to all the telegraph companies in the world. The date of the conference is not yet fixed.

BERLIN, 17th March, 1890.

EMIGRATION FROM GERMANY.—According to the official statistics, 2,765 emigrants left Germany during January. Of this number 500 came from Posen, 340 from Pomerania, 265 from West Prussia, and the remainder from the various States of Southern Germany. Emigration is slightly on the increase.

A TELETHERMOMETER.—Herr Lüders, of Görlitz, has recently invented a thermometer for ascertaining the temperature of the depths of the sea. Its action depends on the different electric conductivities of substances at different temperatures. Inside a glass tube are fixed a spiral iron wire and a bar of carbon, which only touch at their lower ends. Their other ends are connected to copper wires, which constitute an electric circuit, and in this circuit there is a galvanometer which indicates the differences in the current due to the variations in the temperature of the contents of the glass tube.

COAL.—Though the demand for house coal falls off as the summer approaches, the markets of Upper Silesia lose nothing in activity, the shrinkage of business in that direction being compensated by expansion in others. Thus, in consequence of the high prices of Westphalian and Saarbrück coal, large consignments of Upper Silesian produce are being sent to Stuttgart. According to a Silesian journal, three firms of coal merchants control fully 70 per cent. of the production of the Upper Silesian pits. The demand for coke being still in excess of the supply, production is being pushed on with the utmost vigour. New ovens are being built in many places.

LABOUR.—The meeting of the Labour Congress seems to have given a fillip to the agitation which has of late been increasing among all classes of operatives. There is no great industry, and hardly a trade, that is not seriously disturbed by demands for higher wages and shorter hours. Last week we had here in Berlin meetings of the persons occupied in the house furnishing trades, with a view to united action in a proposed attempt to better their position by a strike. Also the coppersmiths, who obtained last year a reduction of their working day to ten hours and a substantial rise in wages, are agitating for further changes in the same direction. In the case of these metal workers, the questions in dispute have been submitted to a Board of Arbitration chosen by both parties. Strikes are reported from all parts of the country. The strike of coal miners in England has had a powerfully encouraging effect on the leaders of the labour movement in this country. By the express desire of the Emperor, overtime is prohibited in the Spandau cartridge factory, and the length of the working day fixed from 6.30 a.m. to 8 p.m., with the usual periods of rest for meals. This is a reduction of from 1½ to 2 hours a day.

FLAX AND YARNS.—At Trautenau the demand continues brisk for yarns, full rates being readily paid by buyers for both tow and linen yarns. The latter are for the moment scarce in the market. At Bielefeld business is slack in the coarser numbers; but the finer sorts are quickly bought up. The imports of linen yarns in the first month of the current year amounted to 17,988 cwt. against 19,656 cwt. in the same month of 1889

THE CHEMICAL INDUSTRY.—At the general meeting of the Silesian Association of Chemical Manufacturers, held on the 10th inst. at Saarau, a dividend of 8 per cent. on the business of last year was declared, against 7 per cent. in 1888 and 6 per cent. in 1887. The state of the industry was reported favourable and the immediate prospects encouraging. The gross profits for the last three years were £47,250, £43,300, and £35,800 respectively.

NEW SMOKELESS POWDER.—Herr Kolk, a chemist employed in the Chemical Institute at Bonn, has invented a new smokeless powder, which, it is said, has given excellent results in trials recently made at Cologne. The invention has been offered to the Prussian Minister of War, who has ordered an investigation of its merits to be made.

VIENNA, 17th March, 1890.

BEER.—The total quantity of beer produced by the Vienna breweries during last year amounted to 2,451,652 hectolitres, or an increase of 90,000 hectolitres upon that produced in 1888. The quantity exported, chiefly to Paris and Berlin, showed an increase of barely ½ per cent.

ELECTRICAL ENGINEERING.—The increasing demand for the electric light in Vienna makes itself more clearly felt daily. Various companies already announce that the present central stations are insufficient for the requirements. The Wiener Electricitäts Gesellschaft has, therefore, decided to augment its capital by 2,000,000fl., to increase its plant by 2,000 h.p., or 24,000 glow lamps. The firm of Siemens & Halske are about to erect a new central station in Bezirke. The town of Bielitz, in Schlesien, has decided to adopt the electric light. The first place to be thus illuminated will be the theatre.

THE COAL MARKET.—The extraordinary animated coal traffic on the Bohemian railways is shown by the reports issued last week, and mentioned in my last letter. The accompanying tables represent the amount of coal in tons carried by the undermentioned railways for the months of February, 1889 and 1890, and also the amounts carried in the first two months of above-mentioned years respectively:—

	Feb. 1890.	Feb. 1889.
Dux Bodenbach Railway	152,524 tons ...	89,413 tons
Prague Dux Railway....	102,511 „ ...	70,535 „

In the first two months the traffic was as follows:—

	1890.	1889.
Dux Bodenbach Railway	319,211 tons ...	193,530 tons
Prague Dux Railway....	213,800 „ ...	169,122 „

The market continues more animated as the shipping on the Elbe has already been reopened, and prices tend to increase steadily. With respect to the high coal prices, the increase on the State railways amounts to 250,000fl.

THE IRON MARKET.—The demand for iron remains unchanged. The pig iron market is firm, and the production already greatly exceeds that of the corresponding period of last year. Works for refined iron are very busy, especially in the manufacture of rails and sleepers. Locomotive and waggon works have sufficient orders to last for several years. The State Railways alone have recently ordered 114 locomotives and 1,000 waggons, to be constructed during the next year. The Steyer manufactory of arms is now producing 45,000 rifles monthly. Ganz & Co., of Budapest, have resolved to pay a dividend of 70fl. per share, or 17·5 per cent.

BRUSSELS, 18th March, 1890.

THE COAL MARKET.—The state of the coal market is uncertain, and the buyers and sellers of coal and coke are waiting to see what will be the result of the strike movement in England. The price of coking coal remains firm at 22fr. in the Centre, but a great number of producers, especially near Charleroi, are asking 23fr. Coke is firm at 35fr., and briquettes at from 23fr. to 25fr., according to quality. For *fines demi-grasses* the price is somewhat variable, and transactions may be made at anywhere between 15fr. and 18fr. During the past week the State railways carried 29,564 waggons of fuel, as compared with 23,259 waggons during the corresponding week last year. The Association of Coalowners of Charleroi and Basse-Sambre have petitioned the Minister of Public Works with regard to the delay in the completion of the Charleroi and Brussels Canal.

THE IRON TRADE.—The price of raw materials causes some difficulty to the producers of pig iron. It is proposed to form an association with the coal owners, for the purpose of arriving at some method of carrying on business. At present there are plenty of orders being offered at slightly reduced prices, but if these prices were agreed to there would be no profit for the ironmaster. There are quite a number of large orders to be placed for girders and joists. In merchant bars the former activity has not entirely returned, but it is expected that some orders will be placed shortly. According to the official statistics of the production of iron in Belgium during 1889 it appears that the output of pig iron has been greater than in 1888, but the manufacture of refined iron has decreased slightly. The Haurez multitubular boiler, which was put down at the works of the Société de l'Alliance, has proved so successful that the company have ordered two more from Messrs. Zimmerman, Haurez, & Co., of Monceau-sur-Sambre. During the fifteen months that the boiler has been in use no repairs have been made to the tubes or any other part, and no encrustation has been formed.

THE GLASS TRADE.—The exports of window glass from Belgium are decreasing. The exports to the United States have fallen from 1,700 tons to 245 tons during the months of January, 1889 and 1890. However, the exports of the same to England have increased from 2,420 tons to 3,652 tons.

FLAX.—At Ghent the sales of Russian flax and tows have been of no importance, and the prices have not changed. As regards home-grown flax and tow the prices have been firm and the demand active. The current sales of thread are satisfactory, and sufficient to maintain the prices.

DÜSSELDORF, 18th March, 1890.

COAL.—The declaration of the threatened great strike of coal miners has had a bad effect here in encouraging the colliers to persist in their demands for another great advance in wages and a further reduction of the hours of labour. The want of unanimity in the councils of the men is, however, becoming more marked. The moderate party is rapidly gaining adherents, so that it is tolerably certain that the final terms will not include so exaggerated a claim as a rise of 50 per cent. in wages. It would not be risking much to prophesy the preservation of peace by the concession of another ten per cent. advance. The steadiness of the market indicates a belief that prudent counsels will prevail. The syndicate of coal merchants trading with Holland and Belgium, formed a week ago, has already dropped out of existence. There were too many abstentions to admit of success in practice. The export trade in coal has recovered its former life and vigour. The total quantity of coal and coke exported in the first month of the current year amounted to 840,277 tons, against 815,210 tons in the same month of 1889—an increase of 3·1 per cent. The imports for the same periods were 760,358 tons, against 648,146 tons—an increase of 17 3 per cent. This increase is, however, confined to lignite, coke, and briquettes. The quantity of coal received was considerably less than in January of last year.

IRON.—Throughout the last week business was quiet in every branch of the iron market. Buyers manifested the utmost unwillingness to enter into fresh contracts, and as some of the merchants were offering iron, both crude and finished, below manufacturers' prices, the tone of affairs was somewhat weak. But since it became known that the English coal miners had turned out on strike a firmer tone has prevailed. English competition had begun to press heavily upon German trade, and consumers were relying on this to bring down the price of German iron. This influence will be considerably modified by a large increase in the cost of fuel in England. The demand for joists increases as the spring advances. Plates are still actively dealt in. But wire is neglected. The lowest tender for 2,470 tons of steel rails for the Magdeburg railway was received from the Bochum Verein für Bergbau und Gusstahl-fabrikation; the offer was 165s. a ton at the works. For Breslau, a Silesian firm tendered 166s. at works. Founders have plenty of work, and the greatest activity exists at the machine shops.

THE GLASS TRADE.—At a general meeting held the other day the syndicate of German lamp-glass manufacturers was prolonged for another year, and a resolution was passed to announce immediately a considerable addition to the current prices and to take into consideration a further advance to be announced later.

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ELECTRIC STREET TRAMWAYS.—The commission appointed by the Halle municipal authorities to examine a project for substituting electric for horse traction on the street tramways has reported favourably concerning the scheme.

LILLE, 18TH MARCH, 1890.

IRON.—The iron market is much less animated than it was a few weeks ago. Consumers refuse to believe that the present prices can be long maintained, and they are confirmed in their opinion of the tendency of trade by the increasing weakness of the Paris markets. Notwithstanding the growing scarcity of fresh orders, however, the manufacturers hold their ground firmly, the determining influence in their case being the high prices of coal and the uncertainty of the situation relatively to the cost of labour. No. 2 bars cannot be bought under 160s. a ton in lots of ordinary importance. For common plates, which continue in fairly brisk demand, the current quotations are from 192s. to 200s. The supply of coal to the ironworks is now sufficient.

TEXTILE MANUFACTURES.—The last week past was a period of considerable activity in the linen goods trade of Armentières. There have been fewer buying agents in the market, but orders received through the post have been numerous. The turnover for the week was greatly above the average of the last three years, season for season. This satisfactory state of things has brought about a cheerful tone. For the moment the demand is sufficient to absorb the whole of the production. The woollen goods trade is reported from Roubaix to be quiet, as usual at this time of the year. Business in the raw wool market is lifeless, speculative transactions in futures being almost *nil*.

FLAX AND YARNS.—There is an eager market for fine home-grown flax. The quantity on offer being small, spinners have some difficulty in supplying their wants. It is almost needless to add that prices are very firm, with an upward tendency. More business is being done in Russian, and prices are turning in favour of sellers. Tows are but little inquired after. For yarns the market generally is quiet, but the finer numbers are in demand. Slightly higher prices have been paid for some lots. There is a brisk current of business in jute yarns. The fine and medium sorts are very firm in price; the coarser sorts, being less inquired after, are easier.

AMSTERDAM, 17TH MARCH, 1890.

HOLLAND AND THE INTERNATIONAL LABOUR CONFERENCE AT BERLIN.—The Dutch Government has appointed its Minister at Berlin, Sir F. P. Van der Hoeven, Dr. F. J. W. G. Snyder van Wissekerke, a high official of the Ministry of Justice, and Mr. H. W. E. Struve, Labour Correspondent, to be its delegates at the Berlin Conference. These appointments have not given general satisfaction. The Socialists wanted someone specially representing their extreme views to be sent to Berlin, and the Society for the Promotion of National Industries has petitioned the Government for the delegation to the German capital of two or three large employers of labour rather to assist the official delegates and enlighten them than to act as delegates themselves. The Government does not seem willing to accede to this request. In the Lower Chamber the Ministers of Foreign Affairs and of Justice have entered into a few particulars concerning the instructions given by them to the Dutch delegates before their departure. The former said that the Government readily appreciated the high economic and social import of this conference, yet thought it wise for the Netherlands to observe a policy of prudent reserve in questions perhaps involving the free action of the kingdom. Therefore certain reservations have been made in the letter accepting the German Emperor's invitation. The Minister of Justice added that the Dutch delegates have been instructed not to bind Holland in any way by subscribing to international legislation concerning factory labour of adults, whilst adhering to our recent statute regulating the work of women and children in factories and workshops. The Government is certainly of opinion that women and children ought not to work in mines, but Holland has not much interest in this particular question, for her mines are few, and women and children are not employed in any of them. As for adult labour, a great reserve is doubly necessary in a country like Holland, because the condition of the labouring classes here is not sufficiently known, and for that very reason is now being inquired into by a Royal Commission. Concerning Sunday labour the Dutch delegates will have to point out that their Government is sincerely desirous of curtailing it as much as possible, and has shown that desire by practical legislation. Sunday labour of young women and children, unless necessary, is already forbidden on a Sunday in Holland by statute law, whilst the postal and telegraph business on Sundays has been much curtailed recently. The train service on railways might also be reduced, but international action is necessary as regards through train services.

ELECTRIC LIGHTING AT ROTTERDAM.—The communal authorities at Rotterdam are studying the question of lighting the city by electricity. Different systems are being tested. Companies are already at work, but all under immediately terminable contracts.

GOLD IN FRENCH GUIANA.—A company has been started, with a capital of £100,000, at the Hague, for the acquisition of an auriferous territory in French Guiana, known as the Placer National, and having an area of 80,000 acres. Only one-fortieth part of the property has been worked by a French syndicate, and it is said that that one-fortieth part contains sufficient alluvial gold to repay the whole capital of the company nearly three times over. One of the directors is the French civil engineer, M. Soupé, Government contractor of the first railway in Tonquin.

COPENHAGEN, 15TH MARCH, 1890.

A FREE PORT FOR COPENHAGEN.—The Committee of the Landsthing appointed to consider the Government Bill for establishing a free port near Copenhagen has reported in favour of the measure, expressing the opinion that, in view of the competition in the Baltic, the proposed port would greatly benefit the trade of Copenhagen. The Committee also agreed to the proposal for placing the construction and management of the port in the hands of a joint-stock company, and recommend the abolition of harbour dues on the earliest opportunity.

THE PRODUCTION OF METALS IN SWEDEN DURING 1888.—The following list gives the production of metals, &c., in Sweden during 1887 and 1888:—

		1887.	1888.
Iron ore, rock	*Sw. Cwt.	21,224,753	22,498,500
Do. from bags, &c.	,,	22,888	74,887
Pig iron	,,	10,624,921	10,645,672
Cast ware produced at the blast furnaces	,,	117,284	106,563
Cast ware produced by smelting down pig iron	,,	568,348	664,643
Blooms	,,	—	5,602,108
Bar iron	,,	6,007,936	5,954,000
Steel	,,	—	--
Bessemer steel	,,	1,604,395	1,614,306
Martin steel	,,	985,659	1,051,864
Steel, other kinds	,,	34,542	28,357
Manufactured iron and steel	,,	1,158,632	1,403,996
Gold ore	,,	33,018	21,878
Silver and lead ore	,,	367,374	274,778
Gold	Sw. lb.	196	178
Silver	,,	13,724	10,936
Copper ore	Sw. Cwt.	485,869	450,990
Copper	,,	21,634	24,765
Nickel ore	,,	2,000	22,805
Nickelstone	,,	—	—
Nickelspeis	,,	—	—
Nickel copper	,,	—	—
Brass	,,	6,381	5,518
Hammered copper, &c.	,,	6,084	6,570
Cast ware of other metal than iron	,,	1,306	1,684
Lead	,,	6,632	7,711
Zinc ore	,,	1,087,836	1,175,599
Cobalt ore	,,	5,440	3,374
Refined cobalt	lb.	885	760
Oxide of copper	Sw. Cwt.	95	77
Manganese ore	,,	203,706	227,950
Pulverised manganese	,,	2,843	6,428
Pyrites	,,	58,964	31,359
Sulphur	,,	1,276	1,517
Sulphuric acid	,,	—	40,579
Sulphate of copper	,,	3,721	4,627
Sulphate of iron	,,	9,111	12,062
Red ochre	,,	32,474	29,093
Alum	,,	3,577	15,414
Cerite	,,	917	654
Lead ore	,,	621	475
Marble, value in	Kr.	9,800	5,000
Coal	Cubic ft.	8,072,182	8,071,654

* One Swedish cwt. = 42·5 kilogs.

MADRID, 17TH MARCH, 1890.

GLASS MANUFACTURE.—One of the most promising industries in this country is glass manufacture—that is, those branches of it which do not require skilled workmen in any great number. Plate glass is very little used in this country on account of its great cost, but if sold at the prices which rule in England and Belgium the demand would increase very greatly, and any establishment would prosper. Excellent sulphate of soda is found in mines near Madrid, and sand is as plentiful as in most places where plate glass is made The drawback of expensive fuel could be compensated by the advantages of a large local market and cheap labour, and perhaps also by the use of water power.

THE PRICE OF ELECTRIC CURRENT AT MADRID.—The Electricity Supply Company in Spain have issued their circular advertising that they supply electricity for light and power. The prices fixed are one halfpenny per lamp hour of ten candles, and 1s. 4d. per 1,000 watt hours. Of course these prices are high, but they have been fixed in strict accordance with the price of gas, viz., 9s. per 1,000ft. It is supposed, however, that these prices cannot be maintained for any time, as there are many isolated installations in which the real cost of electricity will become evident, and all kinds of competition will ensue. One of the small theatres has an installation of its own with an excess of power, and it supplies electricity to the shops situated in the same street at different prices, according to the number of lamps; the profit on the current supplied pays for the cost of the theatre lights, which amounts to about £3 to £4 per day.

THE TRANSATLANTIC COMPANY.—This great business, which has in its hands the carrying of the whole of the foreign mails of the country, has issued a report, which is not particularly detailed. The directors have to stick to generalities in order to justify their inability to pay any dividend. They boast of having improved their fleet considerably, and hold out hopes for the future prosperity of the Company. It is, however, likely that the present state of affairs will go on indefinitely, for many unsubventioned lines of steamers are taking away much of their traffic.

NEW YORK, 8TH MARCH, 1890.

THE COAL MARKET.—There has been no improvement in the outlook in the anthracite trade. Prices have fallen and the competition between the individual operators is damaging the trade. It does not look as though the proposed restriction to two million tons for the current month would improve the trade in the slightest. For the past year the average working time throughout the coal districts has been about two-thirds of the full time; but the stocks are heavier and the prices lower than they were a year ago. At the same time the expense of stopping for a few days in the week has been heavy, both to operators and miners. Unless some means can be fixed upon for absolutely stopping the production for a time, there seems to be no prospect of the market again recovering a healthy tone.

THE IRON AND STEEL TRADES.—There is little doing in iron. The cost of raw material has advanced much more than the selling prices, and it bids fair to be still higher in the near future. Pig iron has shown a declining tendency lately. Foundry irons are firmer, but there is no demand of any importance. In manufactured iron the demand is barely sufficient to keep the mills going. Old orders are nearly finished, and some mills are beginning to lower their prices. There is a little more inquiry, and at the lower prices there is a probability that a number of good orders will come in.

FREIGHT BLOCKS ON THE AMERICAN RAILWAYS.—The freight blocks on the various railroads are the most serious ever known. On the Pennsylvania road all the yards from Pittsburgh to Jersey City are crowded with loaded cars, and there is no certainty when any of them will be moved. This is due to the unusually heavy shipment of freight of all kinds. Not only are the cars loaded, but the freight depôts are crowded to the roofs. The coke manufacturers are great sufferers on account of this condition of affairs. Nearly all the cars that have been recently loaded at the coke works are still standing in the yards waiting to be moved. The coke houses are filled to overflowing, and the works are consequently unable to run more than four or five days a week.

ELECTRICITY AS A MOTIVE POWER.—Commissioner Mitchell, of the United States Patent Office, has given an important decision by refusing to grant a patent to M. C. A. Faure for a patent for new and useful improvements in the application of secondary electric batteries as a motive power for the propulsion of vehicles. It was urged on behalf of the applicant that he was the first, practically and commercially, to succeed in accomplishing the desired result. The Commissioner holds that the application of the Faure secondary battery to the propulsion of vehicles was an obvious use, and that the public are entitled to practise a given invention in all its obvious utilities when the patent has expired, and may not be lawfully debarred from the enjoyment of it by subsequent patents seeking to monopolise uses which, although special, are at the same time recognised by persons skilled in the art as pertaining to it.

INDIA RUBBER.—At a meeting of the india rubber goods manufacturers, which was held in New York on the 26th of February, there were present the representatives of all the rubber boot and shoe companies in the United States. It was resolved to advance the prices of rubber boots, shoes, and goods 10 per cent. Attempts are being made to organise a rubber trust. The price of raw rubber is very high.

SOUTH AMERICAN TRADE.—Pittsburg manufacturers are making some attempts to capture part of the South American trade. With this end in view an agent has been sent out by the Oliver & Roberts Wire Company, Park Brothers & Co., steel manufacturers, Macbeth & Co., gas manufacturers, and several smaller Pittsburg concerns, to establish a trade for their products in South America. He will spend six months in the principal cities along both coasts, and will, if possible, establish agencies, and ascertain in what line of manufactories there is an opportunity to get a foothold. It is believed that with their enormous plants, cheap fuel, and superior methods, the Pittsburg establishments will be able to sell goods as reasonably as the European firms who have the advantage of cheap labour.

SUGAR.—The appointment of a receiver for the American Sugar Refinery of San Francisco has again given Mr. Claus Spreckles the monopoly of the sugar business on the Pacific Coast. The first act of the Receiver was to close the establishment as soon as the sugar in the vats was worked off, and 500 men were discharged. Granulated has risen in consequence. In the East there is a light business in raw sugar owing to a lack of demand. Refined sugar is stronger. The report of the Kansas State Sugar Inspector gives a most encouraging outlook for the future of the sugar industry in that State.

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LYON'S IMPROVEMENTS IN SLIDE VALVES.

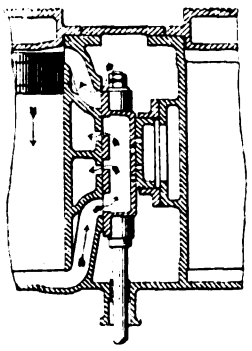


FIG. 1.

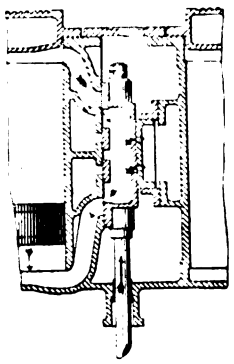


FIG. 2.

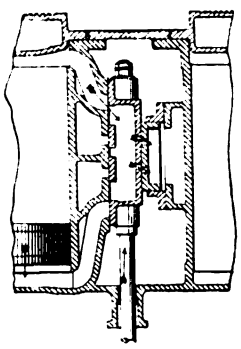


FIG. 3.

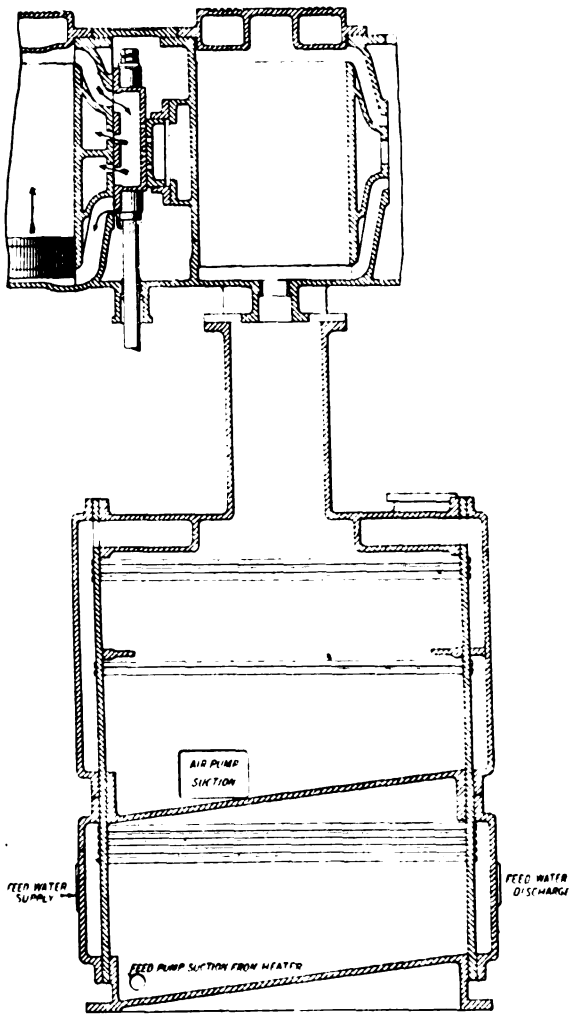


FIG. 4.

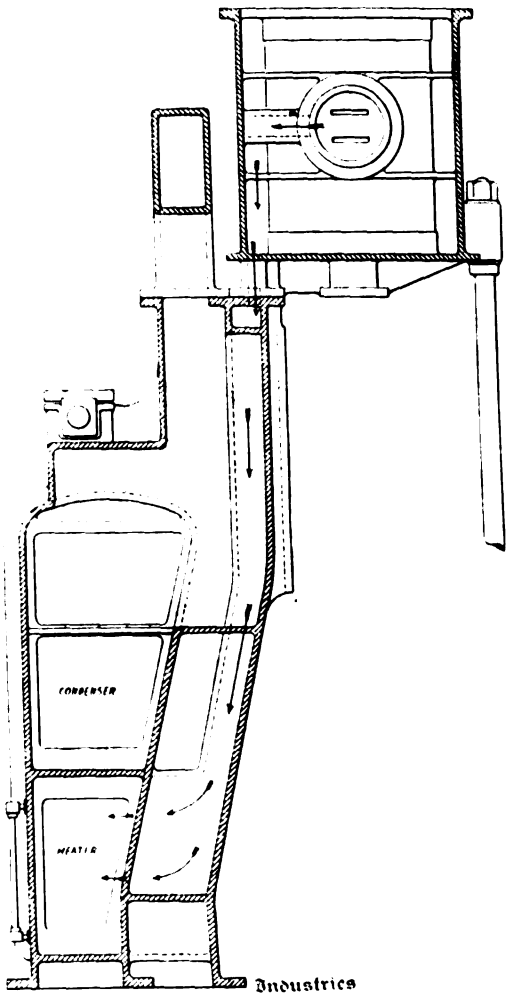


FIG. 5.

LYON'S IMPROVEMENTS IN SLIDE VALVES.

IN the illustrations above we show a new arrangement of slide valve which is designed for cushioning the low-pressure pistons in multi-cylinder engines and for heating the feed water, which has been patented by Mr. James Gourdon Lyon, a member of the firm of Gourlay Bros. & Co., Dundee. In the illustration, the apparatus is shown as applied to a small set of triple-expansion engines whose cylinders are 14in., 22½in., and 36in. in diameter by 27in. stroke. The lowest section of the condenser forms a heater through whose tubes the feed water passes on its way to the boiler. Some of the steam which is exhausted from the low-pressure cylinder is sent into the heater on its way to the condenser, and thus imparts some of its heat to the tubes through which the feed water circulates.

The slide valve is made of box form, and it has apertures in its face which make communication with the exhaust and cylinder ports, and apertures at its back opening and closing communication to the heater. The heater and condenser have separate communications to the low-pressure cylinder, and part of the exhaust steam is first passed to the heater and what remains in the cylinder to the condenser. In Figs. 1, 2, 3, and 4, the valve is shown in the effective positions it occupies during one revolution of the engine. In the position shown in Fig. 1 the piston of the low-pressure cylinder is at the commencement of its downward stroke; the valve is admitting boiler steam to the top of the piston and exhausting the steam below the cylinder to the condenser. In Fig. 2 the piston has nearly completed its downward stroke, and the valve is passing the steam from above the piston to below it, and to the feed water heater. Fig. 3 shows the piston at the point where the feed water heater is just shut off from the bottom end of the cylinder, but still in communication with the top end, and where the compression below the piston is just commencing. Fig. 4 shows the piston on the bottom centre, and the space above the piston in communication with the condenser. Fig. 5 shows a transverse view of condenser and passages. The advantages claimed by Mr. Lyon are that the cushioning of the low-pressure piston is very effective; that it saves otherwise wasted steam; that the ports, cylinder, and piston are warmed before steam is admitted from the chest, and that the feed water is heated on its way to the boiler.

COAL, IRON, AND COGNATE INDUSTRIES.

THE Board of Trade returns, which have now been issued for the second month in the year, must be regarded from a general point of view as being of a fairly satisfactory character. The figures relating to the industries under review bear witness to a large volume of business conducted at remunerative values. The total declared value of the imports for the month of February and for the two months of the present year show a decrease of £1,321,254 and £1,235,722 respectively as compared with the corresponding periods of 1889. The total declared value of the exports for the month was £21,084,228, and for the two months £42,670,980, being an increase of £2,413,876, or nearly 13 per cent., and £3,473,591, or about 8 per cent., respectively, as compared with the corresponding periods of 1889. The total quantity of iron and steel exported in February was 277,062 tons, valued at £2,392,042, as compared with 262,278 tons, valued at £1,962,958, in February, 1889, being an increase of 5½ per cent. in quantity and 22 per cent. in value. The enhanced value of materials is shown principally in the crude metal and in railroad iron. In the latter case the quantity exported showed an increase of 50 per cent. in quantity and 80 per cent. in value. We append our usual tabular statement:—

	Month of February.		Two Months.	
	1890.	1889.	1890.	1889.
Pig and puddled...	£214,096 ...	£122,086 ...	£460,798 ...	£275,776
Bar, angle, &c.....	120,070 ...	139,533 ...	257,230 ...	275,458
Railroad.....	556,241 ...	308,478 ...	1,094,923 ...	684,753
Cast and wrought	483,827 ...	388,203 ...	968,065 ...	787,172
Hoops, sheets, &c.	308,695 ...	297,901 ...	650,637 ...	625,442
Unwrought steel...	148,051 ...	111,024 ...	205,555 ...	217,866
Unwrought copper	229,406 ...	39,423 ...	394,524 ...	92,647
Coals.....	1,337,621 ...	957,928 ...	2,693,622 ...	2,017,611

The great increase in the exports of unwrought copper might have been expected, and is pretty equally distributed among the various markets. An increase of 39 per cent. in the value of the exports of coal is a gratifying feature of the returns.

When we turn from such a satisfactory retrospect of the export trade of the first two months of the current year to the home markets, it must be a matter of great disappointment to find the existence of a different state of affairs. The gambling in the Scotch markets which took place during the latter part of 1889 has induced a reaction, the full effect of which is now being felt throughout the country. We cannot profess much sympathy for the thousands of individuals—clerks, clergymen, shopkeepers, and commercial men—who, in helping to bring about this result, have found themselves mulcted in heavy "differences"; but it is unfortunate for the staple industries of the country that trade should be paralysed, and the tide of prosperity stemmed, as the result of a rash speculative mania, the collapse of which was inevitable. The result of the severe fall in the value of warrants has been to induce consumers and merchants to withhold their orders, and thus to bring manufacturers to easier terms. It is useless to disguise the fact that at the present moment producers are making substantial reductions in prices in order to obtain orders sufficient to keep their works going. The agitation amongst the colliers, with the possible prospect of a national strike, has also had its effect on the stability of trade. We do not consider a strike of any magnitude or of any longevity is probable, as neither employers nor employed can afford to lose what may turn out to be the few remaining weeks of remunerative prices, but if such should prove to be the case the detrimental effect of the agitation will not thereby be lessened. The supporters of optimism and pessemism have their respective theories as to the future course of trade, but the outlook has certainly become clouded during the current year.

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THE FORTH BRIDGE.

On our two-page supplement this week we give a view of the completed Forth Bridge as now opened for traffic. The view is from the south-west, and the engraving is reproduced from a photograph by Messrs. Valentine & Sons, of Dundee. We have dealt so fully with the Forth Bridge in these columns and in our Special Number, that a detailed explanation of the engraving is not necessary.

Notices of Meetings.

NEXT WEEK.

Society of Arts.—Monday, March 24th, at 8 p.m. Lecture on "Some Considerations Concerning Colour and Colouring," by Professor A. H. Church, M.A., F.R.S. Tuesday, March 25th, at 8 p.m. "Engraving in Wood, Old and New," by W. J. Linton. Wednesday, March 26th, at 8 p.m. Sixteenth Ordinary Meeting. Lecture on "Carriage Building and Street Traffic in England and France," by S. N. Hooper. Saturday, March 29th, at 3 p.m. Lecture on "The Atmosphere," by Professor Vivian Lewes.

Institution of Electrical Engineers.—Thursday, March 27th, at 8 p.m. Paper on "Alternate *v.* Continual Currents in Relation to the Human Body," by H. Newman Lawrence and Arthur Harries, M.D.

Liverpool Engineering Society.—Wednesday, March 26th, at 8 p.m. Twelfth Ordinary Meeting.

Society of Architects.—Tuesday, March 25th, at 7.30 p.m. Paper on "The Influence of Material upon Design," by Mr. G. A. T. Middleton.

Royal Institution of Great Britain.—Friday, March 28th, at 9 p.m. Lecture on "Foam," by Lord Rayleigh. Saturday, March 29th, at 3 p.m. Lecture on "Electricity and Magnetism," by Lord Rayleigh.

Chemical Society.—Thursday, March 27th, at 4 p.m. Anniversary Meeting. Dinner at the Whitehall Rooms, 7 p.m.

Institution of Civil Engineers.—Monday, March 24th, at 7.40 p.m. Seventh General Meeting. Discussion on Mr. R. L. Weighton's paper on "The Institution's Rule for the Normal Indicated Horse-power of Marine Engines and Boilers." Paper on "The Structural Strength, &c., of Cargo Steamers of Different Types," by Mr. G. Bergström. Students' Meeting, Friday, March 21st, at 7.30 p.m. Paper on "Economy Trials of a Compound Mill Engine and Lancashire Boilers," by L. A. Legros, Student Inst.C.E. Ordinary Meeting, Tuesday, March 25th, at 8 p.m. Discussion on "Lough Erne Drainage." Paper on "Barry Dock and Railways," by John Robinson, M.Inst.C.E.

PRICES CURRENT, 19th March, 1890.

Quotations at per ton, unless otherwise specified.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	7 5 0	.....	7 15 0	f.o.t. wks.
„ Angles	7 0 0	.....	7 10 0	„
„ Plates	7 5 0	.....	7 15 0	„
Staffordshire Bars (cheaper makes)	8 17 6	.....	9 7 6	London.
„ Angles	8 17 6	.....	9 7 6	„
Crown Sheets	8 15 0	.....	9 5 0	„
„ Hoops	8 2 6	.....	8 12 6	„
"Siemens-Martin" Steel Boiler Plates			9 15 0	„
„ Ship and Girder			8 15 0	„

Market dull; demand quiet.

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	77/-	..... 66/6

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

METALS.

Spelter: Ordinary	£23	0	0	to	£23	5	0
Copper: British Cakes and Ingots	54	0	0	„	55	0	0
„ Chili Bars, G.O.B.'s	47	2	6	„	47	10	0
„ Other sorts, G.M.B.'s (equal to Chili Bars)	47	2	6	„	47	10	0
„ Manufactured (strong)	62	0	0	„	.....		
Lead: Common Pig	13	12	6	„	13	15	0
„ English Sheet	14	2	6	„	14	5	0
Tin: Straits	90	5	0	„	90	10	0
„ Australian	90	10	0	„	90	17	6
„ English Ingots	95	0	0	„	.....		

Messrs. Carrick & Brockbank, Manchester, report as follows:—

Copper: No change of importance has taken place in copper during the past week. The market for Chili bars improved somewhat on the 12th, consequent on a better demand for refined copper for consumption. The reduction in the Bank rate on the 13th to 4 per cent. also tended to strengthen prices. A steadier feeling has since prevailed, and quotations to-day are £47 2s. 6d. to £47 10s. cash. Manufactured is still quoted £62 sheets and £65 bottoms, with a quiet market.

Tin continues inactive, with a very small business doing. Values are lower on the week, but steady at the moment.

Lead is also quiet, in sympathy with other metals, prices being slightly lower.

Spelter: The demand is quiet and prices are rather easier.

PIG IRON.

Middlesbro' Warrants, No. 3		51/6	Cash
Scotch Warrants, m/n		51/-	„
Hematite Warrants, m/n		63/9	„
Stocks in Stores: Scotch	846,084.—Dec. for week,	8,358	Tons
Middlesbro'	165,043.—Dec. „	3,449	„
Hematite	372,286.—Dec. „	3,264	„

Exclusive of stocks in makers' yards.

	No. 1.	No. 3.		
Coltness	72/6	65/6	f.o.t.	Glasgow.
Gartsherrie	70/-	63/6	„	„
Langloan	72/6	66/-	„	„
Summerlee	70/-	65/-	„	„
Glengarnock	73	66/-	„	„
G.M.B. ex Store	51/9	51/6	„	„

CHEMICALS.

		£ s. d.		£ s. d.
Acid: Carbolic Crystals	lb.	0 0 10½	to	0 1 0
„ „ Liquid	gal.	0 1 2	—	.....
„ Citric	lb.	0 1 7	—	.....
„ Oxalic	„	0 0 3¾	—	.....
„ Sulphuric	ton	1 12 0	—	.....
„ Tartaric	lb.	0 1 4	—	.....
Alum: Lump (powder 10/- ex.)	ton	4 17 6	—	.....
Ammonia: Carbonate	lb.	0 0 8½	—	.....
„ Muriate (Grey)	ton	22 15 0	—	.....
„ „ (White)	„	26 10 0	—	.....
„ Sulphate	„	11 17 6	—	.....
„ Liquor	lb.	0 0 3½	—	.....
Antimony	ton	.....	—	.....
Bleaching Powder	„	5 10 0	—	5 12 6
Bisulphide of Carbon	„	18 10 0	—	.....
Borax	„	30 0 0	—	.....
Benzole (90 %)	gal.	0 3 10	—	.....
„ (50/90 %)	„	0 3 0	—	.....
Copper Sulphate	ton	26 10 0	—	.....
Copperas	„	2 0 0	—	.....
Kieserit	„	.....	—	.....
Lead: Nitrate	„	22 10 0	—	.....
„ White Sugar	„	24 0 0	—	.....
„ Brown „	„	19 0 0	—	.....
Potash: Bichromate	lb.	0 0 4	—	.....
„ Caustic	ton	22 0 0	—	.....
„ Carbonate	„	19 10 0	—	.....
„ Chlorate	lb.	0 0 4½	—	.....
„ Prussiate (Yellow)	„	0 0 9½	—	.....
„ Sulphate (Basis 90 %)	ton	9 10 0	—	.....
Precipitate: Red	lb.	0 3 1	—	.....
„ White	„	0 3 2	—	.....
Salts: Epsom Bags	ton	3 0 0	—	.....
Epsom Casks	„	3 15 0	—	.....
„ Glauber	„	1 10 0	—	.....
Sulphur: Sublimed Flowers	„	9 0 0	—	.....
„ Recovered	„	4 10 0	—	.....
Soda: Ash	deg.	0 0 1⅛	—	.....
„ Caustic (White 70%)	ton	10 0 0	—	10 5 0
„ „ „ 60%)	„	9 0 0	—	9 5 0
„ „ (Cream 60%)	„	8 10 0	—	8 15 0
„ Crystals	„	2 12 6	—	.....
„ Bicarbonate	„	5 15 0	—	.....
„ Hyposulphite	„	6 5 0	—	.....
Solvent Naphtha	gal.	0 3 6	—	.....
Tartar, Cream of	cwt.	5 12 6	—	.....
Zinc Sulphate	ton	7 10 0	—	.....

Messrs. S. W. Royse & Co., Manchester, report as follows:—

Chemicals: The effects of the coal strike are severely felt, especially by alkali manufacturers. Caustic soda is almost unobtainable on spot, stocks having been kept low for some time past. Soda ash also is very scarce. Bleaching powder has secured a good advance this week, though the pressure for the delivery of this article is not so great. In the sulphate of ammonia market there is no movement of any note. Carbolic acids continue depressed, and benzoles are lower. Oxalic acid is steady. Tartaric acid firmer. Yellow prussiate of potash easing.

OILS.

		£ s. d.
Cocoanut: Cochin	per tun	27 5 0
„ Ceylon	„	25 5 0
Cottonseed	„	22 0 0
Cod	„	21 0 0
Lard	„	36 10 0
Linseed	„	23 2 6
Palm, Lagos	„	24 10 0
Rapeseed: English	„	33 0 0
Seal: Pale	„	28 0 0
„ Brown	„	22 0 0
Sperm	„	46 0 0
Whale	„	24 0 0
Turpentine	per cwt.	1 10 6
Coal	per gal.	
Petroleum (Refined)	„	0 0 5½
„ Spirit	„	

FOREIGN TELEGRAPHIC ADVICES.

(From our own Correspondents.)

Paris, March 20.—*Iron.*—The strike of miners in England has greatly strengthened the tone of business here. Bars are firm at 160s.; joists, 164s. A similar effect has been produced in the markets of the provinces. In Haute-Marne business very active. Wire in strong demand. Wire nails largely bought at 216s. to 224s. a ton. In Ardennes markets firm. In Nord quiet, but improving in tone.

Metals.—Copper maintains its price at £52 Chili bars and £57 best selected, but there is hardly any business doing. Tin remains dull in spite of some improvement abroad: Banca, £99; Straits, £96. Lead is recovering a little. Paris £13 5s. Spelter has further receded. Silesian, £24, Havre. Demand light.

Berlin, March 20.—*Bourse.*—The market for industrial securities is somewhat weaker in consequence of apprehensions concerning the course entered upon by the German Emperor relatively to the labour question. Shares in iron manufacturing and colliery companies retain the improvement gained last week, thanks to the strike of English miners, but the tone of business is weak and hesitating.

Iron.—There is a growing demand for building iron; but on the whole the market is less favourably situate than it was a week ago. Buyers hesitate, and limit their dealings to present necessities. An uneasy feeling prevails relatively to the labour question. Good Silesian bars are quoted from 205s. to 210s. a ton. Other prices remain unaltered.

Metals.—Business in metals continues slack; only the most urgent needs of the moment are being covered by current transactions. Prices for Mansfeld refined copper remain firm at £59 to £60. English brands are still quoted at £56 to £57. Tin is very dull at £100 to £101 for Banca. The market for lead is quiet, but moderately firm: Claustthol refined, £15 10s. to £16. Spelter firm, at £25 15s. to £26 10s. for Silesian W. H. brand; ordinary, £25 to £25 10s.

Breslau, March 20.—*Coal.*—The tone of the coal market has become distinctly firmer since the declaration of the strike in England. Upper Silesian coal is making headway against English competition in some of the markets of North-East Germany. The advance reported last week is readily paid by consumers.

Iron.—The demand for pig iron continues brisk. Forge pig in second hands is quoted higher, 85s. to 90s. a ton. There is great activity in the market for finished iron and steel. Boiler plates are much sought after at from 250s. to 260s. For the local trade bars are quoted 220s. Founders report brisk business in machinery castings and in cast iron pillars for export.

Metals.—The market for zinc continues languid. Sellers of spelter are making small concessions in prices to induce buyers to operate. Zinc dust, which is but little inquired after, has receded in price from £19 10s. to £20 per ton to £17 10s. to £18. The prices of lead, in which there is a fairly active current of business, remain unchanged.

Düsseldorf, March 20.—*Coal.*—There is no diminution of activity in the market for coal. Prices remain unchanged. Merchants manifest a disposition to make harder terms with buyers. Large bodies of miners are withdrawing themselves from the Socialist party. This circumstance is favourable to the maintenance of peace in this district.

Iron.—There is a little more life in the market for pig iron. Consumers, having apparently convinced themselves that lower rates are not to be hoped for for some time to come, are disposed to deal more freely. Prices are firm all round. The market for finished iron and steel has not recovered from the loss of business reported last week, but prices exhibit no tendency to decline. Hoops are in brisk demand for home consumption. Wire is very dull.

Charleroi, March 20.—*Coal.*—The exceptional demand for coal on German account keeps the market buoyant. No business is done below the full official rates. The date for receiving tenders for 150,000 tons of coal for the State railways is fixed for the 3rd of April. This quantity is divided into seventy-five lots.

Iron.—A stronger tone in the market here has resulted from the colliers' strike in England. There is not much buying, however. Makers of finished iron say that present prices leave no margin for profit. The output of the blast furnaces is now less than it was a month ago.

Ghent, March 20.—*Flax and Yarns.*—The demand continues very brisk for home-grown flax of all sorts, and prices are steadily rising. There is not much doing in Russian produce. The quality is complained of. Yarns are actively dealt in at last week's prices.

Erratum.—In the description we gave in our last week's issue of semi-portable hauling engines, constructed by Messrs. John Wild & Co., Ld., engineers, Falcon Ironworks, Oldham, the cheeks of the drum were inadvertently stated to be "2in. thick"—"½in. thick" should be read instead of "2in. thick."

Liverpool Engineering Society.—The eleventh ordinary meeting of this Society was held on the 12th inst., the President, Mr. Henry H. West, M.Inst.C.E., being in the chair. After the usual routine business, Mr. Charles H. Yeaman gave a *résumé* of his paper, entitled "Notes on Central Station Electric Lighting," which was read before the Society on January 29th last, and a long and interesting discussion took place. Afterwards Mr. Yeaman replied to the various points raised during the discussion.

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HOME INDUSTRIES.

LONDON 20th March, 1890.

THE MONEY MARKET.—The money market is easy and featureless, without any indication of immediate change. The position of our market is strong just now, and arrivals of gold from abroad continue to reinforce it. The demand for money is in moderate proportions, and the supply is equal to all needs, and rates are consequently easy. The stock markets are uncertain in tone, with a tendency towards dulness. The wages difficulty in the coal trade acts as a damper on home securities, the quotations of the stocks of the mineral-carrying lines declining in view of the restriction of the coal output. Foreign securities have been adversely affected by the announcement of Prince Bismarck's resignation, the bonds of the States of South-Eastern Europe showing themselves most sensitive to this influence. American railway shares are rather uncertain in tone, with a disposition to move towards better prices. Canadian lines continue to show good traffic returns. The market for miscellaneous securities is very dead, and the little spurt of fresh life which lately showed itself in the mining department has exhausted itself.

COMPANIES.—The following companies have been registered since our last report:—Northfleet Portland Cement Co., Ld., with a capital of £100,000; Macmahon's Patent Electric Cheque System, Ld., with a capital of £30,000; Rivers Purification Co., Ld., with a capital of £100,000; The British Copal Refining and Varnish Manufacturing Co., with a capital of £100,000; Inesperada Gold Mining Co., Ld., with a capital of £60,000, to carry on mining operations in Chili; Gippsland Proprietary Co., Ld., with a capital of £200,000, to acquire certain mineral leases in Victoria, Australia; St. Helens Smelting and Sulphate of Copper Co., Ld., with a capital of £60,000; Aldous, Son, & Co., Ld., with a capital of £8,000, to carry on the business of engineers; Pontianak Diamond Syndicate, Ld., with a capital of £20,000, to carry on mining operations in Borneo; Brewery Assets Corporation, Ld., with a capital of £705,000; White River, Colorado, Coal Syndicate, Ld., with a capital of £12,480; Phosphorus Co., Ld., with a capital of £150,000; North African Exploration Syndicate, Ld., with a capital of £5,000; Key's Electric Co., Ld., with a capital of £15,600, to carry on the business of electrical engineers; The Sulphur Co, Ld., with a capital of £10,000; British Paper Co., Ld., with a capital of £3,000; Latha, Ld., with a capital of £10,000, to acquire a patent for making corks; McMillan's Patent, Ld., with a capital of £1,000, to acquire certain patents; South Barracas (Buenos Ayres) Gas and Coke Co., Ld., with a capital of £50,000; Kilhivan Mines, Ld., with a capital of £120,000; Krantner's Bluman Brewery, Ld., with a capital of £75,000; Mount Osmond Silver Lead Mining Co., Ld., with a capital of £100,000; Patent Weldless Steel Chain Co., Ld., with a capital of £12,000; Balaghat Mysore Gold Mines, Ld., with a capital of £150,000; D'Eresby and Gwydyr Mines, Ld., with a capital of £20,000; Central Silver Mining Co., Ld., with a capital of £25,000, to acquire mines in Peru; Ashton-under-Lyne, Oldham, and Hyde Tramways, Ld., with a capital of £75,000; Durham Paper Pulp, Ld., with a capital of £20,000; Patents Mining and Financial Trust, Ld., to acquire any inventions, &c., relating to chemical, mechanical, or other matters; The Liberian Government Concessions and Exploration Co., Ld., with a capital of £110,000.

WORKMEN'S EXHIBITION.—There is going to be opened, on the 9th of April, at the Central Hall, Holborn, under the auspices of the Working Men's Club and Institute Union, Limited, an Exhibition of work in various trades, including engineering and machinery and metals, building, leather, textiles, scientific instruments, and so on. One section is devoted to workmen and apprentices, another to amateur work, and a third to feminine trades. The exhibits will be mainly from clubs affiliated to the Union, and entries will have to be made by Monday next, the 24th inst. The office is at 150, Holborn, E.C. Several of the City Companies are contributing to the enterprise, and about 700 exhibits are expected.

INSTITUTION OF NAVAL ARCHITECTS.—The following are a list of the papers to be read before the above Institution on the 26th, 27th, and 28th inst.:—"Notes on Recent Naval Manœuvres," by W. H. White, Esq., F.R.S., Director of Naval Construction, Vice-President; "The Maritime Conference," by Rear-Admiral P. H. Colomb, R.N.; "On Leak Stopping in Steel Ships," by Captain C. C. Penrose FitzGerald, R.N.; "Strength of Ships, with Special Reference to Distribution of Shearing Stress over Transverse Section," by Professor P. Jenkins; "Steatite as a Pigment for Anti-corrosive Paints," by Frank C. Goodall, Esq.; "On the Evaporative Efficiency in Boilers," by C. E. Stromeyer, Esq.; "On the Application of a System of Combined Steam and Hydraulic Machinery to the Loading, Discharging, and Steering of Steamships," by A. Betts Brown, Esq., F.R.S.E.; "The Revolving Engine Applied on Board Ship," by Arthur Rigg, Esq.; "On the Variation of the Stresses on Vessels at Sea due to Wave Motion," by T. C. Read, Esq.; "Spontaneous Combustion in Coal Ships," by Professor Vivian Lewes, F.C.S.; "On the Screw Propeller," by James Howden, Esq.; and "Experiments with Lifeboat Models," by J. Corbett, Esq.

THE "EIFEL AUTOMATIC AËRATOR."—We recently inspected the working of an apparatus for aërating mineral waters by means of natural carbonic acid gas. This is known as the Eifel Automatic Aërator, and consists of a small machine in which is a mixer and pump, and to which is attached a swing cradle of the usual type for holding the bottle during charging. The oscillation of the cradle is obtained by a lever, one stroke of which turns the bottle upwards for charging, and at the same time forces the water into it. The reverse stroke draws into the pump the exact quantity of water required to fill a bottle, so that, given a tank or other source of water supply, the machine is a self-contained aërator and bottler. The gas is collected at the Eifel springs on the Rhine, and is evolved from the surface of the wells after passing through about 250ft. of water. It is then compressed into steel tubes until a pressure of 900lb. is obtained, after which the outlet of the tube is closed by a wheel valve, and a cap is screwed over the latter to protect it in transit. The tubes are tested by the German officials to 3,000lb. prior to being used for storage. When coupled to the machine the wheel valve is slightly opened to admit sufficient gas to set up within the apparatus the necessary pressure, and the expansion of the gas within the mixing chamber causes a loss of heat by which the water is cooled. The aëration at 100lb. pressure was superior to that usually obtained at higher pressures, and the time occupied in bottling was very small. The makers state that 30 dozens of full-sized bottles can be filled and the water aërated in an hour, and this statement would appear to be an accurate one. The machine stands in a very small space, and brings within the reach of almost everyone an easy method of producing aërated waters. It is being worked in this country by the Eifel Automatic Aëration Company, 112, Strand, London.

ROYAL INSTITUTION.—The discourse to be given by Lord Rayleigh, on Friday evening, March 28th, will be on "Foam."

COPPER.—Messrs. James Lewis & Son report that from £47 on the 3rd inst. good merchantable copper declined to £46 10s. on the 6th. Scarcity of available warrants and a moderate demand for cash caused an advance from this point to £47 15s. on the 13th, but 10s. of this improvement was lost on the 14th. The closing value is £47 7s. 6d. cash and £47 13s. 9d. three months' prompt, buyers. The warrants for the 4,000 tons of good merchantable copper sold by the French holders early in the year have now been nearly all absorbed by consumers, and, as the demand exceeds the arrivals, there seems great probability that the market will again advance to the level at which the French bankers will be willing to sell a further portion of their stock. The quotations on Monday were:—Chile bars and good merchantable copper, £47 7s. 6d. cash, and £47 13s. 9d. three months' prompt, buyers. English, best selected, £54 to £55; and tough cake, £52 10s. to £53 10s. per ton. American matte 10s., and good ore 9s. 9d. to 10s. per unit.

MANCHESTER, 20th March, 1890.

THE COAL TRADE.—The greater part of the miners in Lancashire have now struck work, although in some special cases the advanced terms have been given and the men continue at work. There are a number of indications that the advanced rates will be granted by a large number of colliery proprietors before long. In the meantime those who have any coal to sell are getting big prices. In one instance a cotton spinning company has a contract running for 2,500 tons at 8s. 2d. per ton delivery, which it is unable to get, and has 250 tons of an inferior quality offered as a favour at 18s. 6d. per ton. This is a sample of the existing state of things throughout, and observations show that the pit-bank accumulations will be cleared out at a good price if the strike continues. In some places works are already stopped, the scarcity being especially felt by the ironworks of the district. A few days' continuance of the strike will result in a general stoppage, the supply of coal having for some time been so little above the demand that users have been quite unable to accumulate stocks. The joint conference to be held to-day is looked forward to with much hope, and it is expected a compromise will then be arrived at. The whole trouble demonstrates the necessity for a Wages Board such as exists in Cleveland and South Staffordshire.

EMPLOYMENT IN THE ENGINEERING TRADES.—Recent reports published by the Amalgamated Society of Engineers and the Steam Engine Makers' Society show that the percentage of unemployed members remains remarkably low, being respectively 1 and ½ of 1 per cent. There are a few disputes as to wages in this district, but they do not generally affect the result stated.

MEASURING AND FOLDING MACHINE.—A simple machine is being introduced in this market, the object of which is to enable the folding of piece goods to be effected without creasing them as is the case at present. As ordinarily wound, the inner layers of the fabric are very badly creased, but by an ingenious contrivance the drag on the cloth is reduced as the bundle is formed, and the creasing is entirely obviated. This is a source of loss to merchants and drapers, and the new style of wrapping is likely to be much appreciated by the former. The machine, which is made by Mr. C. Bell, of Richard Street, Bradford, is provided with a measuring drum and indicator dial, by which the length of a piece can be ascertained and checked.

THE LINEN AND JUTE TRADES.—One topic—that concerning the coal strike—overshadows all others. The effects of the sudden cessation in the supply of fuel are felt in every branch of Manchester trade, directly or indirectly. The distributing houses are affected, because their customers, the retailers, who are of course in close touch with the public, the first sufferers, find sales diminishing. Nevertheless the linen branches have had a fair share of what has been going, and in Scotch makes a satisfactory amount of business is doing, although a little more activity on the part of buyers would by no means unduly tax the productive capacity of the mills. Though not a linen manufacturer's case, the action of Messrs. Barlow & Jones against a local firm for trade mark infringement has been watched with interest by those concerned in the linen industry, and the judgment of Mr. Justice Chitty has been generally received with satisfaction. There is a fair inquiry for hucks and crashes, but drills are not in such request as could be wished, largely owing to the dulness which prevails in the South American and other foreign markets. Damasks of Dunfermline make and German specialties in silk and linen mixed goods go off well, and the last named articles command high prices in comparison with similar class fabrics of British manufacture.

GLASGOW, 20th March, 1890.

THE NEW TUBE COMPANY.—The prospectus has now been issued of the company to whose formation reference was made in these columns a fortnight ago. The company has been formed for the purpose of taking over and amalgamating the businesses at present carried on by Andrew & James Stewart, Ld., the British Tube Company, Coatbridge, and the Clydesdale Iron and Steel Company, Mossend. The capital of the company is £700,000, divided into £250,000 of 6 per cent. cumulative preference stock in shares of £10 each, and £450,000, in ordinary shares of £10 each, 16,000 preference shares and 30,000 ordinary shares are offered for subscription. The leading firm in this combination, Messrs. Andrew & James Stewart, was established in 1861, and the Clydesdale Company in 1870. The board of directors of the new company consists of the following: Andrew Stewart, John Wotherspoon, Sir William Arrol, James L. Mitchell, Dugald McCorkindale, Andrew Bain, and John Graham Stewart. A sum of £650,000 is to be paid for the properties, partly in shares and partly in cash. The net profit of the concerns for the past seven and a half years is stated at £66,000.

RAILWAY RATES INQUIRY.—The Railway Rates Commissioners began their sittings in Scotland at the Royal Hotel, in Edinburgh, on Monday, the 17th inst. The Commissioners were Lord Balfour of Burleigh and Mr. Courtenay Boyle, C.B. A formidable array of legal talent represented respectively the Scotch railway companies and the traders objecting to the proposed classification. It is estimated that this inquiry is being conducted at an expense of £3,000 per day, and since it is expected that twenty days will be occupied in the hearing of evidence on the Scotch cases, the cost to the traders and to the public will be on this estimate about £60,000. The first witness examined was Mr. John Walker, well known as the General Manager of the North British Railway Company. Mr. Walker's examination lasted all day on Monday, and was resumed on Tuesday morning. Those who had the privilege of hearing it will remember it as among the ablest performances of a witness under examination and cross-examination. In reference to the fixation of maxima rates, Mr. Walker insisted that the fluctuations in the working expenses due to alterations in the prices of iron and other materials, and in the cost of labour, rendered it necessary for the companies to possess powers to charge on occasion higher rates than might normally be necessary. He maintained that both the classification and the rates were fairly fixed, and that the companies had no intention of charging the maximum rate, pointing out that they had not hitherto taken full advantage of the powers invested in them by various Acts of Parliament.

ENGINEERING.—Messrs. Neilson & Co., Hydepark Locomotive Works, Springburn, are supplying some fine engines of the "Fairlie" type for the Mexican Railway. These engines are specially constructed for travelling on steep grades, no less than 14 miles on which constant grades of 1 in 25 have to be traversed in combination with curves of 330ft. radius.

LABOUR.—A number of non-Union men were engaged by Messrs. Allan in loading the "Canadian." As the work proceeded slowly, Messrs. Allan had bills posted offering steady employment at 30s. per week for day work, and 35s. for night work.

EXPERIMENTS WITH A NEW EXPLOSIVE.—Under the auspices of the agents in Scotland, Messrs. A. Baird & Son, Glasgow Mr. Dobbie, from the Flanders Explosive Company, has recently carried out several successful experiments in a number of the collieries in Hamilton, with the new explosive, called "Securite."

PIG IRON.—A steady firm tone has characterised the pig iron market this week, while the complex nature of the consequences of the great labour troubles in England had a discouraging effect upon speculators. The evident impossibility of producing pig iron cheap imparts confidence to buyers and holders. Prices were consequently well supported, a large business being done whenever sellers showed a willingness to accept 50s. 3d. cash. There are not lacking evidences of good work yet to be done in most departments of the iron trade, much of which has been delayed by dear money and by the high prices which were asked some weeks ago.—Messrs. Wm. Dixon, Limited, of the Govan Ironworks, Glasgow, have decided to take up the manufacture of briquettes on an extensive scale, and have ordered a complete plant capable of turning out 100 tons per diem, from Messrs. Yeadon & Co., Leeds.

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(From our own Correspondents.)

LIVERPOOL, 19th March, 1890.

Important Scheme of Dock Improvement.—At the last meeting of the Mersey Dock and Harbour Board, an important scheme for the improvement of the north dock was considered, which will involve an estimated expenditure of £1,000,000. The leading features of the scheme are as follows: (1) The deepening of the southern part of the Canada basin to 14ft. below old dock sill and the provision of sluices to maintain that depth; the deepening of the Canada lock to 12ft. below O.D.S., and the lengthening of the lock to 600ft., at an estimated cost of £68,000; (2) the alteration of the Canada dock by removing the present south passage and the construction of a new 80ft. passage to the Huskisson dock, with sill 9ft. below O.D.S.; deepening the dock, straightening the quays, and constructing new shed at a cost of £165,000; (3) constructing a new dock 300ft. wide at the southern end of the Canada dock, with new sheds, at a cost of £237,000, or a total of £470,000; (4) the provision of pumping machinery for raising the water level in the Huskisson and Canada dock at a cost of £50,000; the construction of a graving dock at a cost of £65,000; and the construction of a half-tide dock on the site of the London basin, with deep water entrance to the river, at an estimated cost of £415,000. It was decided to carry out the first portion of the scheme, involving an outlay of £470,000.

The Mersey Railway Company.—In the directors' report for the half-year ending December 31st, it is stated that the total receipts amounted to £28,175, as compared with £25 598 for the corresponding period last year; the working expenses were £23,498, or at the rate of 83·40 per cent., as against 90·48 per cent. last year. The number of passengers conveyed was 4,268,288, as against 3,786,480 last year, exclusive of season tickets, which numbered 1,850.

The Strike of the Dock Labourers.—This unfortunate strike still continues, and the men refuse arbitration; the shipowners receive fresh drafts of men each day, and a large number are now employed, many of whom will no doubt be retained by their employers after the strike is over. It has been considered advisable to obtain the assistance of the military and additional police to preserve peace and protect the workers. An attempt has been made to induce the carters and others to join in the strike, but their union has passed resolutions against such action being taken. There are signs of disagreement amongst the leaders of the strike, which may soon lead to a collapse.

SHEFFIELD, 19th March, 1890.

The Coal Trade.—Although the coal strike is but three days old there are already many thousands of men engaged in other industrial occupations thrown out of employment. Several manufactories had to suspend operations on Monday through want of coal, and it is estimated that by the week end there will be no less than 40,000 men idle for want of fuel, as, with the exception of the large Brightside firms, who own collieries, very few can continue working more than a few days. Messrs. John Brown & Co., Limited, of the Atlas Works, have stocked something like 30,000 tons of coal, and Messrs. "Cammells," who are extensive colliery proprietors, have 60,000 tons. This stock, however vast it may appear, will only serve a few weeks. The Sheffield Gas Light Company have also secured a stock of 12,000 tons.

Engineering.—Employment is very good in the engineering trades, where the men are agitating for an advance of 2s. per week, making the standard rate of pay 36s., which the best men have had for some time. Blacksmiths are rather scarce here now, and can earn from 10s. to £1 per day when on piece work. The annual report of Messrs. "Cammels" is very satisfactory. The balance-sheet for the year 1889 shows the profits to have been £171,081 7s. 10d. Other manufacturing concerns also show fair profits on last year's working, and, granted a fair year's work, it is highly probable that 1890 will give equally as good returns.

The Sheffield Society of Engineers.—An elaborate paper, entitled, "The Indicator and its Practical Working, with a Description of the Tabor Indicator," was read before this Society, on the 15th inst., by Mr. A. G. Brown, M.A.S.M.E. The author, in commencing, referred to the office and scope of the indicator, and showed that its use was not restricted to steam engines. He then gave a history of the indicator, and a sketch of the leading instruments that have been used. Various arrangements for giving motion to the indicator barrel were shown, and the proper method for taking diagrams described. A number of characteristic diagrams were referred to in the paper, and also very full instructions were given by the author, as the result of his extensive experience, with the view of showing the valuable data which may be obtained from a carefully taken indicator diagram.

LEICESTER, March 19th, 1890.

Wool Spinning and Yarn Trades.—The conditions of the local wool market do not show any great change. There is an uneasiness prevalent, prices are firm on the whole, but tendencies in some quarters to soften. Stocks are generally light, and holders do not press sales, whilst buyers abstain from operating beyond pressing wants. This attitude causes much uncertainty in trade. English lambswools are very scarce and eagerly bought up. The following prices are prevailing:—Deep stapled lustres, half hog and ewes, 28s. to 29s. per tod; superior hogs, 29s. 6d. to 30s. 6d.; Shropshires, average quality, 30s. to 31s.; superior, 31s. to 32s. per tod. Spinners are moderately busy just now, and are extensively engaged in sampling. Placing new contracts is difficult in the face of the state of the wool market, and spinners decline offers at old rates. The yarn market is rather quiet. Cashmeres have declined in price.

SWANSEA, 19th March, 1890.

Tinplates.—The decision to stop work in the tinplate mills for one week has been adhered to by a much larger number of firms than was at first anticipated, and a reduction of stock of 200,000 boxes has been effected. This is regarded as a further proof of the very unfavourable conditions under which of late work has been carried on. Mr. J. R. Turnock, whose experience of the trade, both as manufacturer and in its commercial aspect, is well known, regards the present condition of affairs as entirely due to the incessant erection of new mills and the extensions that are going on in old works. The "survival of the fittest" would be his remedy. Whatever may be thought on this point Mr. Turnock strikes a pleasant note when he refers to the question of American Protection, which, to the minds of many people, seems to hang over the trade like a sword of Damocles. He thinks it would be a long time before any effect whatever would be felt in Wales from such a policy, and, apart from considerations of the advantages derived from actual possession of the trade, the canning industry of the States would be inevitably and irretrievably ruined, because other countries would have such an immense advantage over them "while the little game lasted that they would never be driven to earth again."

Refuges in Coal Mines.—The recent explosions at the Llanerch and Morfa Collieries, which have been attended by such a disastrous loss of life, have called attention to schemes by which men imprisoned in the workings might be kept safe from the effects of the after-damp until assistance could reach them. A plan of this kind has already been adopted at Tylerstown, where the refuges are constructed of good air-tight masonry or of steel, and are supplied with fresh air from above ground by means of adequate pipes, an outlet valve being provided. Every collier knows the position of the nearest refuge, and in the event of an explosion an immediate rush is made for it.

CARDIFF, 19th March, 1890.

Coal and Coke.—There is still a spirited demand for coal, and the labour difficulties in the northern centres have had the natural effect of keeping the tone firm. Prices for best quality are 16s. to 16s. 9d.; second, 15s. 3d. to 15s. 9d.; and third, 14s. 6d. to 15s. f.o.b. Cardiff or Barry. Buyers, who have held back their orders in the hope of lower prices, are now coming into the market freely, and colliery owners find it impossible to load the steamers tendered to them in the limited time stipulated in the charter parties, in consequence of which steamers have now to wait four or five days for cargoes which formerly were loaded in 36 to 48 hours, and, as freights in all directions are low, shipowners are feeling the position very acutely. Small coal finds a ready sale, and the demand for coke is steady. A large quantity of coke has been sold for shipment to Bilbao, where North-country coke has until now had almost a monopoly.

Iron and Steel.—The pig iron warrant market has depressed legitimate business, but now that the violent fluctuations caused by outside speculation seem to have ceased, there is every prospect of a steady business. Steel rails are weaker, and the inquiry has fallen off considerably. Steel bars for tinplate making are quoted at £7 5s. to £7 15s., but lower prices have been accepted. Tinplates do not seem to have improved much, notwithstanding the enforced stoppage of the majority of the works. Iron ore is quiet, but prices in Spain are very firm, the demand evidently being far in excess of the supply.

BARROW-IN-FURNESS, 19th March, 1890.

Hematite Pig Iron.—The make of hematite pig iron has already been reduced by the blowing out of a furnace at Millom and another at the Lowther Works. Three other furnaces will be blown out before the close of the month at the Carnforth, the Harrington, and the Maryport Works, and there is reason to believe that other furnaces will soon be damped down, not perhaps so much with the direct intention of reducing the output as because of the paucity of fuel. Already the effects of the coal strike are being felt in the district, and in a few days makers of iron will either have to damp down furnaces or put them on slack blast. Thus the output will, by force of circumstances, soon be reduced to a marked extent, and in the meantime, as makers are quoting from 70s. per ton upwards for mixed numbers of Bessemer iron, while hematite warrants are changing hands at 64s. 6d. per ton, the chief trade being done is in the latter, with the result that stocks are being gradually reduced. This week they show a decrease of 2,455 tons, and they now stand 8,976 tons less than they did in the beginning of the year. The aggregate of the warrant stocks now represents 372,680 tons. Prices of pig iron are expected to advance as a result of the present crisis in the coal trade and the enforced restriction in the output of pig iron.

Steel.—A quiet tone prevails in the steel trade, and orders are not offering on a large scale for any of the classes of the district's product. Makers are so well employed that they are not troubling themselves about the depression in prices, but are waiting until the present crisis is over before again pressing business. Heavy rails are down at £6 per ton, and merchants in some cases are quoting below this figure. Steel shipbuilding material is in quiet demand, with plates at £8 and angles at £7 10s. The tinplate bar trade is quieter in tone.

MIDDLESBROUGH, 19th March, 1890.

Pig Iron.—The pig iron market seems to have quite recovered its tone. Yesterday the market opened at 51s. 3d., but soon advanced to 52s. 3d., some sellers asking as much as 52s. 6d. per ton. For April-June delivery 53s. is offered, but none are inclined to accept. Makers are still out of the market, and are more than ever determined to hold on, as they consider prices are bound to rise in the immediate future. Warrants are thus very much run upon for shipments, and the warrant stores are being gradually depleted. Cleveland warrants are 52s. 2d. cash sellers and 52s. buyers. The stock in Connal's store on Monday, the 17th inst., amounted to 166,752 tons, as against 171,914 tons a week ago, showing a decrease over to the week of 5,162 tons. In hematite East Coast brands are quoted at 75s. per ton for Nos. 1, 2, and 3 makers' iron.

Manufactured Iron and Steel.—These are slightly better, if anything, but prices remain much the same. Iron ship plates, £7; angles, £6 15s.; common bars, £7 per ton, less 2½ per cent. on trucks at works. Steel ship plates, £8 5s.; angles, £8 2s. 6d.; rails, £6 12s. 6d. (heavy section) per ton free on trucks at works. Inquiries in both are more frequent, and meantime the works are busy enough on old orders.

Coals and Coke.—Coal is easier in all kinds, except coking coal, which is as firm as ever. Coke also is strong. If the miners are settled with the prospect is likely to be in the direction of easier prices still.

Engineers' Strike.—The engineers' demand for one hour's less labour in the week by stopping work at twelve noon instead of one p.m. on Saturdays was considered as good as settled, many firms having conceded it at once. The masters met yesterday, however, and decided not to grant the request of the engineers, whereupon the men have struck work to-day in obedience to orders from their union. Only Westgarth, English, & Co., marine engineers, are affected at Middlesbrough, and they are quite willing to concede the hour.

NEWCASTLE, 19th March, 1890.

The Engineers' Strike.—On Monday the whole of the operative engineers in the mid-Tyne and Newcastle districts came out on strike for what is called the "12 o'clock Saturday." The action of the Newcastle men with regard to this matter is somewhat singular, as less than a week ago they were almost unanimous in the acceptance of the masters' alternative offer, of a second shilling per week addition to the wages rate, with the option of ceasing work at noon on Saturdays, instead of at one o'clock, in shops where they were willing to work up the hour during the week. On Saturday, however, they reversed their vote of the previous Wednesday, because a majority of the men at the other centres had decided to reject the masters' offer, and to come out on strike for the "hour." This action greatly complicates the situation, as the employers now believe that the Tyne men are going against their conviction of what is right merely out of a desire to be at one with their fellows in other districts. They maintain, indeed, that by the first vote taken, their offer was accepted by the men to whom it was addressed—namely, those employed on the Tyne and Wear, and that is literally the fact if the voting on those two rivers only is taken into account, the figures being: For employers' offer, 4,480; against the offer, 3,917. The engineers' committee, however, insisted on combining Stockton and other places with Sunderland and Newcastle, and in this way secured a majority of the aggregate vote against the offer. The Mayor of Newcastle has offered to mediate, and it is considered probable that his mediation may lead to satisfactory results.

BELFAST, 19th March, 1890.

Shipbuilding.—It is stated that Messrs. Harland & Wolff, Ld., and Messrs. Workman, Clark, & Co., Ld., shipbuilders, have rented about 30 acres of the newly made ground on the County Down side of the river for the erection of engineering and boiler making works. The ground is in every way suitable, and is close to the new Alexandra Graving Dock and the 100 tons crane. The new White Star Liner "Majestic," which has been waiting to open the spring passenger traffic, will leave this port on the 22nd inst., after adjusting compasses.

Light Railway.—The scheme for promoting the light railway from the important fishing station of Airdglass to Downpatrick has now taken definite form, the Grand Jury of the Co. Down having voted £17,000 as their share of the undertaking. It will be about eight miles in length, and will cost about £6,500 per mile. It is expected to very largely develop the fishing industry, as before there was no quick communication with Belfast, the nearest export town.

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DOCK PUMPING MACHINERY FOR THE JAPANESE GOVERNMENT.

CONSTRUCTED BY MESSRS. W. H. ALLEN & CO., ENGINEERS, LAMBETH.

(*For description see page* 268.)

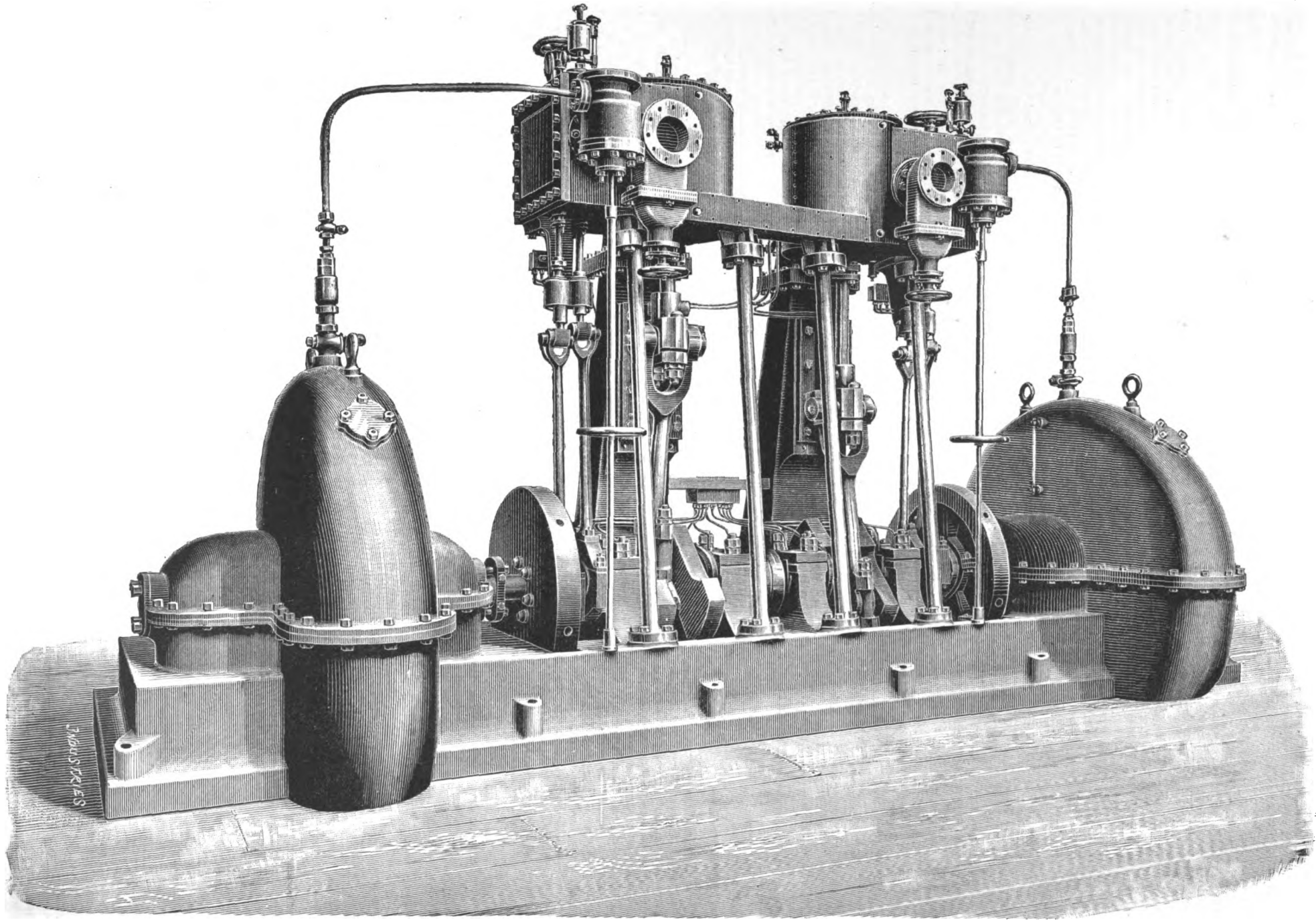


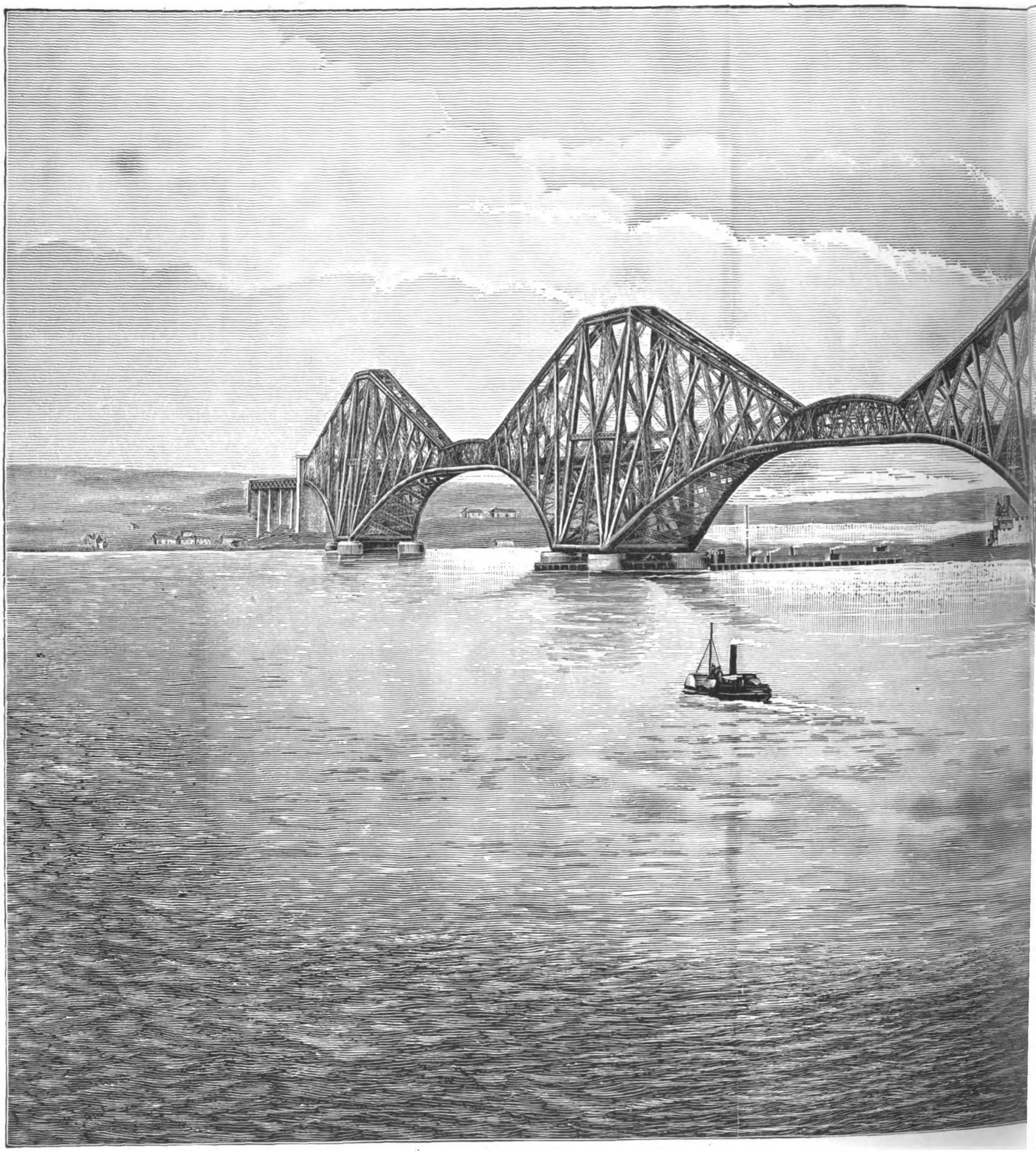
FIG. 4.—GENERAL VIEW OF ENGINES AND PUMPS.

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THE FORTH

(*For description*

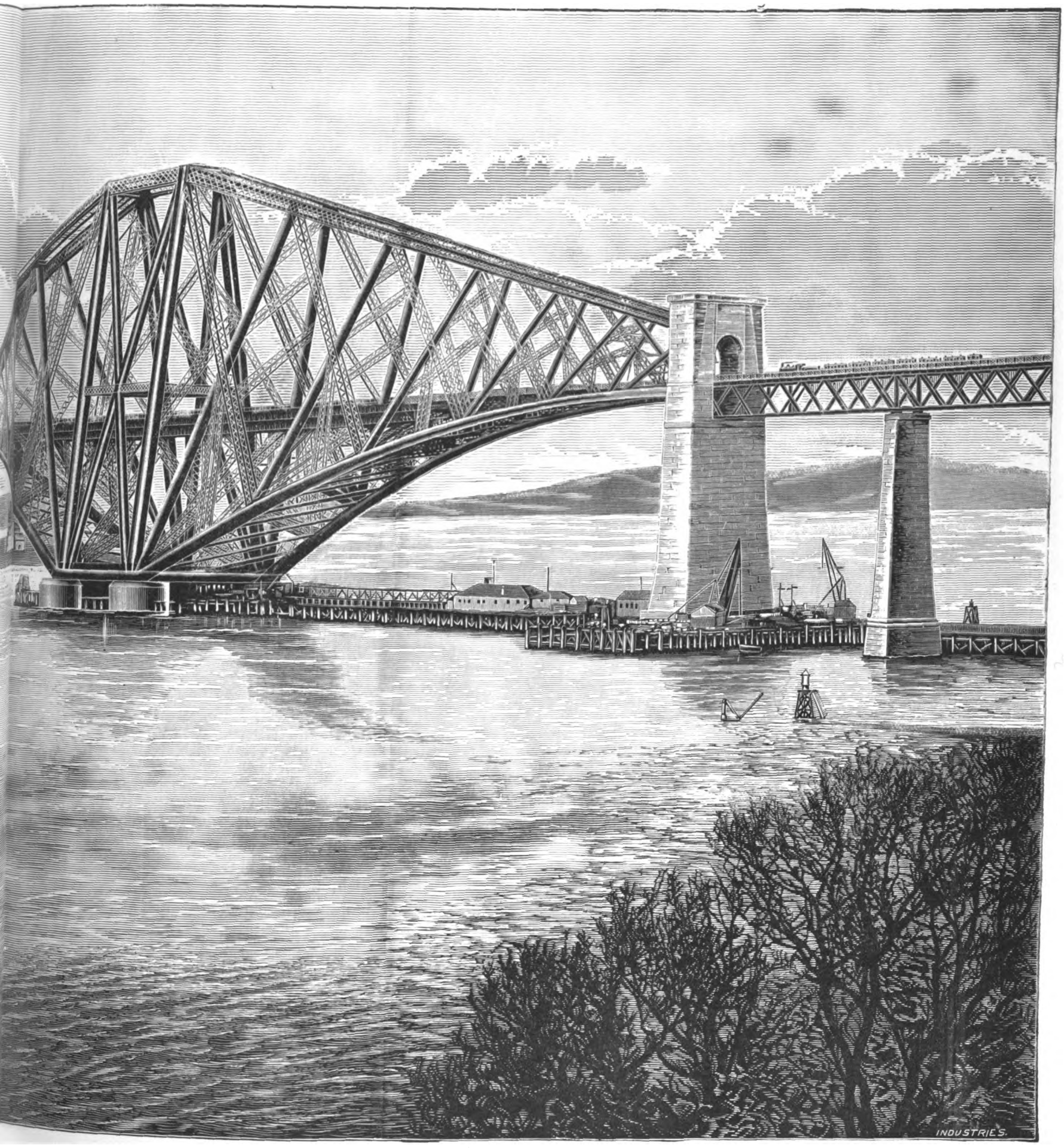


VIEW OF THE BRIDGE

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...IRTH BRIDGE.

(... see page 273.)



...AS OPENED FOR TRAFFIC.

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As we go to press early with certain of our advertisement pages, all Alterations to Standing Advertisements should reach the Publisher not later than 2 o'clock on Wednesday afternoon in each week.

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

Contents.

	PAGE
Messrs. Arbey's Tools at the Late Paris Exhibition (*Illus.*)	265
Training for Trades and Crafts —III.	266
Low-Pressure Compressed Air Tramcar (*Illus.*)	267
Pumping Machinery for the Japanese Government (*Illus.*)	268
Foreign Industries (Corres.)	270-271
Lyon's Improvements in Slide Valves (*Illus.*)	272
Coal, Iron, and Cognate Industries	272
The Forth Bridge (*Illus.*)	273
Notices of Meetings	273
Prices Current	273
Foreign Telegraphic Advices (Corres.)	273
Home Industries (Corres.)	274-275
The Navy Estimates	277
The Efficiency of the Merchant Service	278
British Investments in Mexico	278
Ship Propulsion by Multiple Screws	278
The Coal Crisis	279
The Late Mr. Thomas Gray, C.B.	279
Two-page Supplement illustrating the completed FORTH BRIDGE as opened for traffic.	
Letters to the Editor:— Platinum for Electrical Purposes	279
Forthcoming Silk Exhibition	279
Discovery of Coal in Kent	280
The Institute of Marine Engineers	280
London Association of Foremen Engineers and Draughtsmen	280
Japanese Exhibition at Tokio, 1890 (*Illus.*)	280
Shipbuilding Notes	280
Improved Wenström Dynamo (*Illus.*)	281
Safety in Electrical Distribution	281
Practical Working of the Electrical Subways in New York (Corres.)	282
The Institution of Electric Engineers	283
The Physical Society	283
Notes	284
"Industries" Patent Record:— Applications and Acceptances	285-286
Illustrated Abridgments	286-288

To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

We cannot undertake to return manuscripts or drawings, and must request correspondents to keep copies.

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In half calf, gilt lettered, may be obtained at our London, Manchester, and Glasgow Offices, Price 20s. each.

Industries:

FRIDAY, 21ST MARCH, 1890.

THE NAVY ESTIMATES.

THE Navy Estimates for the year 1890-91, which have been issued along with an explanatory statement by the First Lord of the Admiralty, show that the sum voted in the financial year 1889-90 for the requirements of the Navy was £13,685,400, while for the year 1890-91 the amount to be asked is £13,786,000, being an increase of over £100,000. The largest addition comes under the head of shipbuilding material, and reaches £194,000. Wages are larger by £89,868, victualling and clothing by £42,100, and the *personnel* of shipbuilding by £35,556. On the other hand, there are decreases of £264,300 for contract work, of £5,200 for pensions and gratuities, and of £3,900 for reserved and retired pay. The total amount to be spent on construction, without armaments, in the coming year is estimated at £6,551,031, exclusive of the Australasian squadron. Of this amount £3,595,930, which is to be expended upon the vessels constructing by contract, is to be defrayed from the funds provided for by the Naval Defence Act of last year. The remainder will be paid out of the unexpended balances of 1889-1890, and by advances under the provisions of the Naval Defence Act. The scope of this Act does not seem to be clearly understood by the public, and therefore it may be explained that the twenty-one and a half million pounds with which it deals is not altogether extra expenditure. While the Act gives control over this amount, eleven and a half millions are voted from year to year as part of the annual provision for the Navy, while the remaining ten millions are charged upon the Consolidated Fund and are to be spread over a period of five years. If, however, the sums which are set aside for any year are not fully spent in that year the unexpended balances are to be disposed of by the Admiralty in such a manner that the total sum expended over the whole term shall suffer no reduction. Doubts are now, however, raised by the First Lord whether it will be possible to carry out the whole of the programme laid down in the Act; for he points out that during the financial year 1889-90 the extraordinary activity displayed in shipbuilding and other industries for the mercantile marine has caused a remarkable rise in the price of the materials employed in shipbuilding and of labour on contract-built ships. In the Naval Defence Act the estimates of the cost of work to be done were so framed as to allow a margin for a rise in prices and for other contingencies. This margin has, in many of the contracts made for hulls and machinery, been more than absorbed in consequence of the inflation of prices during the past year. There is at present a tendency to a fall in prices, but of course the amount of work which can be carried out with the money mentioned in the Bill will to a considerable extent depend on the prices prevailing during the next three years. The Admiralty are not, therefore, in a position to say whether during the next three years further sums may not be required to satisfactorily carry out the work of completing and thoroughly equipping the 70 ships included in the programme of the Naval Defence Act. The First Lord promises that, so soon as information is obtained to justify an authoritative statement on the subject, a full communication will be made to Parliament, but in the meantime the contracts made and the liabilities incurred will be kept well within the authorised maximum. We may be pretty certain from the start which has been made that we will have a demand for a considerable addition to the sum mentioned in the Act. With regard to the progress which has been made, the Act arranged that altogether 70 vessels should be built, 38 of which are to be undertaken in the dockyards, and 32 are to be built by contract. Of the former 21 have already been commenced, seven more will be commenced in 1890-91, and only ten will be left to commence after March, 1891. The ten thus left till after next year are five second-class cruisers and five torpedo gunboats. Of the 32 vessels that have to be built by contract under the Naval Defence Act, 26 were ordered before the close of 1889. The remaining six vessels are torpedo gunboats, which admit of being rapidly constructed, and which have been held over for the present. These 26 vessels include four battleships of the first class, five protected cruisers of the first class, and 17 protected cruisers of the second class. It was decided, after careful consideration, to give to the dockyard-built ships of each type a sensible start upon the contract-built ships of a similar type, in order that all details of fitting and equipment might be thoroughly worked out in the dockyards by naval and professional officers, and thus be available for guidance in the construction of the contract ships. These have been entrusted to eleven of the leading shipbuilding firms in the country, nearly all of them having had previous experience of warship construction. The work has been widely distributed. Eight of the vessels are building on the Tyne, eight on the Clyde, four on the Thames, three at Barrow, two at Hull, and one on the Mersey. The whole of the thirty-two vessels to be built by contract have thus been placed, except six torpedo gunboats, which have been kept back purposely pending the conclusion of the steam trials now going on. The designs of the new vessels were described in the statement of last year, and in Mr. White's paper which he read before the Institution of Naval Architects, so that we need not enter into them here; but it may be mentioned that advantage has been taken of the experience gained in the naval manœuvres of last year to improve some details. The most important of these had reference to coal tranport and ventilation of engine rooms beneath protective decks, and the suggestions which were made were embodied in the designs of the ships which are being built under the provisions of the Naval Defence Act. The First Lord states that the details of dockyard administration are carefully scrutinised, and the various charges are kept as low as is consistent with efficiency, and seldom are the estimates for building or repairs exceeded. The cost of building ships in the dockyards is steadily diminishing, though it is not yet so low as that of some of the ships procured by contract, after allowing a reasonable amount for incidental charges. We can never expect that cost to be so low as in private yards; but, as we have often pointed out, if "red tape" were minimised, and improved methods of work introduced, there are no reasons why the cost in the two cases should not approximate very closely, and we trust that the improvement which has taken place will be continued. Attention is now being directed to the administration and business of the foreign naval yards, with a view of improving their efficiency and

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economising their expenditure, although the great distances from England makes this a difficult and slow process. The improvement which has taken place in the dockyards has enabled repairs and outfits to be completed with despatch and economy.

With regard to the manufacture and supply of guns for the Navy, the First Lord admits that that has been fairly satisfactory; but on this point he remarks that the Admiralty speaks on ordnance questions as users of the articles supplied, and is not responsible either for the design or manufacture of the weapons with which they are armed, except so far as gun mountings and torpedoes are concerned. Every gun on board ship has, after it has passed proof, to be tried with full service charges by naval officers, to test the gun mounting upon which it is placed. Every gun so passed, with its mounting, is tested once a quarter when in commission, and the charges fired are heavier than those in use in other navies. The experience thus gained by naval officers during the past four years in the practical use of modern breech-loading guns is unique. It is satisfactory to find that the absolutely unanimous evidence of all so engaged is highly favourable to the quality of the guns they have been handling. There is a considerable number of other subjects relating to the Navy taken up by the First Lord of the Admiralty in the statement which accompanies the Estimates. The only one, however, in which we are specially interested is that relating to the machinery of the ships. That, however, is of so much importance, that we have not space here to deal with it at length. We therefore defer our remarks for another occasion.

THE EFFICIENCY OF THE MERCHANT SERVICE.

Every industry in the country depends to a greater or less extent on the efficiency of our merchant marine, and whatever tends to improve that efficiency should receive our earnest attention. Lord Brassey is well known to have made a special study, not only of the affairs of the Navy, but also of those relating to the mercantile marine, and any suggestions he has to make on either of those subjects are always found to be worthy of careful consideration, and his thoughtful paper in the current number of the *Nineteenth Century* contains information, opinions, and suggestions which deserve the careful attention of all who can in any way, either directly or indirectly, influence the condition of the merchant service, and on a few of the more important points we propose to dwell shortly.

Lord Brassey first discusses the character, conduct, and efficiency of the British seamen of the present day, and he quotes the opinions of several authorities. It is probable that the late Mr. Gray, of the Board of Trade, was very near the truth in saying: "There can be no doubt that officers, and the better part of the seamen, as well as the ships themselves, have immensely improved." British seamen have more distinctly become separated into two classes. The bad may be worse, but the good are better. The late Mr. W. S. Lindsay was of opinion that it was not the case that either our ships or the officers by whom they are navigated have deteriorated, but that, on the contrary, they have during the last quarter of a century vastly improved in almost every respect. Lord Brassey himself finds, from his own experience during the past thirty years, that there is no deterioration, whether in discipline or in seamanship. The Royal Naval Reserve, which may be considered the cream of the merchant service, contains, according to the reports of the admirals in command, the finest body of seamen that could be got together. On the whole, the collective verdict of the Commission on Loss of Life at Sea may be taken as representing the evidence on the matter. It says: "After giving our best attention to the subject, we are unable to come to the conclusion that there is any just foundation for the allegation that British seamen have deteriorated in quality. We feel satisfied that shipowners who offer continuous service at good rates of pay have no difficulty in finding as good seamen as were ever in the merchant service in past times. . . . . There is a general concurrence that British seamen, even when inclined to be unruly in ordinary times, have, in times of emergency, courage, coolness in the presence of danger, and resources which are not to be found in their more submissive mates from abroad." Lord Brassey enters into the consideration of the difficulties and dangers, both moral and physical, which attend a sailor's life, and mentions some of the measures which have been passed for alleviating them. We cannot at present enter into these, but would mention that he strongly advocates a well-established pension fund for seamen, and states that they have a special claim to receive generous treatment from the State.

Lord Brassey treats of the education and professional training of the officers of the mercantile marine, and, while admitting that many of them would be ornaments to any profession, on the quarter-deck, as on the forecastle, there is a residuum little worthy to hold certificates or to fill commands, and he quotes the opinion of Captain Methven, that the mode in which navigation was conducted in a portion of our merchant service has been discreditable to our country. This opinion was confirmed by Mr. Rothery, the late Wreck Commissioner, who told the Commission that he had had cases of certificated masters who did not know how to lay a ship's course properly on the chart, or how to make the requisite allowance for tides or currents, and who knew scarcely anything of compass deviation. This, in our opinion, arises in great part from the too great importance which has hitherto been given to mere examination, apart from the education of seamen. It is well known to all who have looked into the matter that the ordinary examinations of the Board of Trade are samples of cram which are not surpassed anywhere. A class of men has arisen whose work it is to stuff into the candidates as much information as they can in a short time preceding the examination, which, as soon as it has served its purpose, is forgotten.

The late Mr. Gray, of the Board of Trade, recommended an entire revision of the present classification of masters and mates, and that only those should be styled captains who could pass in the subjects of the extra examination. He thought that if a regulation were made that such men alone should be entitled to command large passenger ships, it would raise the status of the mercantile marine generally. No doubt it would, but if more efficient arrangements were made for systematic training the process would be much more satisfactory, and Lord Brassey directs attention to the want of any organised system for professional training. He points out that, while a university has been created for the higher scientific training of officers of the Royal Navy, the Government renders no assistance in the education of the mercantile marine, and he suggests that the facilities which we have created at Greenwich might be utilised for this purpose by the professors giving lectures in London. Such aid as could be afforded by the naval university would, however, only be available to students who had served at sea. In the preparatory stage of apprenticeship the conditions usually found in the merchant service leave much to be desired. The training ships "Conway" and "Worcester" are doing excellent service for youths of from thirteen to sixteen years of age destined for the sea, but the subsequent stages of professional training have not been followed up. In a few ships only apprentices are carried, and, as a rule, the benefits they receive do not correspond to the high premiums which have been paid for them. The majority of the future officers of the merchant service commence their careers as apprentices, and receive no systematic instruction in professional subjects. A little desultory reading, combined with their practice at sea, and the hurried cram which they get when a few weeks on shore, enable them to get through the Board of Trade examination, but comparatively few of them can claim to be well educated. No doubt it is difficult to combine good theoretical training with practice at sea, but still a great deal could be done if more systematic instruction were given in secondary schools in those subjects which were preparatory to the more strictly professional training. Lord Brassey has decided to make an experiment. With the assistance of Messrs. Devitt and Moore it is proposed to make special arrangements in two sailing ships for the instruction of officers. Twenty-four midshipmen will be carried in each ship. A naval instructor will be appointed, who, under the supervision of the captain, will teach navigation and exercise control in all matters of discipline. The dietary will be on a scale approved for the junior officers of the ships, and it is hoped that the boys, instead of forgetting their preliminary training in theoretical subjects, will extend it, and after four years' service will have little difficulty in passing a satisfactory examination by the Board of Trade. We think that Lord Brassey's experiment is on the right lines, and we trust that he will receive sufficient encouragement to induce others to follow the example he has given, and thus turn out numbers of men who are thoroughly trained for the highest positions in the mercantile marine, in the continued success of which our industrial prosperity so much depends. Lord Brassey considers other subjects connected with the merchant service, especially those relating to its *matériel*, insurance, compulsory load lines, and surveys.

BRITISH INVESTMENTS IN MEXICO.

For some years past the low rate of interest in this country has been sending a large amount of capital to foreign countries, and especially to North and South America. Of these Mexico has been one of the chief favourites. Being one of the largest producers of silver, it has been looked upon as a kind of El Dorado, while the distance is too great for people to go and judge for themselves of the soundness of their investments. The unscrupulous promoter has therefore an admirable field for his operations in Mexico, and in many cases he has taken advantage of it. From a paper upon the finance and land investments of the country, which has been sent from the British Legation by Sir Francis Denys to the Foreign Office, we see that the British capitalist has been investing largely in Mexico. In 1886 there were 11 companies formed in London for undertakings in Mexico, with a registered capital of £2,555,000; in 1887 there were 15, with £5,135,800; in 1888 there were 25, with £10,956,020; and in 1889, up to November 9, there were 26, with £14,343,370, thus giving a total of 77 companies, with a total registered capital of £32,990,190. This enormous sum has been invested in railways, lands, mines, public securities, banks, &c., and Sir Francis Denys says that this tremendous mortgage on the resources of the Republic renders the maintenance of public order a matter of almost as much importance to Great Britain as to Mexico itself. The railway system of the country is almost entirely in the hands of British capitalists and investors, the Mexican Railway is an English Corporation, the control of the National line is in English hands, the Interoceanic and Mexican Southern are also English companies; the Tehuantepec Railway is being constructed with British capital, and it is stated that the majority of the first mortgage bonds of the Central Railway have passed into English hands. Sir Francis Denys gives a considerable list of other works which are being carried out chiefly by British capital, and concessions of all kinds are being granted by the Mexican Government, and he thinks it probable that the London market will be flooded more and more with schemes of all kinds for extracting money from the British public. The point, however, to which we wish to direct special attention is that all this British money has not been employed in floating new undertakings, but to a considerable extent represents a process of transference, for, except as regards mines, American capital and control have been gradually withdrawn to make way for those of our own countrymen. Sir Francis Denys, therefore, recommends that every caution should be employed before concessions are taken up second-hand, and especially that the securities offered for local, State, or municipal loans should also be closely scrutinised in view of the existing mode of taxation. At the same time he is of opinion that Mexico is undoubtedly advancing rapidly in material prosperity; the administration has a strong hold on public confidence; and, if proper caution and discrimination are exercised, there need be no fear on the part of the public abroad in embarking under the present Government in those mining, agricultural, or financial enterprises which offer reasonable prospects of success.

SHIP PROPULSION BY MULTIPLE SCREWS.

Steamship propulsion by twin or triple screws has not made that general progress which experience with the twin-screw ships already in existence would lead one to expect, but a forward impulse will in all likelihood be given to this branch of marine propulsion by the adoption in practice of an ingenious arrangement which Mr. Hugh Dunsmuir, of Messrs. Dunsmuir & Jackson, of Govan, has recently patented, and which his firm, as a trial arrangement, are about to fit into a small vessel for Indian coasting service. The arrangement in question consists in driving multiple (two, three, four, or more) screw propellers by means of one set of direct-acting triple or quadruple expansion engines placed crosswise in the vessel to be propelled. Each engine or cylinder is designed to drive its own shaft and propeller, but the crank-shafts of all the engines are effectually joined together by side connecting rods, cranks, or discs, in a somewhat similar manner to the side rods of a locomotive engine. In this way the two, three, or four cylinders are combined into one engine, thereby procuring all the benefits due to a multi-cylinder engine, with cranks set at equal angles, and at the same time giving choice to adopt twin, triple, or quadruple screws as may best suit the type of vessel.

Hitherto the chief obstacles in the way of the adoption of twin screws—even in vessels, such as broad light-draught craft, which specially lend themselves to the system—have been more of a commercial than of a

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practical engineering character. The necessity for duplicate sets of engines, with all their various parts and complicated details, the great additional first cost, the more expensive upkeep, the extra engine-room staff entailed, and the extra space taken up in the vessel are considerations which have stood largely in the way. The liability, also, of twin screws to get damaged when vessels are being taken out of and into docks, or when taking the ground, has also materially influenced owners in rejecting the system. The engines under notice, however, will obviate mostly all of these objections. They may be fitted with the same facility, and nearly the same cost, as an ordinary set of single-screw engines. Being placed athwartship they will only occupy about half the space usually taken up by engines placed fore and aft. The several propellers being worked by one set of direct-acting engines, there will consequently be, in addition to the saving in first cost and in valuable cargo space, much less deadweight to carry, greatly less tear and wear, more economy of steam, oil, &c., and less labour to attendants. This arrangement will also give greater freedom to shipbuilders and shipowners in designing their vessels as regards draught, speed, and economical propulsion. The use of two screws has beyond doubt, during the past four or five years, come more into favour for large and fast ocean-going steamers, as well as for light-draught coasting and other steamers. In the Navy the practice is quickly displacing the use of the single screw, as our naval authorities have found, from repeated trials during the last few years, that two small screws are more efficient and give better results in manœuvring and direct speed than one of large diameter having equal surface. Owners of large passenger ships, also, have found it safer and equally efficient and profitable to adopt twin screws, and owners generally may soon find it preferable in all essentials to adopt two or three small screws, well emersed in solid water at all draughts, than one of large diameter with its top blade working half out of water when in ballast trim or half loaded, thus greatly destroying its own efficiency by drawing down air and wasting engine power. But there is, of course, a limit to the reduction of diameter with one propeller, as enough blade surface must be left to propel the vessel. With twin screws, however, the diameters can be greatly reduced, and with triple screws propelling surface can be got with smaller diameter still. It also follows that the adoption of smaller screws results in more revolutions, more piston speed, more relative power, shorter strokes, lower and lighter engines, and more efficiency in the engines as well as in the propellers, with reduced weight and space occupied, and greater economy throughout. We hope in a future issue to give details and illustrations of this system of propulsion.

THE COAL CRISIS.

The precise number of miners idle in Lancashire, Yorkshire, and the other districts affected by the strike is difficult to estimate, but 200,000 will hardly be regarded as an extravagant figure. This, however, by no means represents the number of persons affected by the strike, for coal at famine prices in London and in the manufacturing centres of England means that hundreds of thousands of persons suffer both from want of work and from the payment of the high rates. The holders of stocks have gained enormously, especially the London Coal Ring, which seems to be taking full advantage of the situation. The claims of the men for an advance of 5 per cent. immediately and another advance of 5 per cent. on the 1st of July have been met in some few cases, but the majority of the coalmasters hold out against the claims. So far as the claim for an immediate advance of 5 per cent. is concerned, it is likely that no serious disadvantage to the mine owners would have resulted by the concession, although in many cases it could only be given at a sacrifice. It is understood that the bulk of existing contracts for coal will have run off by the end of May, and a judicious compromise might have enabled the masters to arrange an advance in such a way as to save themselves from serious loss even upon old contracts. The second claim, for an advance of 5 per cent. to come into operation on 1st July, is, however, quite another affair. The price of coal at that date is much too problematical a quantity to deal with at this stage. The opinion on the Continent, derived from leading coal merchants there during the past few days, is that prices will fall as the summer advances. Instead of being disposed to increase their limits, even with the knowledge of the state of affairs in this country at the moment, foreign importers are actually even now diminishing them. Circumstances may conspire to falsify these forecasts, but the want of elasticity in prices now to be obtained for forward delivery of coal for exportation must have a certain influence on the wages question. It is understood that the railway coal contracts do not generally expire till June, so that till then the coalmasters who have not stock are on the horns of a dilemma. They must supply coal against contract, or suffer loss through damages for breach of engagement, or they must accept the situation. It is to be pointed out, however, that the districts presently most affected by the strikes are not so much exporting districts as home-trade districts. The home trade in coal—about six-sevenths of the whole—is, after all, the most considerable factor, and here the shoe pinches very hard at the moment. It is one of the curious incidents of a series of strikes over a great number of industries that the inconvenience is slow in becoming manifest. The contemporaneous strikes of the dockers at Liverpool, of the engineers on the North-East coast, and numerous other strikes of less importance, in the aggregate involving the idleness of a great amount of machinery and of a large number of men, have lessened the demand for coal so materially that the pressure is less great than it would otherwise have been. So far as domestic coal is concerned, the demand is also lessened owing to the mildness of the weather. In Yorkshire, in Staffordshire, and in Lancashire mills are everywhere stopping, and men are being thrown out of employment. The influence of this extensive dislocation of industry upon the demand for commodities must be immediate and enormous, and there can be no doubt that, even though the strike should last no longer than a few days, a very serious check has been given to the expansion of trade. In one or two districts, where Wages Boards have been in existence, work goes on as usual. The moral of this whole series of disturbances is that the industry of the country cannot be allowed to be dislocated by the quarrels of employers and employed. The establishment of Boards of Arbitration is indeed the paramount necessity of the time.

THE LATE MR. THOMAS GRAY, C.B.

We regret to announce the death of Mr. Thomas Gray, C.B., of the Board of Trade, who died on the 15th inst. at Rokesley House, Stockwell, at the age of 58. Sir Thomas Farrer sent to the *Times* the following notice of his old friend and colleague:—"By the death of Mr. Thomas Gray, of the Board of Trade, the public have lost an excellent servant and his colleagues an old and valued friend. The many Presidents whom he has served—the Duke of Richmond, Lord Norton, the Speaker, Mr. Stanhope, Mr. Shaw-Lefevre, Mr. Chamberlain, and Mr. Mundella—would, I am sure, bear willing testimony to his merits. He was one of those men whose energy would have made a mark in any sphere of life, and who, if engaged in business, would probably have amassed a large fortune. He was the son of a poor man who gave his son something better than wealth—a strong character and a sound, practical education. He came into the Board of Trade about the year 1851 as a boy clerk at 15s. a week, was attached to the Marine Department, and won his spurs by making himself master of the business of surveying steamships—a branch of work to which he always remained much attached. There was something of genius in his rapid comprehension of mechanical problems, and his knowledge of ships and their machinery was as accurate and extensive as that of a shipbuilder or marine engineer. Few persons have such capacity as he had for making the technicalities of these subjects intelligible. The Duke of Richmond, when he came to the Board of Trade as President, used to say that after an hour with Mr. Gray he felt that he had been all the time in the inside of a ship. But he was not a mere specialist. In all subjects connected with the mercantile marine and with the welfare of seamen, in the abolition of crimping, in the improvement of officers, in wreck inquiries, in the commercial code of signals, in all the legislation and administration arising of Mr. Plimsoll's move, he took a leading, helpful, and useful part. The rules of the road at sea he made almost his own, and his rhymes on that subject are as well known among seafaring men as 'Rule, Britannia,' and have been translated into all languages. Like all energetic men, he was fond of power, and sometimes overshot the mark; but he was always public-spirited, loyal, and invaluable to those who trusted him. He was insatiable of work, and drew too largely on his powers. His holidays were work in another form—rough voyages, exposed to hardships in search of practical information to be used in his official duties. His place brought him into inevitable contact—not infrequently collision—with shipowners, sailors, and engineers. But I believe there are few among them who will not now join with me in recognising his devotion to the public service, his energy, and his very peculiar and unusual knowledge of the subjects with which he had to deal."

Letters to the Editor.

PLATINUM FOR ELECTRICAL PURPOSES.

To the Editor of "Industries."

Sir,—Can any of your readers give me an approximate idea of the quantity of platinum annually used in the industrial applications of electricity? For what purpose is it principally used in this connection?

Yours, &c.,
W. M.

Newcastle-upon-Tyne, 18th March, 1890.

FORTHCOMING SILK EXHIBITION.

To the Editor of "Industries."

Sir,—I am requested by the Council of the Silk Association of Great Britain and Ireland, and also by Lady Egerton of Tatton, the Hon. Sec. of the Ladies' Committee of this Association, to ask you to be kind enough to insert the accompanying preliminary announcement of the forthcoming Silk Exhibition, and also the report of the Ladies' Committee.

Yours, &c.,
Thomas Wardle, President.

The Silk Association of Great Britain and Ireland, Society of Arts, Adelphi, London, 14th March, 1890.

Silk Association of Great Britain and Ireland.

Report of the Ladies' Committee of the Silk Association for the year ending February 28th, 1890.

The Ladies' Committee report that they have been, through their Honorary Secretary, in constant communication with the President of the Silk Association during the past year. They have also attended two meetings of the Silk Association, at which they urged the importance of holding an Exhibition of Silk Manufactured Articles, which would give an opportunity of verifying the improvement in English manufacture. Two causes have prevented this Exhibition being, as was hoped, held this year—the difficulty of obtaining a suitable building, and the desirability of giving a longer time for the production of the articles.

The Ladies' Committee consider that popular attention should be drawn to the improved and improving condition of the silk industries in the British Isles. It is patent to all that furniture silks can be, and are, made in England, which will bear advantageous comparison with those produced in other countries, both as to excellence of material, beauty of colour and design, and cost of production.

It is the belief of the Ladies' Committee that in other branches of the silk industry similar excellence is or might be attained, though for various reasons the goods now made are not always recognised as of British manufacture.

It is not within the province of the Ladies' Committee to inquire and enter into the vexed questions affecting industrial and mercantile prosperity, but seeing that for the first time the silk manufacturers and others interested in this industry have formed a representative association, which is a guarantee both of good faith and of united action, this committee, formed at the request of the Silk Association, consider that the time has come to invite the attention of the ladies of England to the revival of this ancient industry. In order to do this the committee propose to form a Ladies' Silk Association on an extended scale. Its members will not be pledged (any more than are the members of the Ladies' Committee) to the exclusive purchase and use of English-made silks but they will be asked to interest themselves and their friends in this British industry, and to make inquiry for and inspect English silks before deciding to purchase those of foreign manufacture.

In conclusion, the Ladies' Committee of the Silk Association trust that before long ocular demonstration of the excellence of English silks may be afforded by an Exhibition; and should success crown the efforts of those who have been working on behalf of the silk operatives of England, Scotland, and Ireland, they will feel rewarded by the knowledge that the time and energy they have devoted to this enterprise have resulted in increased material prosperity to their working brothers and sisters in silk factories.

Mary Adelaide,
President of the Ladies' Committee of the Silk Association.

At a meeting of the Ladies' Committee, held at 7, St. James's Square, London, on March 1st, H.R.H. Princess Mary presiding, it was resolved:—

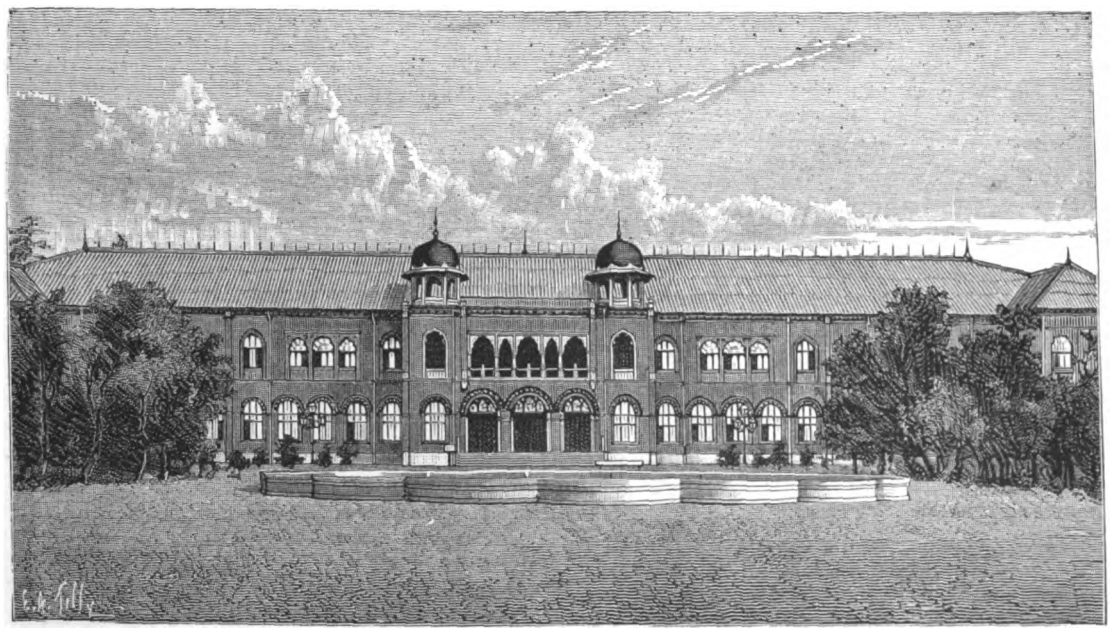
> "That a small Loan Exhibition of British-made Silks be held by the Ladies' Committee early in May this year, subject to the approval of the Silk Association, and that Lady Egerton of Tatton be requested to communicate with the President of the Silk Association on the subject."

In consequence of this resolution the Council and Exhibition Committee of the Silk Association met at the Society of Arts, London, on Friday, the 14th inst., Mr. Wardle, F.C.S., F.G.S., President, in the chair. It was unanimously resolved to adopt the resolution of the Ladies' Committee, and to cordially co-operate with them in the carrying out of the Exhibition, which it is proposed to open on or about the 6th of May next, and to be open for a fortnight. Lord Egerton of Tatton has kindly offered his large ball-room, at 7, St. James's Square, for this purpose. It is intended that the Exhibition shall be as representative as possible, and, whilst the more ornamental silks for dress and household decoration would naturally form the most important part of the Exhibition, all the various branches of the silk industries of Great Britain and Ireland, it is hoped, will be adequately represented both through the manufacturers and distributors.

Intending exhibitors are requested to communicate as soon as possible with the President, addressed to Leek, Staffordshire, who will supply conditions and all particulars.

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JAPANESE EXHIBITION AT TOKIO, 1890.



DISCOVERY OF COAL IN KENT.

We recently gave a short account of the find of coal near Dover, as obtained from the report of Mr. F. Brady. The connection of Professor Boyd Dawkins with the experimental borings is well known, and we note with some interest that he read a paper on the subject at the last meeting of the Manchester Geological Society, held on the 11th inst. The Professor is inclined to be cautious in making the details of the "find" public, although he expresses himself as quite confident that the true coal measures have been struck. We shall have a further opportunity of noticing Professor Dawkins' opinion when he lectures on the same subject at the Royal Institution at the beginning of June, but in his recent paper Professor Dawkins said that as yet he was only in a position to give a first sketch of an unfinished work, as obviously the promoters of the undertaking did not intend to publish a complete account until the work was finished. The question, however, of the existence of the coal measures under the newer rocks of South-Eastern England had now been proved beyond all doubt by the boring that had been undertaken by Sir Edward Watkin, acting under his advice. The hypothesis that the coal measures lay at workable depths under the tract of country which intervenes between the several coal-fields of South Wales, Somersetshire, Belgium, and the North of France, was started by Mr. Godwin Austen, thirty-five years ago, and, although opposed by Sir Roderick Murchison, was considered by the Coal Commission of 1866. Up to 1872, however, it was only a matter of theory, but in that year it passed into the experimental stage, when a committee organised by Mr. H. Willett conducted a trial boring near Battle, in Sussex. This work was abandoned after passing through 200ft. of Purbeck shale and 1,705ft. of oolitic rocks. From the fact that the bottom of the bore-hole was in the Oxford clay it would appear that the eroded surface of the coal measures at that point was over 2,000ft. deep. In 1886 Sir Edward Watkin commenced the present bore-hole at Shakespeare Cliff. This work, carried out by Mr. F. Brady, has passed through the following section:—

Cretaceous rocks	500 feet
Oolitic rocks	660 „
Coal measures, sandstones, shales, and clays	20 „
	1,180 „

The coal measures were struck at a depth of 1,160ft., and on the 15th February a seam of blazing coal was found at 1,180ft. Considering that most of the important collieries in Lancashire raise coal from depths between 2,000ft. and 3,000ft., and in Belgium and the North of France from still greater depths, a coal-field had thus been proved in South-Eastern England at the comparatively shallow depth of 400 yards. The amount of coal that might be expected to exist under the newer rocks might be estimated by comparing the coal measures of Somersetshire, Namur, Mons, and Douai. In the latter coal-fields the thickness of the coal measures was 9,400ft., and the thickness of workable coal was 240ft. These measures, coming to the surface from underneath the same rocks as those in Somersetshire, had been traced to within thirty miles of Calais, and in general direction made straight for Dover. It was too soon to measure the full importance of the discovery, but the proving of these concealed coal-fields was a question of national importance, well worthy the attention of Parliament.

THE INSTITUTE OF MARINE ENGINEERS.

A meeting of the Institute of Marine Engineers was held on the 11th inst., in the Langthorne Rooms, Stratford, when Mr. E. L. Morgan read a paper on "Coal." The author began by noticing the earliest records of coal being used for fuel, and then went on to mention such epochs in the history of coal as (1) its introduction for domestic purposes; (2) its condemnation by the citizens of London for polluting the atmosphere of the City by its smoke, and its use forbidden; (3) its re-introduction in consequence of the scarcity of wood; and (4) the use of coal for smelting iron and steel. He also discussed the question as to which quality of coal is best for use in steamships. The stowing quality of the block fuel, both in respect to ease in handling and cleanliness, appeared to give it a great advantage, and in addition it was made from the accumulated waste at collieries, and should therefore be cheap. The evaporative power and the qualities of the different kinds of coal, and the suitability of each kind for the various purposes for which coal is used, were carefully entered into, and the paper concluded with a reference to the introduction of oil for fuel as well as for lighting purposes.

In the discussion which ensued the various speakers dealt with the evaporative power of the various kinds and qualities of fuel under natural or forced draught, from which it appeared that under certain conditions of stokehold and boiler arrangement north country coal gave equally good results with Welsh, while in several cases cited the block fuel appeared to give results in no way inferior to good steamship coal. Reference was made to a new patent fuel to be placed on the market soon; it appears to be a composition of petroleum manufactured into a solid state. Several speakers pointed out that a very grave mistake was made by manufacturers of patent block fuel in not keeping up the quality of the fuel. The theory of heat and combustion was also dwelt upon.

LONDON ASSOCIATION OF FOREMEN ENGINEERS AND DRAUGHTSMEN.

Mr. W. H. White, Director of Naval Construction, presided, on Saturday evening, at the Cannon Street Hotel, on the occasion of the thirty-seventh anniversary festival of the above Association. In addition to the Earl of Ravensworth and Admiral Mayne, M.P., there were also present the representatives of the leading engineering firms in London and the provinces. In proposing the toast of the evening—"Prosperity to the Association"—the Chairman said it was impossible to over-estimate the value of such an association. Its objects were threefold—social intercourse, technical instruction, and benevolence. Standing, as foremen engineers did, intermediate between the employers and workmen, they naturally looked very much to their own ranks for friendly association and the pleasures of life, and that association was offered by the monthly meetings of that society. He owed a very great deal to the foremen and draughtsmen who had worked out his designs in the past and had always given him the benefit of their constant help and loyal and generous assistance. And what was true in his own experience was, he was sure, true in every workshop, when they reflected how much a design gained in its execution by the intelligent assistance of the foremen, and the cost of production was affected by comparatively little things. If that was so, how important it was that those who occupied such positions should not be content simply with what might be called mere workmen's knowledge, but should add to that technical culture; and he could conceive nothing more beneficial in that direction than the technical papers which were read, and the technical discussions which took place, in connection with that Association from time to time. To put into precise terms the ideas floating in one's mind was in itself an education, while the difference of opinion which arose in the treatment of any engineering subject was a further step in education and a distinct gain in knowledge. During the past year they had many valuable papers read to them by experts in various departments of engineering; and the fact that such men were content to place before them their thoughts and ideas was the highest testimonial which the Association could receive of its value to public life. Nor was that all. Engineering was a pure democracy: there was always an upward movement from the ranks to the leadership, and they who were engineers in any of its branches knew that it was for the best that that should be so, and that anyone who had the necessary ability, energy, and perseverance should be also able to rise. And then, with regard to the benevolent department of that Association, he pointed out that, besides the superannuation fund for old members and the assistance given to unemployed members, they had also a widow and orphans' fund, so that, should any member of that Association fall on evil days, they would know that the Association would not desert them in the time of their greatest need. He sincerely trusted that so excellent an Association would continue to flourish, and that its funds would be largely increased as the result of that gathering.

JAPANESE EXHIBITION AT TOKIO, 1890.

We give above a view of the principal building in connection with the forthcoming Japanese Exhibition which is to be held at Tokio during the present year. The site selected for the Exhibition is situated in the Uyéno Park, which is one of the most beautiful parts of Tokio. We hope soon to be able to place before our readers plans of the several Exhibition buildings, as no doubt great interest will be taken by many Europeans in this Exhibition. We are indebted to our contemporary, *La Nature*, for our illustration.

SHIPBUILDING NOTES.

The s.s. "Bremerhaven," which was recently launched by Messrs. Russell & Co. from their Greenock yard, was taken on her trial trip on the Clyde on the 14th inst. Her dimensions are: Length, 340ft.; beam, 42ft. 8in.; depth, moulded, 27ft. 4in.; and she has been specially designed for the carriage of petroleum in bulk between America and the Continent. For this purpose the holds are divided into numerous watertight compartments, or tanks, each of which has been severely tested by a head of water before launching. She is capable of carrying upwards of 4,000 tons of oil in addition to bunkers, and is, therefore, one of the largest, if not the largest, bulk steamer afloat. There are two very large oil pumps, made by the Worthington Company, of New York, each of which is capable of discharging the entire cargo in 24 hours, and as all the piping is duplicated, both pumps can discharge at once if required. Two large donkey boilers are fitted to supply them with steam. This is the fourth vessel by the same builders for Messrs. Hermann Stursberg & Co., of New York, and, like her predecessors, she has been built to the designs of Messrs. Flannery & Blakiston, of Liverpool and London, who also superintended the construction of the vessel and her machinery. In addition to receiving the highest class at Lloyd's, the Bureau Veritas have registered her with their special mark denoting that she is practically unsinkable. The engines are by Messrs. Duncan Stewart & Co., of Glasgow, with cylinders 25in., 40in., and 66in. diameter, and with a stroke of 42in. Steam will be supplied by two extra large double-ended boilers having 4,800 square feet of heating surface. Four runs were made on the measured mile at Skelmorlie, when a mean speed of close on 11 knots was obtained.

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IMPROVED WENSTRÖM DYNAMO.

We illustrate herewith a Wenström dynamo of the latest type. Its output is 110 volts and 180 amperes at 500 revolutions per minute. Its weight is 1,800 kilogrammes, or under 2 tons. It has four poles, with the armature conductors in series parallel.

Mr. Wenström was the first, or, at least, one of the first, to imbed the armature conductors in the iron of the armature. He has apparently arranged the field magnets on the ironclad principle. We would suggest that this is a pity, as it prevents ventilation without any compensating advantage.

These machines have been very thoroughly tested in America at the John Hopkins University. They give very good results. It must also be remembered that the method of winding the armature conductors admits of great mechanical strength and durability. These machines are made by the Wenström Southern Electric Manufacturing Company, Baltimore, and are very largely used in America.

SAFETY IN ELECTRICAL DISTRIBUTION.

By James Swinburne.

II.

(*Concluded from page 259.*)

Direct Supply on Low Tension.—In this case direct currents are always used, though there seems no reason why alternating currents should not be employed where batteries are not used. On the two-wire, and perhaps on the three-wire system, danger to life need not be considered. There can, of course, be danger from fire.

In the case of the two-wire system a leak-finder with an earthed middle connection may be used to show that there is a leak; but that is all it can do, for, though it might be advisable to shut down an arc circuit as soon as a fault occurred, especially as the lamps on one circuit are frequently arranged alternately with those on another, it would be impossible to shut down a direct current supply station directly a bad place began to show in some private house. It would be like shutting down a gasworks whenever some one left an unlighted burner turned on. It is no easy matter to localise a fault on a large parallel circuit which is under pressure all the time. The question of localising such a fault, whether possible or not, is outside the present subject. It would seem as if the simple direct current supply low tension system may be really the most troublesome to protect from fires. Of course it takes two faults to cause a fire, though a large general leakage might act as one; but if, on the alarm being given by the first fault, nothing can be done to find out where it is except cutting the houses off one at a time and testing their circuits, there seems to be little to be done until another fault shows somewhere else, and evidence of mischief gives the clue. It may be possible to localise a fault in a direct current system by superimposing an alternating current on the direct current through the leak, and awaiting notice of disturbance from the telephone companies. The telephone might also be applied directly for more nearly localising the leak. Of course, nothing has been said about the safeguard, which consists in putting in good wiring to begin with, and in periodically testing the various consumers' premises. The same difficulties in localising faults, after their existence has been made known, are to be met with in the case of three and five wire disturbances. When batteries are used, and charged in series, and discharged in parallel, the leak-finder, like that discussed in connection with series arc lighting, will detect any failure in the high tension circuit. There are the same difficulties in the discharging circuits as in the case of direct supply already discussed.

Alternating Current Systems.—Alternating systems have received far more attention in the matter of safety than direct current systems, and not without reason, for the transformer is generally placed on the consumer's premises, thus involving the introduction of high tension leads. Even if it is not, there is always the chance of a contact between the primary and secondary circuits at the sub-station, which might result in fires or dangerous personal injuries. The ordinary supply system with a transformer in each house will be taken first.

Danger to life may arise if the primary makes contact with the secondary, and, at least in the case of 100 volt circuits, it is not impossible that a sensitive person who made very good contact might be seriously injured, if not killed, by the low tension circuit. Of this more will be said at a future date. A fire may occur from leakage of the secondary circuit to earth in two places, or by leakage between two neighbouring wires without any earth; or it may occur if the primary circuit comes into contact with the secondary and there is a ground leak on the secondary also. It must be remembered that if the primary were to make contact with the secondary it would probably also soon find its way to earth, as the secondary insulation is seldom fit to withstand 2,000 volts alternating.

The dangers from contact between the primary and secondary circuits may be lessened either by preventing the contact, or by making it harmless if it does occur.

It has been proposed by Professor E. Thomson and by Mr. Kent to surround the primary completely with a sheath of thin metal, and to earth this sheath. This seems a most admirable plan, as low insulation will protect the secondary from the sheath, and even if the secondary were to come into contact with it, and if the primary were to break down too, there would be no danger. It has been urged against this plan that putting an earthed sheath round the primary is tempting it to break down. This criticism is not valid, for if there is the same insulation between the primary and the sheath as there would otherwise be between the primary and secondary there is just as little chance of breakdown, for the low insulation of the secondary circuit is, in comparison, so low, that the primary could find earth practically as soon through the slightly insulated secondary as through the earthed sheath. Even if it were to cause a break down, or, to write more correctly, if a break down were to occur with the sheath, it would be harmless as far as the consumer is concerned.

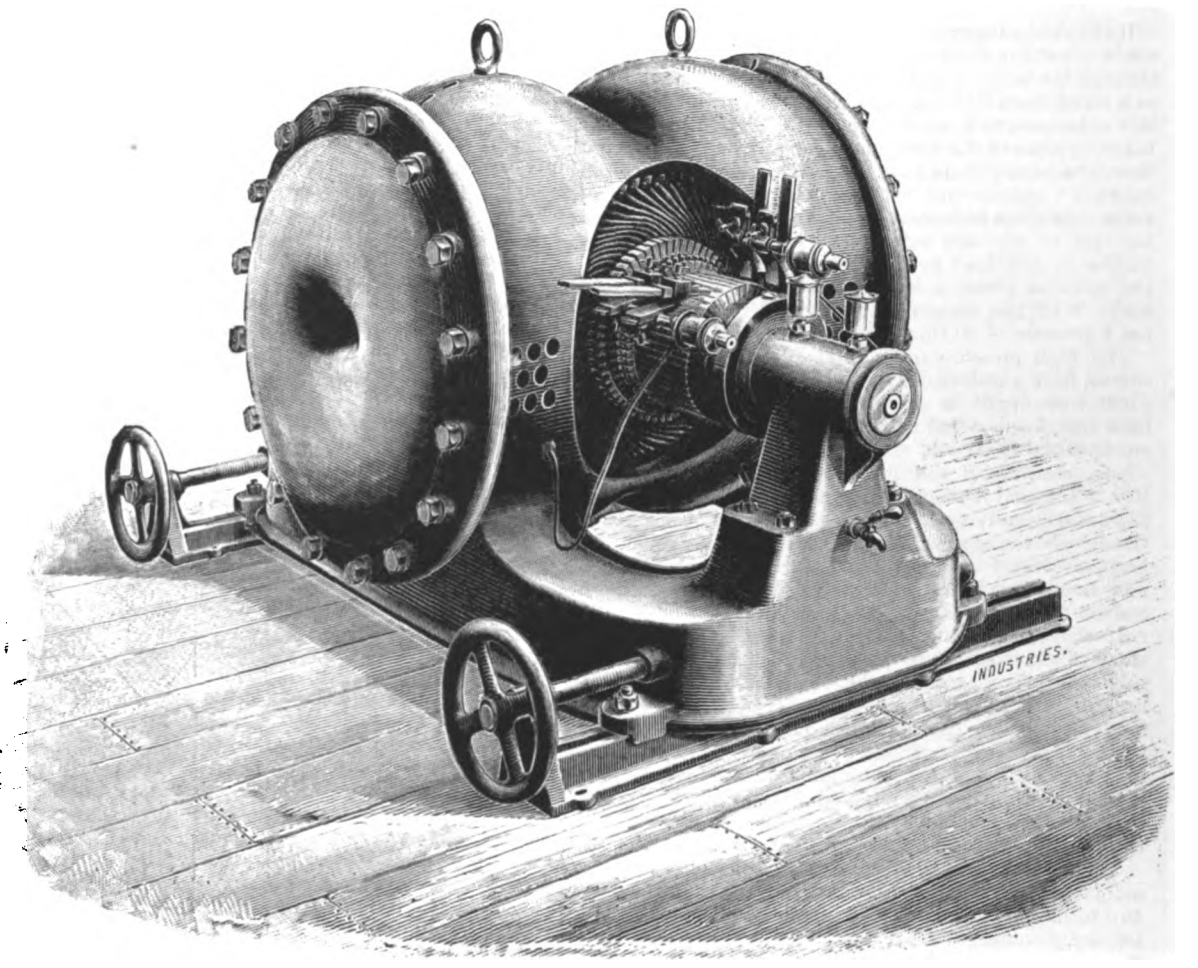
Mr. Mordey strongly recommends earthing the secondary. If the middle of the secondary is earthed there can be no danger from leaks from the primary, as each of the secondary leads can only differ by 50 effective volts from the earth. There is one objection to earthing the middle of the secondary, and that is that it only requires a leak on one lead to cause a fire.

Major Cardew's arrangement and Professor E. Thomson's film and vacuum tube apparatus avoids this difficulty, as it only earths the secondary if there is a dangerous pressure between it and the earth—that is to say, if there is a leak from the primary to the secondary. Major Cardew, in his patent, proposed an arrangement so that if a difference of 200 or 300 volts existed between the secondary and the earth a simple little electroscope short circuited the secondary or primary, and thus blew the fuses on both poles, so that the house was immediately cut off. In practice the little electroscope is arranged merely to make an earth contact with the secondary if necessary, and thus to prevent any danger to life or fire if the primary makes contact with the secondary. This ingenious contrivance will do nothing to prevent fires from faults in the secondary circuit—in fact, it is not intended to do so; it merely prevents danger from the primary. Its advantage over a directly earthed secondary is that it takes two faults in the secondary to cause trouble in the secondary.

The automatic leak-finder is applicable to secondary circuits of transformers, and prevents all sorts of risk. The middle of the secondary is earthed through an electromagnet. The armature of this electromagnet, when attracted, releases a small double-pole spring switch in the primary circuit, and thus cuts the consumer's premises off completely. Take the various possible accidents and trace the action. If the primary makes contact with the secondary there is an earth circuit through a local leak-finder and the station leak-finder. The station leak-finder merely gives an alarm and shows that some house has been automatically turned out. Even if the local leak-finder did not work, the station earth circuit would be broken, so that there is still only one earth in the whole of the primary circuit; and the house is in the same position as if the secondary had been purposely earthed to begin with, or as if the electroscope apparatus was in use. There is no reason to suppose the automatic leak-finder is not absolutely to be relied upon; it is only for the sake of argument, and because the best designed automatic arrangements sometimes go wrong, that this contingency is mentioned. The automatic leak-finder seems to have immense advantages over other methods, as the alarm is given at the supply station, and the whole installation is kept without one leak.

Take next the case of a leak to earth from one secondary wire; the automatic leak-finder immediately cuts the house off. At first sight this might appear to be a rather heroic remedy, but the companies have power, or will have power, under the new regulations, to cut off a house if the insulation is bad, so it cannot but be advisable to cut a house off automatically as soon as a fault occurs, without waiting for someone to find it in his ordinary tours of inspection. If the double-pole switch which is controlled by the leak-finder is locked, the consumer must apply to the company before he can get the light again. It is to be borne in mind that this does not mean that every now and again a house should suddenly be left in darkness; if the insulation is looked after properly, such a thing should never happen. If the light is put out through a fault on the consumer's circuits he has himself to blame, as he is responsible for his leads, and has probably had them put up badly. If his lights are extinguished on account of a leak from primary to

IMPROVED WENSTRÖM DYNAMO.



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secondary, he would have a claim against the company for not supplying him continuously. There is no reason why the primary should not be perfectly insulated from the secondary; and if it is not, the company, too, are in that case flagrantly at fault, and should have to pay a heavy penalty.

If the electromagnetic leak-finder is sensitive, it can be made to cut the circuit off even if a man makes an earth through his body. It is doubtful if this is really advisable, as a shock from 50 volts can hardly do him any harm. If this extreme sensitiveness is not needed, a small fuse may take the place of the electromagnet, as it is simpler, and therefore more certain to act. A fuse like this goes off between a quarter and half an ampere. Such an apparatus thus gives immunity from dangers to life and from fire due to currents running to earth. Earthing the middle of any lead has also another effect; it prevents the extreme pressure coming on the insulation of one lead. With this system, on a 100 volt circuit, each lead has a pressure of 50 effective volts.

The high pressure on a 2,000 volt circuit should, of course, have a leak-finder at the central station. If the 2,000 volt circuit is only intermediate, and is supplied from transformers fed at 10,000 volts, it is most important that the 2,000 volt circuit should be earthed somewhere, especially if the 10,000 circuit is itself earthed. For if not, and if the 10,000 volt gets into contact with the 2,000 circuit, it will easily penetrate the insulation of the house transformers, and will run to earth in the houses. Transformer insulations designed for 2,000 volts and house insulations meant for 100 will offer little resistance to a 10,000 volt pressure.

If the consumers are supplied from sub-stations instead of transformers on their premises, a leak-finder for each sub-station can be used. The difficulties of localising faults then come in, as in direct current supply systems. In this case the leak might be localised with the help of a direct current superimposed on the alternate current and passed through the leak. When there is no network the superimposed current system might be of considerable value, but it is more complicated in the case of networks.

It must be remembered that none of these arrangements provide security against shocks from touching two terminals, or even fires caused by leakage between two neighbouring wires, the whole leak being insulated from the ground. For instance, the leak-finder would not be worked by a short circuit across a double-pole switch on an insulated base.

There is another source of danger from transformers. If two neighbouring turns of the primary circuit come into contact, or, as more often occurs, if two neighbouring layers come into contact, they act as a short-circuited secondary on the transformer, and grow very hot. The neighbouring insulation is burnt, and more primary turns become short circuited until the primary fuse goes. This is not at all an unlikely contingency, for in many transformers there is a difference of pressure of some hundred volts between the neighbouring layers of primary wire. A 10-horse transformer, for instance, if the fuses are set to go at 15 h.p., will, if this accident occurs when there is no external load on, have 15 h.p. converted into heat in its primary coil before the fuses go. If not provided against, this may easily cause fires, and it is also not unlikely that when the whole apparatus is charring the primary and secondary may make contact, and that, as one fuse goes first when there is a gradual rise of current, they would be left in contact. In America one eminent inventor has patented an arrangement, in which he places his transformers in a sort of stove with a chimney, so that if or when this catastrophe does occur the products of combustion are carried away by the flue without setting the house on fire. In this country all danger will be at an end when the Board of Trade rules are enforced, and transformers are confined in fire-proof cases.

There is still one more source of danger, and that is from explosions of accumulated gas in culverts. When the attention of the Commons Committee was called to this danger, during the conflict of the electric light companies, it was generally considered rather far-fetched, but since then there have been several accidents through explosions of culverts. Some culverts are free from this danger, either because they are quite air-tight, or because they have no space for gas to accumulate. The remedy, where there is possibility of accident, is to ventilate the culverts. There are several ways of doing this, by blowers, exhaust fans, &c. One of the simplest, perhaps, is to arrange a ventilating post here and there with a resistance to cause a constant draught. As the resistance can be easily heated by being connected with the mains in the culvert, the cost is small. Of course the resistance itself must not be hot enough to fire any explosive gas that may be finding its way out. A few openings into cool cellars supply cold air and make a draught.

(To be continued.)

PRACTICAL WORKING OF THE ELECTRICAL SUBWAYS IN NEW YORK.

(From our New York Correspondent.)

(Continued from page 259.)

The Johnstone sectional conduit has hitherto been the most extensively employed for distribution in New York City. This consists of sections of cast-iron ducts about 5ft. in length. The sections are placed directly above each other, and are held together when in position by removable clamp pins. The upper section rests in a groove in the lower section. Each section of the conduit is divided into two, six, or more compartments or ducts—depending upon the size of the section, the ducts being formed by removable partitions or slats held in position by suitable channels or grooves within the sections. Opposite each house, or every alternate house, a hand-hole is provided in the upper section of the conduit. This hand-hole consists of a removable cover, about 2ft. in length, on the upper section, and the side of the section at this point is provided with a branch or spigot.

This conduit is laid directly in the earth, not in cement. When it is desired to obtain access to a conductor to tap or loop the circuit into a building, the paving and earth are removed from the street and the cover of the hand-hole is lifted, thus exposing the conductors in the ducts. A 3in. iron pipe is run from the branch at the hand-hole to the basement or vault of the house or to the lamp-post with which connection is desired to be made. This iron pipe fits on to the spigot at the side of the conduit. The connection is then made with the conductors by splicing on short lengths of cable leading through the iron pipe to the house or lamp. Should the conductor which it is desired to tap be at the side of the section remote from the spigot, the intermediate partitions are removed to permit the passage crosswise of the connecting cable. After the joints are made, the cover of the hand-hole is replaced, and the earth and the paving are restored to their normal condition. When a hand-hole has not been provided originally at a point where access is desired to a conductor in the conduit, the entire upper section is removed and replaced by a half-section containing a hand-hole cover and spigot. This work can be done in a short time. The sections in use for this purpose are in some instances somewhat small, for ease in joint-making especially, as but very little slack is available when T joints are to be made, and in future larger hand-holes will be provided. These conduits are presumably made air and water tight at the junction of the two sections, and at the ends of the ducts, by the use of plumber's putty. In view of the number of supposed opportunities for the entrance of moisture at these junctions, it would be naturally expected that this type of conduit would be in a chronic moist condition Indeed, it has been predicted of it that the ducts would act as canals for the surface water, but, as a matter of fact, these ducts are almost invariably dry. There are two theories given to explain this fact—the first, that in reality the plumber's putty makes an air and water tight joint; the second, that if the joints are so imperfect as to admit water, they are quite capable of permitting its escape also. It must be said that this system has been found of much utility in the practical distribution of electric light currents. Recently a method of distribution in which wrought-iron pipes are used has been employed, consisting of a row of three or four iron pipes laid like the Johnstone conducts as near the surface as possible, in the earth, without concrete. Opposite every party wall, or at intervals of about 50ft, iron boxes about 18in. square are placed. These boxes have removable covers. The ducts enter at the ends of the box, but do not pass through it. The boxes are provided with side openings also for the entrance of the subsidiary iron pipes. Access is had to these boxes also by the removal of the street paving and earth. This method of distribution has, like the one just described, been found satisfactory. Certain mechanical improvements in the construction of both are, however, desirable. When it is desired to cross a street to reach customers subsidiary ducts are constructed.

The cables used for telephone service are chiefly of the Patterson type, ordinary cotton covering being used. The conductors, after being cabled, are drawn into a lead covering, and paraffin forced into the interstices. The insulation resistance laid and jointed in the subways is about 100 megohms, and the electrostatic capacity about ·16 microfarad. The longest stretch of telephone cable is seven miles, and the greatest number of conductors a hundred or fifty pairs. The telegraph companies have used kerite, okonite, Waring, and Patterson cables. The kerite and okonite are india-rubber compounds, and not usually lead-covered, although they might be. The Waring and the Patterson have fibrous covering saturated with insulating compounds and lead-covered. The india-rubber insulation has given satisfaction, excepting in the vicinity of steam pipes where the heat runs as high as 200° F. The average number of conductors in the telegraph underground cables is about fifty. The size of the wire used is No. 16 B.W.G., and the outside diameter, including the insulation, $\frac{6}{32}$in. The insulation resistance of the okonite insulation is about 2,500 megohms, that of the kerite 500 to 800 megohms, and that of the Waring and Patterson about 1,500 megohms per mile for the thickness of insulation. Outside of the injury to the cables due to the presence of the steam heating pipes no undue deterioration of the telegraph cables in the subways has been noted. The effect of the increased electrostatic capacity of the underground circuits has not caused any marked inconvenience in the operation of the telegraph circuits. Most of the telegraph conductors are placed on the elevated railroad structures instead of in the subways.

In the electric light service there are, exclusive of the Edison system, four different types of insulation used—namely, the Bishop rubber compound, the Waring, the "Safety" insulated, and the Cobb vulcanite-paraffin cable. All of these cables are lead-covered, as a precaution against mechanical injury, action of acids, &c., or moisture.

The sizes of conductors used in the electric light service vary with every company and with the character of the service. For feeders the conductors range in size from No. 6 down to No. 2 American gauge. For mains, from No. 2 to No. 6 American. In many instances, No. 10 American is used for connecting from the mains to lamps through the subsidiary ducts.

There are now in actual service for electric lighting purposes in the New York subways over 95 miles of Waring cable, carrying currents of an e.m.f. of from 500 to 3,000 volts, including many 1,000 volt alternating currents, and an additional 50 miles of the same cable will shortly be in operation. The thickness of insulation used in these cables is $\frac{5}{32}$, $\frac{6}{32}$, and of $\frac{7}{32}$ an inch. This refers to the thickness of the insulation from any given point of the circumference of the conductor.

The insulating material of the "Safety" cable is an india-rubber compound. This compound is vulcanised to a moderate degree of hardness sufficient to prevent decentering of the heavy conductors which it insulates, but yet it retains a high degree of flexibility. The thickness of insulation used in No. 4, B. and S. wire, ·204in. diameter, is ·108in. The weight of this conductor, lead covered, is 4,861lb. per mile.

A special thickness of this insulation was made in one instance in response to a call for cable to withstand a strain of 7,000 volts for arc lighting. This cable is now in the subways. Its length is about three miles. There are now over 65 miles of the "Safety" cable in actual use in the subways, assigned to electric light circuits, carrying continuous and alternating currents of from 1,000 to 2,500 volts e.m.f., and about 15 miles additional are now being placed in subways.

The Bishop rubber compound cable is of the well-known Silvertown type; having first a coat of rubber without sulphur, then a coat of rubber compound with sulphur, and over this a lapping of rubber cable, which is then taped. There are two sizes of this cable in the subways, namely No. 4 and No. 6 American gauge. The thickness of the insulation is $\frac{4}{32}$in.; the thickness of the lead covering is $\frac{5}{64}$ of an inch.; the outside diameter of the cable is 0·65 of an inch.; and the weight of the cable is about 3,432lb. per mile. There are of this cable in successful operation about ten miles assigned to alternating currents of 1,000 volts, and five miles to arc circuits of 2,500 to 3,000 volts e.m.f. Double this amount of this cable will soon be laid for similar purposes.

The Cobb vulcanite-paraffin cable is of a unique construction and design. It also differs, materially in one respect, from the other cables described, in that the conductor is freely movable within its insulating medium. The cable is made in practically the following manner: A vulcanite tube is first made in lengths of about 300ft. This tube is moderately flexible. The tubing is vulcanised in boiling paraffin. The wire is then threaded through the tube, after which the sections of tubings are jointed together. A thick cord is then wound spirally around the vulcanite tube. The whole is then lead-covered, and the space between the vulcanite and lead formed by the spirally wound cord is filled with paraffin. There are about 25 miles of this cable in the subways.

In the case of the Bishop, "Safety," Cobb, and Patterson cables, the lead is alloyed with about 3 per cent. of tin. The lead covering of the Waring cable is unalloyed, but it is covered with a thick cotton braiding soaked in "P. & B." paint (the latter a product of petroleum), which, it is claimed, will protect the lead from acid gases, &c., and the braid also acts to protect the lead from mechanical injury.

All of these cables are guaranteed by the manufacturers for three years. This term, however, is not to be taken as signifying the limit placed upon the life of the cables by the manufacturers. It is over a year since current was turned on the first high-tension electric

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light circuit in the New York subways. The insulation resistance of the cable, as measured just before the turning on of the current, showed it to be 1,750 megohms per mile. A test made of the same circuit, after one year's continuous service, showed an insulation resistance of 1,516 megohms. Since the installation of the circuit just referred to, electric light cables of the various types described have been drawn into the subways almost as rapidly as they could be manufactured, and tests made of the conductors, months after the initial test, have shown them to be in the same electrical condition as when first laid. There have been several burn-outs in cables in the subways within the year, but, with the exception of an abandoned type of cable, these burn-outs have been traceable in every case to defective joints or to mechanical injury. In all, according to the records, and best obtainable information, there have been, exclusive of those in the abandoned cables, but five burn-outs in over 185 miles of electric light wire during a period of active service of the conductors, ranging from one month to thirteen months. In the case of 27 out of 34 of the electric light circuits in the subways, not a single defect of any kind has occurred since they were placed in the ducts. There have been several instances when faults not amounting to burn-outs have been discovered by the regular tests, which have brought the insulation resistance of certain conductors below the requirements of the rules of the subway, but these defects have generally been located and removed without serious delay to the circuits. Where this has not been the case it can be fairly attributed to the employment of untried insulation, unfamiliarity with underground service, or to the inexperience of the men to whom the work of connecting up circuits, &c., has been entrusted. For instance, in a number of cases grounds have been traced to contact of the conductor with the lead covering, and the linemen so connecting them have explained that they were not aware the lead covering would cause a ground.

The method employed for locating faults in electric light conductors in the subways is to test the conductor from point to point until the defect is placed between two lamps or man-holes. When a fault is located between two lamps or two man-holes, if it is in the cable proper and not in a joint at a hand-hole or box, the defective section is withdrawn and a perfect section put in its place.

In the case of arc light or series circuits, defects in the cables are more readily located than in multiple arc circuits, because of the facility afforded by the openings at the lamps for testing the conductor in sections. In the case of multiple arc circuits, there is at present no means of locating faults but by cutting the conductor in man-holes. For, as the house connections are made from the cable by T joints, it is obvious that the only effect of disconnecting the lamps or converters from the cable is to separate the two conductors of the circuit. No attempt is made to locate faults in electic light circuits in the subways by electrical measurements, for the reason that the obstacles in the way of obtaining accurate data are so numerous that it has not been considered expedient to rely on the results of such measurements—for instance, the uncertainty as to the distribution of the resistance of the conductor, owing to the numerous joints in the circuit; the variations in temperature of the subways and the difficulty in ascertaining it, &c. To facilitate the locating of faults, should they occur in the subways, several forms of accessible joints have been suggested for use in the manholes.

(To be continued.)

THE INSTITUTION OF ELECTRICAL ENGINEERS.

At the adjourned discussion on Mr. Swinburne's and Mr. Esson's papers on the 13th inst., Professor Ayrton exhibited curves representing results of experiments on the Gramme magneto and Gramme dynamo when run as motors and generators, which he described on the 27th ult. From these observations, he concluded that Mr. Swinburne and Mr. Esson were wrong in saying that the back e.m.f. in a motor could not be greater than the forward e.m.f. in a dynamo working under the same conditions as to speed and current. The secret of obtaining this increased e.m.f. in motors was, he believed, the employment of a relatively powerful armature.

Mr. Willans, speaking of the Admiralty temperature limit, said that in testing the combined efficiency of engines and direct driven dynamos they had, with machines that run cool, obtained 84 or 85 per cent. of the indicated horse-power available at the dynamo terminals. On the other hand, machines that get hot never yielded more than 70 per cent. Whilst agreeing with the Admiralty that the rise of temperature allowable should be small, he objected to the method of taking the temperature; this method he characterised as being more a test of the heat conductivity of the insulation and thermometer than of the temperature of the machine.

Professor Forbes said he could not accept Mr. Swinburne's statement that self-induction *prevents* waste of power, for all sparking is due to self-induction, and consequently it *causes* a waste of power. Another point about which he had grave doubts was the efficacy of the method of throttling cross induction. His own opinion was that such methods would tend to concentrate the lines about the trailing corners of each half of the partially divided pole piece, and to diminish them at the leading corners of each half. He also thought that by partly filling up the space at E a greater induction through the armature would be obtained. Referring to reversing pole pieces, he thought them ingenious, but open to considerable objection, and believed other and better means of preventing sparking would be devised. Coming to Mr. Esson's paper, he said the author's remarks, respecting the utility and accuracy of calculating the waste field, were directly opposed to his own opinion on the subject, and also to the experience of Mr. Ravenshaw. This point, he thought, gave a good instance of how some self-designated "practical men" object to spend the few hours necessary to calculate the waste field, and prefer spending a month's labour in making a machine, with all its attendant expense, in order to obtain experimentally results which could have been readily derived by calculation.

Mr. Mordey did not agree with Professor Forbes as to the result of reducing cross induction by the methods shown in Figs. 3 and 4 of Mr. Swinburne's paper; in fact, he considered the plan quite natural, and it was very effective in well-designed machines. He thought that subsidiary or reversing pole pieces would not be practical, and that sparking is generally due to overloading. A better plan of preventing sparking would be to utilise the additional length of armature which the pole pieces require for lengthening the main core, thereby reducing overloading.

Mr. Swinburne here pointed out that the devices were not to prevent sparking, but to reduce the back turns, thus diminishing or rendering unnecessary the series windings on machines for constant e.m.f.

Mr. Mordey (continuing) referred to "small air space dynamos," and said Mr. Swinburne was once a great advocate of such machines, as well as of "large output dynamos." However, as far as he was aware, no great progress had been made with either variety, for makers seem to have come back to machines having moderate air spaces and of moderate output. The Brush machine had been tried shunt wound, but it would not excite at small loads, and at large loads it flashed round. The supposition as to the cause of excessive heating of the trailing horn given in the paper was not satisfactory, for the same corner heats if the machine be run as a motor, only not quite so much. The effect is probably due to the magnetic tufts from the Pacinotti projections. In discussing methods of measuring temperature of machines, he said this was sometimes done by measuring the resistance of the armature when hot, but this was not to be relied upon, for, owing to expansion and consequent charge of coated resistance at the soldered joints, the resistance hot might be less than when cold.

Mr. Sayers questioned the accuracy of Mr. Swinburne's view of the action of coils short-circuited by the brushes shown, and thought the various statements were not consistent. One serious cause of sparking, which had not been referred to in either paper, was the want of accuracy in making all the sections and commutator bars exactly alike, and spacing them with rigorous exactness, round the armature. In his opinion nothing short of the accuracy obtained by engineers in cutting wheels would effectually overcome sparking. Neglect of such precaution causes variation in the non-sparking position, the result of which may sometimes be seen in some segments being marked whilst the others remain perfect.

Mr. Crompton said in making large machines difficulties presented themselves which were unimportant in small dynamos; for example, as pointed out in Mr. Swinburne's paper, the magnetic leakage across the internal cavity of Gramme armatures becomes serious. On the whole, he was inclined to agree with Mr. Swinburne's remarks on the disadvantages of Gramme as compared with drum armatures. Some doubt, he said, still exists as to the necessity of insulating the driving hubs of drum armatures from the shaft; in his opinion it was not necessary. The question as to what material should be used for transmitting the driving strain from the shaft to the armature required careful consideration; he himself found aluminium bronze and delta metal fairly satisfactory, for they combine good mechanical strength with high electrical resistance. Another point requiring particular attention was the subdivision of the armature conductors in machines for large currents. The heating of the conductors in "bar armatures" due to Foucault currents may be considerable, but by subdividing the bars into sections, and twisting them through half a turn, he had succeeded in reducing this effect to about half its former value. Referring to Mr. Mordey's statement about the lessened resistance of hot armatures, he said he had never observed such an effect, and thought the joints in machines exhibiting such peculiarities must have been defective. In conclusion, Mr. Crompton replied to Mr. Esson's remarks respecting his dynamo, by saying that this was the first machine in which the design had been influenced by the idea of magnetic resistance; and he was glad to see that its armature was the father of all modern ones of the Gramme type. In support of this he pointed out that the ratio of radial depth to diameter was one to five, a proportion now almost universally adopted.

The discussion was then adjourned to the 20th inst.

THE PHYSICAL SOCIETY.

At a meeting of the Physical Society, held on the 7th inst., Dr. S. P. Thompson described Bertrand's refractometer, and exhibited the capabilities of the instrument before the Society. Its action depends on total reflection. The refractometer consists of a hemisphere of glass, about 8 mm. diameter, set at the end of a tube, the plane face being outwards and inclined at about 30 deg. with the axis. One side of the convex surface of the hemisphere is illuminated through a piece of ground glass, set about perpendicular to the plane face. The hemisphere is viewed through an eye-piece focussed on a scale divided to tenths of millemetres placed within the tube. The instrument is particularly useful for mineralogical specimens and liquids. The procedure in the latter case is to smear a film of the liquid over the plane face of the hemisphere, and by looking through the eye-piece determine the scale reading of the line which separates the light and darker portions of the field. A reference to a calibration table gives the refractive index. In experimenting with solids, a thin film of a very dense liquid (supplied with the instrument) is placed between the specimen and the glass, and the procedure is then as above. The refractive index of opaque solids can be determined in this way. In using the instrument for minerals great care must be taken not to scratch the glass. The handiness of the refractometer and its perfect portability (its dimensions being about 5 cm. long by $2\frac{1}{2}$ cm. diameter) are great recommendations.

In the discussion which followed, Mr. Blakesley asked to what accuracy the scale could be read, and whether the sensitiveness of the instrument was at all comparable with that of other methods; and Professor Dunstan inquired if it could be used with volatile liquids. In reply, Dr. Thompson said that with non-homogeneous light the scale could be read to one division, but with a sodium flame one-tenth of a division could be estimated. For volatile liquids a drop may be used instead of a film, or the evaporation of a thick film may be pre-retarded by a cover glass.

Professor Dunstan then described an apparatus for distilling mercury in a vacuum, devised by himself and W. Dymond, and showed the working of the arrangement. It consists of a 3 mm. soft glass tube, rather more than a metre long, having an oblate spheroidal bulb blown at the upper end. The bulb is placed over a ring burner. At the top of the bulb, a tube of 1·5 mm. diameter is attached, and this passes outside the bulb and descends close to the larger tube. The part of the smaller or fall tube just below the bulb is enlarged so as to form a condensation chamber, and the lower part serves as a Sprengel tube. A conical reservoir, containing the mercury to be distilled, is in flexible connection with the lower end of the large tube, as in Clark's well-known apparatus. The advantages claimed for the new apparatus are, its relative shortness and portability, the small quantity remaining undistilled, and its non-liability to damage derangement if left unsupplied with mercury. To ensure satisfactory working a constant pressure of gas is necessary, and this is obtained by inserting a Sugg's dry governor in the supply pipe. During distillation, peculiar green flashes are seen within the condensation chamber, and these are intensified by bringing it near an electric machine in action. The apparatus also serves well to show the character of an electric discharge through mercury vapour, for the mercury in the two tubes may be used as electrodes.

After the reading of the paper, Professor Thompson said he devised a simple form of distilling apparatus some time ago which answered fairly well, and could be made by any amateur glass worker. It consisted of a double barometer, one leg of which was of small bore, so as to act as a Sprengel tube. The rising part of the bend at the top of the larger tube was expanded, and served as the evaporating chamber, below which a burner was

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placed. The President asked why Clark's apparatus is made so lengthy. In reply to this question, Mr. Boys said that as the fall tube goes down within the rising one, the mercury near the top of the latter is heated by the condensing mercury (thus economising gas), and hence condensation does not take place until the vapour has passed a considerable distance down the fall tube.

Professor S. U. Pickering then read a paper on "The Theory of Osmotic Pressure and its Bearing on the Nature of Solution." The author said that considerable doubt exists as to the accuracy of the premises on which the theory is based, and if the theory is to be regarded as true, and not merely a rough working hypothesis, the following conditions must be fulfilled by weak solutions: (1) The molecular depression of the freezing point must be independent of the nature of the dissolved substance; (2) any deviations from (1) must be in the direction indicated by the theory; (3) the depression must be independent of the nature of solvent; (4) the depression must be independent of the amount of solvent (all solutions being weak); (5) the deviations, with strong solutions, should be in the theoretical direction, and (6) they should be regular. Prof. Pickering proceeded to show that experiments, instead of confirming the above statements, disproves them all. As regards (1), without counting abnormally low (half) values, Raoult's results show variations of 60, 40, 30, &c. per cent. in different cases, and the author quoted other values where the variations were 500, 260, 230, &c. per cent. These variations, he considered, were too great to be explained by the fact of the solutions used being three or four times too strong. Referring to (2), he said that low values are explained by the polymerisation of the dissolved molecules, high values by their dissociation into ions. He then argued that there are no abnormally high values, for the view that such exist and that they are explainable by dissociation involves the following conclusions:—(*a*) That the more stable a substance is, the more easily is it dissociated; (*b*) that solution dissociates molecules which we know can exist undissociated as gases; (*c*) that water must consist of $1\frac{1}{2}$ H_2O and the atomic theory is wrong; (*d*) that energy can be created, and therefore the theory of its conservation is untenable. With respect to (3) it was pointed out that in many instances the same dissolved substance gives the full depression with one solvent, and half depression with another. Cases were quoted where the depression produced by the same dissolved body in different solvents showed variations of 36,000, 21,000, and 28,000 per cent. In discussing (4), the author said that, even with solutions weaker than that corresponding to a gas, the law is not fulfilled. Taking the case of sulphuric acid (the only one at present fully investigated), the variations amount to 40 per cent., or about 28 times the experimental error. With reference to (5) it was stated that with strong solutions the molecular depression should become smaller, but in every known case (nine were quoted) it becomes larger, the increase in one instance being 3,200 per cent. As regards (6), all experimental data available, especially those relating to sulphuric acid, show that the deviations are neither regular nor always in the same direction.

M. T. H. Blakesley said he was greatly interested with Professor Pickering's paper, for some time ago he was induced to make experiments on the volume of salts in solution by reading Joule's papers on that subject. Some of the results confirmed, but others did not agree with, Joule's theory that the molecular volume in solution was a whole number. If this theory was true, then (he said) it would be possible to predetermine the density of solutions, and from the measured density of any known solution we could determine the water of crystallisation of the salt from the formula

$$n = (A/H_2O + x)[1 - (D - 1)\,W/w]/D$$

where W and w are the masses of the water and salt respectively, D the density of the solution relative to water at the same temperature, A the molecular weight of the dehydrated portion of the salt, x the number of molecules of water, and n the molecular volume of the salt in solution, the two latter being whole numbers.

Notes.

PATENTS IN QUEENSLAND.

We have recently received the first installation of a series of publications containing the complete register and illustrated abridgments of the patents granted in Queensland from 1860 to 1884. A patent law was first established in that colony in the former year, but it was far from being perfect, and it continued in that state until 1884, when the improved law came into force. During those twenty-four years no official abridgments of patents were made, and these arrears of work have devolved upon the Patent Office during the last few years. Great difficulties were in the way of the successful completion of the undertaking, but the authorities have managed to turn out some very satisfactory abstracts and illustrations.

RAILWAY CONSTRUCTION IN THE UNITED STATES.

According to the *Engineering News*, railway construction in the United States will, during the present year, show more activity than in any year since 1887. A summary shows 5,038 miles partially completed, 7,041 surveyed or under survey, and 2,831 miles to be surveyed—a total of 14,910 miles. Canada has a total of 2,118 miles.

A NEW PHOSPHORUS COMPOUND.

In the course of a lecture at the Royal Institution on Friday last, on "The Glow of Phosphorus," Professor T. E. Thorpe mentioned that, in experimenting on the slow combustion of phosphorus, he had recently discovered a new compound whose composition is represented by the formula P_4O_6. This body exists as acicular crystals, which melt on the application of the hand, and it can be made to glow in the same way and under the same conditions as phosphorus itself. It readily burns in oxygen and chlorine, and its action on ethyl alcohol is to form the hitherto unknown compound $POH(C_2H_5O)_2$. It is quite probable that further researches as to its properties will reveal some interesting facts about the glow of phosphorus.

MINING IN CHILI.

Some time back a new mining law was passed in Chili, and a full translation thereof has now been published by the Foreign Office. The effect of the law will be to greatly encourage the mining industries, and this should open up an increased market for the makers of mining plant in this country. Chili possesses a very large number of gold mines, but these were abandoned when copper mining was taken to, and also because at a certain depth they all run into iron pyrites, and with the primitive method of extraction then existing 60 per cent. of the gold was lost in washing the pyrites. The people at present working gold mines are poor, and without the necessary means of working on a scale adequate to the requirements of the industry, and for introducing new and more perfect methods of gold extraction. The remedy suggested is that English syndicates should be formed for taking up mining properties in Chili, and to exploit them with modern machinery.

THE PROPOSED UNDERGROUND RAILWAY IN EDINBURGH.

Notwithstanding the decided opposition which is offered to the proposed underground railway in Edinburgh by the Town Council, there is a considerable feeling in favour of the proposals of the Caledonian Railway Company. The Trades Council has strongly supported them, and expressed the opinion that if carried out they would promote the prosperity of Edinburgh and Leith. Sir James Gowans, the Dean of Guild of the City, supports them on the same grounds, and moreover thinks that, if certain precautions were taken, the amenity of the city would be enhanced rather than depreciated. Recent events have shown the correctness of the opinion which we expressed when writing of the subject a few weeks ago. (See *Industries* of the 28th ult.). We said that "if the North British and the Caledonian Railway Companies, instead of attending only to their own interests, would unite, and bring forward a scheme which, while respecting the rights of owners and of the community, also met the convenience of the general public, it would receive the support of all concerned, and would in the end lead to their own advantage."

TWENTY-FIFTH ANNIVERSARY OF THE BENZENE THEORY.

On March 11th, in Berlin, was held a meeting to celebrate the twenty-fifth anniversary of the benzene theory as advanced in 1865 by Professor Kekulé, of Bonn University. Since this date rapid strides have been made in organic chemistry mainly by its aid, and as a result of this progress in the pure science many important technical industries have arisen, which, by the manufacture of coal-tar colours, pharmaceutical and medicinal products, disinfectants and antiseptics, have wrought immense changes in the health, comfort, and progress of mankind. At the meeting the secretary of the London Chemical Society presented the following address from the Society:—"The President and Council of the Chemical Society, on behalf of British chemists, desire to offer to Professor August Kekulé their warmest congratulations on the occasion of the twenty-fifth anniversary of the promulgation of his theory of the constitution of aromatic compounds. The influence which the felicitous conception of benzene as a closed chain has had on the development of chemical theory, the impetus which it has imparted to the intricate problems of isomerism among the derivatives of this and similar compounds, and the guidance which it has afforded in an industry of such importance and magnitude as that of the coal-tar colours, is universally recognised; and it is with special pleasure that the countrymen of Faraday, the discoverer of benzene, recount these benefits while paying honour to their author. This theory found the chemistry of even the immediate derivatives of benzene an almost untilled field. It has transformed it into a fertile province, to which have been annexed regions the very existence of which was unknown. May it long be permitted to Professor Kekulé, whose work has been so full of suggestion and inspiration, to remain witness to the benefits which continue to flow from his fruitful generalisation."

PRODUCTION OF PIG IRON IN THE UNITED STATES.

The production of pig iron in the United States of America is making rapid progress. During 1888 the output was about 6,000,000 tons, while for last year, although the exact figures have not yet been published, it is estimated at 7,600,000, being an increase of nearly 13 per cent.

A LARGE SALT FIELD.

At the annual meeting of the Stockton-on-Tees Chamber of Commerce the President stated that the Teeside salt field covered an area of eleven square miles, averaging 70ft. in thickness, although in some places it was as thick as 100ft. Each acre contained about 200,000 tons of salt, and the district contained enough to supply the whole world for 800 years.

THE INDUSTRIAL DEVELOPMENT OF THE SOUTHERN STATES OF AMERICA.

The difference in the industrial position of the Northern and Southern States of America has always constituted one of the greatest difficulties in arranging the policy of the United States of America. In fact, it may be said that this difficulty was as great a factor in causing the war between the North and the South as the slave question. In his recent message to Congress, the President pointed out the advisability of developing the industrial resources of the Southern States. From recent reports it seems as if that development were taking place with rapid strides. Particular attention is being paid to the improvement of the facilities for internal and external communication, and especially to the navigation of the rivers and harbours. Considerable quantities of coal are now being exported, while a large importation of Cuban or Spanish iron ore has taken place, for use in making steel from native ore, is anticipated.

FOREIGN TRADE OF JAPAN IN 1889.

It will be some time before complete reports are published of the foreign trade of Japan during 1889, but a short summary has been issued, some of the items of which may in the meantime be mentioned. The total trade excluding exports and imports of specie, amounted to 136,163,459 dollars, against 131,160,739 last year, showing an increase of over five million dollars, the greater part of which has taken place in the exports, for the imports were almost stationary. Yokohama, of course, takes the first place, with a total trade of 76,183,046 dollars, the imports showing a decrease of nearly two-and-a-half million dollars, and the exports an increase of about a million dollars. In Kobe (Hiogo-Ozaka) the total was 49,759,332 dollars, being an increase of over four million dollars. This increase is largely due to the improved railway facilities which now connect Kobe with the interior and open up the country for trade. The trade of Nagasaki is about ten million dollars, while that of Hakodate is under one million. The foreign trade of Japan for last year does not show very much of an increase, but it ought to be remembered that during the previous five years the increase was very great, and it is satisfactory to find that the total amount has been maintained.

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Patent Record.

(Compiled from "The Illustrated Official Journal (Patents).")

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

3rd March, 1890.

3321. Jewiss, A. ..... Sewing machines.
3324. Hoey, D. G. ..... Apparatus for ventilating.
3326. Anderson, A. ..... Sewing machines (*Singer*).
3330. Fisher, T. ..... Screw propellers.
3336. Bibby, T. ..... Saws.
3341. Melvin, A. M. ..... Hydraulic engines.
3343. Fletcher, Brown, & Ure Brick and pottery kilns.
3344. Morgan, D. J. ..... Furnace grates.
3345. Ives & Barker ..... Lifting and lowering bridges, viaducts, &c.
3346. Barnett, F. ..... Low level bridges.
3347. Sheppard & Rispin ..... Couplings for railway carriages.
3348. Walker & Stephenson (trading as John Perry) ..... Vices.
3349. Taylor, J. ..... Removing sand from river beds, &c.
3356. Jones, W. J. ..... Oil cups.
3359. Cutlan, F. ..... Machines for attaching heels.
3363. Heucken, C. ..... Coke ovens.
3369. Cammell, G. H. ..... Welding metals.
3370. Van Gülpen, M ..... Cigar-bunching machines.
3383. Johnstone, J. F. ..... Drying machines.
3385. Tafel, P. A. ..... Separation of iron from grain.

4th March, 1890.

3386. Ball, A. F. ..... Calculating machines.
3394. Brown, A. F. G. ..... Metallic packing.
3395. Morgan, D. J. ..... Steam gauges.
3396. Wade, J. ..... Self-feeding motor.
3400. Allison, H. J. ..... Rock drilling machine (*Githens*).
3402. Wilson & Welsh ..... Protecting locomotive engines and trains from damage by collisions.
3404. Legge, J. ..... Lever rim locks.
3405. Salmon, H. ..... Automatic registering machines.
3414. Légé & Job ..... Air meters.
3415. Armour & Armour ..... Retorts for distilling shale.
3420. Whytlaw & McLaren ..... Looms.
3423. Summerskill, C. W. ..... Compound valve.
3428. Edwards, D., Jun. ..... Lifts.
3431. Naylor & Williams ..... Moulding bricks.
3434. Mayer, L. J. ..... Extinguishing fire.
3435. Cousins & Clarke ..... Machinery for bending cranks.
3438. Boult, A. J. ..... Tool-grinding machines (*Benton & Waldo*).
3442. Pegg, S. J. ..... Stone-breaking machines.
3447. Caspar, H. ..... Sleeping cars.
3449. Shaw, D. D. ..... Car couplings.
3451. Naylor, W. H. ..... Machinery for twisting cords.
3454. Trask, C. H. ..... Milling machines.
3456. Billings, J. D. ..... Machines for the manufacture of horse shoes.
3457. Lake, H. H. ..... Machines for lasting boots (*Copeland*).
3462. Von Solemacher, Baron A. ..... Manufacture of bricks.
3466. Justice, P. M. ..... Wood working machines (*Thompson*).
3468. Horsey, J. G. ..... Chairs for railways.
3469. Denne & Denne ..... Sewing machines.
3473. Malam, W. ..... Steam generators.
3474. Kiddier, Kiddier, & Kiddier ..... Rotary knitting machines.
3476. See, H. ..... Pistons.
3477. See, H. ..... Horizontal pistons.
3478. Graham, J., Jun., & Graves ..... Hydraulic travelling cranes.
3479. Sharpe, F. S. ..... Sewing machines.
3483. Burdom, L. L. ..... Seamless compound ingot
3485. Brotherhood, P. ..... Slide valves.
3486. Winburn, W. ..... Ball valves.
3487. Lake, H. H. ..... Smoke consuming furnaces (*Walker*).

5th March, 1890.

3488. Ledward, T. ..... Ejector condensers.
3497. Hampson & Bagnall ... Links of chains.
3498. Hunter & Machie ..... Winding yarn.
3500. Sayer, R. C. ..... Hoists and elevators.
3504. Fox, S. ..... Dies.
3506. Pickering, J. ..... Increasing the draught of furnaces.
3507. Sparkes, S. H. ..... Machinery for sectional warping.
3511. Campbell, H. ..... Machinery for making nails.
3514. Lloyd & Hemming ..... Draining tramways.
3516. Thompson, W. P. ..... Railway couplings (*Ford & Whitworth*).
3525. Schönheyder, W. A. G. Sight feed lubricator.
3531. McDougall, A. ..... Construction of vessels.
3535. Borland, Wood, & Carter ..... Injectors.
3536. Jones, W. ..... Sewing machines.

6th March, 1890.

3543. Elwell, T. ..... Steam boilers.
3549. Sabel, F. W. ..... Engraving machines.
3550. Johnston, D. ..... Lowering ships' boats, &c.
3552. Auld, W. ..... Furnaces.
3554. Elsworth, J. F. ..... Hydraulic valves.
3568. Mackenzie, J. ..... Propelling vessels.
3573. Parsons, E. ..... Railway chairs.
3575. Hayes, J. ..... Light steel railway.
3581. Granotier, P. ..... Constant water level in steam boilers.
3583. Lindner, R. ..... Starting gear for compound locomotives.
3587. Kreyczik & Kapri ..... Operating tramways.
3588. Horn, W. W. ..... Metallic railway cross-tie and rail-fastening (*Wiegand*).
3590. Hughes, Rigby, & Pirrie Valve for hydraulic elevators.
3591. Paddon, E. F. ..... Furnaces.
3593. Marchant, S. W., Jun. Apparatus for the manufacture of paper.
3594. Redfern, G. F. ..... Nut locks (*Barney*).
3595. Stanley, R. ..... Boring machines.
3599. Boult, A. J. ..... Metal cylinders (*Coas*).
3603. Pifre, A. ..... Hydraulic lifts.

7th March, 1890.

3614. Holgate, F. ..... Doors of lifts.
3615. Milnes & Birks ..... Round or conical shot and shell.
3621. De Macedo, J. A. ..... Tram rails.
3626. Norton & Hinchliffe ... Apparatus for dyeing warps.
3627. Arnall & Peirce ..... Hydraulic lifts, &c.
3632. Taylor, G. ..... Loading and discharging vessels, &c.
3634. Earnshaw, A. ..... Planing machines
3637. Walker & Carey ..... Lifts.
3642. Bawden, R. ..... Ploughs.
3646. Blaiberg & Marson ..... Drill braces, &c.
3651. Teasdale-Buckell, G. T. Printing apparatus.
3659. Galloway & Beckwith Slide valves.
3665. Papendick, R. E. ..... Fitting pulleys to shafts, &c.
3668. Foulds, R. ..... Circular shuttle box looms.
3674. Naumburg, S. J. ..... Railway switches.
3675-6-7. Lever, Holland, & Todd ..... Boiler furnaces.

8th March, 1890.

3678. Tosh, G. ..... Rolling mill machinery.
3679. Hulme, W., Jun., & Hulme Connecting pipes.
3681. Keith, J. ..... Hydraulic valves.
3688. Rothwell, Rothwell, & Collier ..... Picking motion of looms.
3696. Culpan, J. ..... Looms.
3699. Hetherington, J. M. ... Mules.
3700. MacLellan, J. A. ..... Stop valves.
3703. Norton & Hinchliffe ... Apparatus for dyeing hanks.
3704. Bremberg, A. ..... Rotary gun carriages.
3706. Phalp, O. ..... Automatic relief springs.
3707. Pollard & Lichtenstein Fastening rails to sleepers.
3719. Harrison & Howard ... Connecting metallic pipes.
3724. Brooke, J. W. ..... Steam capstans.
3729. John & Maylin ..... Tube expander.
3735. Hayes, J. R. S. ..... Rolling or pressing machine.

ELECTRICITY.

3rd March, 1890.

3322. Keep, F. ..... Voltaic battery (*Morrin*).
3335. Schirner, A. ..... Incandescent lamps.
3373. Sappey, M. ..... Charging secondary batteries.
3374. Pritchett, G. E. B. ..... Accumulators.

4th March, 1890.

3419. Van Depoele, C. J. ..... Alternating currents in closed circuits.
3439. Currie, S. C. C. ..... Storage batteries.
3455. Lake, H. H. ..... Secondary batteries (*Ewing*).
3484. Schweizer, E. ..... Electrical clockwork.

5th March, 1890.

3523. Nebel, J. ..... Dynamo-electric machines.
3534. De Grave, L. W. ..... Extending the circuit of incandescent lamps.
3544. Patten, F. J. ..... Electric telegraphy.

6th March, 1890.

3572. Forbes, Sir C. S. ..... Primary batteries.
3574. Low & Pritchett ..... Distributing electricity.

7th March, 1890.

3622. Clegg, J. ..... Electric lamps.
3625. Scales, J. S. ..... Insulator for securing telegraph wires.
3654. Edmunds, H. ..... Distributing currents.
3658. Steinheuer, J. ..... Electrical signal clock.
3660. McClellan, S. B. ..... Connecting and disconnecting electric circuits.
3663. Edmunds, H. ..... Metering electric currents.

8th March, 1890.

3697. Anderson, J. ..... Batteries.
3717. Weigert, L. ..... Batteries.
3731. The Mining and General Electric Lamp Company, Ld., & Fitz-Gerald ..... Secondary batteries.
3732. Hopkinson, J. ..... Electro-locomotives.

CHEMISTRY.

3rd March, 1890.

3332. Sykes & Blamires ..... Water-gas.

4th March, 1890.

3391. Pohl, O. E. ..... Salt.
3397-8. Willcox, B. ..... Dyestuffs (*Fried. Bayer & Co.*).
3409. Harbord, F. W. ..... Utilisation of tinplate scrap.
3410. Hyde, A. C. ..... Removing tin from tinplate.
3412. Hodgkinson, A., Jun. ... Treating iron ores.
3440. Sebenius, J. L. ..... Removing impurities from metals.
3460. Michel, T. ..... Carbonate of soda and hydrochloric acid from chloride of sodium.

5th March, 1890.

3503. Williams, M. ..... Soft soap.
3532. Crookes, W. ..... Extracting gold.

6th March, 1890.

3601. Scott, R. C. ..... Soap.

7th March, 1890.

3628. Bale & Sims ..... Peroxide of hydrogen.

8th March, 1890.

3684. Holgate, T. ..... Coal gas and compounds of ammonia.

MISCELLANEOUS.

4th March, 1890.

3475. Bull, J. C. ..... Percussion fuses.

5th March, 1890.

3533. Bassingham, W., Jun. ... Ventilators.
3540. Taylor, W. E. ..... Softening and filtering water.
3542. Leech, T. ..... Bullets and projectiles.

6th March, 1890.

3556. Thomas, J. ..... Fog signals.
3582. Siemens, F. ..... Hot air gas lamps.
3585. Walford, N. L. ..... Range finders.
3604. Acland, F. E. D. ..... Percussion fuses.
3606. Carez & La Société Générale de Maltosé Saccharification of amylaceous materials.

8th March, 1890.

3683. Stanley, W. F. ..... Telemeters.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form, of such opposition.

Year 1889.

1855. Hobson, Rushton, & Wood.
1997. Field.
2009. Storey.
3761. Holden.
3816. Kinsey.
3977. Chaffe.
4241. Davy.
4349. Holmstrom & Nordenfelt.
4451. Frederick Firth & John Whitehead.
4607. Farrow & Carson.
5311. Kaye.
5372. Jones.
5552. Marten & Lees.
5566. Tuke & Ramsden.
5596. Sugden.
5676. Reid & Kean.
5687. Holden & Ashworth.
5768. Garland.
5973. Yates.
6181. Briggs & West.
6264. Hulse.
6336. Hatton.
6595. Cobbaert.
6682. Priestman & Priestman.
6718. Pickles & Pickles.
6931. Huxtable.
6939. Gunn & Rice.
7087. Hill.
7125. Bailey & Baker.
7219. Cook.
7275. De Ferranti.
7350. Shepard.
7381. Hawes.
7412. Barrey.
7418. Salsbury.
7428. Pollak.
7439. Rosskothen.
7504. Manning.
7522. Sumner.
7551. Buermann.
7609. Berkefeld.
7624. Rumbelow & Rumbelow.
7683. Butler.
7697. Bear & Paxman.
7729. Brotherhood & Pester.
7738. Vogt.
7746. Moore.
7769. Nuttall.
7882. Lynde.
7913. Hindley & McKenzie.
1050. Bollé (*Gutmann*).
1893. Boult (*Bontemps & Boutet*).
3707. Tichborne, Darley, & Purcell.
3846. Thompson (*Krämer*).
4100. Panter, Taite, & Carlton.
4409. Gill.
4421. Phillips.
4467. Foster.
4569. Dennis.
4963. Bauer.
5337. Smith & Willis.
5536. Hargreaves & Parker.
5555. Coleman.
5594. Murrell.
5627. Tomkins & Sudron & Co., Ld.
5753. Jagger, Jagger, & Turley.
6137. McGregor.
6185. Arbuthnot & Hookham.
6359. Turnbull.
6634. The Nottingham Manufacturing Company, Ld., Groves, & Whatnall.
7023. Snowdon.
7108. Drake & Gorham.
7134. Larkin.
7238. Boult (*Michotte*).
7292. Mills.
7358. Dawson.
7384. Addicott & Holland.
7415. Harcourt.
7424. Chambers & Smith.
7432. Bate.
7500. Bilharz.
7517. Adant.
7533. Sumner.
7586. Howarth.
7623. Cross.
7634. Armour & Armour.
7650. Whitehouse & Clifford.
7710. Tatham.
7734. Archer & Bowley.
7789. Müller - Hoffmann. (2nd January, 1889).
7838. Grove.
7902. Brown.
7937. Igel.

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8085. Jones.
8323. Phillipson & Baker.
8412. Ward.
8634. Vickery.
9432. Greeven.
9537. Timmis.
10233. Graham.
10472. Johnson (*Pieper*).
11330. Groeger.
11812. Robinson.
12032. Bruch.
12914. Powell & Hart.
14148. Kumme.
14870. Sale.
16374. Serraillier & Armstrong.
17161. Baird.
17789. Thompson.
18034. Emery.
19367. Philburn.
19940. Dixon.
20167. Watson.
20400. Murday.
20606. Lawton.
20685. Höfel.
20976. Johns.
8318. Ackermann. (20th October, 1888.)
8472. Mallet.
9129. Arthur.
9437. Thomlinson-Walker.
9905. Becker.
10385. Fölscher.
10477. Rylands.
11383. Lahusen & Feuerlein.
12637. Mann & Mann.
13628. Barry & Haynes.
14518. Barker (*Foster*).
15764. Montague.
16711. Augé.
17088. Irish.
17600. Haddan (*MacFarlane*).
17937. Armstrong.
18747. Andrews & Parker.
19638. Hannan.
20008. Dugdale.
20217. Marx.
20401. Boult (*Pardo*).
20644. Kalkbrenner.
20914. Klapperstuck & Meyer.

1890.

429. Scherbel & Remus.
683. Imray (*The Celluloid Manufacturing Company*).
720. Smythies.
850. Baker.
1105. Newton (*R. Hoe & Co.*).
1288. Marsh.
1428. Strüver.
1500. Whitehead.
1525. Button, Peters, & Goodsell.
1788. Grayston.
1840. Vanorman. (31st August, 1889.)
1885. Ripson & Frazer.
1890. Maxon, Coleman, & Boyer.
1973. Gäbel.
2041. Rütgers.
682. Imray (*The Celluloid Manufacturing Company*).
687. Mewburn (*Lowe*).
768. Teuber.
955. Pfaff.
1133. Jordan.
1328. Appleberg.
1494. Monfort & Peck.
1505. Reens & Singer.
1549. Turton & Codner.
1783. Mortson.
1837. McGovern.
1875. Lightfoot (*Linde*).
1877. Riedler.
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1912. Bell.
2017. Dinkelmeyer.
2052. Meyer (*Jeantet*).
2078. Sims.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

Mechanical Stokers.—*W. Leach, Accrington, Lancashire.*—The apparatus here described is intended to be worked in combination with the deflecting plate which is employed for distributing fuel into the furnace of a steam boiler as described in the specification of a previous patent, No. 16096 of 1887. According to this invention a tube is inserted in the front and at the top of the furnace, and a steam pipe made to communicate between it and the steam in the boiler. The outer end of the tube is open to the atmosphere, so in passing steam through it to the furnace air is drawn in with it. The air and steam thus passed into the furnace descend upon the smoke and force it down into contact with the fire, which consumes it, thus preventing its emission of dense smoke. By combining the smoke preventer with the mechanical stoker previously patented, the regulation of furnaces will be nearly automatic. Claim: In steam boiler furnaces the introduction of air and steam for consuming smoke in combination with a deflecting plate as described.—No. 9500. June 8th, 1889. 6*d*.

Scutchers.—*W. Hurst, Rochdale.*—This invention relates particularly to the gratings or grids which are placed between the beaters and the cages used in these machines, and the novelty consists in the arrangements by which the bars or grids of the gratings or grids may be altered in position such as to be in the most effective position. One method of carrying out this idea is to employ a grating or grid formed of bars or metal plates, and so arrange the alternate bars or plates that they may be raised or lowered by means of a cam or other suitable means. Another method is to secure the bars or plates in a cross-rail, which cross-rail and the bars secured to it may be raised or lowered by a cam. A third method is to employ a grating or grid formed of bars or plates, which are caused to approach towards or recede from one another as desired. The bars are mounted in suitable guides, and made to approach or recede from each other by means of a shaft or shafts formed with screw-threads of variable pitch. Or the bars or grids may be connected in the manner of parallel rulers. Three claims are made.—No. 6327. April 13th, 1889. 8*d*.

Spinning Rollers.—*E. de Pass, London.* (*G. Carbonnier, Pont St. Pierre, France.*)—The rollers made according to this invention do not slip upon the axle; they are cylindrical and without joints. The roller is made by glueing to an axle a facing of carded cotton, which is laid on in sheet form and then silicated. The silicate is applied in the form of silicate of soda, and at the same time the roller is rolled between other rollers to bring it to the thickness required. The silicate of soda serves as a varnish and agglomerate, but it may be substituted by any other suitable substance that would effect the same purpose. Claim: The improved covering for spinning rollers, characterised by the application of carded cotton, or other analogous material, glued or cemented on to the axis, then impregnated or treated with silicate of soda, or other like substances, producing the same effect as described.—No. 6352. April 13th, 1889. 4*d*.

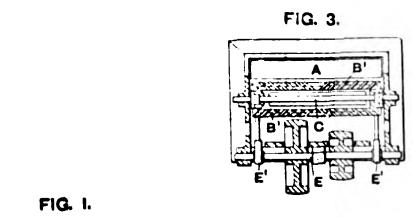
Tramway Points.—*J. Burrow & R. Johnson, Manchester.*—By this system the driver of a tramway car is enabled to guide the car in any desired direction without dismounting. A metal case is let into the ground, between the rails and at a short distance before the points. In this case is fitted a rocking lever, whose two arms extend upwards and project through openings and into grooves made in the lid of the case. The arms of the rocking lever are arranged so that when one projects into its groove the other is below. The rocking lever is connected by a bell-cranked lever and rods to the movable tongue of the points. On one of the axles of the car is a long boss provided with two arms, each arm carrying a small wheel. These arms are so mounted that the positions of the two small wheels correspond with the grooves in the top of the case. The long boss is provided with a third arm, which is connected by a rod to a controlling lever at the front of the car. By this controlling lever the driver can lower one or the other of the small wheels and cause it to pass along one of the grooves and operate the rocking lever. The rocking lever shifts the points, and the tram car passes in the required direction. Claim: The improved means for enabling the driver to actuate the points on a tramway without dismounting from the car, which consists principally of a rocking lever or scale beam, the arms of which project through grooves in the lid of a box sunk in the road between the tramway lines, the said rocking lever being connected to the movable tongue of the point; in combination with a corresponding rocking lever attached to the car, and fitted with wheels, which are adapted when depressed to run in the said grooves, such rocking lever attached to the car being so connected to a hand lever, within easy reach of the driver, that by moving such hand lever he can depress either wheel so as to act upon either arm of the first-named rocking lever, and thus move the tongue of the point, all being constructed and arranged as described.—No. 6303. April 13th, 1889. 11*d*.

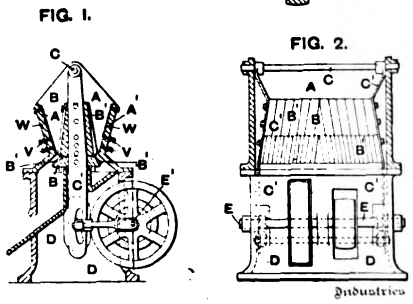
Pickers of Looms.—*T. Radcliffe, Halifax.*—This invention refers to a method of attaching picking straps to the pickers of looms for the purpose of reducing the friction upon the spindles when the shuttles strike the pickers. The picker is constructed with a projection or lug at the top of any suitable shape. The strap is passed through the picker, over the top, and the projection is passed through a slot in the strap, securely fastening it to the picker. The picker is formed with an ordinary scoop bottom with folded top. Claim: Pickers constructed with a projection at top, to which the picking strap is attached as described.—No. 6243. April 12th, 1889. 6*d*.

Fans or Blowers.—*A. Dougill, Leeds.*—Improvements are here introduced into the construction of the blades of fans and blowers with the object of rendering them more efficient. The vanes are formed of corrugated sheet iron. The corrugations may be made to run radially in the vanes, that is, at right angles to the axis of rotation; or they may be made to run longitudinally in the vanes or in a direction parallel to its axis; or lastly, they may be constructed diagonally across the blades, that is, in a screw or spiral direction around the axis of rotation. Claim: In rotary fans, ventilators, or blowers, the construction of the blades or vanes with corrugations as set forth.—No. 6248. April 12th, 1889. 6*d*.

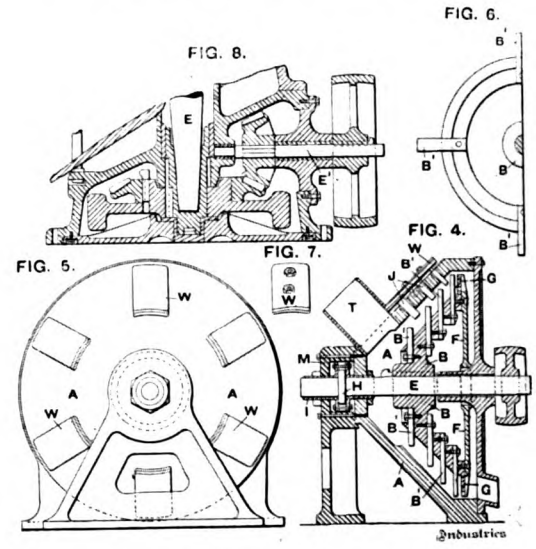
Steam Ferry Boats.—*A. Brown, Renfrew.*—This invention describes an attachment to ferry boats for steadying them against the effect of a current, tide, or wash, and for holding them securely in position during the embarking or disembarking of vehicles and passengers. The appliance consists of a series of beams or spars, each one sliding in a socket pivoted to the side of the vessel, or otherwise connected to the vessel, to permit them being moved from a horizontal to a vertical position. When not in use the beams or spars lie horizontally against the side of the vessel, and serve the purpose of fenders, but to secure the vessel they are swung round to the vertical position and allowed to drop until they touch the bottom. The ends of the spars may be provided with spikes or otherwise suitably shod. Any suitable mechanism may be used to operate the spars, and be worked by steam, hydraulic, or other means. Three claims are made.—No. 6281. April 12th, 1889. 8*d*.

Pulverisers.—*G. Lowry, Barnsley, Yorkshire.*—Two separate machines are described in this specification; the one, as shown in Figs. 1, 2, and 3, is for coarsely crushing the material, and that shown in Figs. 4, 5, 6, 7, and 8 for pulverising the material to a very fine powder. In the crushing apparatus illustrated at Figs. 1, 2, and 3 A is the hopper or receiver, which is made of

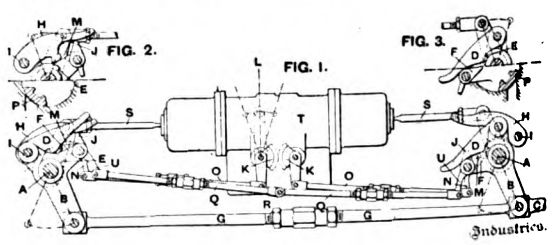




oblong shape, with inclined sides A1. B is the crusher head, which is suspended in the hopper A by means of the shaft C and the side plates C1 C1. The plates C1 C1 extend down the ends of the crusher head B into the frame D, and are connected to the cranks or eccentrics E1 of the actuating shaft E, which thus imparts a pendulous motion to the crusher head B. The blades or moving tool B1 on the crusher head B are made by preference in two sections, so as to form a double set. The crusher head is tapered towards the top, so that the blades B1, which are set parallel with the ends of the crusher head, are spread out at the bottom. The blades B1 on the upper section are of greater pitch (say 4in. pitch) than the blades of the lower section (which may be, say, 2in. pitch), so as to break the material finer as it passes down. The hopper A is provided with adjustable side plates W, which can be set by the set screws V, so as to regulate the size of the opening between the crusher head B and the side plates W of the hopper A, and thereby regulate the size of the crushed material. Now with reference to Figs. 4, 5, 6, 7, and 8, in this case the receiver A is of a circular conical form, placed horizontally, the fixed tools or blades J, which are adjustable, are fixed by the plates W (see Fig. 7) which are placed round the shell of the receiver A, the tools passing through slots in the shell. The beater tools B1 are fitted to the head B, which is mounted on and driven by the shaft E. The tools J are stronger and coarser at the entrance part of the receiver than towards the extremity. The material or substance to be operated upon is fed in through the shoot T into the small end of the receiver A. The back of the crusher B is provided with an outlet plate or changeable screen F, having annular openings G as shown. The tail end of the shaft E is provided with a collar H, which runs in a screwed sleeve I, so that the shaft can be adjusted in the bearing M, and thereby the position of the crusher B and the tools B1 can be adjusted in relation to the tools J. Nine claims are made.—No. 1209. January 23rd, 1889. 8*d*.



Valve Gear.—*R. Middleton, Leeds.*—The valve gears referred to in this invention are of the form of trip gear valves in which the slide valves have cylindrical faces working in seats of corresponding curvature. The tripping mechanism is controlled by the governor, and improvements are made in the mechanism to cause it to act with greater promptness than heretofore. In Fig. 1 of the illustrations is shown a front elevation of the principal parts of the gearing. In the position shown the piston is at mid-stroke, the left-hand gear has just been tripped, and the right-hand gear is at the commencement of its stroke. In the Figs. 2 and 3 the valves are shown in section in the positions corresponding to those of the gear below. The valves P are worked by the rotary movement of the valve spindles A. Three armed levers B are fitted freely to the spindles A. The levers are coupled together by the rod G, and are rocked to and fro by an eccentric rod C. The other arms of the levers B support catches D and tripping toes J, M, and F. The toes J and M are part of the levers N, which are connected by the adjustable rods O to sector gear wheels K of the governor lever L. The toes F are part of the levers U, which are connected by the adjustable rods Q to a fixed pin R. Other catches H are supported upon stationary pins I. The valve spindles A are connected by the rods S to the dash pot T. The operation of the valve is as follows:—Referring to the right hand side of the gear in which the lever



B is in its extreme right hand position, the motion of the eccentric rod will now move B to the left. As B is moved to the left, the catch D engages with a catch E fixed to the valve spindle, and so shifts the valve over and opens it. As the valve is being shifted over, the toe F by the nature of its connections gradually assumes the position as shown in the left hand side of the gear and trips the catch D out of E. At the instant the catch D is tripped out of the catch E, the catch H falls into E and holds the valve in its open position, unless, as is shown in the left hand side of the gear, the toe J, which is actuated by the governor, holds the catch H out. When the speed of the engine is below the normal the valve is held by H in its open position until tripped by the toe J, actuated by the motion of the governor through the gear K; when the speed is above the normal, the toe M is caused by the action of the governor to lift the catch D, so that in the motion of the lever B to the left the valve is not moved. Claims: (1) The method of using double tripping devices on the steam inlet valves of a Corliss or other such valve gear, a part of the gear—actuated from a fixed centre—being used for bringing about the preliminary release and retention of the valve when it arrives in its "full open" position, whilst the other portion—actuated by the governor —is arranged to accomplish the final release and accompanying

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closing of the steam port, for the purposes explained herein; (2) the valve gear with double tripping action, arranged, constructed, and operated, substantially as described and shown.—No. 4976. March 22nd, 1889. 8*d.*

STEAM ENGINES.—*C. Capeyron, Bordeaux, France.*—The invention is based upon a new application of a well-known geometrical principle, which is as follows: When a circle A (Fig. 1) rolls upon the inside of another circle F of double its radius, the two extremities of a diameter B C of the smaller circle will move upon diameters D E and G H of the larger or outer circle, the diameters being at right angles to each other. The centre I of the inner circle will also describe a circle X whose radius I L is equal to the radius of the inner circle. If, therefore, to one of the extremities B of a diameter of the inner circle is pivoted the rigid connecting rod of two opposite pistons, and to the other extremity C of the said diameter the connecting rod of two opposite pistons at right angles to the first, it follows that the alternating rectilineal movement of the pistons will transmit a circular movement to a crank whose radius I L is

FIG. 1.

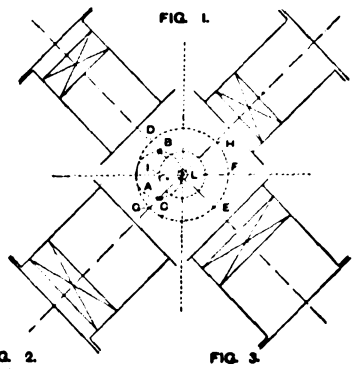


FIG. 2.

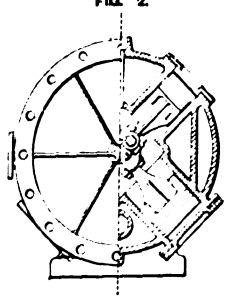
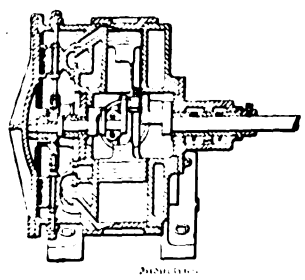


FIG. 3.



equal to that B I of the first circle A, and the centre L of which coincides with that of the second circle F. The improved engine constructed according to this invention is shown in Figs. 2 and 3. It comprises four fixed cylinders, the axes of which are at right angles to each other, and may be in the same plane, or in two parallel planes. By reason of the application of the geometrical principle above stated the stroke of the pistons will be equal to four times the radius of the crank. Claims: (1) The improvements hereinbefore described and represented in the figures of the accompanying drawing, substantially characterised by the arrangement of the fixed cylinders with perpendicular axes in the same plane or in different parallel planes; (2) the application of an intermediate crank enabling a rotary movement of the driving shaft to be obtained, the centre of which coincides with the point of intersection of the perpendicular axes of the cylinders; (3) the application of eccentrics to the movement of alternating slides.—No. 4570. March 15th, 1889. 8*d.*

BEARINGS FOR SHAFTS.—*E. W. G. Pomroi, London.*—In order to reduce the friction between axles and their bearings, the bearings are constructed according to this invention with a series of grooves cut longitudinally in their surfaces, and in these grooves are placed hardened steel rollers. The grooves are nearly cylindrical, but permit the rollers to project sufficiently to take the bearing of the shaft. Claims: (1) In axles and bearings the use of hardened steel rollers rotating in longitudinal grooves in the axles or bearings as described; (2) the improvements in axles and bearings as described.—No. 4571. March 15th, 1889. 6*d.*

STARTING GAS ENGINES.—*M. Partridge & R. H. Brutton, Yeoril, Somersetshire.*—A mechanical means is here described for starting gas engines. To the crank shaft of the engine is keyed a small ratchet wheel, by the side of which is mounted loosely upon the shaft a lever or hand crank. The hand crank carries a pawl which engages with the ratchet wheel in one direction, that is, the direction required to turn the shaft of the engine for starting; in the other direction the pawl passes freely over the teeth of the wheel. Thus the shaft may be turned by the hand crank until the engine has got well started, and then by letting go the crank its pawl will fall out of gear and the crank hang down stationary. Claim: In means or apparatus for starting gas and other engines or machines, a ratchet or other driving wheel fixed on the main or driving shaft, and a lever provided with a pawl or other driver, which, when the lever is raised, is capable of giving motion to the ratchet or other driving wheel, and when the lever is allowed to fall drops out of gear.—No. 6161. April 10th, 1889. 8*d.*

SIGNALLING TRAINS.—*S. B. Kincaid, Woodbridge, Suffolk.*—This appliance is for signalling trains in foggy or misty weather. To the under part or side of a locomotive is fitted a magazine for a number of short tubes. These tubes can be placed one at a time by the driver to hold down the end of a lever and keep closed a valve which operates a steam whistle. The tube is placed in position by the driver pulling a cord or some equally simple action. By the side of the rail is a second device consisting of a stiff post which can be raised or lowered simultaneously with the ordinary signals and by the same means. When in the raised position the post is so situated that as the engine passes the post it strikes the tube holding the whistle valve closed. The tube is thus smashed or bent and so dislodged, permitting the valve to open and blow the whistle, indicating danger. If the signal is not at danger the arm is lowered and no signal made. As one tube becomes broken another is caused to replace it from the magazine. Claim:—The use for signalling to the driver or other person on a moving train of a tube or bar of metal or other material fixed on the train in such a way as to operate the signal by the destruction of such tube or bar by its encountering a stationary cutter or breaker set when required so as to intercept the tube or bar, this tube or bar being so fixed that it cannot be struck out without being destroyed.—No. 20837. December 28th, 1889. 8*d.*

ROPE AND CHAIN GEARING.—*S. Eddington & J. E. Steerenson, Chelmsford.*—Bosses are fixed at certain intervals to the wire, rope, or chain. They are preferably made of a reel shape, and the rope passed through their holes. The bosses are secured in position by pins driven through them and the rope, and by filling up the remaining space of the holes, which are recessed, by metal such as lead. The pulleys for driving these belts are of the usual grooved form, with notches cut radially in their rims to receive the bosses or reels fixed to the rope. The bosses, instead of being made reel shape, may be made in halves of a disc form. The holes in the halves for admitting the rope are made to face each other when the halves are bolted together. The hole through the boss is thus made larger at its centre than at its outer parts. Where the boss is attached to the rope the rope is swelled by driving in a wedge. The swelled portion fits the enlarged part of the hole in the boss, and so the boss is retained in position upon the rope. Claims: (1) For transmitting power to machinery and for elevating or conveying goods, hauling carriages, trucks, and the like, or for dredging or other analogous purposes, the use or employment of bosses, cogs, or projecting blocks, fixed or fitted at intervals upon metallic ropes or cables, and engaging in recesses or wheels or pulleys as described; (2) the method of fixing such bosses, cogs, or projections as described; (3) the method of and means for transmitting power to machinery of various kinds as described.—No. 4,376. March 13th, 1889. 6*d.*

LOCOMOTIVE FURNACES.—*D. Clegg, Philadelphia, U.S.A.*—This device is constructed for the purpose of consuming the smoke and fine cinders that are otherwise discharged from the stack. The stack is divided longitudinally into three passages. The central passage leads to the smoke box of the engine, the two outer ones to the ashpit. The central passage of the stack is covered with a cap, to direct the smoke as it issues from it down into the passages leading to the ashpit. In order to drive the smoke down the passages into the ashpit the top of the stack is covered, and a flaring funnel-shaped opening made in the front near the top. When therefore the locomotive is in motion, the smoke, as it issues from the central passage, is directed down into the ashpit passages, and then driven down by a draught of air entering the funnel-shaped mouth. The smoke and fine cinders, with the draught of air thus driven down, pass through the bars of the furnace and are consumed, the larger cinders remaining in the bottom of the ashpit. Claims: (1) The combination of the combustion chamber and ashpit with the smoke stack at the upper end, and having communicating up and down flues with a deflecting hood and a valved inlet opening in the down flue; (2) the combination of the smoke stack provided with up and down flues, the deflecting hood, the head having an air inlet opening communicating with the down flues, and a valved opening in the upper portion of the said head, and mechanism for operating the valve from the cab of the engine; (3) the combination of the smoke stack having up and down flues, with openings in the said flues, and slats in each of said openings for directing air into the stack and creating a draught in the down flues for carrying the smoke to the ashpit; (4) the combination of the stack having up and down flues, openings in said down flues, with pivoted slats in said openings, said slats being controlled from the cab of the engine so as to regulate the draught: (5) the combination of the smoke stack, the up and down flues therein, a valved opening in the top of said stack, and openings in the down flues, with pivoted slats therein, a rod connected to the slats and to the valve rod, said rod being connected to a lever in the cab, so that on the operation of said lever the slats and valve will be operated simultaneously.—No. 19001. November 26th, 1889. 8*d.*

SHAPING BOLTS AND NUTS.—*O. Koch, Germany.*—This machine is intended for shaping a number of bolt heads or nuts simultaneously. In the accompanying illustrations Fig. 1 is a right hand side elevation, Fig. 2 a plan, Fig. 3 a cross section, Fig. 4 a left hand section, and Figs. 5 to 11 details. The machine has cutters B, one to each of the bolt heads being shaped; thus, in the machine shown there are six. The cutters B are mounted upon a slide A which receives motion from a crank M in the usual

FIG. 1.

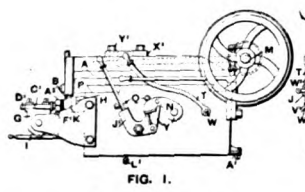


FIG. 3.

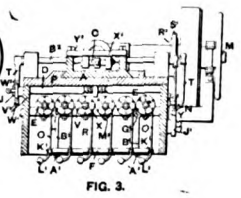


FIG. 2.

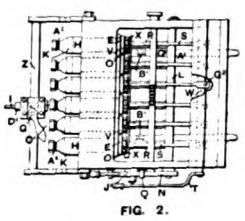
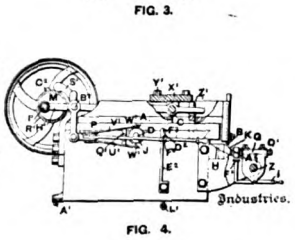


FIG. 4.



manner of shaping machines. The slide A is mounted upon a second slide P, which has a lateral motion sufficient to move the tool over the face of one bolt. Motion is given to the slide P by the screw spindle D which is revolved by the motion of the oscillating shaft B^2 transferred through the ratchet wheel J and spring pawls V^1, U^1 (Fig. 4), whose actions are reversible by the lever D^2 and spring stop E^2. The connecting rod H^1 of the slide A does not partake of the lateral motion due to the slide P, but is retained in position by the fork Z^1 and slides upon a cross-bar C, by which it is connected to the slide A. For shaping bolt heads the bolts are placed in the sleeves H under the cutters B. On each of the sleeves is a head K which receives a conical spring sleeve E^1 (Figs. 6, 7, 8, and 9). The bolt is placed in the sleeve E^1, as shown in Fig. 7, and the head of the bolt is pressed home, so that the sleeve E^1 grips the bolt firmly. For inserting the bolt in a proper position and driving it home, a small appliance G is provided, worked by the levers I and C^1, and sliding upon the bar Z. The part F^1 is brought to bear upon a face of the bolt head, whilst the pusher D^1 forces the bolt home. For turning the bolts

FIG. 5.

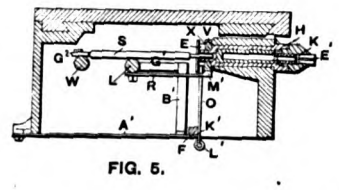


FIG. 6.

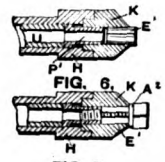


FIG. 7.

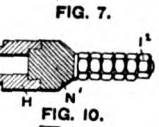


FIG. 8.

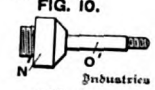


FIG. 9.



FIG. 10.

FIG. 11.



upon their axes, small division plates or discs E are fixed to the sleeves H, and revolved through one sixth of a revolution by the lever J^1 situated at the side of the machine. By moving the lever J^1 to and fro between the stops Q, the stops R are removed from the disc E, and the discs revolved by the pawls O and ratchet wheels X. The bolts are discharged simultaneously from the machine by forcing out the sleeves U by the rods S, to which motion is imparted by the shaft W and lever T. When shaping nuts, they are fixed to the machine by mandrils as illustrated in the Figs. 10 and 11. Five claims are made for this machine.—No. 18264. November 15th, 1889. 8*d.*

CARDING FLATS.—*E. W. Wrigley & Robert Patterson, Oldham.*—This invention relates to an improved means of more effectually protecting and supporting the carding wires at the edge of the card filleting forming the flat, and in that part generally named the heel of the flat. In performing this invention the length of the wires is reduced all along at this edge, and to the extent of about an eighth of an inch more or less in width, or wires of reduced length are employed, or a solid strip of metal is applied of about the same depth, riveted or otherwise secured in the same position. It is found that this means of supporting the edge of the card filleting also gives a straighter and more parallel edge to the carding wires than has been hitherto practicable. Claim: Improvements in carding engines as described.—No. 6485. February 15th, 1889. 6*d.*

ELECTRICITY.

SECONDARY BATTERY PLATES.—*W. L. Wise, London.* (*The Gibson Electric Company of Europe, Paris.*)—According to this invention a plate is constructed by striking out raised loops from the surface of a sheet of lead, or by casting similar loops on it. The active material extends under these raised loops, and becomes firmly united with the plate. The plate is preferably prepared with a raised rim round its edge of a height approximately equal to the thickness of the active material, and the loops are made of about the same height as the rim. Claims: (1) A storage battery plate, consisting of a sheet of metal, having portions thereof raised above its surface in the form of loops; (2) a storage battery plate, consisting of a sheet of metal, having loops raised from its surface and active material covering the surface of said plate and extending under the loops; and (3) referring to the drawings of specification.—No. 2472. February 12th, 1889. 8*d.*

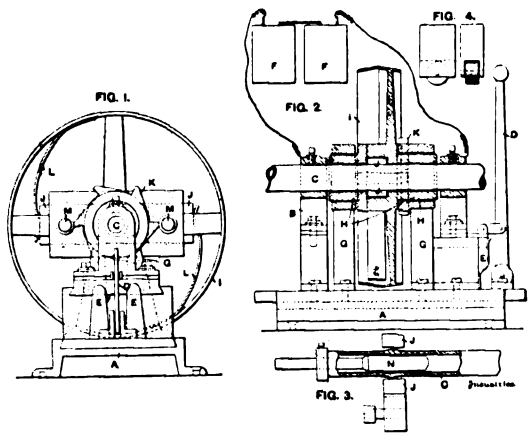
INSULATORS.—*C. V. Boys, London.*—The insulators are made by melting quartz or materials that are very largely composed of silica with the oxy-hydrogen flame or by the heat of the electric arc or by heat generated in infusible conducting rods or plates such as the carbons used for electric lighting, and when it is in the plastic condition working it into rods or pieces of any desired shape much as glass is worked, the treatment being slightly modified on account of the high melting point of quartz. In melting quartz in small quantities it is held in the flame much as the glass blower holds glass. When melted in larger quantities it rests on a bed of clean sand or broken quartz and heated from above or by electricity passing through carbon rods buried in the material. The quartz is preserved as far as possible from contact with earthy materials. When melted it is drawn or blown into rods, tubes, or other desired forms or rolled or worked in moulds. Claims: (1) The making of rods, tubes, or pieces of other desired shape by melting quartz, sand, or other material that is largely composed of silica substantially as described; (2) making insulators of quartz that has been melted or material largely composed of silica.—No. 4849. March 20th, 1889. 4*d.*

TELEPHONE TRANSMITTERS.—*J. C. Goulding, Cardiff.*—The transmitter is so arranged that it can be placed temporarily at any desired height to suit the person using it. Claims: (1) The improvement in telephone transmitters, which consists of mounting the telephonic apparatus upon a carriage capable of being raised and lowered upon guide-ways and of being readily adjusted thereon at any desired height, the connecting wires being provided with sufficient slack to permit of such vertical movement; (2) a telephone transmitter, in which a carriage having the telephonic apparatus mounted thereon is adapted to slide vertically between parallel uprights, and to be held stationary in any position in its vertical path by a friction device capable of setting up a sufficient amount of friction between the sides and the opposing

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surfaces of the uprights, substantially as described; and (3) referring particularly to the appliance as illustrated in the specification.—No. 11215. July 12th, 1889. 8*d*.

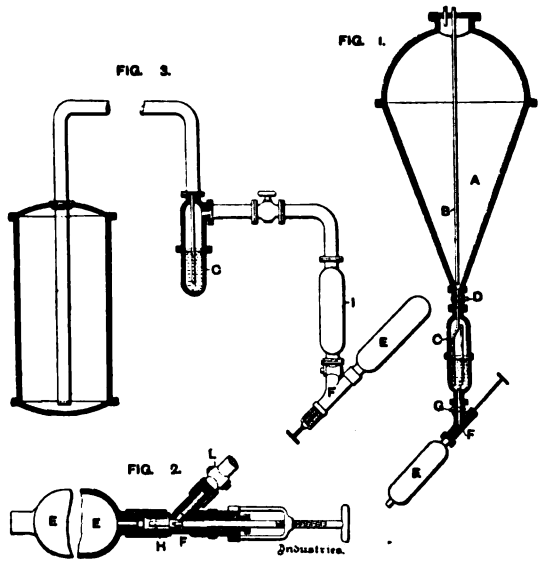
WELDING METAL BY ELECTRICITY.—*H. E. Fowler, New Haven, U.S.A.*—In this machine the weld is formed by working the joint without removing any of the metal. After the weld has been formed by pressing the ends of the work together, the bulged part is hammered or rolled down to the normal size of the work by revolving hammers or rollers. In the accompanying illustrations, Fig. 1 is an end elevation, Fig. 2 a part section upon the side elevation, and Figs. 3 and 4 show details. Upon the base A are supported insulated standards B, which hold the tube C or other work to be welded. The standards B are connected to the source of electricity F, and one of the standards is made movable upon a slide operated by the spring E and the lever D. Two second standards G are fixed to the base and support the hollow trunnions H of a driving pulley I. In the boss of the pulley I are formed guides for the sliding hammers J. As the



pulley I is revolved these hammers are caused to oscillate in their guides by the studs M and cam wheel K in conjunction with the springs L. The operation of the machine is as follows:—Two sections of pipe, rod, or bar are secured in the bearings of the standards B, with their ends in contact, and the current of electricity is passed along the wires to the pipe. When the abutting ends of the sections are sufficiently heated or fused, the movable standard, with its section of pipe, is forced against the other, thus upsetting the ends of the pipe, as shown in Fig. 3. The pulley carrying the hammers or rolls is then rotated around the work, and the blows or pressure delivered upon this upset portion by the hammers or rolls, as the case may be, spread the metal on both sides of the joint and form a secure weld without removing any of the metal raised by the upsetting. Where the machine is used to weld pipe, a mandrel N may be inserted to prevent unevenness on the interior. Three claims are made.—No. 19892. December 10th, 1889. 6*d*.

CHEMISTRY.

MANUFACTURE OF LIQUID CHLORINE.—*J. B. Hannay, Loch Long, Dumbarton.*—In certain metallurgical operations—such, for instance, as extracting gold from the ores containing it—chlorine is advantageously employed. It is, however, generally difficult to produce the chlorine upon the spot where it is required to be used, and a method of storing it for conveyance, such as the one here described, is necessary. In this invention the chlorine is stored in a liquid state in the following manner: Chlorine gas is produced by any of the known processes and passed into a vessel A (Fig. 1) containing water at a temperature a little above



freezing point. The gas flows into A by the pipe B, and as it bubbles up from the mouth of the pipe to the surface of the water some of the gas combines with water and forms crystals, which fall to the bottom of A. Attached to the bottom of A is a smaller vessel C containing sulphuric acid and communicating with the vessel A by the cock D. To the bottom of the vessel C is connected the storing vessel E and its sealing appliance F, communication between the storing vessel C and the storing vessel E being formed by the cock G. When a sufficient quantity of crystals have accumulated at the bottom of A by the passage of chlorine gas through it, it is sealed and gently heated. The crystallised chlorine is thus liquified, and remains at the bottom of the vessel whilst the water it contained separates and ascends. By this process pressure is produced in the vessel A, and when the cocks D, G are opened the chlorine is forced through the vessel C, and the sulphuric acid contained in it to the storing vessel E, in which it is sealed by a screw plug H, as shown in Fig. 2. By passing the liquid chlorine through sulphuric acid any water present in it is absorbed before it passes to the storing vessel. Fig. 3 shows a modified form of the apparatus fitted with a graduated glass vessel I to make the charge visible. Claims: (1) For storage and transport of liquified chlorine the use of a holder made of bare steel tube closed at the ends with an end boss provided with a screw plug substantially as described; (2) for producing liquified chlorine and charging holders therewith, the combination of the funnel-shaped vessel A, the water trap C, and the branched pipe F fitted with screwed spindle substantially as described.—No. 4037. March 7th, 1889. 8*d*.

EXTRACTION OF IRON.—*A. Hodgkinson, Jun., Talke, Staffordshire.*—This invention relates to the manufacture into blocks of the calcined and hitherto generally unused or wasted products of the various ironstone seams known in North Staffordshire as the Half Yard Mine, the Red Shag Mine, the Red Mine, the Bassey Mine, and Red Mine Shale, and the respective equivalents thereto in parts of the United Kingdom other than North Staffordshire. Those products are generally known as "small mine," and they include uncalcined pieces of stone or rock containing iron which may have been left in the rocks on the mine hearths after the puddle or furnace mine has been formed and removed from the mine hearth for smelting. By this process the "small mine" is pressed into blocks by means of hydraulic machinery. These blocks are then ground or crushed to a semi-plastic powdered or granulated condition. If the "small mine" is damp it will, when reduced as above, be sufficiently plastic, but if it is not damp sufficient water should be added to make it plastic. This semi-plastic stuff is moulded by any suitable means into bricks, and then dried in the open or by artificial heat. The bricks so formed are suitable for further reducing the iron substances contained in them by the usual methods adopted in blast puddling or other furnaces. Claim: The treatment of calcined products and "small mine" of the above-mentioned iron ores, ironstone mines, and shale singly, or when two or more are mixed together, or with any other iron ores, ironstone mines, or shales, or other matter, and the manufacture by means thereof of blocks for the production of iron substances as described.—No. 4537. March 15th, 1889. 4*d*.

PRODUCTION OF HOMOGENEOUS IRON.—*A. E. Barthel, London.*—By the following method, pure and homogeneous iron may be deposited of any desired form and thickness. The process is a wet galvanic one. The bath for producing deposits of iron according to this invention is prepared as follows:—In five litres of well or river water six hundred grammes of crystallised ferrous sulphate (copperas) are dissolved. In a second vessel a solution of two thousand four hundred grammes of carbonate of soda in also five litres of water is made and the two solutions are poured together into a larger vessel. This mixture produces a deposit or sediment of ferrous oxide. Concentrated sulphuric acid is now added in small quantities to this fluid until the above deposit has again dissolved and has taken a cloudy or muddy green colour. Pure water is then added until the two solutions become a volume of twenty litres. Blue litmus paper when dipped into this solution must change but very little and should take a deep red wine colour. Should it become red only carbonate of soda must be added until the proper colour is obtained. Red litmus paper must retain its colour. Into the bath above described the object is placed upon which an iron deposit is to be produced as for instance a plate for the production of sheet iron or any object with a smooth or relieved surface to obtain a corresponding smooth or relieved impression or deposit. Cylindrical objects are required to produce tubes. Leaden bullets or other leaden articles can in this way be coated with iron. Opposite to the article intended to be covered with the above mentioned iron coating the anode of about the same surface as the object to be treated is suspended This anode may consist of cast iron, wrought iron, steel, or iron ore. Both the cathode and anode are now connected with the corresponding wires of a dynamo or any hydro-galvanic battery, and thereby acted upon until the iron deposit has attained the desired thickness. The temperature of the bath ought to be at least as high as 14° Reaumur to obtain a satisfactory deposit. Surfaces and forms from which the precipitate or desired iron deposit is to be removed must be first carefully cleaned from all dirt, grease, and oxide, and then rubbed with graphite and cotton, and may be even slightly coated with cyanide of silver or any other metal foundation. Claims: (1) The production of chemically pure homogeneous iron by a wet galvanic process, forming a deposit upon cathodes in a bath, composed as described, of hydrated ferro-protoxide, employing pig iron, or wrought or cast iron, or steel or iron ores, as anodes; (2) the production of fixed and firmly connected undetachable deposits of chemically pure homogeneous iron upon metallic surfaces or objects of all descriptions in a bath composed as described of hydrated ferro-protoxide and previous thorough cleaning of the article to be coated, the objects when of lead being first thinly coated with any other metal; (3) a direct process for the production by a wet galvanic process of detachable or firmly connected deposits of chemically pure iron in any desired form and thickness, such iron being formed by the employment of a bath of ferro-protoxide as hereinbefore described, and by placing the objects to be treated (after they have been cleaned from dirt, grease, and oxide) in the said bath, with an anode of wrought or cast iron, or steel or iron ores, both anode and cathode being connected with the corresponding poles of a dynamo, hydro-electric battery, or any other source of electricity.—No. 5078. March 23rd, 1889. 6*d*.

MANUFACTURE OF COPPER.—*P. C. Gilchrist, London.*—The invention particularly relates to the purification of copper from arsenic, antimony, and tin. Certain of the operations in connection with the production of refined copper are conducted according to this invention in furnaces lined with shrunk dolomite, magnesia, or other base. These linings are not employed in all the stages of copper refining, but may be advantageously in the following: In the fusion of calcined coarse metal, in the roasting of the white or fine metal for the production of blister copper, and in the refining of copper from blister or bar copper. The operation of refining the coarse, white, blister, or other form of impure copper is performed either in a reverberatory furnace as at present used, or preferably in an open-hearth regenerative gas furnace or other convenient form of apparatus, in either case furnished with a basic or chrome lining. The charge of coarse, white metal, blister, or other impure copper is placed in the basic furnace and melted down in an oxidising atmosphere as at present. With the copper is charged some lime or limestone, and some copper slags rich in oxide may be added. When the bath is thoroughly molten successive additions of lime or fine limestone are made, and when necessary some copper slags rich in oxide, the object being to obtain the oxidation of the arsenic, antimony, and tin present, either by means of the atmospheric air or by means of the small amount of cuprous oxide which forms, and to combine and fix the impurities in the slag. The amount of lime or limestone to be used varies with the composition of the charge. The slag should not be very silicious; it is preferable always to keep the silica under 20 per cent., the best results being obtainable when silica is under 10 per cent. Claims: (1) The purification and treatment of cupriferous reguluses and mattes and copper in basic or neutrally lined vessels in the presence of a basic slag whereby a slag lower in copper oxide than has heretofore been usual is obtained with a correspondingly larger yield of metallic copper substantially as set forth; (2) the treatment of cupriferous reguluses or mattes and copper in basic lined furnaces for the removal of arsenic partly by combining it with lime in the slag in place of copper oxide as at present, and partly by volatilisation, substantially in the manner herein described.—No. 4882. March 20th, 1889. 6*d*.

MISCELLANEOUS.

SIGNALLING UPON STEAMSHIPS.—*R. R. Little, South Shields, J. Hall, Newcastle-on-Tyne, & T. Archer, Gateshead.*—The appliance here described is for the purpose of signalling between the engine and the captain's bridge to indicate that orders referring to the working of the engine have actually been carried into effect. Upon the propeller shaft or other shaft operated by the engine is fixed a projection which revolves with the shaft and strikes two tappets, so constructed that when the shaft moves in one direction one of the tappets is worked, and when revolving in the contrary direction the other is worked. The tappets, when moved, compress air pumps or air displacers which are connected by tubes to the captain's bridge. On the captain's bridge the tubes are made of glass and contain balls which rise and fall as the air in the tubes is alternately compressed and expanded by the tappets working the pumps. Thus the one or the other of the balls work according to the direction in which the engine is going, and as the balls make but one rise and fall in one revolution of the shaft the captain is able to see any alteration in speed or direction. Claims: (1) In apparatus of the kind hereinbefore referred to, the combination of a projection from the propeller shaft (or from a shaft driven therefrom) and a pair of tappets or levers and air forcing or drawing devices for operating a signal and acted upon by the said levers in accordance with the direction of rotation of the shaft as described; (2) in pneumatic apparatus for conveying signals directly from the engine to the captain's bridge or other place the combination with air forcing or drawing devices and tubes of balls, spigots, or the like moving in the said tubes to act as indicators as described.—No. 5495. March 30th, 1889. 8*d*.

SIGNALLING TRAINS.—*A. S. von Blendorf & C. Adler, Baden, Vienna.*—This invention consists in providing an adjustable obstacle between the rails, which is adapted to operate a suitable device on the train as the train passes. The obstacle between the rails is preferably a metal disc mounted upon a slide. This slide, and with it the disc, is constructed to move to and fro transversely between the rails by means of the mechanism that works the signals. Upon the locomotive or tank is suitably mounted a mechanical device consisting of a spring arm or lever. When the signal is brought to danger the obstacle is simultaneously brought to danger by the slide plate already mentioned, and as the train passes the obstacle it acts upon the spring arm or lever and operates an alarum, air-brake, or similar means for warning the driver or stopping the train. At the time of operating the alarum, &c, the spring lever also causes the disc to partly revolve and connect up the electric circuit actuating an alarum at the next station. Claim: In combination with a line signal, a disc carried in and capable of turning in bearings between the rails of the permanent way, and adapted to engage with a yielding or resilient pendant device, and as a consequence to operate an acoustic signal on the engine, or the throttle valve, the reversing gear, or the brake, as and for the purpose described.—No. 5632. April 2nd, 1889. 6*d*.

INDICATING STATIONS, &c.—*H. Brocklehurst & H. Constein, London.*—The apparatus is designed for use on railway platforms for the purpose of indicating the stations that a train will stop at during its journey. It is worked by a current of electricity. A number of apertures are made one above the other in a hollow column or box. Behind these apertures are arranged tablets having the names of the stations marked upon them in the order they are situated on the line to which the column refers. These tablets are hinged so that when they hang down they may be seen through the apertures, and the name of the station upon them indicated. Normally the tablets are held up out of view by small catches, which are controlled by electro-magnets. When the electromagnet of a tablet is vitalised the catch is drawn back and the tablet falls upon its hinge, and the name of the station marked upon it is exposed. The wires of these electro-magnets are connected up, and the current passed through them, by a series of switches. Each tablet may be actuated individually or the whole series collectively. Three claims are made.—No. 3683. March 1st, 1889. 8*d*.

Copies of the British specifications may be obtained on application to H. READER LACK, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at* ½*d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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IMPROVED DRILLING MACHINES.

THE design of the machine shown in Fig. 1 is very simple. It will be seen that no overhead motion is required; that there are four changes of speed; and that, as the mitre wheels always run at the same rate, there is no more tendency to cause noise at the highest speed than at the lowest. Silent running is still further secured by one of the mitre wheels being of gun-metal. The pillar is turned, and the table can be adjusted to any desired height. These machines are well made. The spindles and shafts are all of steel, and the feed motion is hardened to resist wear. They are also easy to fix, and entirely self-contained.

Fig. 2 shows a hub drilling machine which is complete in itself. The hub is carried between the centres of two small headstocks, one of which carries the dividing plate. These headstocks are mounted upon a sliding bed, which can be moved sufficiently to bring either flange of the hub opposite to the drill, and suitable stops can be adjusted to bring the slide always to the same position. This slide has also an independent swivelling motion for giving the correct angle; this motion is also controlled by stops, so that when the machine is once set a boy can work it without fear of mistake. The division plates employed are compound, with two rows of divisions arranged round the circumference, and the dividing catch may be readily moved from one row to the other. The first row of divisions is used for drilling the left hand flange of the hub, and the second row for the right, or *vice versâ*, so that the spokes in each flange are always correctly spaced with reference to those in the other. Also it is not necessary to reverse the hub, or to remove it from the machine, until it is drilled in both flanges. The makers of these two machines are Messrs. Herbert & Hubbard, engineers, Coventry.

THE PROTECTION OF CHIMNEY SHAFTS FROM LIGHTNING.

BY C. MOLYNEUX AND J. M. WOOD.

IT is by no means uncommon, even in the present scientific age, to see tall chimneys in various parts of the country which are unprovided with lightning conductors. Can this be due to ignorance and thoughtlessness, or to the consideration of the question of expense; or again, to a disbelief in the efficiency of a conductor as a means of protection against injury by lightning? To one or other of the above reasons must be attributed such culpable neglect. On the other hand, many chimney shafts are so provided; but if examined it would be found that their conductors are not in an efficient condition. So long as the rod is visible and in its place it is taken for granted that it is ready to perform its function; its efficiency is assumed to be as good now as when it was first fixed, perhaps twenty years ago. Corrosion, however, may have destroyed the joints, and even severed in two the conductor; whilst the upper terminals may have entirely perished under the action of the gases and weather. So, too, at the lower extremity there may be no proper earth connection.

On account of its height a tall chimney is more liable to be struck than any other structure—excepting perhaps a church spire—and such an accident may be attended with disastrous results to life when the shaft is placed in close proximity to a factory full of workpeople. This contingency alone should be sufficient to call for some legislation for the compulsory provision of lightning conductors.

A flash of lightning has been described as the passage of an electric spark between two bodies oppositely electrified, and between which the difference of potential or electric pressure is sufficiently great to cause a breaking across of the air space or dielectric which separates them. The object of a lightning conductor is to facilitate the safe discharge of this spark from the clouds should it occur; but it has another and equally important function, its action being preventative as well as curative. It tends to prevent the occurrence of a flash—*i.e.*, of a disruptive discharge—by silently neutralising the conditions which determine such discharges in the neighbourhood of structures which it is proposed to protect. Such being the case, and prevention being better than cure, a lightning conductor should be so constructed as to have that end in view as well as that of safely conducting the discharge to earth; and both these results are obtained by the same means—viz., by increasing the number of terminal points—thus reducing the tension and enlarging the zone of protection. Nevertheless, experience shows that the occurrence of a flash cannot be prevented by the silent discharge of very numerous terminal points.

IMPROVED DRILLING MACHINES.

CONSTRUCTED BY MESSRS. HERBERT & HUBBARD, ENGINEERS, COVENTRY.

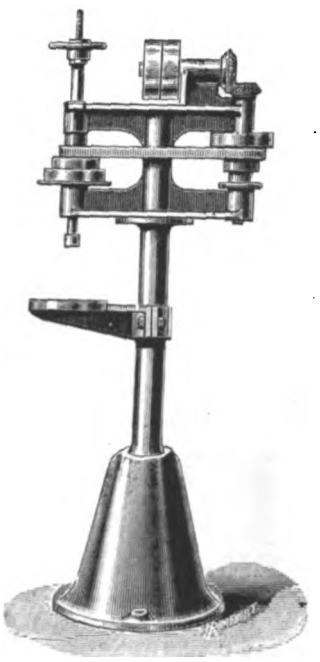


FIG. 1.



FIG. 2.

Such cases are attributed to the electrical energy stored up in the clouds being so great that no points are sufficient for the work of silently reducing the tension below the sparking point. Or, again, the electrical energy may be so rapidly generated or sparked from cloud to cloud that there is not time for the choice of the best path, and the nearest object is struck with apparently little discrimination. But under ordinary conditions of electrical disturbance, a path is created inductively beforehand; and a well-made lightning rod, if near that path, will become part of it, thus protecting the building to which it is attached. As a matter of fact it has been found in the course of many years' experience, both in Europe and America, as also in all parts of the world, that lightning conductors seldom fail to act the part expected of them. In this country the past experience of the postal telegraphs clearly points to the practical value of conductors. In the Navy no accident is stated to have occurred since 1872, whilst the rods attached to British lighthouses have failed on very few occasions only.

The following is a description of a good recognised form of conductor for chimney shafts. Starting with the sky end, points offer the best protection, but they need not be high spikes or tridents. The Lightning Rod Conference of 1881 expressed the opinion that a coronal or heavy band, with copper points about 1ft. in height at intervals of 2ft. throughout the circumference, would form the most useful and durable sky end for a conductor, and this advice has since been followed in many cases. Under no circumstance should one point only be carried high up above the shaft, as till comparatively lately used to be the universal practice in England; for one guiding principle is to avoid attracting the lightning—to "let the lightning come to you, but not to go to meet it." Several points are better than one, not only because the electric tension (by the influence of silent discharge) is thus more reduced, but because single points are occasionally fused or blunted by a flash, and this injury may remain for awhile unnoticed. Copper points should be so platinised, gilded, or nickel-plated as to resist oxidation. On account of this fusion or blunting of points the Lightning Rod Conference advised the use of a sky terminal, consisting of a stout copper rod having a short point (height equal to one-half of the diameter) to receive the flash without risk of melting the metal, and having at the same time, at 1ft. below the extreme top, a copper ring bearing three or four copper needles, each 6in. long, and tapering from ¼in. to as fine a point as possible, thus separating the double functions of a terminal point; whilst Dr. Lodge (in his lectures before the Society of Arts) suggested the use of cones of copper not too sharp, and gilded or otherwise protected against corrosion.

With regard to the choice for the form or section of the main conductor, of the various styles in use—rope, rod, ribbon, tube, plait, and tape—that most approved of by the Lightning Rod Conference is the copper tape. It is neat, easily fixed, flexible, and free from joints; whilst this section is considered to offer less resistance to the passage of electricity than any other. It should be about ⅝in. by ⅛in. thick, and weigh 6oz. per foot run. The junction with the upper band or coronal can be easily made by clamping and riveting the two surfaces together and embedding the whole mass in solder.

Materials for Conductors.—Iron and copper are the only two metals which can be advantageously adopted for lightning conductors. The Lightning Rod Conference recommend copper, but do not put it much before iron. If the latter be used it should not weigh less than 2½lb. per foot run. Copper has the advantage on the score of durability; on the other hand, it is much dearer than iron, and is more easily melted. The principal objection to iron is its liability to oxidation, but this is in a great measure prevented by galvanising. As iron rod, on account of its rigidity, cannot be used in long lengths, many joints have to be made, which is objectionable, because these joints are liable to rust, and thus destroy the metallic continuity. Copper has been generally adopted in England for many years past as the proper metal for conductors attached to all important structures, including chimneys of note. In America and the Continent, however, iron is much more in vogue, and has stood the test of a very long experience.

Mode of Attachment.—There must be no insulation, and the copper tape should be fastened to the chimney with holdfasts of the *same* material, to prevent voltaic action. The holdfasts should be driven in just tight enough to support the tape without distorting it, and so as to allow play for expansion and contraction. The conductor should be placed in such a position as to be least liable to corrosion from the gases, and also, if possible, where the extremes of temperature are at a minimum. Inasmuch as in this country the prevalent winds are from the south-west and north-east, the face or corner towards the north-west would seem to be the best position for it. The Lightning Rod Conference, however, recommended the side most exposed to the weather—*i.e.*, that which is usually more or less damp. An allowance in the length of the conductor has to be made for contraction and expansion—1in. in 40ft. is sufficient. Slight bends in the tape, if not too abrupt, answer this purpose very well. The bends necessary for passing over and through cornices and mouldings should be eased, inasmuch as lightning is apt to take a direct course, jumping over sharp turns in a conductor: in other words, the latter should be as straight as possible. The tape should not be bent at a greater angle than 30 deg. at any point of its length. As copper is a valuable metal, and offers a temptation to thieves, the tape should be carried in wrought-iron gas tubing for the 10ft. or 15ft. above the ground surface and for some few feet below it. It is considered best to connect the conductor electrically—*i.e.*, metallically—to all metal in the chimney, such as strapping and metal caps. Conductors are sometimes duplicated, which is a good

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method, as it facilitates testing for electrical conductivity, &c.

Earth Terminal.—This portion of a conductor is of equal importance to the rest, and expense should not be spared to obtain a very good "earth." The best "earth" is water, and when a deep well or other large body of water is close at hand, the conductor should be carried down into it. The Lightning Rod Conference advised soldering the end of the conductor to a plate of metal (copper to copper and iron to iron, to avoid voltaic action) at least 3ft. square and $\frac{1}{16}$in. in thickness, buried as deeply as possible in a damp spot. A good earth may also be made by coiling the end of the tape or rod in a few tons of coke or ashes deposited in a soil which is always damp. The addition of a bag or two of salt is recommended, or rain water may be led there from roofs by stoneware pipes. Under all circumstances there should be a good, deep, damp "earth," and this can usually be obtained by boring, where other methods are not available. It is still better practice to have a duplicate "earth," bifurcating the conductor underground, and carrying each branch to a separate metal plate; the latter being surrounded, as before stated, with coke or ashes, which are good conductors of electricity. When there are gas or water mains in the immediate neighbourhood, the conductor should be connected to them metallically for their own protection; otherwise the lightning may jump across to them and injure them. Such mains, however, must not be relied upon as terminals, because they are often in dry weather badly earthed. When the mains pass under or have branches entering the building, it is best not to connect the conductor to them, but rather to place it as far as possible from their neighbourhood.

The painting of a copper conductor is optional, but an iron one is usually both galvanised and painted.

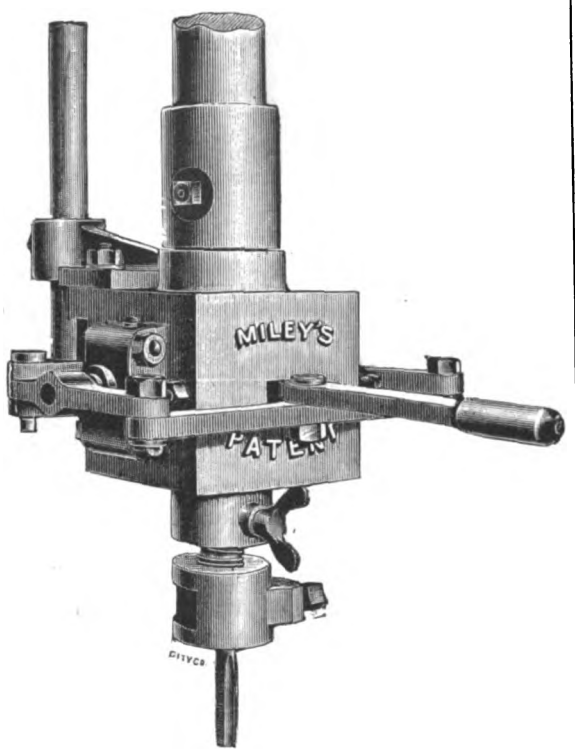
The providing and fixing of this important safeguard should be—and usually is, in the case of tall chimney shafts—left to firms who make this their speciality. It seems a pity, however, that a cheap, yet thoroughly efficient, conductor is not readily to be obtained in this country to meet the case of the small shafts which are so very numerous in various districts. If such were in the market, with clear instructions how to fix them correctly, many builders might feel disposed of their own accord to attach them to their chimneys, who, as it is, leave them unprotected. He who provides a good lightning rod not only protects his own structure but benefits the neighbourhood. The effect of the presence of many conductors in a town is—by the relieving action of silent discharge—to lessen the violence of the storms passing over it. Such has been the experience of Paris and of other cities.

Inasmuch as an ordinary chimney shaft is seldom built alone, but usually stands close to an engine-house or factory, it is not out of place to add a few words as to how these buildings may be protected. Terminal points are generally erected at the ends of all ridges, and they can sometimes be made a slight feature in the architectural design. The conductor should run along the ridges, and may be provided with short terminal points at intervals. It should be carried down all hips and corners of the structure to "earth," so as to cage the latter in, as far as possible, with metal. The different branches of the tape or rod should be taken to a good deep "earth," and by preference to earth at several points, care being taken—as before stated—to have soldered joints and to avoid galvanic action, &c. Rain water spouts, vanes, finials, &c., and all outside metal should be in perfect metallic connection with the lightning conductor, and, generally, with one another; but it should be kept well away from soft metal and small bore pipes and from internal gas pipes of every kind. Some judgment is required in this matter as in that of connecting to water and gas mains. A cheap method of protecting a building, and one which is recommended on high authority, is that of using ordinary stout galvanised telegraph wire for the conductor, carrying it up all corners, along all ridges, hips, and eaves, and up chimneys, taking it down to "earth" in several places, and at each place burying a load of coke or cinders. It stands to reason that, whatever style of conductor be adopted, the general course of the path offered to the possible flash of lightning, from sky end to earth, should be as direct and as vertical as possible. For instance, right angled changes of direction in the conductor from the vertical to the horizontal and back to the vertical, in order to avoid a roof or to lead it from one face of the building to another—as is occasionally to be seen in the case of lightning rods attached to modern structures—should be avoided. The course chosen should be one more or less diagonally downwards—*i.e.*, one making a considerable angle with the horizontal.

Finally, when the lightning conductor is in place it has to be electrically tested; an operation which is best entrusted to an expert. This testing has to be repeated from time to time in order to ensure the conductor being in working order; and to make provision for this a wire is sometimes, in the first instance, metallically connected to the upper end of the conductor and brought down to the base, being attached to the structure in the same manner and with the same care as the conductor itself. If this practice were universally followed, the periodical testing of conductors would not be so much neglected as it undoubtedly is.

MILEY'S PATENT TAPPING TOOL.

The tapping tool shown below can be used on any ordinary drilling machine, without the machine having to be fitted with a reversing motion. Special taps are dispensed with, as the appliance is made to work with ordinary machine taps with square ends of various sizes. Any breaking of taps is avoided, as the tapper is so constructed as to convey to the handle a percentage of the pressure on the tap, and the moment undue resistance is offered, or the tap comes to the bottom of a hole, it is detected at the handle, and the working instantly stopped or reversed. The tool consists of a square box, jointed in the centre, and enclosing five mitre wheels, all of which have turned bosses at their back. These revolve in bearings arranged in the sides of the box. On the driving wheel is a shank which fits into the spindle nose.



The driving wheel supports the box on its back, and the box is prevented from revolving by a rod at the back. The spindle wheel has a hollow boss at both sides, and the part at the back takes a bearing in a recess in the driving wheel. The spindle is fitted inside this boss, so that it can rise and fall with the tap, and the end of the tap is provided with an adjustable driver, to suit the square of the various sized taps. The remaining three bevel wheels are arranged at right angles to the other wheels, two of them being horizontally opposite to each other, to the right and left of the vertical spindle, and the other at the back. The latter wheel always retains its position, and is always in gear with the driving wheel; the other two wheels are arranged so that their bosses can slide in the sides of the box, and each is brought into gear in its turn and held there by the compound levers shown in the illustration. The tool is made by Messrs. Dean, Smith, & Grace, Worth Valley Tool Works, Keighley.

THE IRONMONGERS' EXHIBITION.

This Exhibition, which was started by Mr. H. Etherington as a purely ironmongery Exhibition, has now developed itself into an "International Exhibition of Machinery, Manufactures, Appliances, and Inventions Incidental to Engineers, Electricians, Builders, and Ironmongers." The Exhibition was opened on the 17th inst., at the Agricultural Hall, Islington, and will be closed tomorrow. The exhibits are less imposing than the length of the title of the Exhibition would lead one to believe, but although a good many of them deserve the respect which is due to old age, inasmuch as they have figured at exhibitions for many years past, some novelties are presented. It is almost needless to say that on the opening day affairs were in a somewhat backward condition, but they have now got into order.

Messrs. Alldays & Onions, of Birmingham, have numerous types of smiths' forges with hand blasts, and a Roots blower driven by a small steam engine. They have also a pneumatic hammer.

Some handy little tools are exhibited by Mr. J. Parkinson, Chester Street, Bradford. Among them is a small drill for foot driving, and a combination breast and table drill for holes up to $\frac{5}{16}$in., and a very neat lathe. A vice is also shown for heavy work with a very ready adjustment.

A good show of gas engines is made. Several "Otto" gas engines are shown by Messrs. Crossley Brothers, and one of 14 h.p. is in motion running a Thomson-Houston dynamo, supplying current to thirty Thomson-Houston arc lamps of 1,200 c.p. Messrs. Dick, Kerr, & Co., 96, Queen Victoria Street, have seven of their "Griffin" gas engines, one running a "Tyne" dynamo of Messrs. E. Scott & Co., Newcastle-on-Tyne, for the supply of twelve arc lamps. This firm also shows a "Fife" arc lamp of simple construction on the lines of the "Pilsen-Joel" lamp. The "Stockport," the "Campbell," and Atkinson's "Cycle" gas engines are well represented. We also noticed a new gas engine made by Fawcett, Preston, & Co., Limited, Liverpool, which is called the "Fawcett." The advantages claimed for this engine are its extreme symplicity of construction, the ease of starting, and an impulse at each revolution.

Wood working machinery is represented by Messrs. Lewis & Lewis, of Cambridge Heath Road, London; Messrs. L. Amette & Co., 291, City Road, E.C.; and Messrs. E. Jacobs & Co., 105, Queen Victoria Street, E.C. The last firm has a large exhibit, which includes band saws, tenoning machines, hand and power feed surfacing and thicknessing machine, single deal frames surface planer and jointer, four-side inch moulder, and a self-contained circular-shaped recesser and surface moulder. A most ingenious arrangement is that shown by the Folding Truck and Carriage Company, Bellevue Street, Swansea, by means of which a hand-cart 3ft. 6in. in width folds up to 1ft. 6in.

Messrs. Winnal, Callow, & Winnal, Bromley Street, Stepney, have various electrical appliances, including an electric ship's bell. They also exhibit a small "Phœnix" dynamo, not in motion, and a model of Newall's rotary engine.

The Incandescent Gas Light Company, Limited, 3, Victoria Mansions, S.W., have introduced into the Welsbach lamp an improvement in the method of attaching the mantle to the burner. Several regenerative lamps are on view, including the "Champion," made by the Champion Gas Light Company, 37, Southwark Bridge, S.E.; the "Meteor," of Messrs. Henry Greene & Sons, 153, Cannon Street, E.C.; and the "Thomas," of the Thomas Lighting Company, Limited, 15, Carthusian Street, E.C. The last mentioned is specially prominent by the brilliance of its light. Messrs. J. Stott & Co., 174, Fleet Street, have their well-known gas governor on view; they are introducing a new type of sunlight for theatres and workshops. Mr. Joseph Shaw, Albert Works, Lockwood, Huddersfield, is represented by his gas governor, which is shown in different sizes. Mr. H. L. Müller, 22, Mary Ann Street, Birmingham, has some of his "Alpha" portable gas making machines, but these are not at work.

Mr. Dan Rylands, of 62, King William Street, London, shows his patent glass-lined metal piping, which he has just put on the market. This patent piping consists of a distinct internal solid glass tube, which is covered and protected externally by ordinary iron tubing; a suitable cement is inserted between the glass and the iron, making the whole homogeneous, and at the same time rendering this new piping unbreakable by ordinary use. Tee-pieces, bends, elbows, and crosses can be similarly manufactured with the internal solid glass lining. The advantages claimed for glass-lined tubes are many, and they would appear to have a future before them for chemical and electrical purposes.

THE PROGRESS OF BRITISH WATCH AND CLOCK MAKING.*

The one fact which the late Paris Exhibition has made patent is that the English watch and clock making trade has awakened from a long lethargy and has entered on a veritable Renaissance. At Paris, there were altogether 500 clock and watch making exhibits, coming from Austria, the Argentine Republic, Belgium, England, France with five centres (Besançon, Haute Savoie, Beaucourt District, St. Nicholas d'Alièremont, and Paris), Italy, Japan, Roumania, Switzerland (with its 147 exhibitors), and the United States of America. Of these 150 were watch and 37 clock manufacturers, and these are the sections that will be the subject of my paper.

Taking the class of watch manufacturers, the somewhat large number of 150 exhibitors may at once be separated into two

* Paper read by Mr. Julien Tripplin before the Society of Arts on the 5th inst.

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groups, viz.:—*A.*—Manufacturers by the new mechanical processes, that is to say, those who by means of steam or hydraulic power, new appliances, improved organisations, and larger output, make the whole or part of the watch on the interchangeable system. *B.*—Those makers who follow the old mode of watchmaking, still almost exclusively in use in Clerkenwell, partly at Coventry, and also at Besançon and parts of Switzerland, wherein the rough movement is produced in places which are far distant from those localities in which the finishing operations of jewelling, dial-making, 'scaping, chasing, finishing, timing, and adjusting are done under a system of sub-letting to small makers who work at their own homes.

Of the former there were 25, and of the latter 125 exhibitors. Dividing these again into nationalities we found that in Group *A* (25) England had 1, France 6, Switzerland 16, America 2; while in Group *B* (125) England again had 1, France 49, and Switzerland 75. This classification is, of course, not sharply defined as in some cases it became difficult to discriminate, but it facilitates the task of examining and comparing.

The importance of the question of watchmaking by mechanical processes, suggesting as it does a large, complicated, and complete manufacture, deserved some analysis. A small amount of investigation made it clear that under this heading were grouped a number of manufacturers who differed widely in the extent to which they carried out the principle; indeed, five fairly-well defined divisions were seen to exist. These may be stated as follows:—*A.*—The watchmakers using automatic appliances more or less in the making of plates and barrels, and of various parts of the watch, but who obtain wheels and pinions from outside their own organisations. *B.*—Those firms making the movement complete, including wheels and pinions, but not the parts of the escapement. *C.*—Those who couple the finishing process with the operations of Group *B*, but who yet obtain the parts of the escapement outside. *D.*—Firms who add casemaking (sometimes only in metal and silver, sometimes both in silver and gold) to the operations of Group *C*; still, however, obtaining the parts of the escapement from elsewhere. *E.*—Those firms whose organisation embraces the making and finishing of the whole of the parts of the watch and the case, except the specialised parts of the mainspring, balance-spring, hands, and perhaps jewel holes. Accepting these divisions as in the main indicative of various degrees of watchmaking by machinery, although it is true they interlace in great complexity, and applying this analysis to last year's Exhibition, it was noticed that Switzerland, so strong in collectivity, was comparatively weak in work of type *E*. Looking at the testimony of the exhibits themselves, we found none that realised the conditions of Group *E*, except the English firm of Rotherham & Sons (and perhaps that of Messrs. Japy Frères, and the well-known Waterbury Company of America; but these two firms only deal with metal-cased watches of less than ten shillings in cost, and can scarcely be considered when speaking of watches of precision), and this firm thus at once attracted attention, even among so large a number of exhibitors taking part in the competition. It is difficult to assign a reason why the Swiss have not yet carried their revision of operations far enough to cover the ground that the American and English companies consider the ultimate necessary extension of the modern mode of manufacture. Probably the causes are manifold; it may be that a large command of skilled labour and an extensive subdivision in their older method have created certain vested interests in the community and make it more difficult to change; or it may be the large capital required and the absence of joint stock enterprise in Switzerland. Again, the cheapness of their productions, made under their old methods, would naturally at first render them freer from competition, and so necessity, which on close investigation is always seen to be the compelling agent, was not early felt by them. Be this as it may, there can be little doubt to-day of the enormous gain of carrying the combinations to the extent of Group *E*; it is, in fact, the only rational course which meets the requirements of this present time.

Before entering into a more detailed consideration of this Group *E*, which forms the main body of my remarks, allow me to say a few words on the British section as it was arranged in Paris last year. This section had a compact and collective appearance, and as such arrested attention. The exhibitors were chronometer-makers, turret-clock makers, and watch manufacturers by both methods; a school of horology, tools and materials, and literature were also represented. It differed widely from that of previous exhibitions in many ways. Formerly the few exhibitors were scattered about, and their stands arranged with small counters for purposes of sale, justifying in some measure the Continental sneer "that England is a nation of shopkeepers." In the present instance the very reverse was the order of the day, the firms exhibiting were of weight and substance (chiefly *bonâ fide* manufacturers), and were for the most part induced to do so from patriotic motives, endeavouring to counteract by ocular demonstration the feeling which had begun to take root in the public mind, that English watch and clock making was a thing of the past. The representative character of the exhibitors and the substantial merits of their exhibits greatly impressed the jury, and obtained for our section the unprecedented number of awards it received; in point of merit, the watch and clock making section stood before all others in the Exhibition. In chronometry Mr. V. Kullberg carried the palm from all competitors. Messrs. Dent, of the Strand, and Gillett & Johnston, worthily sustained our reputation for public clocks, this last firm emphatically so. Messrs. Grimshaw & Baxter's exhibit of watch and clock tools and materials was large, and representative of the excellence of our products in this particular; while Messrs. Usher & Cole, Parkinson & Frodsham, and Webster, of Queen Victoria-street, showed that the traditional skill of Clerkenwell was still the best of its kind. For the first time, too, an English school of horology presented itself to the consideration of a jury, and we must note, in this new departure, a happy augury for our future. As tending in the same direction should be classed the translations into English of Saunier's textbooks for schools and workshops by Mr. Edward Rigg, jointly with myself.

But the exhibits I have selected to illustrate my conclusions to-night are those of the British United Clock Company of Birmingham, as regards the manufacture of the cheap drum clocks (with which American and French firms have flooded the markets because of their singularly low price); and the old and important house of Rotherham, of Coventry, as regards the manufacture of standard types of English lever watches. I may say that the latter's exhibit was intended to show the reorganisation that English watch manufacture has undergone during the present decade, and the result is, perhaps, best shown by quoting two criticisms by foreign experts. One was delivered by an eminent Swiss writer, who said of the English trade, as represented at the Paris Exhibition of 1878:—"It is complacently asleep in the conviction of having raised limits which its rivals or successors can never surpass" The other criticism is taken from the *Revue Chronométrique* of November, 1889, and is from the pen of Mons. E. Antoine, one of the Besançon jurors, himself a watch manufacturer of the first rank. He says of this firm, in showing the application of machinery to watchmaking:—"It equals, if it does not surpass, its predecessors in every country." We have here a complete reversal of previously existing impressions, and this should be highly gratifying to every Englishman. The exhibit was in itself very simple; it consisted of a connected series of pieces of the movement, showing, step by step, the condition of each part as it passed, process by process, from the raw material to the finished work. Every part of the watch was illustrated in this way, and so arranged as to convey a clear indication of the methods, and to show the nature of the machinery employed throughout the whole of the manufacture. In like manner the making of enamel dials, of gold and silver cases, and of pendants and bows, were exemplified; but simple as it was, it was readily seen by the jury that they had under their consideration as complete an organisation as could be found in any country. The various branches of watch manufacture were found to be all brought under one control, and each of those branches had been revised in its methods by the introduction of automatic machinery of the latest type. By a series of photographs it was also seen that they were manufacturers of their own machinery and appliances, and it was elicited by the jury that in their tool-making a regular system of measurements and gauges secured the advantage of interchangeability in the lathes, engines, and general machinery of the place.

I will try to make clear the essential difference between the old and the new methods of manufacture. It is generally known that in the very early days of watchmaking the whole of the mechanism was the handiwork of some master craftsman, who designed and fashioned all its parts from crude metals, and even worked up the metals themselves, by his own peculiar treatment, into a condition of special fitness for his wants. This craftsman, with mechanical aptitude of the first order, was of good education and wide reputation, and such workmen were often retained by emperors and princes for the making of costly gifts. The whole of the operations were thus concentrated under one roof and control, with a high level of education in the worker. After this time came the usual evolution, differentiation began, and slowly we find the making of the parts more and more subdivided, and specialists in the various branches combining their work to form the whole machine, resulting in a very great advancement in quality. Further divisions and sub-divisions follow, also further raising of the standard of excellence, until the errors of time-keeping fell from five minutes a day to less than one minute a week. But all this was attended by a greater and greater separation between the workers. Beginning by occupying different houses in a given district, and then different districts in a town, they eventually became distributed over the whole face of the country, until the loss of time in fetching and carrying became from 10 per cent. to 20 per cent. of the cost. Even this, however, was not the most serious evil. Absence of control gave rise to the much greater disadvantage of a loss of unity of proportion and of evenness of quality; excellence in one part joined mediocrity in another, this being discoverable even in the most costly watches; and, finally, the impossibility of bringing such a disconnected course of working under fixed standards of reference or under a uniform system of exact measurement, brought about such a condition of things that at last a point was reached when the advantages of specialisation were balanced by the want of dovetailing in this disjointed and cumbrous procedure. Such was the condition of things up to forty years ago, when these drawbacks gave rise to the desire in many minds to get back the advantages of unity of control without losing the advantages springing from sub-division and specialisation; and this is exactly what has been secured by the new system of manufacture in large factories. The system is fundamentally sound and logical, because it secures the union of these advantages. The twenty odd branches of the trade are once more aggregated under one roof and control; an extreme sub-division is set up, and the whole fabric linked together and governed by a rigid system of measurement for the size and proportion of every part.

The increased application of machinery, associated with this revised method of manufacture, excellent as its results are, is, one may say, almost secondary in importance to the reorganisation which this re-grouping of the trades admits of; but when the automatic processes are added to this reorganisation, we have the powerful weapon which gave the Americans, who early adopted it, a leverage in economic production which threw the old manufacturing centres of Europe for a moment into confusion and panic. The American companies were thus able to develop themselves on a vast scale, and to obtain almost complete control of their own markets before the other countries had time to reform. It is now difficult to dislodge them, although it has long been evident that, with anything approaching equal manufacturing facilities, the old centres would once more invade American markets were it not for the existing heavy prohibitive duties.

It has been said that an extreme subdivision is made possible by the factory system; this involves as its corollary great quantities in manufacture. It has been further said that this specialising of the functions leads to increased excellence, but it has this further advantage that, for industrial purposes, it enables the creation of skilled labour in the least possible time. Take, for instance, the formation of a balance-staff-cone pivot; a lad can be taught in two or three months to pivot a staff in a style that would not be possible without several years' practice in the old order of things, and, from doing but this one thing he quickly obtains a dexterity that surprises, until it is remembered that he has made more pivots in six months than an ordinary watchmaker, in the old way, would make in a lifetime.

It should be pointed out that one of the special difficulties in establishing a watch factory is that—until quite recently—it was not possible to purchase the machines indispensable to commence the manufacture. It was necessary to begin by starting an engineer's shop, in which to build up the tools and machinery; and to design these, to make the patterns, and to make a long series of machines, required some years of preparation.

In the "plate room" of Messrs. Rotherham's all the brass parts of the movement are turned and milled into the required form and size, as well as the drilling and tapping of the holes, the steady pinning of the pieces, the planting of the position of each wheel, and the boring out of the recesses to receive the jewel holes. The parts are received here from the press-room, where they have been stamped out to a given shape, and are here finished ready for gilding. Girls are largely employed in these operations, as the machines, when set up to measurement by the foremen, are rendered wholly independent of the skill and judgment of the worker. Quickness, care, and cleanliness are the only requirements. Gauges, verniers, and micrometers are *de rigueur*, to check the wear and tear of cutter edges and points. Fines are imposed if anyone is found working without a periodic testing of their work by the standard. An independent office examination of the pieces when completed gives a further check to these precautions. This is one of the strong points of a factory organisation. It is desirable to note here that an essential difference between the old and new methods shows itself at this point. There is no roughing the part out somewhat nearly to its right proportion, and then passing it on to another workman to remake it smaller, to refit it, or to shorten it to the right height and length, thus practically travelling over the same work twice. This was the custom formerly; but now a book of drawings of each piece is furnished to the foreman who has to set the machines, and therein a diagram and measure are given for every cut made upon the piece, so that it is reduced at once to the proper dimensions with quickness, directness, and with the certainty that it will coincide with the part it is to be attached to. There is obviously a minimum waste of time in this way.

In another room the workers are engaged in making the steel work of the watch—that is, the cutting of pinions, ratchets, springs, regulators, studs, and numerous steel pieces of strange shapes which constitute the keyless mechanism. The directness of procedure is again apparent in the fact that, contrary to the older plan, the pinions are at once turned to the right height of head, the arbors to the right length between shoulders, and the pivots to the right size according to the diagram of measurements furnished to the foreman of the department. No hesitation or mental debating as to proper size is called for; that has all been decided in getting out the original drawing and model from which the measurements are obtained, and action, and nothing but action, is now the order of the day. The general rule of this department is that all finishing operations are done by automatic machines, which only require the operator to feed in the "blanks." The approach of the cutter to its work, the travel, or feed, and the withdrawal of the cutter and the stoppage of the machine, and the completion of the operations, are functioned automatically, leaving the worker free to attend to several machines, or prepare the blanks, or cleanse them. The reason why these machines are not made self-feeding is twofold: firstly, the minuteness of the parts, and secondly, the need of clearing the centres and surfaces of chucks and cutters after each operation, when dealing with such minute pieces and with such exact measurement.

In the next shop the workers are all skilled hands engaged in putting the parts of the watch together, and in timing and adjusting, and in casing the movements. Messrs. Rotherham receive the time current daily from Greenwich for this purpose, and the low, middle, and high temperatures are obtained by refrigerators and ovens placed under ground, and kept within a variation of one or two degrees Fahrenheit all the year round.

In illustration of the kind of economy obtained by the latest labour-saving appliance, let us take the case of a wheel—that most important element in a watch. A watch wheel has four, five, or six arms or spaces, formed to give lightness to it, and these are stamped out in a press, and in cheap watches it is left so, but the act of stamping out these spaces leaves a very rough, torn surface where the metal parts, and hitherto it has been the habit to laboriously file and scrape the surfaces of every arm, web, and boss to give squareness and finish to the object when completed. This required some skill, and was a costly operation of a minor kind; but I will refer to a new kind of sub-press or cutting instrument (Figs. 1 and 3) which is devised to cut just a thin shaving off all the twenty sides and surfaces of a five-armed wheel at one stroke; the operation, including the fixing of the wheel, is accomplished in less than thirty seconds, and, what is more, leaves the wheel in perfect poise. The whole of the parts are fitted by a slow process of polishing when hardened, and this fact, coupled with the fact that it must be related to the previous punch, which forms the spaces by very exact measurement, makes this a very costly tool. Messrs. Rotherham's is the only place in England where this is practised.

The formation of the pivot of a watch is an operation of the first importance. In Fig. 2 is an apparently simple machine in use for this purpose at the factory at Coventry. The principle on which it is built is the recognised one for securing perfect roundness—viz., the work revolving one way and the polishing disc rotating at high speed in an opposite direction. The driving band or gut, it will be observed, is arranged to take off all side pressure from the spindle, and this leaves the "feel" or touch of the worker's hands unimpaired. A device consisting of an inclined plane and roller is added at the base of the machine, which, by adjustment, will give any desired taper to the pivots. The pivoting is all done to ruby holes of standard sizes.

In illustration of the control in detail made possible in the new system, I may mention a machine (Fig. 4), the sole function of which is to repair the polishers used on another line of machines, in order to insure uniformity of form when the polishers require renovation from slight distress in wear. This machine is used to preserve a uniform shape on the cone of balance pivots, and is simply a type of a line of tools, existing in a well-organised factory, to preserve unchanged the curves and angles of polishers and cutters under the strain of constant use and repairs. Running in a head-stock is a revolving abrader, which may be either a file or emery disc. To this is presented the polisher, moulded in a holder having a circular motion. The radius of the curve given to the edge of the polisher is regulated by the distance it is fixed from the centre of motion of the holding frame, and this distance is an adjustable one.

Perhaps there is no part more difficult to deal with by machinery than the pallets of a lever watch, and especially is

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THE PROGRESS OF BRITISH WATCH AND CLOCK MAKING.

Tools used in the Manufacture of Watches at Messrs. Rotherham's, Coventry.

(*For description see page* 290.)

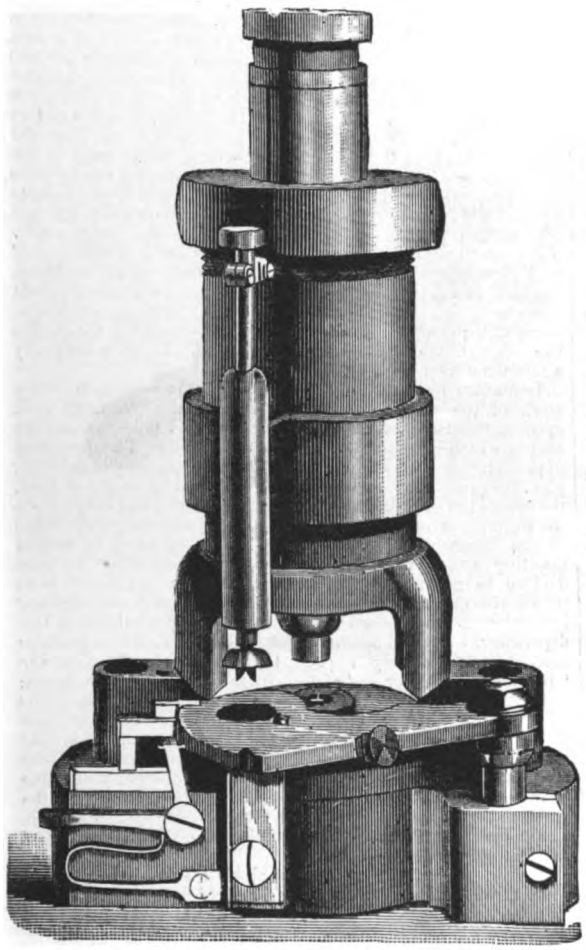


Fig. 1.—Sub-Press Wheel Shaving Machine.

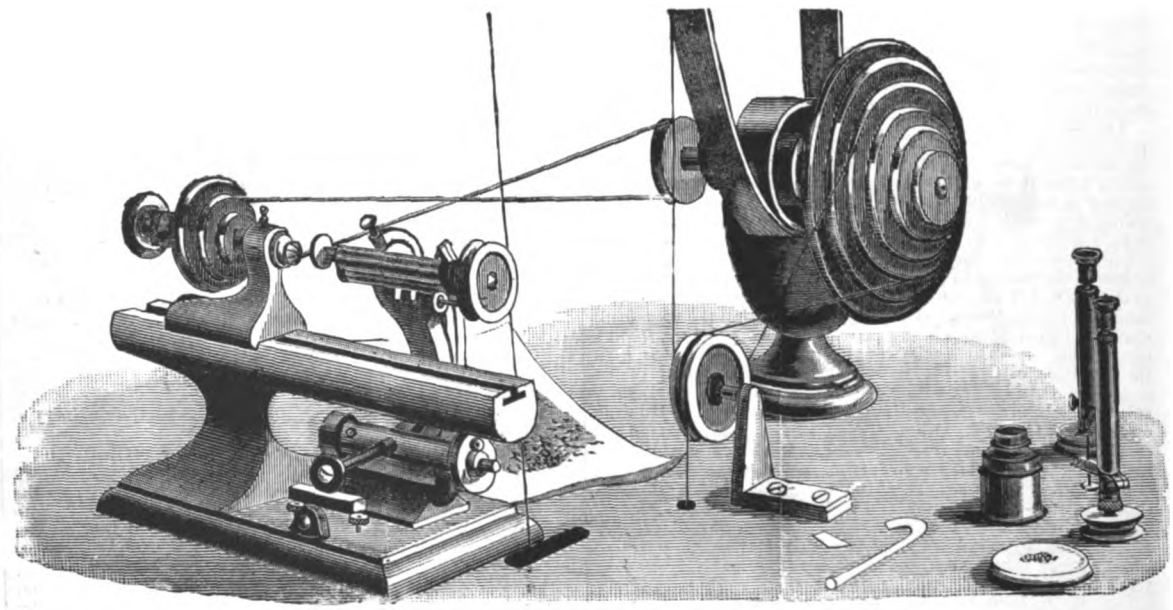


Fig. 2.—Balance-Staff Riveting Machine.

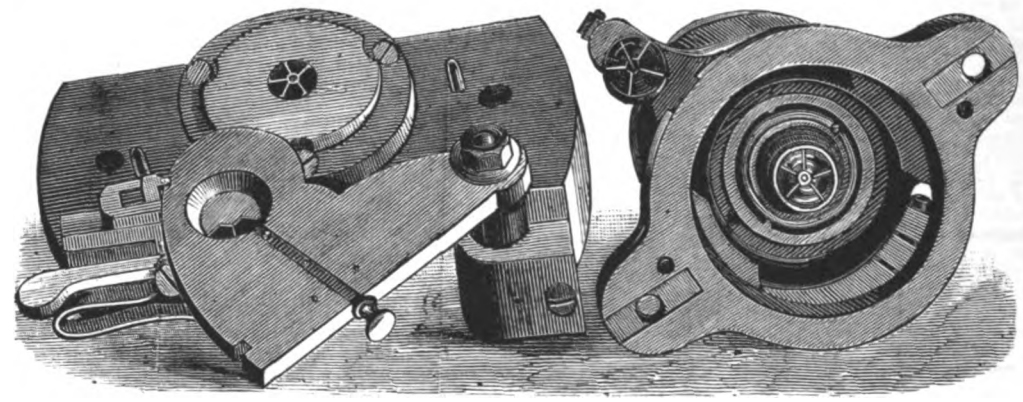


Fig. 3.—Portions of the Sub-Press Wheel Shaving Machine.

this so in the form which it assumes in an English lever, where, for the purpose of being secured against any sort of accident in use or repair, the slips of ruby are encased in steel. In most cases the difficulty has been evaded by adopting some other form more convenient for the application of machinery; but Messrs. Rotherham were very desirous of preserving this distinctive feature of the English watch, and, after a rather considerable outlay in experimenting, they were able to produce a line of tools which gave excellent results. Fig. 5 shows a view of the semi-automatic cutting engine for forming this English form of pallet. Here the whole of the nine angles that have to be cut are expressed on a dividing plate, and the blank pallet (mounted on its pallet holes and the two lever pinholes) is cut to these angles, all in absolute relation to one another, in the same manner that the teeth of wheels are cut; the three cutter spindles that revolve are shifted by hand as each cutter is brought into action, but the eighteen stops required and geared together are all moved automatically by the up movement of the cutter handle. The principle in the design of this tool is that the angles cut on the pallets shall not depend upon any angle given to the cutters, but be cut by square-faced cutters easy to produce. Similar devices permit of the polishing of these faces after the insertion of the slips of ruby.

The operations of working the precious metals are necessarily directed to guard against waste, and to this end do away with filing or scraping, or the making of shavings by turning, or any operations which, by producing dust or minute fragments, result in loss; and further, to do away with soldering the parts together, as this involves filing or dressing in some way the points of junction. The modern method, therefore, is to treat metals as plastic material, and force them by pressure into the required forms and thicknesses. The metal is rolled down into a ribbon of given thickness, and then a disc of a calculated diameter is stamped out, and then fashioned into a cover as follows:—A disc (Fig. 6) is placed in a cupped die under a strong screw-press, and a stamp of corresponding shape with one blow turns up the disc into the form shown in Fig. 7. A second stamping turns over the edge a little for the snap, as in Fig. 8. A third continues the formation of the snap, and completes it as in Fig. 9. The die used in the foregoing operations has a groove to correspond with the bead required on the bottom, but as yet the bead is not well defined, and therefore a stamp is now used, the contour of which, instead of following closely the outline of the die, bears hard on the points where the beads should be. A blow from this gives the requisite fulness and sharpness to the bead, as shown in Fig. 10. Well and uniformly shaped bottoms are thus produced without soldering. The snaps and outer surface of the bottom are skimmed in the lathe. However necessary turning might be for the snaps, it seems like painting the lily to apply the lathe tool to the already smooth and finished surface of the remainder, but the silver would not yield the particular high polish desired unless the skin of the metal were first removed.

The making of machinery for gold and silver cases is an industry which has kept pace with that for dealing with the watch movement. In Fig. 13 is shown a view of a tool designed by Messrs. Rotherham to cut the spaces and recesses into which the knuckles or joints of the case are to be soldered. These spaces are cut by a revolving cutter, at a fixed distance from each other, by means of a dividing plate, and a novel invention is introduced into the machine for securing the truth and accuracy of the depths of the hollows, in spite of the twisting of the case under the heat of soldering. This spacing on a dividing engine, and providing for the distortions of metal in soldering, strikes one as refinement in manufacture.

The British United Clock Company is a company formed for the production of cheap lever drum timepieces and alarms, a work hitherto monopolised by foreigners, and in the short space of five years they have successfully checked the importation of these goods. The production of the company has reached 500 clocks per diem. This may appear a large number, but is comparatively trifling compared to the demand. The best appliances have been laid down, and the factory, although it covers 1,250 yards, and is fitted with engines of 70 horse-power, as yet only covers one-third of the ground acquired for future extension. An excellent machine room is established for making dies and machines, and for repairs. This and an extensive press-room are fundamental requirements in such a manufacture.

A simple recital of a few of the operations in making these clocks may interest those unacquainted with the care and precautions made possible in large works, even where the goods are sold at the singularly low price at which these clocks can be obtained. The wheels have their teeth cut in an engine in place of being stamped out, and the pinions are no longer made from "drawn" pinion-wire, but are also cut in an engine, three cutters in succession traversing each leaf, and they are then subject to a certain degree of polishing. The mainsprings are tested individually after hardening.

There is a very neat invention in connection with the winding of the Speedwell alarm. The great wheels of the going and alarm trains are mounted on the winding arbor, one on each side of the mainspring, which serves to actuate both. The wheels are loose, and driven by ratchets and clicks to allow of the arbor being reversed to wind the spring, the outer end of which is attached to the great wheel of the going train. When the alarm is let off, the force of the spring will cause the winding arbor to turn and carry with it the great wheel of the alarm train. But the problem is to lock the spring again when the alarm has run its course. On the winding arbor is a pinion with coarse teeth taking into a segment having a strong butt, which forms the alarm stop. In winding the piece, the first turn of the winding arbor winds the alarm stop, if it is down, and a missing tooth in the segment allows the winding of the going train to proceed in the usual way. This is made clear in Figs. 11 and 12, where the wheels and segment are shown as they appear before and after winding. There is, it will be observed, a light spring, which presses against a pin in the segment when it is wound, thus keeping the butt away from the pinion, and ensuring the engagement of the pinion and segment teeth when the alarm is let off. The arrows in Fig. 11 indicate the course of the wheels in winding, and the arrow in Fig. 12 the direction in which the segment will move when the alarm is in action.

In evidence of the thorough-going way in which the company uses every modern aid in furtherance of its work, I may mention that the cases of these clocks and the ornamental dials are prepared for gilding with that peculiar soft grain known as "satin-matt," by the use of a steam sand blast, the process being as follows:—The object is placed in an air-tight box and over the orifice of a pipe containing the sand; the box is then exhausted of air and a jet of sand impinges on the metal, and in a few seconds it has the desired matt. The energetic way in which the management attacks the difficulties that arise is shown in this fact that, finding the brass supplied in Birmingham is not so good for the purpose as that obtainable in America and Germany, because the sulphur from the coal used in annealing injuriously affects the surface of the metal, and shows itself as an uneven surface after being "dipped," it is now preparing plant to make brass with the object of overcoming this defect. Such great energy and enterprise, as I have alluded to, leads one to understand how, in the short space of less than five years, this company found itself strong enough to venture on competition with the whole world in an international exhibition, and in the opinion of many competent judges did so more successfully than even their Paris award indicated. There is here a lesson of what may be accom-

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THE PROGRESS OF BRITISH WATCH AND CLOCK MAKING.

Tools used in the Manufacture of Watches at Messrs. Rotherham's, Coventry.

(*For description see page* 290.)

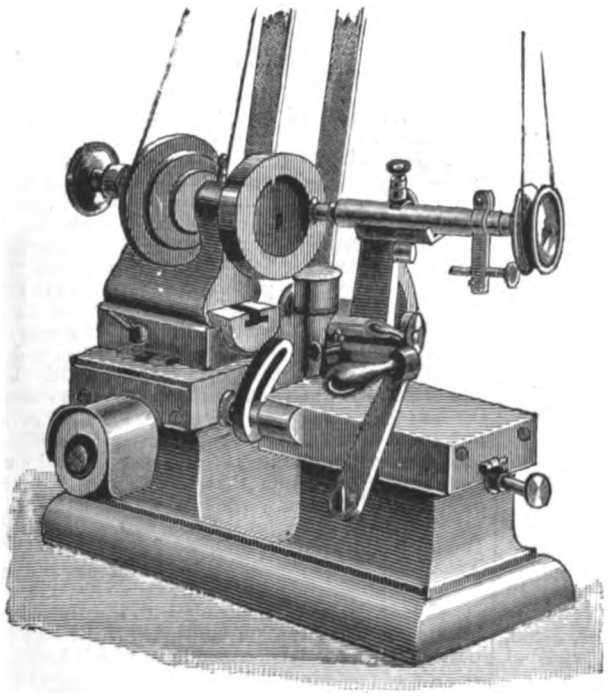


Fig. 4.—Cone Pivot Polisher and Shaping Machine.

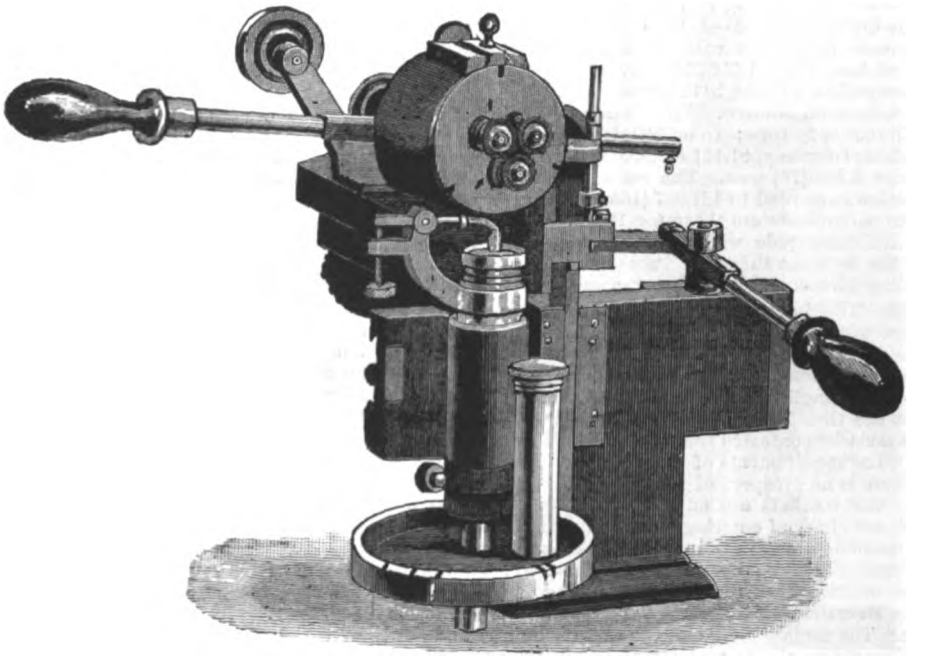


Fig. 5.—Pallet Cutting Engine.

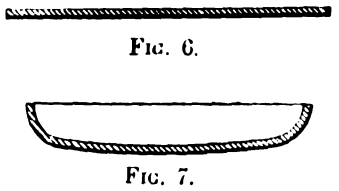


Fig. 6.

Fig. 7.

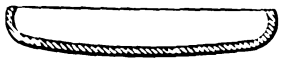


Fig 8.



Fig. 9.

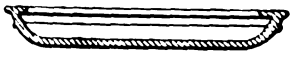


Fig. 10.

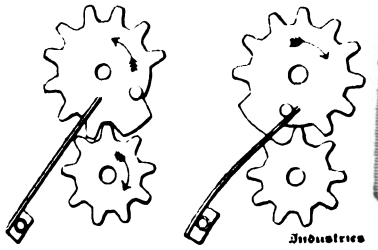


Fig. 11. Fig. 12.

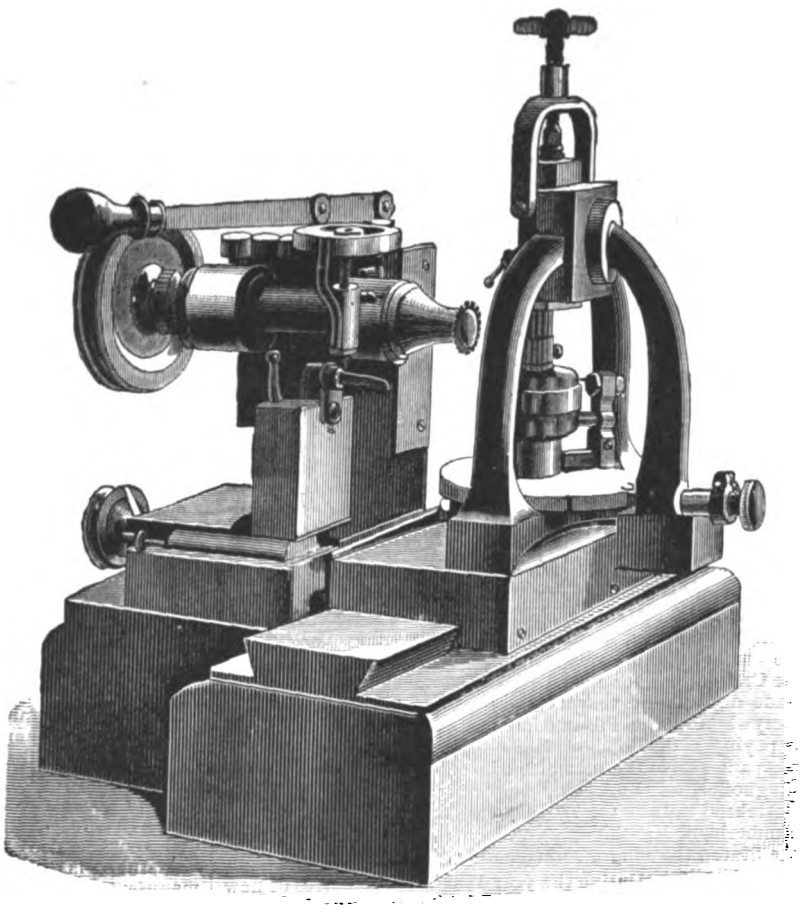


Fig. 13.—Case Knuckling Machine.

plished by a union of intelligence and energy on the one hand and capital and commercial capacity on the other; for it must always be remembered that it is not enough to make the goods, but that to distribute them with sufficient rapidity and volume is an essential of success where great producing power is developed.

I hope this hasty glance at these few details may have served to convey an idea of the manner in which watches and clocks are produced by the new method, and that you will perceive that it is not of the nature of a new discovery, but rather a development from our past, and that, as is common in such a case, is attended by an increasing complexity, which requires greater grasp and width of knowledge, and more organising power on the part of those who conduct it. The superintendents, foremen, and sub-foremen of the various departments have not only to know all that appertains to their own proper business, but to deal with the details and functions of the complex machinery set in motion to produce these watch parts, and they have, further, to conduct operations on a much larger scale than has been the custom hitherto. All these requirements demand new facilities for acquiring this special knowledge, and imperatively call for the specialisation of theoretical training in schools equipped with a proper range of teaching appliances. Our continental rivals have long recognised this fact, even before the advent of this complicated machine system, and the magnificent display of their ten horological schools at Paris last year testifies to the importance attached to this educational machinery abroad. It is true that for the first time in our history we had a Clerkenwell school exhibiting side by side with these foreign schools, but the comparison naturally showed our weakness, and the great advantage it is now to the foreigner that he established these training centres a generation before us. The necessity for these schools amongst us has become so great of late, owing to the gradual decrease of the apprenticeship system, that we are not without some movement in the desired direction, for a second school has been established in London and one at Edinburgh; while Coventry has, within the last two years, established one in connection with the technical institute in that city. But in view of its supreme importance this matter moves too slowly with us, and it is to be hoped that the energy and thoroughness which distinguishes the English character will display itself in anxiously promoting and fostering schools of horology.

These remarks bring me to the conclusions at which I have arrived after a careful study of the horological display at Paris. I find that in comparison with our competitors our position to-day stands as follows:—1, In chronometry we are supreme; 2, In two or three branches of the clock trade we have a decided lead; 3, In the manufacture of the cheaper kinds of clocks we show a successful and hopeful new departure; 4, I find that the cost of our best grades of adjusted watches is now as moderate as is the corresponding grade of foreign work, while the gradual elevation shown by the timing records at the Kew Observatory trials testifies that their excellence is being steadily advanced year by year; 5, The records of our deck watches under the severe trials of the Greenwich Observatory show performances unequalled in the world; 6, As I have shown, in the important matter of watchmaking by machinery we have, during the past ten years, vigorously pushed ourselves to the front rank in quality and organisation, for besides the large factory of Messrs. Rotherham, we have in London those of Messrs. Guye & Company, and Nicole, Nielsen, & Company, and two in Birmingham, that of Messrs. Erhardt & Company and the English Watch Company; besides these a new organisation is now arising in Coventry, while only last month Lord Derby attended the opening ceremony of the new Lancashire Watch Company in the village of Prescot, a very old seat of watchmaking.

Now, taking the contrary impressions, I am struck with the, to me, unmistakable evidence that the following points of advantage which the foreigner appears to have over us is closely, if not solely, related to his having so long possessed those specialised educational advantages we are in the habit of speaking of as technical instruction. In the first place, then, he is decidedly superior to us in the variety and flexibility of his manufactures, in the wealth of his style, and in the beauty of his decorations; 2nd, in many branches of clockmaking, notably in mantelpiece clocks, where the decorative art comes into play, he holds a decided monopoly; 3rd, in the application of electricity to horology he is considerably more advanced than we can claim to be; 4th, in all that relates to the synchronising of timekeepers, whether by electricity or pneumatically (although perhaps this is debateable ground), I fear we must grant the foreigner a foremost place. In considering these four points, I venture to reiterate the thought that they are all more or less related to the widened mental condition that comes from special training in the science and technics of the art. I have estimated that the ten schools exhibiting in Paris have during their existence trained more than 7,000 students, who have passed out and taken positions in the trade as manufacturers, foremen, &c., and thus become centres for extending the knowledge they have acquired.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

(FOR LATEST TELEGRAPHIC DESPATCHES SEE PAGE 297.)

PARIS, 25TH MARCH, 1890.

COAL.—The effect of the dearth of coal, due partly to strikes among the miners and partly to greater activity in the iron trade, is distinctly visible in the Customs returns recording the imports of coal in the first two months of the current year. Throughout 1889 there was a constant falling off in the deliveries of foreign coal. Now the import trade is increasing, and the increase has been such that the quantities received for consumption in the country compare favourably with those of the corresponding period of last year—1,312,058 tons, against 1,166,124 tons. The particulars of which this total is made up show an increase from all sources. Thus we have from England, 666,357 (550,982) tons; from Belgium, 552,140 (530,071) tons; from Germany, 91,131 (84,995) tons; and from other countries, 2,430 (76) tons. The coke imports in the period in question amounted to 181,367 (165,424) tons. The quantities in parentheses are those for 1889. There is a falling off in the coke trade with Germany, where the home demand has for some time past exceeded the supply. Very little English coke is shipped to France.

IRON.—The improvement which was brought about in the iron markets of this country by the colliers' strike in England is maintained, and the rates have become firm on the announcement of a considerable permanent increase in the cost of English coal. Our merchants here refuse to accept less than 160s. a ton for bars and 164s. for joists; but it must be confessed that they are doing but little business. The requirements of consumers are now very small, and there is no prospect of a larger demand. In the provinces the markets are on the whole fairly active; but buyers are chary of entering into large contracts. In fact, consumers do not believe in the maintenance of the present rates for any great length of time. There is more life in the district of the Haute-Marne than anywhere else. In the Meurthe-et-Moselle the pig iron trade is somewhat slack. The declared value of the exports of iron and steel of all sorts in the first two months of the current year amounted to £244,280, against £59,680 in the corresponding period of 1889.

STEEL HORSE COLLARS.—The latest application of steel to a new use is to be learned from the circulars of the Société du Harnachement Métallique, a company formed here for the manufacture and sale of steel horse collars. The collar consists of two halves of a U jointed at the bottom and joined at the top by a clasp of arched form. The weight is from 8lb. to 12lb.

THE TRIAL OF ELECTRIC METERS.—The electrical authorities of Paris some time ago offered several prizes for the best instruments for recording the consumption of electrical energy, with a view more especially of choosing a suitable meter to use in the systems of electrical distribution. A large number of makers sent in meters, viz.:—Desroziers, Aron, Ferranti, Richard, Bauer, Cauderay, Jacquenier, Leslie, Batault, Weber, Brillié, Clerc, and Blondlot. Although the judges considered that none of these were sufficiently excellent to deserve the premium offered, the following grants were made:—M. Cauderay, 2,000fr.; M. Aron, 2,000fr.; M. Brillié, 1,000fr.; M. Blondlot, 1,000fr.; M. Jacquenier, 1,000fr. On account of the premium not being awarded, and also because several meters arrived too late, the judges have decided to hold another trial in August next.

ELECTRIC LIGHT AT THE VAUCLUSE HOSPITAL AND REFUGE.—The hospital and refuge at Vaucluse, near Paris, which is intended for the reception of foreigners, has had an electric light installation since November last. This installation is supplied with steam from three Belleville boilers, whose heating surface is 26 square metres, and which give 600 kilogs. of steam per hour at a pressure of 12 kilogs. per square centimetre. The steam is collected in a common chamber, from whence it passes at a pressure of 6 kilogs. per square centimetre. There are three vertical engines made by Messrs. Breguet, of 30 h.p. each and 350 revolutions per minute. Each engine drives a Desroziers compound-wound dynamo of 140 amperes, 122 volts, and 850 revolutions per minute. The service comprises 322 incandescent lamps of 10 c.p., and 243 incandescent lamps of 16 c.p. The hygienic conditions of the hospital have been immensely improved since the adoption of the electric light.

TELEPHONES.—Since the 17th inst. the subscribers to the Paris telephones have been able to communicate with the Brussels centre up to midnight.

BERLIN, 24TH MARCH, 1890.

IRON.—Though the demand for iron is considerably below what it was at the beginning of the year, the tone of the market continues strong. Silesian bars maintain their price firmly at 210s. a ton. That this price will be upheld throughout the summer months seems pretty certain, but a further advance is not probable. Great activity prevails in the foundries. The production of pig iron in Germany, including Luxemburg, in the second month of the current year amounted to 362,026 tons, against 374,066 tons in the first month and 334,912 tons in February of 1889. The total production in the two months of 1890 amounted to 736,092 tons, against 702,023 tons in the corresponding period of last year.

FLAX AND YARNS.—There is a growing activity in the market for flax and yarns. At Trautenau the demand for tow and linen yarns is very brisk. The latter are hardly procurable for prompt delivery. A late report from Bielefeld describes the market as animated, yarns being in strong demand at prices a little above those of a week ago. As the cost of production has considerably increased of late, spinners are compelled to advance their rates.

THE PROPOSED COAL SYNDICATE.—The attempt to include the fiscal mines of Upper Silesia in the projected syndicate of colliery owners and coal merchants has failed. As the output of these mines forms fully one-third of the total production of the Upper Silesian coal-field, the scheme may be regarded as having fallen through.

SOAPMAKERS' CONGRESS.—An International Congress of Soapmakers is to be held in Stuttgart from the 16th to the 18th of April inclusive. During the time of the Congress there will be an exhibition of soap goods, as well as machines, tools, and utensils used in the manufacture of soap.

STERILISED MILK.—A share company, with a considerable working capital, has been floated here to work a patent for what is called the "sterilisation" of milk, that is, the destruction of the bacteria, through which certain diseases, notably typhoid fever, are spread. The milk in bottles is subjected to heat by means of a jet or current of steam at a temperature of 215° Fahr. Heat so applied has, it is said, no effect in changing the colour or taste of the milk. The stoppers are put into the bottles before the latter are removed from the steam. Care is taken to fill the bottles quite full to prevent a churning action during transport. Thus prepared, the milk will be sold retail by the ordinary milkmen at the price of 0 25 mark per litre. Arrangements have already been made with the Berlin milkmen for this purpose. It is said that the municipal authorities will specially favour the trade in sterilised milk with a view to promote its use among the general public.

DWELLINGS FOR OPERATIVES.—M. Krupp, of Essen, has recently given a sum of 500,000 marks as a fund out of which advances may be made to workmen who are desirous of buying dwelling-houses. He has also established a school of housekeeping for the benefit of the daughters of his workmen.

VIENNA, 24TH MARCH 1890.

THE COAL MARKET.—The market is without any change, and continues very firm. It is as much as the producers can do to keep pace with the demand. The Dux-Bodenbach Railway has already this year forwarded 160,000 tons more than during the same period of 1889. The two coal railroads, Dux-Bodenbach and Prague-Dux, each week show a greater increase of income. The Salgo-Tarjan Coal Company produced last year more than 600,000 tons, and made a clear profit of 432,000fl., which enables a dividend of 20 per cent. to be paid. The best orders for Bohemian brown coal come from Saxony. From the 1st of January to the 8th of March the Saxony State railways forwarded 1,702,000 tons of coal, 790,000 tons of which came from the Western Bohemian territory. Nearly 47 per cent. of all the Saxony coal traffic comes from Bohemia. The average has been 60,000 tons of brown coals per week from Bohemia to Saxony, but now the weekly export amounts to 80,000 tons.

THE IRON MARKET.—In the home iron market the influence of the English market is not yet visible. The brisk demand for pig iron is still steadily increasing, and cannot be satisfied, as there are no stocks. The works have orders for nearly the whole of the year. Refined iron has a good sale. The favourable condition of the market may be seen from the high prices of the shares of the public companies. The 3,000 shares of Sigl's locomotive manufactory, which remained in possession of the State since the fall of the ancient establishment, have recently been bought by the Credit Bank for a sum of 753,000fl. The condition of trade during last year is signified by higher dividends everywhere. The Pilsen Machine and Waggon Company is paying a dividend of 5 per cent. In general, waggon companies have the best of business. A few days ago Mr. Ringhoffer, of Smichow, received an order from the Bustehrad railway for 760 coal trucks and 11 tenders. The Simmeringer Maschinenfabrik have received an order from the State railways for some goods cars.

RAILWAYS.—During the year 1889 763 kilometres of new railways were opened for traffic in Austria-Hungary. Of these new lines 306 kilometres were in Austria, and 467 in Hungary. Most enterprise has been shown by the State Railways and the Northern Railway. Most of the new lines are only of local importance.

ELECTRICAL ENGINEERING.—The scheme is now settled for the construction of the electric railway between Baden and Vöslau. The contract is in the hands of Messrs. Siemens & Halske, of Berlin, and the work will be on their overhead wire system.—At a meeting of the Vienna and Brünn Telegraph and Telephone Company, held last week, it was announced that the total number of subscribers had increased from 1,317 at the end of 1888 to 1,776 at the end of 1889, and that already during the current year 250 new stations had been established. The directors also reported a very substantial profit.

BRUSSELS, 25TH MARCH, 1890.

THE COAL MARKET.—The condition of the coal market does not change, though the state is extremely sensitives The rumours of strikes in Germany and France and the recent labour troubles in England have given rise to hope. for better times in the Belgian centres. To lower the prices of fuel would, of course, be contrary to the desires of exporters, but if the prices do not slacken a little it is feared that the manufacture of iron and steel in all branches will suffer considerably. *Fines demi-grasses* are quoted at from 15fr. to 18fr., and nuts for rolling mills are firm at 18fr. The sorts for sugar works are at 20fr. Domestic coal at the pit, which has shown some activity lately, remains at from 20fr. to 22fr. Coking coal maintains its price of 22fr. to 23fr. for good qualities, and the minimum for coke is still 35fr. The Administration of the State Railways will proceed to grant contracts for the supply of 75 lots of 2,000 tons each of coal for use on locomotives.

THE IRON MARKET.—There is not much to report of the iron market. The buyers are still expecting that circumstances will arise which will prove more favourable to them, but all the same many of the products in manufactured iron are in good demand. In spite of the slowness of the market the prices are held firmly. If, however, the present condition of things is prolonged for any length of time, the manufacturers will experience some difficulty in obtaining replacing orders at the official rates of the iron syndicate. The raw materials continue to be expensive, and the price of fuel especially is out of all proportion with that of iron. The State railways are asking for tenders, to be sent in by the 2nd prox., for the supply of 2,500 tons of steel rails 52 kilogs. per metre.

THE GLASS TRADE.—The glass trade could manage with much more animation than is the case at present. The production has been decidedly raised lately, though perhaps to a greater extent than the demand. The prices are bound to be high on account of the cost of fuel. The Glass Association will meet this week to discuss and probably to settle definitely the statutes drawn up by the commission for the regulation of the trade with the United States. In plate glass the situation continues to be very good. The cost of raw materials has made itself felt here also, but the margin of profit is still large enough to satisfy the majority of manufacturers.

DÜSSELDORF, 25TH MARCH, 1890.

COAL.—The situation of the coal trade in this locality is significantly indicated by the fact that for a contract of 10,000 tons required by the railway authorities for delivery in April, only 5,700 tons were offered. The daily output of the pits is now about 108,000 tons. The present strong demand, which is in part the result of the measures taken by consumers to protect themselves against another interruption of the output, is not likely to continue many weeks longer, for the stocking is nearly completed, and business in the iron markets is falling off. There is no diminution of the agitation among the miners; indeed, the success of the English miners has given fresh impetus to the movement here.

IRON.—There has been a little more life in the market for pig iron during the last week, and prices have been firmer. The stimulant has been the increased cost of coal in England. Business in finished iron and steel has, however, shown no improvement. Joists are more inquired after; but in most other classes of iron goods the volume of business now being transacted is very appreciably less than it was a few weeks ago. The export trade is slack, the demand growing more languid week by week. Exaggerated reports of the falling off in the iron markets are being circulated for Stock Exchange purposes; but that they contain a large proportion of truth no unbiassed observer will deny. The American Institute of Mining Engineers has invited the members of the "Vereindeutscher Eisenhütteleute" to attend its meeting in Pittsburgh in October.

THE MILITARY EXHIBITION.—The Military Exhibition to be held at Cologne promises to be a great success. Upwards of 400 applications for space have been already received. The limit of time for receiving such applications expires with the current month. The scope of the Exhibition covers every branch of the military service. Some of the exhibits will be of a very instructive character. Thus we are to have a carefully arranged collection of rifles and field guns illustrating the progress made in the last twenty-five years. The Metal Cartridge Works Company at Karlsruhe, is preparing an interesting exhibit of its manufactures.

LILLE, 25TH MARCH, 1890.

IRON.—The iron market is moderately active and firmer in tone, but there is not much buying forward. Numerous small orders are being placed for prompt delivery. Generally consumers avoid dealings for which the necessity is not urgent, being persuaded that prices cannot long be maintained at their present level. The manufacturers, on the other hand, affect to believe that no relapse is possible, because the cost of the raw materials cannot be reduced for at least many months to come. As the building season is now commencing, a brisker demand is expected for joists. For the moment, the market is unusually quiet in that class of iron goods. Export orders are still coming to hand in considerable abundance.

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TEXTILE MANUFACTURES.—The three last weeks of February and the first two weeks of March have been marked by a degree of activity in the market for linen goods considerably above the average for that time of the year. This activity has been maintained throughout the last week, and the tendency of the market is still good. The Roubaix woollen goods trade continues slack. In the raw wool market prices have given way. This decline is, however, wholly the effect of speculative operations. The state of the tulle trade at Calais is disappointing. A few months back everybody believed that the spring of 1890 would bring a great revival, and certainly there seemed to be good grounds for this belief. But the event has not fulfilled the hopes entertained. The season generally has been slack, and there is not much prospect of improvement. The tone of affairs in the tulle industry is therefore somewhat gloomy.

FLAX AND YARNS.—The market for flax grows stronger. The demand for home-grown steadily increases, and as there is not much on offer the price keeps up. Business in Russian has fallen off considerably. First-class Riga tows are in good demand, but there is not much doing in other sorts. Fine linen yarns are much inquired after. In the coarser numbers business is somewhat slack. For jute yarns the market continues active at full prices.

AMSTERDAM, 24TH MARCH, 1890.

THE ROYAL MACHINE WORKS.—The Royal Machinery Factory, an old-established and once prosperous concern at Amsterdam, has fallen upon evil days. Its president last week told the shareholders that the previous losses have not been made good in 1889, but, on the contrary, have been heavily increased. The company is losing over some completed contracts, whilst the profit on others, upon which it is still engaged, is still doubtful. The meeting of shareholders resolved to petition the Courts for a suspension of payments as a protection to the creditors. This means virtually a compulsory winding up, a result which must be regretted, because, on the one hand, it will throw thousands of mechanics out of employment, and on the other will bring to a close one of the largest machine works of Holland.

TRAMWAYS IN ROTTERDAM.—From the report of the directors upon the results of working of the Rotterdam Tramway Company, which enjoys a monopoly, it appears that the lines of the company have a total length of 24 kilometres. The company owns 116 cars, with accommodation for 3,728 people. In 1889 the company had 398 horses, and carried 5,961,050 travellers, who paid 446,000 guilders, or nearly £40,000.

STRIKES.—The strike among the stevedores and boatmen of Amsterdam still continues. Messrs. Burns and Tillett are coming from London to speak at meetings of the strikers. An extensive strike is now in progress at the large cotton mills of the company of Messrs. Ter Kuile at Enschede, the ostensible reason for this strike being the fining of two operatives who would not obey orders. The weaving factory of Messrs. Van der Weyll is also at a standstill, and the strike is rapidly extending. Thousands of artisans are idle. The authorities keep the Municipal Guard under arms for fear of disturbances.

THE WEST INDIAN MAIL SERVICE.—The Royal West Indian Mail Packet Company has done well in 1889. In twelve monthly journeys out and as many back the company has made a profit of nearly £20,000, and, after allowing £6,000 odd for depreciation, the directors propose a dividend of 6½ per cent. on the ordinary shares.

COPENHAGEN, 22ND MARCH, 1890.

INDUSTRIES IN SWEDEN.—The advances in Swedish industries are shown by the statistics of last year's exports. One of the most striking examples is wood pulp; the export of this article has been:—

25,630,000 kilogs.	in 1886	38,484,000 kilogs.	in 1888
28,578,000 „	1887	52,035,000 „	1889

There is a corresponding movement in the export of paper, although the rate of increase is a much smaller one; a still further growth of this industry may be confidently reckoned upon. The exports for the last four years were:—

8,596,000 kilogs.	in 1886	11,440,000 kilogs.	in 1888
9,802,000 „	1887	11,540,000 „	1889

In dairy produce Sweden has by no means managed to keep pace with Denmark; the export of butter was, in fact, slightly smaller last year than during 1888. The figures respectively were: 14,734,000 kilogs. in 1889, and 14,809,000 kilogs. in 1888. With regard to cheese the export has been on the decline for the last three years. Bacon has become a very important industry in Denmark and Sweden; from the latter country the exports during the last four years were:—

1,588,000 kilogs.	in 1886	4,744,000 kilogs.	in 1888
3,124,000 „	1887	7,347,000 „	1889

The exports of textile manufactures are steadily increasing, and this industry is doing well in Sweden, most of the manufactories being fully employed. In the mining and metal trades an improvement is manifest in almost all the branches. The export of iron ore has become a very important one and will no doubt continue to increase, especially when the Norrbotter railways are completed.

The exports of iron ore for the last four years were:—

19,288,000 kilogs.	in 1886	117,350,000 kilogs.	in 1888
41,985,000 „	1887	118,573,000 „	1889

Of iron the exports of the more important descriptions were as follows:—

		1888.	1889.
Pig iron	kilogs.	49,095,000	79,175,000
Ingots	„	6,459,000	8,530,000
Blooms	„	14,536,000	15,596,000
Bars (hammered or rolled)	„	187,775,000	200,244,000
Plates „ „	„	5,780,000	5,717,000

MORE BREWERIES.—Another large brewery company has been formed in Stockholm, under the name of "Stora Bryggeriet," with a capital of about 2,000,000kr. A site of 441,624 square feet has been secured, and the erection of buildings will be commenced shortly. The establishment is to be fitted with everything "up to date" in the way of practical and scientific appliances. The capacity is estimated at 100,000 hectolitres annually, but as a commencement it is not intended to brew more than 50,000 hectolitres per annum. The newly-formed Fortuna Brewery Company at Christiania held a meeting a week or two ago, when the chairman informed them that it had not been possible to find a suitable and convenient site, wherefore negotiations had been entered upon with the proprietors of Eger & Co.'s brewery with a view of purchasing this establishment for the Fortuna Company. This brewery would then be gradually extended, and in every respect brought up to the mark. The Fortuna Company would thus have one competitor less, would acquire a going concern, and would be able to commence operations at once instead of waiting till a new brewery had been erected. The proposal was unanimously carried. The price for Eger & Co.'s brewery is 660,000kr.—In Copenhagen the building of a kind of co-operative brewery is understood to have been decided upon, mostly intended for the working classes.

MADRID, 24TH MARCH, 1890.

THE WATER SUPPLY OF BARCELONA.—A considerable increase of the water supply of Barcelona is contemplated, and has every chance of being carried out vigorously.

RAILWAYS IN VIZCAY.—The good commercial results of the railways in the Vizcayan provinces, under the control of local companies at Bilbao, have given a great impulse to the demands for concessions, and within the next two or three years that province will be as well provided with railways as any part of England or Belgium. It is no wonder that this is the case, since the Bilbao and Durango line yielded 17 per cent. interest on the shares last year. Another instance of the excellent business in railways is the line from Bilbao to Portugalete, whose 500fr. shares are sold at 1,250fr.

TINPLATES.—A severe battle is being fought between makers of tinplates and the Galician and Asturian vendors of preserved meats, fruits, &c. There is a law in Spain which authorises the free importation of certain articles which may be worked upon and then re-exported. The makers of preserved foods have asked the Government to include tinplates on the list. This the tinplate makers oppose, and it is very doubtful what will be the final decision. So far there is only one maker of tinplates in the country—Messrs. Goitia & Co., of Bilbao—who make a first-rate quality from Siemens-Martin steel slabs. There is still an opening in Asturias for the manufacture of tinplates at a much lower price.

HORNACHUELOS COAL BASIN.—Señor Ingunza has lately made a report on the Hornachuelos coal basin in the province of Cordova, half way between Peñarroya and Guadalcanal. Although a comparatively small mine, the engineer considers that it would be easy to establish workings to raise 200,000 tons per annum for a period of twenty years without going to any considerable depth. The excellent quality of these coals makes it very desirable that they should be worked, but there is very little chance that this can be done at a profit before the southern lines of railways follow the example of the large northern system as regards reducing the rates of carriage. The high prices prevailing in England would soon lead to the exclusive use of native coals, but a hindrance to this is that many coal mines are in the hands of the railway companies, and these prefer to make large profits on small quantities, and they consider it to their interest to keep the prices as high as practicable in comparison with the cost of English coals.

NEW YORK, 15TH MARCH, 1890.

GRAVITY ROAD UNDER EAST RIVER.—On the 5th inst. the contract for the construction of the tunnel of the East River Railway Company was let in New York to the American Tunnel Construction Company. By the terms of the contract the surveys and drawings are to be made within sixty days. Steps are then to be taken to secure the necessary authority for the cities of New York and Brooklyn, and the president of the company expects to have the railroad in full running order within two years after these privileges are obtained. It is proposed to connect with the Manhattan Elevated Road on Broome Street, New York. The tunnel train will run on an elevated track until within a block of the river, when a plunge will be made into the tunnel; the car will gain a momentum sufficient to carry it up an incline on the Brooklyn side, where before it stops it will clutch a cable, and this cable will draw it to the station platform on South Sixth Street. The car will run back the same way. The whole time of the trip in the tunnel is estimated at fifty-six seconds.

PROSPECTIVE STRIKE.—The miners and cokers of the Fort Hill and Paull Works of Mr. W. J. Rainey have decided to come out on a strike, but have deferred doing so until the employés of Rainey's other plant agree to join them. If they are joined by the Moyer men they claim they can force Rainey to sign the scale and reinstate a discharged man which is the cause of the disaffection. This means a strike of over 800 men, as the men of the three works will join forces. Rainey is the only operator in the district who has not signed the labour contract, and a very small opportunity has been afforded his men to organise, and if any of them attempt further organisation they will be discharged.

SMELTING TRUST.—The *Chicago Herald* states that, with the exception of five companies, all the refining and smelting companies of the United States have formed a trust with a capital of $25,000,000, of which three-fifths is to be common stock and two-fifths preferred. The common stock is to be used for the purchase of the properties that go into the new organisation, while the preferred stock is to be used to carry on their business. The chief object of the smelters, it is said, is to place their interests beyond the control of the late combination.

THE SOCIAL SIDE OF THE ELECTRIC STREET RAILWAY.—At a meeting of the New York Electrical Society, on the 12th inst., Mr. T. Commerford Martin, editor of the *Electrical Engineer* of New York, gave an interesting lecture upon this subject. The effect of the stables which house the 15,000 horses engaged in hauling the street cars of this city upon the public health was a strong point in favour of electricity. The effect of the electric railway upon the physique and morale of the employés compared very favourably with the effect of the horse-cars. One certainly could not expect a man who spends the day with his nose near the tail of a horse to realise a very high ideal of life and duty, especially when the whole of his work is done under conditions exhausting alike to temper and physique. With the electric car the matter is not one of brawn and muscle, but of average intelligence and ordinary readiness of decision. From a humane point of view, electricity was destined to do a great work, for the straining and struggling of tired horses on slippery stones would soon be a thing of the past.

THE "ELECTRICAL ENGINEER" OF NEW YORK.—A change is coming over the aspect of the New York *Electrical Engineer*. Instead of coming out monthly, it will in future appear every week. Messrs. T. Commerford Martin and Joseph Wetzler, well known so far as the able editors of the enterprising *Electrical World*, have now become joint editors of the *Electrical Engineer*. The rapid development of electrical engineering in the United States is noticeable in its literature.

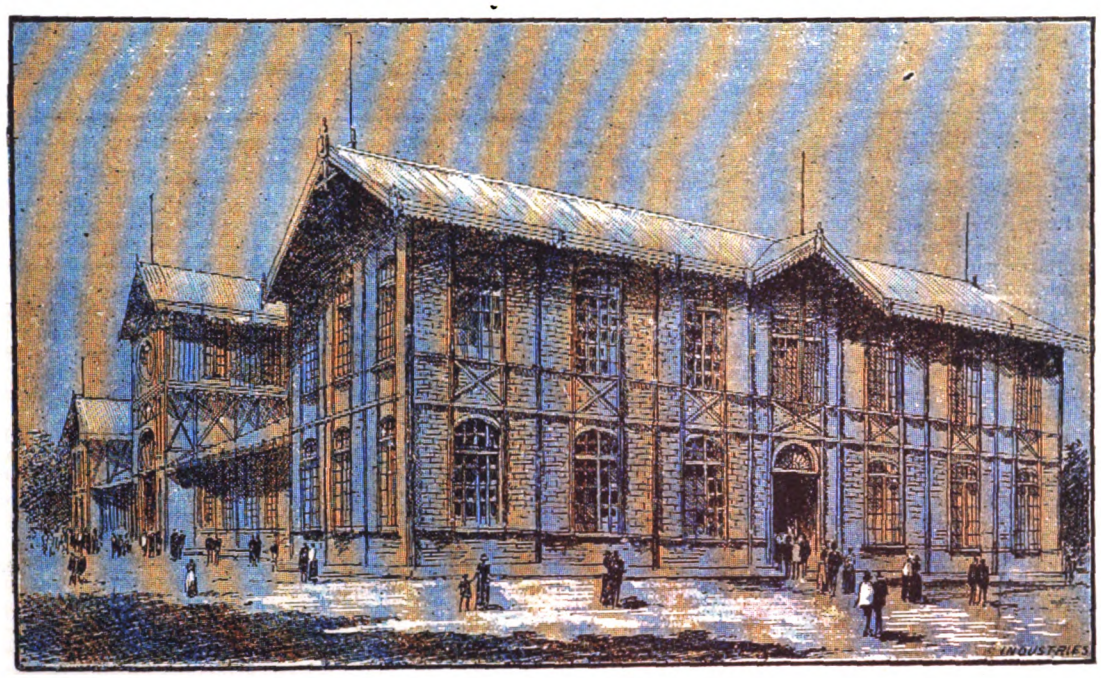
PHILADELPHIA, MARCH 14TH, 1890.

STREET RAILWAY TRANSACTION.—By a transaction recently completed a company, known as the Philadelphia Street Car Syndicate, has obtained possession of a controlling interest in the Twenty-third Street Cross-town Railroad Company of New York. The syndicate purchased 3,300 shares out of the 6,000 of the company's stock, mostly in small lots, from 150 different holders. The road, with the Blecker Street and associated lines, will be hereafter run in harmony with the Broadway and other lines already controlled by the syndicate. The company has been paying 10 per cent. The syndicate offered 17 per cent. rental, but was prevented from securing a lease by a clique which had control of a minority of the stock, a two-thirds vote being necessary to lease the line. By buying up a majority of the small holders the control of the line was secured without the lease.

PENNSYLVANIA RAILROAD.—The annual report of the Pennsylvania Railroad Company for 1889 shows the gross earnings for the whole system to have been $122,917,337, or $6,408,044 larger than in 1888; the expenses were $83,811,127, or $3,073,792 greater than in 1888; and the net earnings were $39,106,209, an increase of $3,334,252 over the previous year. These are the largest earnings in the history of the company; this is a very remarkable fact, for during the whole month of June, owing to the Johnstown flood, the main line was partially closed to traffic. The number of tons of freight carried was 122,164,118, against 110,843,874 in 1888, and the number of passengers was 78,126,957, an increase of 4,126,871. The average earnings per ton per mile for freight were ·686c., against ·693c. in 1888, but the cost of transportation was ·473c. in 1889, against ·482c. in 1888, and the profit ·213c., against ·211c. last year. The average earnings for each passenger per mile were 2·082c., against 2·092c., and the cost of transportation was 1·527c., against 1·543c. in 1888, and the profit was ·555c., against ·549c. in 1888. The average distance travelled by each passenger was 18·1 against 17·9 miles in 1888. Dividends of 5 per cent. were paid. The total amount expended for flood repairs to December 31st was $3,475,425, and a considerable sum remains to be spent; this does not include the loss from suspension of traffic. The improvements under consideration include a locomotive shop at Altoona, a bridge over the Ohio river at Pittsburgh, the construction of a cut-off from Downington to a point near Trenton, a new line from Downington to Lancaster, important improvements on the New York water front, and large expenditures to avoid grade crossings in this and other cities.

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EXHIBITION AT BUENOS AYRES, 1890.



EXHIBITION AT BUENOS AYRES, 1890.

The Société Rurale Argentine will open its second Exhibition at Buenos Ayres next month. The Exhibition will be divided into three sections, namely:—

Section 1.—Cattle, domestic animals, and fowls.
Section 2.—Agricultural machinery and implements.
Section 3.—Products of agriculture.

Sections 1 and 2 are open for all countries, but Section 3 will be devoted solely to national productions. As regards Section 2, it has been decided that no machine in use before the year 1886 shall be available for exhibition. The jury will only admit such machines as have been invented or fundamentally modified since that time. In connection with the Exhibition four prizes are to be offered, amounting to 2,500 piastres each, for the best essay on each of the following subjects:—

(1) The exportation of meat.
(2) The present and future condition of agriculture in the Argentine Republic.
(3) The national industry of wine growing.
(4) The present and future condition of the sugar industry in the Argentine Republic.

We give above an illustration of the grand central pavilion forming part of the Exhibition buildings. We are indebted to our contemporary, *La Revue Illustrée du Rio de la Plata*, for the illustration.

THE INSTITUTION OF CIVIL ENGINEERS.

At the sixteenth ordinary meeting of the Session, on Tuesday, the 18th inst., Sir John Coode, K.C.M.G., President, in the chair, the paper read was on the "Lough Erne Drainage," by Mr. James Price, Jun., M.Inst.C.E.

The physical characteristics of the Lough Erne district, comprising 1,056,160 acres, were first described, and the various schemes proposed at different times for effecting the drainage of the district, without lowering the navigation level, were referred to. The works which had been carried out were designed by Mr. James Price, Sen., M.Inst.C.E., in 1878, and consisted in cutting a channel through a rocky barrier at Belleek, on the River Erne, below the Lower Lough Erne, controlling the discharge through this channel by large sluice-gates, and improving the channels above Belleek and between the two lakes. The sluice-gates, when closed, retained the water at its normal summer level; whilst the raising of the gates, on the first intimation of heavy rain commencing in the upper districts, enabled the large water-surface of 27,643 acres on the lower lake, and 9,453 acres on the upper lake, to be drawn down 6in., so as to make provision for a flood in anticipation of its arrival, and thus prevent the flooding of the adjacent lands. The works were commenced in 1882, at the lower end, and the sluices were completed in September, 1883, the upper works being subsequently carried out. The channel at Belleek was excavated under the protection of clay dams, and the upper channels were mainly improved by dredging. The four sluice-gates, designed by Mr. F. G. M. Stoney, M.Inst.C.E., sliding against a train of 8in. live rollers, were 29ft. 2in. wide and 14½ft. high, and capable of being raised 9ft., and had been working most satisfactorily for the last six years. Each gate weighed 13 tons, and could be easily raised by one man to its full height in forty-five minutes, or the four gates could be lifted simultaneously by a turbine in half an hour. Their total cost, exclusive of masonry, was £4,000. Large compensation had to be paid for anticipated injury to the fishery rights, though the works had actually improved the salmon fishery. The total cost of the works was £180,000, of which £30,000 was for navigation and £150,000 for drainage. The author was the resident engineer for the whole of the works, and the lower works were carried out under his supervision; whilst the works between the lakes, and in the upper lake, were executed by contract. Observations of the rainfall, lake levels, and sluice discharges, for the years 1885–88, had been put in the form of a diagram. Allowance had been made for a discharge of 600,000 cubic feet per minute, of which 400,000 cubic feet had to be provided for by enlargements of the channels; but it appeared from the diagrams that, owing to the power of anticipating a flood by means of the sluices, a discharge of 500,000 cubic feet per minute would have sufficed to prevent flooding, without unduly lowering the navigation level of the lakes. The Erne diagrams showed how little the storage in the lakes affected the summer flow, and indicated that the great store for the summer yield of a river was the ground-water. The general effect of the Erne drainage had been to render the water level of the lakes more uniform—higher in summer and lower in winter. The bad effects of the flooding, during a wet summer, of the extensive flat lands bordering Lough Erne, which extended in an unbroken sheet of water for 50 miles, were not confined to the loss of the year's crop of grass, for the decayed grass affected the next year's hay crop; whilst large tracts of undrained land, by exposing large surfaces of spongy grass to evaporation, chilled the air, preventing or delaying the ripening of corn; and the damp chilled air, mixed with the products of decaying vegetation, fostered disease. In some cases occasional floooding might be beneficial to land, owing to the manuring qualities of the flood deposits, and sluices enabled such flooding of flat lands to be effected for short periods at suitable seasons.

The author advocated the following general principles in designing drainage works: (1) That the cross section of the enlarged channels should be hyperbolic instead of trapezoidal, increasing the discharge in proportion to the section, obviating slips by flattened slopes next the land, facilitating dredging and confining the low-water channel so that the sides could be cleaned; (2) that the channels should be given a fall of only 1ft. or 2ft. per mile, with embankments and back drains where necessary, and accumulating any excess of fall at certain points where the discharge might be effected along paved channels. The extension of arterial drainage in Ireland would render large areas of land available, and would raise the mean summer temperature, which at present was only 58° Fahr. Amended laws, however, would be required for carrying out any large drainage works in the future, and the initiation of the schemes could no longer be left to the landowners, who, under their altered conditions of tenure, had lost their former interest in the improvement of their estates.

THE COAL FIELDS OF THE TRANSVAAL.

(From a Johannesburg Correspondent.)

The coal fields of the Transvaal are perhaps much more extensive than most readers would imagine, both as regards area and mass, and the amount of solid work and money which have been and are being put into the coal industry will probably surprise many people. Avoiding figures as much as possible, we will endeavour to give a brief outline of the position and prospects of this rapidly rising industry.

We will begin, then, at Boksburg, which up to date is the nearest source of coal to Johannesburg, being only some fourteen miles distant. Over a year ago we were informed that it was more than probable that coal would be found within five miles of the town, but owing to this idea being "jumped," the verification has never been put to the test. We will take as our starting point the mine of the Boksburg Coal Company, the property of which is now absorbed by the Transvaal Coal Trust Company. In this mine we have a seam of coal from 5ft. to 10ft. in thickness, at a depth of 60ft., roughly speaking. The coal, however, appears to be "drift" coal, and, as may be expected, not of the best quality, carrying as it does a rather large proportion of shale. The development of this mine has been well thought out—timbering, tram-lines, and other facilities having from time to time been added as required to the underground workings, while the head-gear and hauling-gear are as good as will be found at present on any mine in the Rand Fields. But in the Boksburg district, which is no exception to the general rule, we have varying qualities of coal, and find small companies and even private individuals able to hold their own against companies with a good capital and agents in Johannesburg, simply by having a better quality of coal, as is seen by the Black Diamond property and on one or two lesser blocks.

Leaving Boksburg the next centre reached is Brakpan, where perhaps one of the best planned mines in these coal fields is to be found, due to the exertion of Mr. Newby. The coal at Brakpan is of a better quality than that at Boksburg, yet inferior to that found further east. The mode of working this mine is so conducted as to make it a really good property in spite of the second rate quality of the coal. From Brakpan one or two doubtful "vleis" are crossed, one being the famous Bronkhorst Spruit, the district being the Wilge River, about thirty miles beyond Brakfontein and fifty miles from Johannesburg. Several companies are at work in this district, including the Anglo-African, the Holfontein, Excelsior, Klipfontein, Greville, and others. Some of these companies are already absorbed by the Transvaal Coal Trust Company, others are worked by private companies and individuals, some of which pay excellent returns; one is yielding over £3,000 per annum profit, which certainly is not bad interest for the capital expended, when the amount of opposition is considered. The present systematic operations in the Excelsior mine stand in strong contrast to the old workings now abandoned in the same mine, the output of coal from a 14ft. seam being worked by drive and cross-cuts of only 6ft. by 7ft. These give ample room for easy working without endangering the "falling in" of ground by cutting out huge caverns and having no thought of safety or drainage, two essential points which are carefully attended to in the new workings. The average output of this mine is twenty waggons, or 80 tons, per day, and this without any strain upon the staff of five white men and about seventy Kaffirs, and but for the difficulty of transport this amount could be largely and easily augmented by the present staff. One remarkable feature of this property is that no machinery is used on any part of the mine, hauling being done by mules, and pumping superseded by natural drainage. The quality of Wilge River coal is superior to that of Brakpan and Boksburg, and finds a ready market. About twelve companies are at work in Wilge River district. The Greville Company (one of the latest) are almost down to the coal in their shaft. The quality of this coal has been already tried and proved from borings, and found to be excellent for steam and gas purposes. In this district also several smaller mines are carried on by private individuals, and are made to pay their way. From Wilge River to Steen Kole Spruit, the next centre, is about twenty miles. Many pans, appearing almost like craters, are passed along a rather heavy road due to loose sand. The Johannesburg Gas Company have recently taken over a property in this district to supply their

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works and to be independent of outsiders. There are also several other companies turning out coal of a better quality in most cases than that in the former districts, yet inferior to the next area—Olifants River—chiefly from the fact that the coal from this district is non-coking. This is a rather significant point, as all the districts mentioned so far have non-coking coal, which is an all important point in connection with gas-making. This coal is in good demand for steam purposes. The next and perhaps the most important centre is the Olifants River district, distant from Johannesburg about eighty miles, and from the last-named centre about ten miles. The opening of these fields was carried on in a very primitive manner, as until quite recently the whole of the coal was taken from the splendid seam which in many cases outcrops, or rather is exposed in the bed of the river. This is undoubtedly the true carboniferous formation—a gentle undulating country on the surface, with a true and almost undisturbed sandstone, along with stratas of true shale, give a sort of introduction to the coal. Several large properties are being worked in this area, and but for the inconvenience of transport, this would undoubtedly surpass many of the nearer districts which possess inferior coal but easier transport. Shafts are now being sunk, and most of the properties are taken up and being worked. Want of accommodation is much felt here, and but for the hospitality of people living in the district visitors to this locality would fare badly.

Notices of Meetings.

THIS WEEK.

INSTITUTE OF MARINE ENGINEERS.—Saturday, March 29th. Annual General Meeting. 7.30. Business: Reports, Election of Office Bearers and Council for ensuing year.

NEXT WEEK.

CHEMICAL SOCIETY.—Thursday, April 3rd, at 8 p.m. "Note on the Hydrosulphides." by G. H. Picton.

PRICES CURRENT, 26TH MARCH, 1890.

Quotations at per ton, unless otherwise specified.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best £ s. d.	
Middlesbro' Bars	7 0 0	.....	7 10 0	f.o.t. wks.
„ Angles	6 15 0	.....	7 5 0	„
„ Plates	7 0 0	.....	7 10 0	„
Staffordshire Bars (cheaper makes)	8 15 0	.....	9 5 0	London.
„ Angles	8 15 0	.....	9 5 0	„
Crown Sheets	8 12 6	.....	9 2 6	„
„ Hoops	8 2 6	.....	8 12 6	„
"Siemens-Martin" Steel Boiler Plates			9 15 0	„
„ Ship and Girder			8 15 0	„

Market quiet.

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	77/-	..... 66/-

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

METALS.

Spelter:	Ordinary	£23	0	0	to	£23	5	0
Copper:	British Cakes and Ingots	54	0	0	„	55	0	0
„	Chili Bars, G.O.B.'s	48	12	6	„	48	17	6
„	Other sorts, G.M.B.'s (equal to Chili Bars)	48	12	6	„	48	17	6
„	Manufactured (strong)	61	0	0	„	.....		
Lead:	Common Pig	13	12	6	„	13	15	0
„	English Sheet	14	2	6	„	14	5	0
Tin:	Straits	90	7	6	„	90	15	0
„	Australian	90	10	0	„	91	0	0
„	English Ingots	95	0	0	„	.....		

Messrs. Carrick & Brockbank, Manchester, report as follows:—

COPPER: A large decrease in stocks is reported during the first fortnight in March, owing to heavy deliveries and the smal charters from Chili. The figures are: Decrease for first fortnight March, 3,232 tons; total visible supply 15th March, 91,920 ons. This decrease, together with the settlement of the coal strike, has helped to improve prices of Chili bars, which have advanced 30s. per ton during the week, to-day's quotations being £48 12s. 6d. to £48 17s. 6d. cash, as compared with £47 2s. 6d. to £47 10s. on the 19th. Manufactured, however, continues very quiet, with small demand. Prices to-day are £61 sheets and £64 bottoms.

TIN: This market remains inactive, with but little variation in prices. The continued unsatisfactory condition of the tinplate trade has a decidedly unfavourable influence on this metal.

LEAD: Values are a shade firmer, but with small business doing.

SPELTER: Market keeps very dull, owing to the quietness of the galvanising trade, and quotations are unchanged.

PIG IRON.

Middlesbro' Warrants, No. 3	52/3	Cash
Scotch Warrants, m/n	51/4½	„
Hematite Warrants, m/n	64/1½	„

Stocks in Stores	Scotch	838,551.—Dec. for wk. endg. 22nd,	11,529	Tns.
	Middlesbro'	162,421.—Dec. „ „	6,713	„
	Hematite	369,423.—Dec. „ „	3,595	„

Exclusive of stocks in makers' yards

	No. 1.		No. 3.		
Coltness	73/-	.....	65/-	f.o.t.	Glasgow.
Gartsherrie	70/3	.....	64/6	„	„
Langloan	73/-	.....	66/-	„	„
Summerlee	70/6	.....	65/-	„	„
Glengarnock	73/-	.....	66/-	„	„
G.M.B. ex Store	51/9	.....	51/6	„	„

CHEMICALS.

		£	s.	d.		£	s.	d.
Acid: Carbolic Crystals	lb.	0	0	10½	to	0	1	0
„ „ Liquid	gal.	0	1	2	—	.....		
„ Citric	lb.	0	1	7	—	.....		
„ Oxalic	„	0	0	3½	—	.....		
„ Sulphuric	ton	1	12	0	—	.....		
„ Tartaric	lb.	0	1	4½	—	.....		
Alum: Lump (powder 10/- ex.)	ton	4	17	6	—	.....		
Ammonia: Carbonate	lb.	0	0	3¾	—	.....		
„ Muriate (Grey)	ton	22	15	0	—	.....		
„ „ (White)	„	26	10	0	—	.....		
„ Sulphate	„	11	17	6	—	.....		
„ Liquor	lb.	0	0	3¾	—	.....		
Antimony	ton	.....			—	.....		
Bleaching Powder	„	5	10	0	—	5	12	6
Bisulphide of Carbon	„	13	10	0	—	.....		
Borax	„	30	0	0	—	.....		
Benzole (90 %)	gal.	0	3	5	—	.....		
„ (50/90 %)	„	0	2	7	—	.....		
Copper Sulphate	ton	26	10	0	—	27	0	0
Copperas	„	2	0	0	—	.....		
Kieserit	„	.....			—	.....		
Lead: Nitrate	„	22	10	0	—	.....		
„ White Sugar	„	24	0	0	—	.....		
„ Brown „	„	19	0	0	—	.....		
Potash: Bichromate	lb.	0	0	4	—	.....		
„ Caustic	ton	22	0	0	—	.....		
„ Carbonate	„	19	10	0	—	.....		
„ Chlorate	lb.	0	0	5	—	.....		
„ Prussiate (Yellow)	„	0	0	9½	—	.....		
„ Sulphate (Basis 90 %)	ton	9	10	0	—	.....		
Precipitate: Red	lb.	0	3	1	—	.....		
„ White	„	0	3	2	—	.....		
Salts: Epsom Bags	ton	3	0	0	—	.....		
Salts: Epsom Casks	„	3	15	0	—	.....		
„ Glauber	„	1	10	0	—	.....		
Sulphur: Sublimed Flowers	„	9	0	0	—	.....		
„ Recovered	„	4	10	0	—	.....		
Soda: Ash	deg.	0	0	1¼	—	.....		
„ Caustic (White 70%)	ton	11	0	0	—	11	10	0
„ „ „ 60%)	„	10	0	0	—	10	10	0
„ „ (Cream 60%)	„	9	10	0	—	10	0	0
„ Crystals	„	3	0	0	—	.....		
„ Bicarbonate	„	5	15	0	—	.....		
„ Hyposulphite	„	6	5	0	—	.....		
Solvent Naphtha	gal.	0	4	0	—	.....		
Tartar, Cream of	cwt.	5	12	6	—	.....		
Zinc Sulphate	ton	7	10	0	—	.....		

Messrs. S. W. Royse & Co., Manchester, report as follows:—

CHEMICALS: With the termination of the coal strike matters have become more settled in the chemical trade. Soda ash, caustic soda, and soda crystals continue scarce, and high figures are paid for prompt delivery. There is only a comparatively moderate inquiry for bleaching powder, and prices are likely to be easier. Carbolic acids, crude and crystal, are very dull, but liquid is firmer. Benzoles weak. Sulphate of copper is scarce on spot, and is less freely offered forward. Tartaric acid has advanced strongly, and oxalic acid is also dearer.

OILS.

		£	s.	d.
Cocoanut: Cochin	per tun	27	5	0
„ Ceylon	„	25	5	0
Cottonseed	„	22	5	0
Cod	„	21	0	0
Lard	„	36	10	0
Linseed	„	23	5	0
Palm, Lagos	„	24	10	0
Rapeseed: English	„	32	10	0
Seal: Pale	„	28	0	0
„ Brown	„	22	0	0
Sperm	„	46	0	0
Whale	„	24	0	0
Turpentine	per cwt.	1	10	3
Coal	per gal.			
Petroleum (Refined)	„	0	0	5½
„ Spirit	„			

FOREIGN TELEGRAPHIC ADVICES.

(From our own Correspondents.)

PARIS, March 27th.—*Iron.*—There is not much doing in the iron market here; nevertheless, bars and joists are firm at 160s. for the former and 164s. for the latter. Business is very active in the Haute-Marne, but quiet in the Nord. Prices are maintained at 160s. for No. 2 bars in the Ardennes. The Longwy syndicate is offering forge pig to Belgian consumers at 65s. 3d. a ton delivered.

Metals.—The speculative holders of copper warrants find it hard to maintain the price of Chili bars at £52. Consumers buy only for the present. Tin is a shade better: Banca, £100; Straits, £97. Lead has declined to £13 at Havre, £13 6s. Paris. Spelter is steady at last week's prices: Silesian, £24 at Havre. There is, however, but little demand.

BERLIN, March 27th.—*Bourse.*—The market for industrial securities is unsteady. A large speculative business is being done in shares in collieries and iron and steel manufacturing companies; but investors having for the most part withdrawn from the market, of genuine business there is practically none. The prospect is regarded as uncertain. Industrial securities, too, are quoted too high to attract the investing public.

Iron.—The iron market has become firmer on receipt of more favourable reports from the Upper Silesian districts. Buyers are, however, not operating freely. There is a growing demand for building iron, but generally business is slack. Silesian bars cannot now be bought under 210s. a ton.

Metals.—The metal markets are lifeless, and prices tend in favour of buyers. Mansfeld refined copper is weak at £59 to £60. English brands, £56 to £57. Tin is with difficulty maintained at £100 to £101 for Banca. Lead is a little more inquired after: Clausthol refined very firm at £15 10s. to £16. Spelter shows a declining tendency: Silesian W. H. brand, £25 5s. to £26; ordinary, £25 to £25 10s.

BRESLAU, March 27th.—*Coal.*—Notwithstanding the milder weather, the market for coal loses none of its activity. The export demand continues strong. The production is barely sufficient to meet current requirements. Prices firm at 8s. to 9s. a ton for large and round coal, 7s. 3d. to 8s. for nuts, and 4s. 6d. to 5s. for small, at the pit bank. There is still an insufficient supply of coke.

Iron.—The production of pig iron is now being pressed to its utmost limits in anticipation of many of the hands employed about the blast furnaces being withdrawn for agricultural operations. Demand brisk. Market very active for bars, joists, and plates, and prices firm at last week's quotations. Founders are short of hands.

Metals.—The zinc market has scarcely changed during the last week. Business is dull, and the prices of spelter are a point lower. Some small lots have been sold at £22 to £22 10s., but these are exceptional prices. There is a moderately good market for lead.

DÜSSELDORF, March 27th.—*Coal.*—The tenders for 50,000 tons of unscreened coal and briquettes for the Cologne Railway show lowest prices for the former 14s. 6d., and for the latter 17s. to 18s. a ton. Relatively to last year's contracts this is a rise of 100 per cent. A small lot of coke was offered at 28s. to 29s. a ton. Delivery is to be made in May and June.

Iron.—The business of the iron has greatly fallen off in the last two or three days. Very few transactions are taking place in pig iron, some sorts of which are offered at lower prices. Rhenish-Westphalian forge, 91s.; Siegen forge, 90s.; foundry No. 1, 96s. to 98s. Finished iron and steel quieter, but active business in joists. Prices remain firm. Wire neglected.

CHARLEROI, March 27th.—*Coal.*—The high prices for coal are not only firmly maintained, but for some sorts have been further advanced. Consumers are now buying only for present requirements. Some offers to place a twelve-months' order for coke at the price of 24s. a ton have been refused. Sellers will not accept less than 28s.

Iron.—The situation of the iron market grows worse. There is now practically nothing doing, and nothing is to be expected till the cost of coal is reduced. Many manufacturers have ceased to work on Mondays. The tone of the market is depressed.

GHENT, March 27th.—*Flax and Yarns.*—The market is less abundantly supplied with home-grown flax, and as the demand continues strong, prices have an upward tendency. Russian produce is not much dealt in, but prices are firm. There is a steady current of business in yarns, the prices of which remain unchanged.

THE ELECTRICAL CONSTRUCTION CORPORATION have sent us a bundle of nicely-got-up sheets of prices of continuous current dynamos and storage batteries.

MESSRS. YARROW & CO., of Poplar, have in the course of construction six shallow-draught gunboats for the Portuguese Government, intended for use on the Zambesi. These are similar to those built by the above firm in the early part of last year, and in which Major Serpa Pinto made his recent expedition up that river, which has attracted so much attention.

PAPER MAKERS' DIRECTORY.—Messrs. Marchant, Singer, & Co., 47, St. Mary Axe, London, E.C., have issued a pocket edition of the "Directory of Paper Makers" for the present year. This little work, which is compact and neatly printed, contains an alphabetical list and a classified list of the paper and mill board makers of the United Kingdom, together with useful information relating to "water marks."

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HOME INDUSTRIES.

LONDON 27TH MARCH, 1890.

THE MONEY MARKET.—A fairly sustained demand for loans has kept the money market rather harder lately. Several colonial loan operations have absorbed a considerable portion of the available supply. At the same time the general prospects of the market, as indicated by the exceptionally strong position of the Bank of England, and as reflected in the easy rates at which the Government has been able to raise money on Treasury Bills, has imparted an easy feeling to discount rates, which have given way, and are now about 2¼ per cent. In the stock markets speculation is well nigh dead, and business is, consequently, at a standstill. The cessation of anxiety about coal strikes had only a momentarily good effect on home railway stocks. Selling orders from Berlin, where the fall in coal and iron shares has rather shaken the Bourse, have depressed our market, for latterly the Germans have become large holders of some of the English and American securities. Thus the influence of Berlin selling has spread beyond our foreign department, which, indeed, is fairly firm, save in South American securities. Argentines are quite out of favour, not so much through fears of financial ruin in the Republic as from the expectation of a crisis at the next settlement on the Buenos Ayres Bourse. Nitrate railway shares, and with them all the "North" group of securities, have fallen on the prospect of the construction of a competing line through part of the nitrate country. Mining shares have experienced a sharp fall, South African gold shares being heavily sold. Miscellaneous and industrial securities are receiving very little attention.

COMPANIES.—The following companies have been registered since our last report:—The Peruvian Corporation, Ld., with a capital of £16,500,000, to acquire any property, rights, or claims in the Republic of Peru or elsewhere; The Black Lion Brewery Co., Ld., with a capital of £19,000; The Grass Valley Exploration Co., Ld., with a capital of £5,100, to acquire mines, &c., in California or elsewhere; Samuel Sutcliffe & Sons, Ld., with a capital of £45,000, to carry on the business of spinners, &c.

SPORTSMAN'S EXHIBITION.—The ninth annual Sportsman's Exhibition is to be held at the Agricultural Hall, Islington, from the 10th to the 18th April. The offices are at 43, New Oxford Street, W.C.

THE NAVY.—The "Minotaur," formerly flagship of the Channel Squadron, which has been refitted and repaired at Portsmouth at an estimated cost of £53,000, made a four hours' trial of her machinery on Friday last. The trial was successful, 4,800 horse-power having been developed by the engines and a speed of close upon 14 knots obtained. The Admiralty have issued orders for the construction of the new second-class cruiser "Brilliant" to be begun at Sheerness Dockyard. The "Brilliant" is the largest and most powerful ship ever ordered to be built at Sheerness Dockyard. The vessel is to be 300ft. in length, and 43ft. 8in. in breadth, with a mean load draught of 17ft. 6in. She is to have a displacement of 3,600 tons, and is to be fitted with triple expansion engines, which are to be capable of producing 9,000 horse-power under forced draught, with a speed of 19·75 knots on the measured mile, and 7,000 horse-power under natural draught, with a speed of 18·25 knots on the measured mile.

ELECTRIC LIGHTING IN PADDINGTON.—The other day a special meeting of the Paddington Vestry was held for the purpose of considering the question of the electric lighting in the parish, which had been considered by a committee of the vestry. Colonel H. C. Barchard proposed the adoption of the report, which recommended that the application of the Kensington and Knightsbridge Electric Lighting Company should be assented to. But if the vestry considered the draft regulations now being prepared by the Board of Trade to do away with the objections to the high-pressure supply system, then the committee were of opinion that the application of the Metropolitan Company might be considered. As the cost of lighting the streets with electricity would be very greatly in excess of gas, the committee did not feel justified in recommending it, though in the future, when the electric company's arrangements would be more matured, action could be taken for so doing with advantage. As the report met with much opposition, it was agreed to adjourn the further consideration of the matter.

ENGINEERING.—There are wanted for Finland 2,770 tons steel rails, 230 tons steel chairs, 20 tons fish plates, and 20 tons iron bolts and nuts for a short railway to be erected there. Information may be obtained from the Foreign Office.

MANCHESTER, 27TH MARCH, 1890.

THE IRON TRADE.—A somewhat indifferent feeling prevails in the local market, and buying is on a very small scale. There are still a number of contracts to run out, and most of the large users are not disposed to enter into new ones. Middlemen are anxiously endeavouring to obtain orders, and prices are offered below makers' rates without much success. In some cases a belief is expressed that the market will shortly revive, but until matters are more settled generally this is hardly likely. In the meantime engineers continue to be actively engaged, and they will soon be obliged to begin buying again. The finished iron makers are well occupied with old contracts, but are not receiving many new ones. The price of common bars is down to £8 per ton, at which price they are obtainable from merchants, makers quoting 5s. per ton more. Although the boiler making trade continues to be busy, steel plates are not being bought largely at present, as users expect a reduction of price.

THE COAL TRADE.—The strike of miners came to an end last week, and prices have resumed their normal level. Several mills were stopped for a short time, and high prices were paid for coal supplies. An attempt is to be made to form a joint scheme for fixing the wages in the future, Although it binds neither side to little more than the giving of prior notices, it is hoped that the extended period for discussion will permit of compromises being arrived at.

THE PAPER TRADE.—A conference of paper makers representing the various branches of the trade was held in Manchester on the 22nd inst. The workpeople have protested against the long hours worked in some mills, and have suggested that all mills should stop at 2 p.m. on Saturday, and not resume work before 6 a.m. on the following Monday. Generally the proposal was well received, but in order to allow of a fuller representation the meeting was adjourned for a fortnight.

THE LINEN AND JUTE TRADES.—It is extremely amusing to note the widely divergent character of the accounts given by manufacturers' agents as to the condition of the linen trade. On the whole, it may be said that producers are fairly busy, although prices are not generally satisfactory, owing to the perversity with which buyers profess to disregard the effect of the recent advances in wages, fuel, and other items which go to make up the total cost of production. There is a steady business passing in damasks, towels, and other varieties. Several special inquiries have been received of late for Continental makes of linens, but it is not an easy matter to meet with agents for the sale of these goods, as a considerable portion of the business is transacted direct. There is a fair demand for the coarse makes of Scotch goods, and a moderate inquiry for Dunfermline specialties. Jute fabrics are in active request, and linen threads are extensively called for.

A NEW SALT SCHEME.—A private Bill has been lodged in the House of Lords by a company called the Widnes Brine Supply Company, who propose to pump brine from wells at Wincham, near Northwich, and convey it by means of pipes to Widnes, where it is to be used in the manufacture of alkali. The brine is successfully used by many chemical manufacturers now, and the present scheme, if allowed, would probably be of great value to the Widnes manufacturers. It will, however, be strenuously opposed by the various authorities in Northwich, who claim that they will be subjected to all the inconveniences of subsidence, &c., without any of the compensations which arise from the manufacture of the salt in the neighbourhood. The Weaver Trustees, who act practically on behalf of the ratepayers of the county, will also strenuously oppose the new Bill, as they derive a large revenue from the carriage of salt, and their surplus profits go to relieve the county rate. Parliament has hitherto resisted any such scheme, and the strong opposition to the present proposal will probably lead to stringent compensation clauses, even if it is sanctioned.

GLASGOW, 27TH MARCH, 1890.

PIG IRON.—There is nothing new to report regarding the pig iron market. It is very difficult to reconcile all that is being said about the falling off in demand with the continued large deliveries ex store and the advance of 1s. per ton declared this week by the makers of Gartsherrie, Eglinton, and Carron. Now that we are entering upon the season of spring shipments there is very little prospect of any demand from the States or from Canada, but the Continent is buying pretty freely, and the Lancashire ports are likely to take a good deal of Scotch iron to make up for short supplies from Lincolnshire, where the scarcity of coal and coke has led to a restriction of the make. The advancing prices daily obtainable for Middlesbrough warrants have contributed much to the firmness of the market.

RAILWAYS.—The Town Council of Edinburgh has decided by a majority to oppose the Bill of the Caledonian Railway, by which powers are sought to construct a tunnel under Prince's Street, Edinburgh.

PROPOSED INDUSTRIAL EXHIBITION.—A proposal has just been brought forward for the promotion of a movement to hold an Industrial Exhibition in the East End of Glasgow.

THE NEW TUBE COMPANY.—The ordinary shares of Messrs. Andrew & James Stewart & Clydesdale, Limited, to which reference was made in this column last week, have been subscribed for three and a half times over, and the preference shares four times over.

EDINBURGH ELECTRICAL EXHIBITION.—The rate of insurance upon the buildings, mechanical and other exhibits, and pictures in the Exhibition at Edinburgh has been fixed at 42s. per cent. The buildings are making rapid progress towards completion.

SHIPPING.—Freights seem to have collapsed all at once. In almost all branches of shipping the depression has been sharp and severe. In some cases the reduction has been to one-half of the former rates. Ships are changing hands at prices much less than were ruling a few months ago, and there is absolutely no demand for new vessels.

SHIPBUILDING.—Messrs. Kincaid & Co., engineers, Greenock, have secured a contract for a steel twin-screw steamer of 700 tons for passenger and cargo traffic on the River Plate, South America. Messrs. Russell & Co., Glasgow, are to build the hull, and Messrs. Kincaid & Co., Greenock, the machinery and engines.

RAILWAY RATES INQUIRY.—This inquiry still proceeds in Edinburgh. Several witnesses on behalf of the traders have appeared for examination, and the proceedings, so far as Scotland is concerned, have closed much earlier than had been expected. In closing the proceedings Lord Balfour mentioned that altogether the Commission had sat for sixty days, had heard thirty-one witnesses for the railway companies, and 126 for the traders. Besides the evidence so accumulated the Commissioners had had forwarded to them fifteen hundred written statements of objections. The inquiry opens in Ireland on the 17th April.

PROFIT SHARING.—At a meeting of the employés of Messrs. Ross & Duncan, engineers, Whitefield Works, Glasgow, Mr. Duncan, who occupied the chair, mentioned that some time ago a system of profit sharing had been introduced into the works, but had been discontinued owing to the opposition of some of the men. He intimated that if the men wished the experiment tried again the firm would favourably consider such a proposal. He also mentioned that the plan of supplying the men with savings books as an encouragement to thrift had been successfully carried on.

THE LOAD LINE BILL.—An important communication from the Glasgow Shipowners' Association to Sir Michael Hicks-Beach, President of the Board of Trade, has just been sent. The communication is signed by Mr. Nathaniel Dunlop, chairman, and Mr. Muirhead, secretary of the association. It is, in effect, a protest against the second reading of the Bill, on the ground that it is not proved that overloading has sensibly, if at all, contributed to loss of life. It goes into details regarding missing ships, and points out that these aggregate only 33,216 voyage tons out of a total of 50,000,000 tons.

(From our own Correspondents.)

LIVERPOOL, 26TH MARCH, 1890.

THE BUILDING TRADE.—The carpenters, masons, bricklayers, and members of the other branches of the building trade have given notice to their respective employers of a demand for an increase in their rate of wages. Carpenters and joiners are now receiving 7½d. per hour, and demand 8½d. per hour, with a reduction in the number of working hours; the bricklayers and masons are receiving 8d. per hour, and demand 9d. The notices of the men for the above increases expire on the 1st of May, and if the advances are not granted a general strike in the building trade will most probably follow.

THE DOCK LABOURERS' STRIKE.—The labourers are still holding out, and at present there is little prospect of a settlement of the dispute between employers and men. The large shipping companies are loading and discharging their steamers with comparatively little delay, having an ample choice of picked men imported from other towns; the smaller companies are, however, put to some inconvenience. A large majority of the men would be only too glad to commence work at once, but they are blindly led on the one hand by Mr. Graham, M.P., and on the other by agitators, who make a fat living out of the strike at the expense of the unfortunate men whose wives and families are now verging on starvation. The quiet demeanour of the men in the huge processions which parade the town, headed by brass bands, and Mr. Graham in a hansom, is very marked, and betokens forced and unwilling obedience to the Union. The Liverpool Chamber of Commerce suggested negotiations based on the proposals of the Labourers' Union, but at a meeting of the employers these were unanimously refused.

CHALK FOR MARKING IRON.—A new hard chalk is being manufactured by Mr. George G. Blackwell, Fazakerly Street, Liverpool. Its degree of hardness is admirably adapted for its use in marking cast iron, and it is much superior to the ordinary forms of chalk.

THE S.S. "MAJESTIC."—This steamer has now been added to the fleet of the White Star Line, and will commence her maiden voyage on the 3rd prox. Although she is a sister ship to the "Teutonic," there are many points of difference between the two, both as regards size and engine power, and she is expected to be the faster vessel of the two.

LEEDS, 26TH MARCH, 1890.

THE IRON AND STEEL TRADES.—The output of iron and steel in this district was not lessened by the strike in the coal trade, though a scarcity of fuel was the cause of several important industrial establishments in Leeds being closed for a day or two. The announcement that the conference arranged between the coalowners and the miners' delegates had a successful termination was received in local business circles with satisfaction, for any long stoppage of the pits would have seriously paralysed the iron, steel, and engineering industries. As it was, much inconvenience was experienced, to say nothing of the feeling of uncertainty which was produced by the dispute. Furnaces have been damped down in North Lincolnshire, owing, it is reported, to the high price of fuel. Now that the coal strike has been settled business people are hoping that things will again take an active turn. Iron and steel makers are

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busy in all departments, giving regular work to their hands. Still there is a scarcity of new business. The engineering trade remains brisk, and toolmakers have a fair amount of work.

THE COAL TRADE.—After a week's strike, the colliers of West Yorkshire returned to work on Monday, the masters giving an immediate advance of 5 per cent. and a further advance of 5 per cent. for the first week in August. When the second 5 per cent. is paid the miners will have received 40 per cent. advance in wages within eighteen months or two years. Prices of coal during last week were most irregular and in some cases very high, but they are now steadying. There is a good all-round demand for fuel of all kinds, slack and coke particularly being eagerly bought.

SHEFFIELD, 26TH MARCH, 1890.

THE COAL TRADE.—There is a good demand for coal of all classes, as the recent stoppage has cleared away any accumulation at the pit mouth and on the railway sidings. Prices are rather unsteady, and it is difficult to see how the present rates can be maintained unless the rate of consumption is increased. The recent strike has caused a good deal of trouble everywhere, as many thousands of workmen in rolling mills and factories have been thrown temporarily out of employment.

WAGES IN THE ENGINEERING TRADES.—The turners and fitters, both society and non-society men, have issued a circular to their employers asking for an advance in wages of 2s. per week. Considering the prosperous state of the trade, and the fact that no advance has been given during the past seventeen years, it may be interesting to give the replies of some of the employers. Mr. E. Tozer, of the Phœnix Bessemer Works, Rotherham, is surprised at the request, as no reduction of wages has taken place during the depression in trade. Hadfield's Steel Foundry Company, Limited, said they would give the advance, and Messrs. S. Osborn & Co., Clyde Steel Works, also. Mr. Ambrose, of Shardlow, had already given it to those who were worthy of it. Messrs. John Brown & Co. and Messrs. Cammells have not had time to consider the matter.

NORTH STAFFORDSHIRE, 26TH MARCH, 1890.

THE COAL AND IRON TRADES.—Though an advance of 5 per cent. in colliers' wages has been conceded, accompanied by a promise for a further 5 per cent. on August 1st, there is a feeling amongst local coal and iron masters that the men have taken an unfair advantage of the state of trade to unduly press their claims. Most firms in this district consume a large proportion of the fuel they raise in their own ironworks, and consequently are unable, with a falling iron market, to recoup the additional cost of production. There appears to be little short of a collapse in prices of crude and finished iron. Between this date and the quarterly meetings, when contracts are largely negotiated, it is to be seen whether buyers or sellers are to arrange current prices.

THE POTTERY TRADE.—Efforts are being made to extend the arrangement by which an advance in prices has been declared in the home markets to the trade with the United States. It does not often occur that an artificial enhancement of values can be of long duration, and the present movement is not likely to be an exception to this rule.

DERBY, 26TH MARCH, 1890.

THE COAL CRISIS.—The coal trade of the district has once more settled down into a normal groove. Not much inconvenience was caused locally by the crisis just passed, as it had been anticipated that whatever the result of the struggle prices were sure to rise after any settlement, and hence it was wisdom to stock, a conviction that was acted upon wherever posssible. House coal realised fancy prices in some few instances, but the highest figure that we can hear of for engine slack was 13s. delivered in Derby, a quotation that only held good for two or three days, and which was at once reduced to 10s. when the settlement was effected.

THE MIDLAND RAILWAY.—The Midland Railway Company has entered into an agreement to support in Parliament the proposed amalgamation of the North British and Glasgow and South-Western Railways, conditionally, amongst other things, on their agreeing to forward annually by the Midland route a stated proportion of English traffic under their control. The Midland Company have extended their engine sheds at Derby, and great activity also prevails in the carriage department. Many regular travellers by the Midland line are greatly inconvenienced by the recent changes in the passenger service, and a well-attended meeting was held at St. Albans to protest against the alterations, when it was decided to memorialise the company.

THE DERBY GAS COMPANY.—The continued expansion of Derby, which has grown from a place with 17,400 inhabitants in 1820, when the gas company was originally incorporated, to its present dimensions, with close upon 100,000 people, obliges the company to contemplate extensions, and it seeks for powers to raise £160,000 for the purpose. The Town Council oppose the scheme, as they themselves are seeking to pass a bill through Parliament that shall enable them to purchase the undertaking under compulsory clauses. The Corporation already possess the waterworks, which are conducted in an admirable manner.

AN IMPROVED WASHER.—Messrs. Peters, Bartsch, & Co., of Derby, have just brought out an improved form of washer, which is particularly applicable where high pressures of steam or very great heats are used. It consists of a ring made out of soft metal sheeting, and contains a groove all round it on the outside. This groove is filled with some packing material, such as asbestos, which is capable of resisting great heat.

CARDIFF, 26TH MARCH, 1890.

COAL AND COKE.—The most noticeable feature in the steam coal trade is the abnormally high price which small coal is, and has been for the past few weeks, realising. The current price is from 10s. to 10s. 6d. f.o.b., which, beyond the railway carriage from the pit's mouth, can be taken as absolute profit, as the cost of winning small coal is practically *nil*. It is feared that this rosy condition of things cannot, however, last long, and sellers show great eagerness to accept forward contracts at much less than the above-named figures. Large coal finds a steady sale, best steam being quoted at 16s. to 17s.; second, 15s. 6d. to 16s.; and inferior descriptions from 14s. 6d. The house coal market is steadier than is generally the case in spring, which is no doubt caused by the fact that a certain quantity of bituminous coal is being mixed with steam coal on account of the scarcity of the latter. For coke there is a moderately active demand. Several export orders have come to hand, which more than make up for the slight falling off in the inland business.

IRON AND STEEL.—The pig iron market is on a more satisfactory basis, and some legitimate transactions are reported at better figures. Now that the rash speculation in the warrant market has collapsed there is a prospect of the market creeping slowly up to a profitable basis. Inquiries for steel rails are more numerous, and a few good orders have been placed. Steel bars are irregular, makers quoting £7 10s., but orders are being accepted at less.

IRON ORE.—Deliveries of Spanish ore have been heavy, and as ironmasters are fairly well bought by contract, there is naturally very little outside business doing. Prices in Spain are very firm, owing to the heavy demand from Germany and America. Rubio is quoted at 16s. 6d. c.i.f. Cardiff and Newport, 17s. Swansea, 17s. 9d. Middlesbrough, 17s. 9d. West Hartlepool, 17s. 6d. Tyne, 17s.. 6d Ayr, 17s. 9d. Glasgow.

BARROW-IN-FURNESS, 26TH MARCH, 1890.

HEMATITE IRON.—There are indications that the attitude of makers of hematite iron in restricting the output, and in refusing to run any of their make into warrant stocks, will bring about an improved tone and an increased trade. The demand is fuller, and warrants have gone up to 65s. per ton. Makers, however, are still quoting 70s. to 72s. 6d. for parcels of mixed Bessemer Nos. net f.o.b. The most gratifying evidence of the improvement in trade is furnished by the rapidity with which stocks are being reduced. During the week 4,764 tons of hematite have been cleared from the warrant stocks, which now remain at 367,916 tons, or 13,731 tons less than in the beginning of the year.

STEEL.—No life is shown in any of the departments of the steel trade. Makers are busy, but it is evident they will soon be in want of new orders to supplement the contracts which represent deliveries far ahead. It is also certain from the present tone of affairs that makers will have to accept lower prices. Business is reported at £5 15s. for heavy sections of rails, but local makers are quoting £6 5s. per ton. There is practically nothing doing in the tinplate trade. Steel shipbuilding material is in large delivery, and orders are well held, though no new orders are coming to hand.

MIDDLESBROUGH, 26TH MARCH, 1890.

PIG IRON.—At the market held yesterday there was a good deal of animation. The price of No. 3 began stiff at 53s. per ton for G.M.B. for delivery this month, but this soon gave place to 52s. 10½d. Before the close, however, it had recovered to the opening price. The prospect is favourable, and makers will not abate their price, but will stand out for 60s. They have a large stock accumulating on their hands in consequence. Merchants prefer warrants and are taking largely from the public stores. Upwards of 1,600 tons have been drawn from Connal's stores in the course of the month. Cleveland warrants are quoted at 53s. cash, with a tendency to rise. The stock in Connal's store on Monday amounted to 161,060 tons, as against 166,752 tons a week back, being a decrease over the week of 5,692 tons. In hematite iron, East Coast brands are quoted at 75s. per ton f.o.t., makers' iron, mixed numbers.

MANUFACTURED IRON AND STEEL.—Iron is active and steel rather quiet. Iron ship plates are at £6 17s. 6d.; ship angles, £6 15s.; common bars, £7, all less the usual discount; steel ship plates, £7 15s.; angles, £7 15s.; rails, £6 per ton.

ARBITRATION BOARD RETURNS.—Mr. Waterhouse's returns show decreased sales of finished iron at increased prices. The average net selling price per ton, for the two months ending the 28th ult., is certified to have been £6 12s. 2½d., against £6 1s. 4d. during the preceding two months. This increase in the selling price carries with it an advance in wages of 6d. per ton on puddling, and 5 per cent. on all other forge and mill wages, to take effect from the 31st inst.

SUNDERLAND, 26TH MARCH, 1890.

SHIPBUILDING AND ENGINEERING.—Fortunately the strike in the engineering trade is at an end. Orders are still scarce and inquiries few; only one steamer has been contracted for during last month—viz., by Messrs Short Brothers, Pallion, for the Prince Line, Newcastle. This vessel is to be fitted with three-crank quadruple-expansion engines, by Messrs. George Clark, Limited. The high-pressure cylinders will be placed tandem fashion. The boiler working pressure is to be 200lb. per square inch, and the furnaces will be Purves' ribbed flues, manufactured by Messrs. John Brown & Co., Limited, Sheffield.

SHIPPING.—There has been a decided improvement in the Black Sea market, owing partially to the opening of the Sea of Azof. If shipowners should hold aloof a return to remunerative rates is probable. Outward business to the Mediterranean continues fairly good, but in the East the market is dull and freights are declining. There is no improvement in the Baltic trade, the open winter having left on hand large stocks of coal. There are some signs of improvement in American rates. With the high price of bunker coals and increase in other items of expenditure, without further general improvement in freights it cannot be said that the shipping trade will prove successful this year. Local coal shipments are very fluctuating. During the last week 68,540 tons were shipped, as against 84,257 tons, 65,231 tons, 78,647 tons, 56,962 tons, and 75,402 tons in the immediately preceding weeks.

THE RIVER WEAR COMMISSION.—The monthly returns show a falling off in revenue of £461 2s. 5d., as compared with February, 1889. This is largely due to the decrease in coal shipments. The Commissioners are arranging for a somewhat smaller expenditure on revenue account during the current year.

NEWCASTLE, 26TH MARCH, 1890.

SETTLEMENT OF THE ENGINEERS' STRIKE.—Through the mediation of the Mayor of Newcastle, the representatives of the workmen on strike and the employers were brought together on Monday afternoon, and after some discussion, a settlement was arrived at on the basis of the concession to the men of the 53-hour week from May 10th, the men on their part undertaking to confine themselves to a limited number of holidays per year, and to keep their machines running up to noon on Saturdays, which, after the date named, is to be the time for ceasing work. The men's representatives also promised to support a proposal for the establishment of a Board of Conciliation, by which disputes might in future be settled. The strike, though it has lasted only eight days, has been the cause of serious loss to all concerned, as well as to the trading community generally, involving, as it did, the idleness of some 50,000 men for the time indicated, and the withdrawal from circulation of the wages they would have earned.

SHIPBUILDING.—The Scotswood shipbuilding yard, which has lain idle several years, is about to be opened by a South American company, who contemplate the building of a fleet of river steamers, of which they will be the owners. It is understood that the company will also engage in the building of steel and iron bridges for South America, but this part of the undertaking will not be entered upon for some time yet. The Palmer's Shipbuilding and Iron Company launched, on Saturday, a vessel of 6,600 tons carrying capacity, for the British Shipowners' Company. The engines, which are triple expansion and of great power, are being supplied by the builders.

ORDNANCE WORKS.—At the Elswick Ordnance Works some heavy orders for different types of guns and gun carriages have recently been booked, and briskness in all the departments is now assured for the remainder of the year. The foundations for the new ordnance works at Jarrow are now being marked out, and building operations will be commenced in the course of a few days.

THE COAL TRADE.—The ascertainment of coal prices realised in the months of December, January, and February having been of a nature to admit of a wages advance being given to the miners, the coal owners, at a conference held on Saturday, announced to the representatives of the latter that they would give an advance of 7½ per cent., to take effect from the 31st inst. This was accepted by the representatives. Owing to the engineers' strike stocks of manufacturing coals have somewhat increased, but a resumption of work having now taken place it may be expected that the surplus will speedily be cleared off.

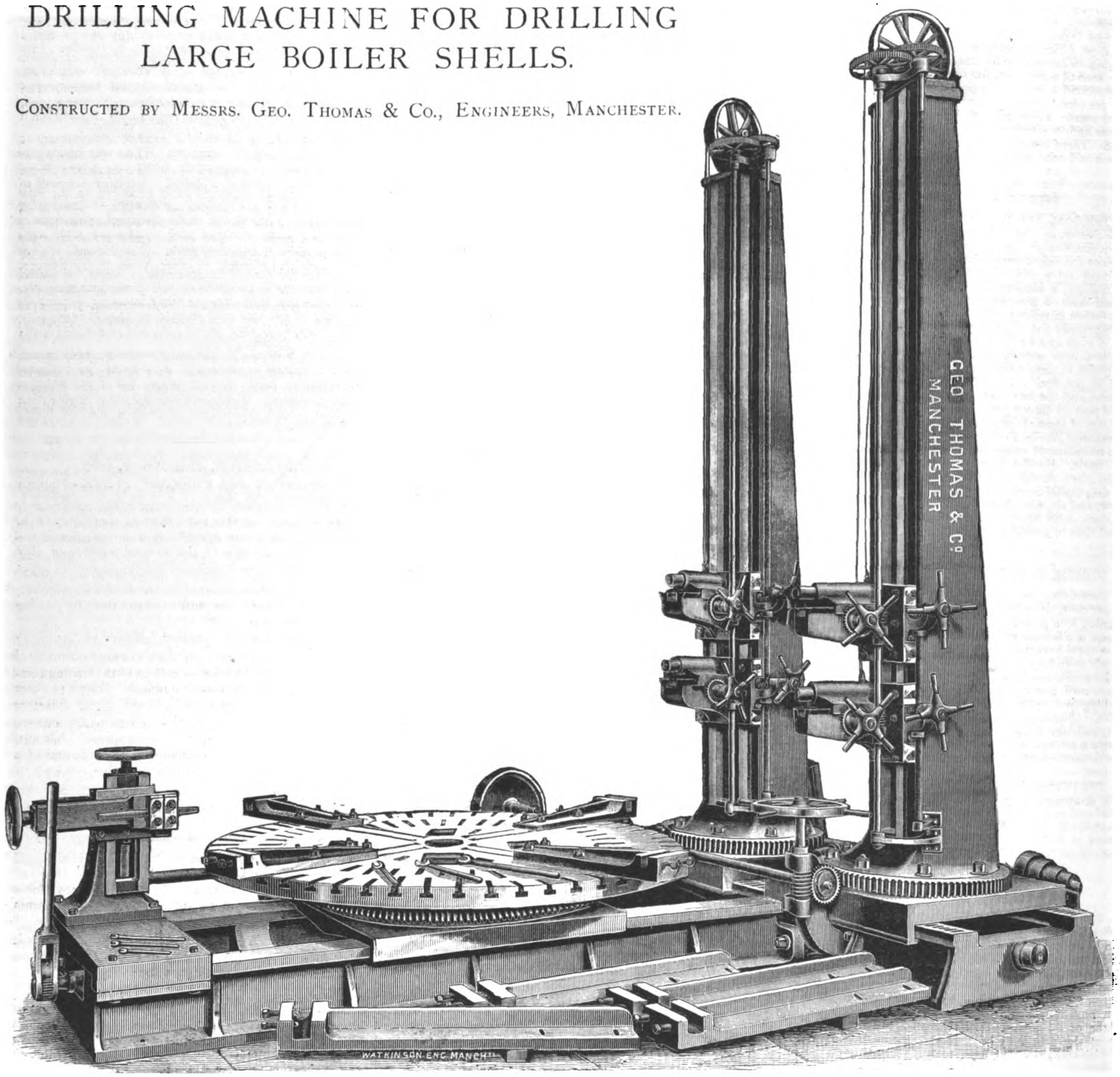
DUNDEE, 26TH MARCH, 1890.

FLAX AND JUTE TRADES.—Both branches of the trade of this district continue quiet. Flax, tow, and codilla are quiet in all positions. Prices on spot are low, and on contract only a limited business is passing at late rates. A fairly good business is passing in flax yarns, and, while prices have ruled low, spinners are becoming less inclined to entertain offers except at some advance. Makers of linens are pretty well employed, and there is a good all-round demand. Narrow goods are still most in request. The spot demand for jute is fair, but in shipments there are few transactions reported, and quotations are lower. In the Calcutta market both loose and baled jute are slow of sale at late rates. In New York Dundee burlaps have been quoted during the fortnight at 5¼c. for 40 in 10½oz. The demand in this market is rather slacker, although light goods show an improvement, and some makers are well booked forward.

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DRILLING MACHINE FOR DRILLING LARGE BOILER SHELLS.

CONSTRUCTED BY MESSRS. GEO. THOMAS & CO., ENGINEERS, MANCHESTER.



POLYTECHNIC INSTITUTE FOR SOUTH-WEST LONDON.

THE Bishop of London recently called a meeting at Fulham Palace with the view of promoting a Polytechnic Institute for South-West London. The Bishop explained the objects of the Institute, and said it was proposed to provide commercial and technical education for those who would have to obtain their living, although he disclaimed all intention of teaching trades, which he said should be done in the workshop. Earl Cadogan had presented the promoters of the movement with a suitable freehold site, together with a sum of £1,000, and the Charity Commissioners had promised £50,000 provided a like sum were raised by subscription. Of this £32,000 had been promised, and a committee was appointed for the purpose of raising the remainder, so that the scheme is likely soon to be carried out. Similar movements are being carried out in other districts of London with the same prospects of success.

DRILLING MACHINE FOR DRILLING LARGE BOILER SHELLS.

THE machine illustrated above is intended for drilling and end-turning marine boiler shells from 4ft. up to 14ft. diameter and 12ft. high. from the top of the table, for turning the flanges of boiler fronts up to 9ft. in diameter, and for drilling, tapping, and inserting studs up to 1¼in. diameter in boiler backs. A strong circular table 8ft. in diameter is fitted with four jaw-brackets, which overhang the table and admit the larger sizes of boilers. The table is arranged to slide along the longitudinal bed by means of a hand-screw and ratchet lever. The transverse bed carries the drill standards and a pinching rack for screwing them. Four drills can be worked simultaneously either on circular or horizontal seams. The machine has two standards, each fitted with two saddles. The steel spindles are 2½in. in diameter, and their noses work against hardened steel washers, lock-nuts being arranged at the other end for purposes of adjustment. There is a self-acting feed motion with a traverse of 6in., and a hand-wheel is provided for the quick withdrawal of the drill. A lever is placed at the bottom of each standard for stopping, starting, or reversing the spindles. The standards are made to swivel to any angle by a worm and worm-wheel. The table is rotated either by hand or power: by hand when drilling, and by power when turning boiler-end fronts. The vertical tool standard for turning the ends has vertical and horizontal adjustments, so that any size of boiler fronts can be turned complete. Messrs. Geo. Thomas & Co., engineers, Manchester, are the makers.

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As we go to press early with certain of our advertisement pages, all Alterations to Standing Advertisements should reach the Publisher not later than 2 o'clock on Wednesday afternoon in each week.

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Contents.

	PAGE
Improved Drilling Machines (*Illus.*)	289
The Protection of Chimney Shafts from Lightning	289
Milley's Patent Tapping Tool (*Illus.*)	290
The Ironmongers' Exhibition	290
The Process of British Watch and Clock Making (*Illus.*)	290
Foreign Industries (Corres.)	294-295
Exhibition at Buenos Ayres, 1890 (*Illus.*)	296
The Institution of Civil Engineers	296
The Coalfields of the Transvaal (Corres.)	296
Notices of Meetings	297
Prices Current	297
Foreign Telegraphic Advices (Corres.)	297
Home Industries (Corres.)	298-299
Polytechnic Institute for South-West London	300
Drilling Machine for Drilling Large Boiler Shells (*Illus.*)	300
The Engines and Engineers of the Navy	301
Industrial Legislation in 1890	302
Official Report on the Mauricewood Disaster	302
The Late J. G. Halske	303
Letters to the Editor:—	
The British Committee at the Late Paris Exhibition	303
The Rating of Machinery	303
The Institution of Naval Architects	303
The Physical Society	304
Messrs. Charlesworth, Hall & Co.'s Dynamo (*Illus.*)	304
The Institution of Electrical Engineers	305
Practical Working of the Electrical Subways in New York (Corres.)	306
Illuminating Water Gas (*Illus.*)	306
Notes	308
"Industries" Patent Record:—	
Applications and Acceptances	309-310
Illustrated Abridgments	310-312

To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

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Industries:

FRIDAY, 28TH MARCH, 1890.

THE ENGINES AND ENGINEERS OF THE NAVY.

AT a public dinner a short time since we heard a distinguished marine engineer say that, if the manager of any private concern made so many mistakes, and allowed so much inferior work to pass, as take place in the Engineering Department of the Navy, he would be instantly sent about his business. Intimately connected with this is the training and professional standing of the engineer officers, and, as both of those subjects are at present being discussed, we propose to refer to them at some length. During the manœuvres of the past two years, and also in the speed trials which are made in the ships of the Navy, we certainly hear of a greater proportion of breakdowns than occur in the merchant service. No doubt part of this is due to the special circumstances under which engines in the Navy are worked, and especially to the great variations of speed and sudden reversings to which they are subject; but these should be obviated by more careful design and greater strength, both of which could be arranged by competent engineers. Then, again, in the matter of speed, which in the present day is the most important quality a ship of the Navy can possess, comparisons between the performances of ships of the merchant service and of the Navy are not at all favourable to the latter. The First Lord of the Admiralty, in his recent statement issued along with the Naval Estimates, touched on all these subjects. He gave a list of ships in which, with certain few exceptions, the machinery trials had passed off satisfactorily on the first occasion, and stated that in most cases the indicated horse-power had exceeded the amount named in the contract, and that this was produced with less air-pressure than that specified. He gave a further list of vessels in which the full-power trials had been postponed for various reasons, which, however, we are afraid were somewhat of the official type. We need not go into this just at present, but it cannot be denied that the impression among marine engineers is that the number of partial failures in the machinery of the Navy is much larger than it ought to be. The First Lord admits that various defects have been observed, but in many cases they have been made good by the engine-room staff; and he expresses the hope that, with greater experience in the working of the machinery, the results will steadily improve. He points out that the design of the engines and boilers of a ship in the Navy is more difficult than that of one in the merchant service, and that it must depend largely upon the service for which she is built. The engines and boilers of a man-of-war are not required to work generally at their highest power, as rapid moving from place to place is not the ordinary work of a war vessel. Moreover, in a fighting ship the weight of the machinery and the space it occupies are primary considerations, it being considered necessary to protect the engines and boilers, either by keeping them below the water-line, or, if above, by defensive armour. The engines must therefore be so designed as to be capable of performing the varying services required of them, which comprise working generally at moderate powers, an ability to meet frequent changes of power according to the duty in which the ship may be engaged, together with a reserve power which may be exerted when required. These conditions, combined with the limitations of weight and space, tend to make the engines less economical in consumption of fuel; and the frequent changes of power tell much more severely on the boilers than would be the case if the engines were working at a nearly uniform power, as in a merchant steamer. In order to meet the complaint of want of speed, the sizes of the boilers have been increased in the ships now building by from 16 to 25 per cent.; that is to say, instead of continuing to design the boilers so that the steam required for full forced draught power can only be obtained by the exertions of the very best stokers and picked coal, on measured mile conditions, the present policy is to increase the weights and the dimensions of the boilers, so that the higher powers occasionally required may be more readily developed and maintained. The new cruisers are expected to have a speed of 20 knots an hour on their trials, and it is to be hoped that they will come very near to that in their everyday work.

We must give the present Board of Admiralty credit for pursuing an intelligent policy, both in the administration of the dockyards and in the design and construction of ships and engines. The next thing to which they ought to direct their attention should be the training of the officers and men who design and take charge of the engines. This subject is now being discussed, and it is somewhat amusing to note the varied opinions which are being expressed regarding it. One of the most remarkable was given by Rear-Admiral R. C. Mayne, C.B., M.P., in a lecture recently delivered at the Royal United Service Institution, and at which the First Sea Lord of the Admiralty presided. He discussed the whole field of Naval policy and organisation, but in this article we will only notice what he said about engineer officers, of whom he makes very short work—in fact, he would make them as a class disappear. He thinks that there is no reason whatever to doubt that if an executive officer devotes as much time, and no more, to learn engineer's work, as he does to learning torpedo work, he would not only be perfectly competent to supervise the engine room artificers, by whom the principal part of the engineer work is now performed, but the "engine-room lieutenant" would bring to the discharge of his supervising duties the habits, constitutional and acquired, of supervision and command, which are known to be characteristic of the class which he joined on first entering the service. The engine-room staff would thus comprise a military officer with one or two assistants, and below them there would be engine-room artificers who would attend to the practical part of the work. We can only characterise this proposal as one of the strangest ever made by any man of such professional standing as Admiral Mayne. A modern warship is the embodiment of all the latest inventions of every department of mechanical and electrical engineering, and it is calmly suggested to hand this over to the charge of a naval officer with a training in engineering extending over a few months, assisted by engine-room artificers. If this were carried out, not only would it be most disastrous to the naval service, but it would also most effectually prevent the training of

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men who were capable of designing or superintending the construction of the engines of ships of war. The engine-room artificers could never develop into such men, for as a rule their education would be deficient, and the designs suggested by the "engine-room lieutenant" would be mere copies, and generally bad copies, of existing types, and thus, not only would there be stagnation, but deterioration in the engines of the Navy.

We are strongly of opinion that, in the training of engineer officers of the Navy, every opportunity should be given for the development of individual ingenuity and skill, and that advantage should be taken of local institutions and engineering establishments for attracting a few of the best of their young men of each year into the Navy. Liverpool, Newcastle, and Glasgow are not only centres of engineering and shipbuilding industry, but they have also educational institutions which are quite as good as any in London for the training of engineers. We have always advocated the utilisation of local advantages, and deprecated any centralised system of education for any department, or the attempt to force all through the same groove, and expressed the opinion that the better course would be to hold out inducements to localities, which would be sufficient to bring out all the men who were wanted for the engineering department of the Navy, and who would have the benefit of the best practical experience in the locality, together with as much theoretical knowledge as they were likely to utilise. We are very much pleased to observe that such a plan has been adopted by the Admiralty, and that notices have been issued stating that an examination of candidates for appointment as probationer assistant engineers in Her Majesty's Navy will be held at the Royal Naval College, Greenwich, commencing on the 29th of May. The ages of the candidates are to be from 20 to 23, and they must have undergone instruction in a College for Technical Education, and three years' training in an approved engineering establishment. Applications must be made before the 1st of May to the Secretary of the Admiralty, Whitehall, London, S.W. This is one of the wisest steps ever taken by the Admiralty, for we are sure that the men who have served their apprenticeships in good workshops, and also undergone a regular course of instruction in the College in their locality, will be well qualified to enter the Navy as junior engineer officers, and they will not be too old to learn those habits of supervision and command which Admiral Mayne thinks so necessary. Opportunities might be afforded to some of them, after they had been in the service for some time, for attending higher courses of instruction, but as a rule this would be unnecessary, as their early education would enable them to keep up with the developments in their profession. We by no means believe that college class-rooms are always the best educational establishments. Much sounder and more useful instruction may be obtained in the engine room and the workshop supplemented by private study. We are much pleased that the policy of the Admiralty is towards the encouragement of individuality and the utilisation of local advantages and institutions, and we trust it will be persevered in. We also hope that, if Admiral Mayne's proposals ever appear in an official form, or even under official patronage, they will receive the most determined opposition.

INDUSTRIAL LEGISLATION IN 1890.

The number of Bills that have been introduced into Parliament this session, with a view to influencing industrial affairs, is more than ordinarily large, and if the session should afford adequate opportunities for their consideration, it seems probable that the statute book, at its close, will not be without additional provisions that will be increasingly onerous to the mine owner and manufacturer. There are other Bills that are drafted with a view to regulating and controlling the conditions under which limited companies are now promoted and established, but of such proposals it need only be said that, while they may make it increasingly difficult to establish on a limited liability basis, or, rather, to transfer to public from private ownership, businesses that are notoriously lean and substanceless, they are likely to aid in the maintenance of sound and prosperous concerns. Perhaps the Bill around which the greatest fight is likely to range is that which proposes to restrict the hours of labour in mines to eight per day. This Bill is backed by the miners' representatives, Mr. Pickard and Mr. Wm. Abraham, by Mr. Conybeare, Mr. Jacoby, Earl Compton, and others; but the names of Mr. Thomas Burt, the tried friend of the miners; of Mr. Crawford, of Durham, who has been for twenty years or more the secretary of the largest miners' union in the world; and of Mr. Bradlaugh, who has long been known as a good friend to this class, and one of their chosen favourites, are conspicuous by their absence. The Bill is a short one, having only three clauses. The first of these is the defining, the second the enacting, and the third the penalising clause. The enacting clause simply provides that no one shall be employed underground in any mine for a period exceeding eight hours in any twenty-four hours, "from the time of his leaving the surface of the ground to the time of his ascent thereto, except in case of accident," under a penalty of 40s., which penalty is to be recovered in the same manner as under the Acts relating to factories and workshops. Another kindred Bill is backed by Mr. Fenwick, another miners' representative, and requires the wages of every workman engaged by time to be paid in full at least once in each week. When engaged otherwise than by time the workman's wages are to be paid in full at the expiration of not more than fourteen days from the commencement of the employment, or from the last pay-day. The last-named Bill is one that is not likely to be attended with much, if any, disadvantage to employers generally, although it may entail some inconvenience to those who have hitherto been in the habit of paying more or less in kind, or of retaining a certain part of each week's wages in hand.

From mines to quarries is an easy and not unnatural transition, and among the Private Bills that reappear on the legislative programme of the current session is the one that was introduced last year for the regulation of quarries. This Bill, which is backed by Mr. Broadhurst, Mr. Ellis, Mr. Abraham, Mr. Childers, and others, limits the age at which children shall be employed in quarries to ten, restricts the hours of boys, girls, and women to 54 per week and ten per day, allows half-hourly intervals for meals during each five hours, and an hour and a half during each eight hours, and requires the owners to furnish periodical returns of their production, the number of persons employed, &c. In cases of accident owners are required to make returns to the inspector of the district within twenty-four hours, and where loss of life or serious personal injury has occurred from an accident, the place is to be left as it was immediately after the accident until visited by an inspector. In cases of quarries being abandoned or discontinued for the time being, they are to be made secure against accident by fencing, but where this discontinuance occurred previous to the passing of the proposed Act, the fencing shall only be required where the quarry is within fifty yards of a road or footpath. The 8th section of the Bill proposes to provide for the appointment of inspectors, who, under the 10th section, have power to examine quarries at all reasonable times by day and night, and who, under the 11th section, are authorised to require anything that may be dangerous or defective about the quarry to be remedied by the owner. Inspectors are required to make an annual report to Parliament as the inspectors of mines are now accustomed to do. Among the proposed general rules, it is required that the practical manager of every quarry shall have had at least five years' previous experience of its working, and regulations are laid down in reference to the use of gunpowder and other explosives. Other provisions deal with the employment of ladders, with the attendance of enginemen, the use of brakes and indicators, the fencing of exposed and dangerous parts of machinery, and the adoption of safety valves and gauges for boilers, &c. Offences against the Act are to be punished by fines not exceeding £5. A quarry, for the purposes of the Act, is to be a "place in which persons work in getting slate, stone, coprolites, or other minerals, clay and brick earth excepted, and all slate quarries now worked under the Metalliferous Mines Act, and every excavation that is being made for commencing or opening any quarry." This definition would extend the Act to the working of the ironstone measures of Lincolnshire, Northamptonshire, and other parts, and to the quarries that provide Cleveland and other districts with the limestone used for a flux in the blast furnace, so that the Bill is likely to have some, although probably not a very serious, effect on the iron trade.

That old familiar face—a Bill to Amend the Law Relating to the Rating of Machinery—reappears in the present, as it has done in several former sessions. It is backed this year by Sir B. Samuelson, Mr. Tomlinson, Sir W. Houldsworth, Sir F. Mappin, and others. The Bill is almost identical with that of former years, and it provides that in estimating the rateable value of any property no machinery, whether attached to the premises or not, shall be taken into consideration, except certain fixed motive powers and the fixed appurtenances thereof, and the "shafts, wheels, drums, and other fixed power machinery, which transmits the action of motive power to other machinery fixed or loose." This Bill is founded upon the report of the Select Committee appointed two years ago to deal with this vexed question, and it is an eminently reasonable one in reference to its main provisions. It is to be hoped that it may become law during the present session, and thereby get rid, once and for all, of the serious discrepancies and anomalies that are every day occurring in the rating of machinery. Another Bill introduced this session, and described as a Bill to divide rates between landlord and tenant, will, of course, affect manufacturers only in so far as it may affect other tenants, and does not, therefore, call for special mention. So also with the Bill to provide for the placing of a mark of origin upon foreign goods, which is backed by Mr. Howard Vincent and nine other members, and which provides that all goods of foreign manufacture "which do not bear in a legible and conspicuous form a definite indication of the country" in which they were made or produced shall not be imported into the United Kingdom, as if they were specified in section 42 of the Customs Consolidation Act of 1876. This Bill is, of course, intended as a supplement to the Act of 1887. Another Bill, which is intended to secure the more effectual prevention of fraudulent trading, and which is backed by Mr. Arthur O'Connor, Sir A. Rollit, and others, proposes to enact that in cases where a business is being carried on by others than the so-called proprietors, the full name, residence, and other occupation, if any, of every person having any proprietary interest in the business, shall be registered. A false statement under the Act shall be treated as a misdemeanour, and shall be punishable by twelve months' hard labour. Access is to be given to the proposed register on payment of an inspection fee of 1s.

Among the other Bills that are printed and awaiting the consideration of Parliament at this comparatively early stage of the session are the Tribunals of Commerce Bill, which is fathered by Mr. Jacoby, Mr. Montagu, and others, the object of which is to establish tribunals for determining speedily and economically claims and disputes arising out of trading transactions, through the machinery already provided by the County Courts; the Partnership Bill, introduced into the House of Lords by the Lord Chancellor, which defines the relations of partners to persons dealing with them and to one another, and which provides for the duties and rights of partners on dissolution; the Companies (Winding-up) Bill, which is a Government proposal, backed by the President of the Board of Trade, and which is intended to extend the policy of the Companies Act of 1867, by giving jurisdiction in the winding-up of companies to county and other local courts, and to assimilate the law and procedure in the winding-up of insolvent companies to the law and procedure in the bankruptcy of individual debtors; a Bill, backed by Mr. Warmington and others, to amend the law relating to the liability of directors and others for statements in prospectuses and other documents soliciting applications for shares or debentures, the effect of which is to make directors personally liable for such statements; and finally, a Bill proposing to enact that incorporated companies shall be entitled to act as executors, administrators, and trustees, and in other fiduciary capacities.

OFFICIAL REPORT ON THE MAURICEWOOD DISASTER.

The Report of Messrs. Johnson and Bell to the Secretary of State, on the disaster which occurred last year at the Mauricewood Colliery, near Edinburgh, belonging to the Shotts Iron Company, has just been issued, and if the opinion therein expressed be correct the disaster must be added to the long list of mining casualties the causes of which are involved in mystery. The Commissioners give a considerable amount of information on various points which were obscure, but they state that the cause of the fire remains, and indeed must remain, unexplained. No evidence was given to show that it arose from a malicious act, and there is nothing indicating that it was caused by spontaneous combustion. The Commissioners say, therefore, that they must attribute the fire to some accidental cause, for which, however, no blame can be attached to the mine owners. But, although they cannot explain the cause of the disaster, the Commissioners show how its consequences were brought about, and from their remarks no doubt some useful lessons will be extracted. These they attribute mainly to the fact of one branch of the upcast air shaft being led through the engine room at the 80 fathom level,

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and this they consider a faulty arrangement. It is impossible that the engine room—and this engine room is one in which the pumps were proved to be working for eighteen hours out of the twenty-four—could be sufficiently ventilated to make it habitable to the enginemen, by means of returned or upcast air, heated in its passage by contact with steam pipes. Consequently it is not surprising that the engineman got into the habit of keeping the door a little open for the purpose of obtaining air from the downcast direct to the engine-room to give a supply of fresh air. The consequence was to make a direct communication between the upcast and the downcast airways, which became, in the opinion of the Commissioners, the principal source whence the smoke got into the main incline, and was carried down and so filled the lower workings of the mine; and immediately on the fire breaking out the air in the upcast shaft must have been expanded by the heat, volumes of smoke must have been generated by the combustion of dry timber and mineral dust, and the total volume of air and vapour to be carried to the surface must have been so increased thereby that it would greedily seek every avenue of escape on the road. Such a communication between the upcast and the downcast airways as was afforded by the engine-room at the 80-fathom level was, of course, instantly brought into action. As such arrangements are not uncommon in other pits, no doubt the attention of the mining inspectors and the mine owners will be directed to them, and a remedy provided. The door was, it is admitted, not very substantial in its construction, and, although it comes in for a mild censure, the Commissioners are not disposed to attach any responsibility to the owners on its account. On the question of the double shaft, to which, and to the operations connected therewith, the miners' representatives directed the attention of the Commissioners, they think that the Shotts Iron Company complied with all the requirements of the statute, and acted in the best interests of the workmen. The Commissioners seem to have considered the evidence very carefully from every point of view, and their decisions appear to be well founded. We doubt, however, whether they will satisfy the representatives of the miners.

THE LATE J. G. HALSKE.

We regret to record the death, which occurred at Berlin, of Mr. Johann Georg Halske, the co-founder and, for many years, partner of the well-known firm of Messrs. Siemens and Halske. He was born at Hamburg on July 30th, 1814, and in early life went to Berlin, where he set up an engineer's shop in 1844. Soon after he made the acquaintance of Dr. Werner Siemens, and it was in Halske's workshop that Werner Siemens, assisted by the mechanical skill of the former, was able to work out his first inventions in telegraphy, so as to bring them before the public. In 1847 the two entered into partnership and laid the foundation to the telegraph construction works which at the present day give employment to thousands of workmen both at Berlin and Charlottenburg and at several branch establishments. Mr. Halske left the firm in 1867, and since then has been an active member of the municipality of Berlin.

Letters to the Editor.

THE BRITISH COMMITTEE AT THE LATE PARIS EXHIBITION.

To the Editor of "Industries."

Sir,—As there is no wrong without a remedy, there must be some remedy for being slandered by *Truth*, but it is hard to find. May I try to discover one by appealing to the fairness of the press in general to correct some misstatements of which one of their number has been guilty, but which he declines to withdraw?

It was stated in a paragraph in *Truth* that exhibitors at the late Paris Exhibition were being dinned for a testimonial to the British Commission, and various comments were made thereon.

May I ask you to state—(1) That no testimonial has ever been proposed to the British Commission, Committee, or Council; (2) that I myself some months since declined to accept any testimonial when on two several occasions the flattering suggestion was made; (3) that some of the exhibitors, acting entirely on their own initiative, are subscribing to make a gift to the members of the staff, who did the work and got none of the credit for it.

The question is one without any public interest: but it is hard, after trying to do one's work honestly, to be accused of petty meanness. I would not have troubled you, had the Editor of *Truth* published even the substance of the disclaimer I sent him, instead of absolutely distorting it.

Yours, &c.,
H. Trueman Wood,
Secretary to the British Committee.

Society of Arts, John Street, Adelphi, London, W.C.,
26th March, 1890.

THE RATING OF MACHINERY.

To the Editor of "Industries."

Sir,—When last year a Bill was introduced in the House of Commons dealing with the much-vexed question of the rating of machinery, the large amount of interest which the members felt in the question was exemplified by the House being counted out. I write to you now in order that attention may be directed to the fact that the Bill for the Exemption of Machinery from Rating has been ordered for second reading on the 16th April, and it is to be hoped that manufacturing constituencies will make a point of requesting their representatives to assist at least in keeping a House.

To say that we live in a time of keen competition with foreign countries appears somewhat like announcing that Queen Anne is dead; but at the same time the former fact has evidently not impressed itself upon our legislators with very great force, or a quorum would have turned up last year. The question is not one of party politics, but one which affects us as an industrial community. It has been agitated for years and years, and it is now high time that it should be seriously considered by Parliament. Cheapness of production is in most cases an essential factor in our maintaining our commercial position, and rating the machinery used in production enhances the cost. It follows, therefore, that the system is injurious to trade.

Yours, &c.,
F. B.

London, 24th March, 1890.

THE INSTITUTION OF NAVAL ARCHITECTS.

The annual meeting of this Institution was opened on Wednesday, the 26th inst., at the rooms of the Society of Arts, John Street, Adelphi, London.

In moving the adoption of the report, which showed that the success of the Institution was maintained, the President, Lord Ravensworth, spoke of their losses by death during the past year, and referred more particularly to the late Sir Spencer Robinson and Mr. Thomas Gray. He went on to say that the year had been marked by great activity in the shipbuilding trades, great production, and moderate profits. There had been turned out 1,286,000 tons of shipping in the course of the year, of the value of £20,000,000, and the remarkable difference between the shipbuilding of last year and that of 1883—another busy year—was, that while in 1883 the ships built were only 15 per cent. of steel, last year 92 per cent. of the tonnage was built of steel and only 8 of iron. Moreover, the ships built last year were for regular lines and special trades, and their construction showed that strength and great steam power were characteristics of the merchant vessels of the present day. The increase of price of material and labour had caused fresh orders to become scarce. Indeed, there were scarcely any new orders at all, and the work now in the yards of the country was from last year's orders, which had kept the yards busy in January and February of this year. He expressed the hope that the workers and the employers would find some means of abolishing strikes, which broke down the confidence of employers, and this lack of confidence would cause workers to lose the advantage of constant wages. As to the Load Line Bill, he expressed his strong objection to legislation of a compulsory character. Such legislation was not required for the best shipowners, and the owners of other than the best ships could evade such laws; and, moreover, such laws could not be enforced against foreign ships.

The first paper which was read was by Mr. W. H. White, Director of Naval Construction, on "The Recent Naval Manœuvres." Mr. White, at the request of the First Lord of the Admiralty, went afloat last August and remained with the fleet during the manœuvres, and his paper therefore embodied the results of his own observations. He divided his subject into four parts:—(1) The influence of size and weight upon the seagoing qualities of ships; (2) the influence of freeboard, height of guns above water, and disposition of armament upon fighting qualities at sea; (3) sea speeds and measured-mile speeds of warships; and (4) special characteristics of warship propulsion. As regards the first head he said that the possibility of any ship continuing to fight and maintaining speed at sea depends largely upon her length and size, as well as upon her freeboard and the disposition of her armament. The first-class passenger steamers of the first rank greatly exceed, in displacement as well as length, the largest cruisers yet constructed. On this account it is unreasonable to expect that war cruisers can catch vessels like the "City of Paris," or "Teutonic," or "Umbria" at sea. Moreover, they are designed for entirely different services, and cannot well be compared. It has been proposed that war cruisers should be built equalling these "greyhounds" in speed and coal endurance, but surpassing them in armament and protection. To do this must involve still greater displacement and cost; and one may well hesitate in embarking on such a course so long as England possesses not merely a vast superiority in swift merchant steamers available as auxiliaries to the regular fleet, but also larger war cruisers than are to be found in foreign navies. In the Royal Navy there is not merely room, but a positive necessity, for vessels of widely differing sizes and types. Furthermore, there is a consensus of opinion that no small proportion of our total force, particularly in the cruiser classes, should be of moderate size and cost, in order that a considerable number of vessels may be available without an inordinate outlay. For sea work and the line of battle, however, there seems good reason for the opinion generally held in the naval service that ships of large size are absolutely necessary.

Under the second head of his paper Mr. White drew a comparison between the behaviour of ships of different types in varying conditions of weather, and pointed out the advantages and disadvantages of each, with special reference to their fighting efficiency. He took occasion to deny that there is any foundation for certain strictures which had been passed on the accommodation, ventilation, and living quarters on the ships of the "Admiral" and "Medea" classes. He mentioned that the Admiralty have decided, largely as the result of experience gained with cruisers during the manœuvres, to construct a considerable number of the second-class cruisers building under the Naval Defence Act with flush upper decks. This entails increase in size and cost, but will add to the seagoing and fighting qualities.

He then passed on to the third section of his paper—Sea speeds and measured-mile speeds of warships. These are designedly and avowedly made under the best possible conditions—engines and boilers in perfect order, the best coal, skilled stokers, calm weather, smooth water, and clean, freshly-painted bottoms. Only under these conditions can such trials be of service either for purposes of comparing ship with ship, or of yielding information which will be of value in future designs. For warships of all nations, moreover, this system of trial is established, and the recorded speeds are measured-mile speeds. In recent years Admiralty practice in the trials of Her Majesty's ships has been varied considerably, and always in the direction of greater stringency. It is doubtful if equally severe trials are made with the ships of any other navy. Official records of speeds for Her Majesty's ships in the Navy Estimates and elsewhere have also for some years past given both the natural and the forced draught speeds. In the Navy List only the forced draught power is given. Passing from these standard trial conditions to the conditions of actual service, everyone having any acquaintance with the subject is well aware that there must be a considerable reduction made both in the powers developed and the speeds obtained. Engines and boilers will not remain in perfect order; coal is often of indifferent quality; stokers are not always equally efficient, nor can one expect from them over long distances work equal to that performed over a trial of a few hours; the bottoms of ships do not long remain clean, and it is rarely calm weather at sea. All these variable conditions affect actual performances at sea, and it is practically impossible to lay down any scale of even approximate reduction in order to connect trial speeds with sea speeds for all classes and sizes of ships.

For years past, however, in Admiralty practice, a rough rule has been followed. It assumes that the maximum power likely to be developed continuously, for steaming at sea over long periods, will be not more than two-thirds, or less than one-half of the natural draught power developed on the contractor's trial. And further, recognising the impossibility of making any constant allowance for fouling of bottoms, roughness of sea, or force and direction of wind, it has been the practice simply to record the speed which the reduced power would give if the vessel had a clean bottom and was steaming in smooth water. In the Navy Estimates for 1890-91 particulars are given for all the ships now building, not merely of the contractor's trial speeds and powers, but the approximate speeds and powers for continuous steaming under the assumed conditions of clean bottoms and smooth water. A new regulation, made about three years ago, has given practical tests to this approximate rule for the ratio of power developed when steaming for long periods to the power developed on the contractor's trial. The results have been eminently satisfactory, much more than fulfilling the office assumption.

This "Medea" class of ship has been made the subject of considerable criticism, more especially on the ground that the intended speed has not been realised. The intentions of the design, however, have been realised in all respects; not merely as regards speed, but also draught, trim, stability, and structural strength. The criticism arises from a misunderstanding of facts. Prominence having been given to the forced draught, smooth water, measured-mile trial speed of 20 knots, it has been treated as if it were the sea speed. As a matter of fact, before the manœuvres began a statement was issued in which the speed of the "Medea" class for continuous steaming was estimated

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at from 15½ to 15¾ knots, and experience justifies this estimate. No doubt this speed could be exceeded for short periods, just as in the chase in the North Sea the "Anson" and "Howe" steamed for six hours, and developed as much power over that period as had been developed on their contractors' natural draught trials. Further experience with all these new ships will doubtless give better results.

The introduction of forced draught has been described by a gallant officer as "an invention of the evil one"—presumably because it is associated with high temperatures. No doubt forced draught requires careful use, and may be abused. However, naval officers who have had experience with forced draught are unanimous in desiring to have in their possession the power and control which it gives, although they regard it as a provision for emergencies, and not for everyday use. To be in a position to gain a knot or two in speed each hour for only three or four hours may be of the greatest importance in critical circumstances. To deliberately sacrifice this power, while it is retained in foreign warships, would be unwise. By a circular issued rather more than a year ago, the Admiralty laid down special rules for the use of the forced draught appliances. It is ordered that "forced draught appliances are not to be used above the ½in. pressure, except in circumstances of emergency, and then only for short periods, when the maintenance of the highest possible speed for three or four hours may be of great advantage." Forced draught was not used in the Naval manœuvres. One result of the use of forced draught has been to widen the gap between sea speeds and trial speeds, and hence misunderstandings have arisen. The facts have been clearly put before the public in official documents, and British ships in the matter of recorded speeds are on the same footing as foreign warships. For all practical purposes, the natural draught trial speeds are, however, to be preferred to forced draught speeds, when comparisons are being made.

Another circumstance deserving notice is that the introduction, in recent years, of swift cruisers of small size has necessarily been accompanied by greater disparity between trial speeds in smooth water and speeds at sea. This is only another way of saying what has already been said—that the larger ship feels the check of the sea upon her speed less than the smaller ship, and may actually be capable of running down the smaller one at sea, although incapable of doing so in smooth water. This source of reduction in sea speeds is necessarily incommensurable. So is that incidental to foulness of bottom. The fact is generally admitted, but scarcely appreciated as it ought to be, and it is very important that an illustration may be given. The "Medea" was ordered to be tried, late in 1888, as a typical vessel of this class. Orders were given that her bottom should be perfectly clean and fresh painted at the time of trial. These orders were not fully carried out, and no anti-fouling composition was applied. The ship was also kept afloat for several weeks in the basin before proceeding on trial. These circumstances did not come to be known until the trials were in progress, when it became obvious that some causes of seriously increased resistance or waste of power were in operation. The trials were stopped and the vessel docked. Her bottom was found to be in a rough and dirty state, fully accounting for the unsatisfactory performance. The sister ship "Medusa" was then tried under identical conditions of draught and trim, with engines by the same firm, and with screws of the same dimensions; the only difference was that her bottom was clean. In the "Medea," 5,800 h.p. had been required to attain a speed of 16·9 knots; this power sufficed to give the "Medusa" a speed of 17·6 knots, and 5,000 h.p. gave her a speed of 17 knots. At lower speeds the difference was equally marked. It will be understood that the condition of the "Medea" was not nearly so bad as that of many ships on actual service; and the figures given furnish a strong argument in favour of the course taken by the Admiralty in giving wood and copper sheathing to a large proportion of the new cruisers now building.

Mr. White then passed on to consider the special characteristics of warship propulsion.

(*To be continued.*)

THE PHYSICAL SOCIETY.

At a meeting of this Society, held on the 21st inst., a communication was read on "The Villari Critical Points in Nickel and Iron," by Herbert Tomlinson, F.R.S. Villari has shown that the permeability of iron is increased by longitudinal traction, provided the magnetising force does not exceed a certain limit, but beyond this limit traction produces a decrease of permeability. The value of the force for which traction produces no change in the permeability is known as the Villari critical point. As far as the author is aware no previous observer has found a similar critical point for nickel, but by confining his attention to temporary magnetisation he has detected such a point with comparative ease. He has also examined the variation of the Villari critical points in iron and nickel with change of load, and has investigated the influence of permanent strain on these points. The experiments were made by the ballistic method, using wires about 400 diameters long. In each set of observations the permeability was obtained with various loads, the magnetising force being kept the same, and with each load the circuit was closed and opened until the swings on make and break were equal; this swing was taken as a measure of the induction under the given load. Several diagrams accompanied the paper, in which load and percentage change of permeability were plotted, regard being had to signs.

The author finds that for annealed unstrained iron the critical value of the force decreases as the load increases, and that the Villari point is much lower for temporary than for total magnetisation. With a load of 4·7 kilogs. on a 1 mm. wire the value of the force giving the temporary point was 2·8 C.G.S. units. He also found that for a given magnetising force there are generally two loads which have no effect on the temporary magnetisation.

With unstrained nickel the critical value of the force is much greater than in iron, being about 114 C.G.S. units for a load of 10 kilogs. on a wire 0·8 mm. diameter and 67 for a load of 6·6 kilogs. For a force of 21 units no critical point exists. Experiments on a permanently strained iron wire show that for magnetising forces ranging from 0·03 to 0·3 there is no critical point, and all the resulting curves are identical. There is, however, considerable difference in the observations taken during loading and those taken on unloading. For greater magnetising forces the curves cease to be identical, and the maximum increase of permeability becomes less and less until for a certain force the curves begin to cut the load line. As the force increases beyond this value the point of cutting approaches the origin, and the curves begin to cut the load line in two points. Further increase of force to 3 C.G.S. units causes the first point to disappear and the second point to recede from the origin. Finally, with sufficiently high magnetising forces, the second point cannot be reached before the wire breaks, and the curve lies entirely below the load line.

With nickel the curves for very minute forces, like those of iron, are exactly the same for the different values of the force, but they lie below the load line—*i.e.*, the permeability is diminished by loading. There is no difference, however, in the loading and unloading curves. Beyond a certain value of the force the identity of the curves ceases, and that part of the curve near the origin bulges towards the load line. For a force a little over 21 C.G.S. units the permeability begins to increase with the load, and the curve cuts the line in one point, which recedes from the origin as the force increases.

Mr. Shelford Bidwell said that Professor J. J. Thomson, reasoning from the change of length by magnetisation, had predicted a Villari point in cobalt when compressed, and this was verified experimentally. On applying similar reasoning to nickel he (the speaker) did not expect to find a Villari point, and both Sir W. Thomson and Professor Ewing had searched in vain for one. In some experiments, not yet completed, he had examined the behaviour of nickel, both loaded and unloaded, when subjected to various magnetising forces. These show that the metal always contracts when magnetised. For no load the contraction at first increases with the magnetising force, but attains a maximum. With a moderate load the contraction is less for small forces, but for larger forces becomes equal and then exceeds the contraction of the unloaded wire. For great loads the contraction is less than when unloaded for all values of the force.

A paper "On Bertrand's Idiocyclophanous Prism" was then read by Professor S. P. Thompson, D.Sc. This hitherto undescribed prism is a total-reflection one made of calc spar, which shows to the naked eye the rings and crosses such as are seen when a slice of spar is examined by convergent light in a polariscope. The spar is cut so that the light, after the first reflection, passes along the optic axis, and, after a second reflection, emerges parallel to the incident light. The rings and brushes are present in pairs, but two pairs may be seen by tilting the prism to one side or the other. This was demonstrated before the Society. Professor Thompson also exhibited a similar prism cut from quartz. Owing to the feeble double-refracting power of the substance no conspicuous rings could be seen, but when examined by the lantern traces of such rings were visible.

The next paper was "On the Shape of Movable Coils Used in Electrical Measuring Instruments," by Mr. T. Mather. The object of this note is to determine the best shape of the horizontal section of swinging coils such as are used in D'Arsonval galvanometers, electrodynamometers, wattmeters, &c. Assuming constant period and constant moment of inertia about the axis of rotation, it is shown that for zero instruments the best shape of the section is two circles tangential to the direction of the deflecting field at the point about which the coil turns. A table accompanied the paper, in which various forms of section were given, together with their relative deflecting moments per unit moment of inertia, the coils being taken of equal lengths and the current density constant. From this table it appears that ordinary D'Arsonval coils only give about 45 per cent. of the maximum deflecting moment, and ordinary Siemens dynamometers from 40 to 53 per cent. The various assumptions made in the paper are shown to be justifiable in commercial instruments, and the modifications necessary in special cases are pointed out.

Mr. C. V. Boys said he had, when working at his radiomicrometer, arrived at a shape similar to that recommended in the paper. He also noticed a peculiar relation true for all shapes where the length parallel to the axis of rotation is great compared with the breadth. Suppose a coil of any dimensions, then another coil of half the breadth and double the length, and cross section will be dynamically, electrically, and magnetically the same as the original; for the moment of inertia, the electric resistance, and the enclosed magnetic field are equal. The above relation is also true when the breadth is not small, if the cross pieces be thickened near the axis so as to make their moment of inertia proportional to their length. He inquired whether the author had considered the subject of grading movable coils; he himself was of opinion that, unlike fixed galvanometer coils, the wire near the axis should be thicker than that further away.

The President remarked that in 1881 Professor Perry and himself exhibited a wattmeter at the Society of Arts, whose movable coil somewhat resembled one of those in the paper, which gave a deflecting moment of 95 per cent. of the maximum. In designing the instrument they had felt that the ordinary method of using a comparatively large swinging coil was not the best, and this led them to the shape adopted.

MESSRS. CHARLESWORTH, HALL, & CO.'S DYNAMO.

The illustration on page 305 represents one of Messrs. Charlesworth, Hall, & Co.'s dynamos, which has been specially designed for driving from a gas engine. These machines are carefully designed mechanically as well as electrically, and the lubricating arrangements are very convenient and perfect. Each bearing is fitted with a special sight-feed lubricator, which is so arranged that the feed, when once adjusted, can be turned on or off without fresh adjustment, and can be increased or decreased at any time when found necessary. Each bearing is also fitted with two simple siphon lubricators, which are intended to be used if any of the bearings should become heated. The waste oil from the bearings is caught in the enlarged ends of the pedestals, and runs from these into the insides of the pedestals and down into the standards carrying them, and can be drawn out as required. These arrangements keep the machine entirely free from oil except where it is required. The bed-plate has been extended to support the extra weight of the fly wheel, which is 30in. diameter and weighs about 6 cwt. After being turned all over, this has a wrought hoop, previously bored, shrunk on and then turned up. The shaft is of hard steel, and is 2in. diameter in the bearings at the pulley end, and 1⅞in. at the other end. The bearings are of aluminium bronze, each 8in. long. The pulley is 13in. diameter, and carries an 8in. belt. The bed-plate is of massive construction and well ribbed to withstand rough usage in transit and fixing.

The magnet cores are of soft charcoal iron fitted into holes bored through the bed-plate and secured in their places by screws. The pole pieces are in one forging with the magnet cores, and are bored from the pedestals to receive the armature, which is placed exactly in the centre. The armature frame is of strong aluminium brass, and the core, which is 12in. diameter, is built up of soft charcoal iron discs insulated from each other, and has an area of 40·5 square inches. The commutator bush is a steel casting with wrought-iron nut and washer, and is 6½in. diameter; it has 80 hard drawn copper bars, 1in. deep, and is insulated entirely with mica. The armature is wound with 200 convolutions of one No. 8 B.W.G., and has a resistance of ·045 ohm. The magnet is shunt wound only (for charging accumulators), and each leg is wound with ten layers of No. 14's and sixteen layers of No. 15's, and has a total resistance of 31·6 ohms. There are two brushes on each side of the commutator, each of which can be adjusted independently of the other. These machines work without any sparking with the full load; when working lamps the normal load is 150 amperes and 100 volts at 670 revolutions per minute, and 150 amperes and 140 volts at 820 revolutions when charging accumulators.

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The electrical efficiency when working lamps as above is—

Loss in armature ... 6·2 p.c.
„ magnet..... 1·94 p.c.

Total loss ... 8·14 p.c, *i.e.*, 91·86 p.c. efficiency.

or when charging accumulators with 140 volts—

Loss in armature = 4·474 p.c.
„ magnet = 2·741 p.c.

Total loss = 7·215 p.c., *i.e.*, 92·785 p.c. efficiency.

The above machines are 5ft. long and 2ft. 8in. wide, and 3ft. 6in. high over all.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

THE meeting of this Institution on the 20th inst. was occupied with the continuation of the discussion on Mr. Swinburne's paper, "The Theory of Armature Reaction in Dynamos and Motors," and on Mr. Esson's paper, "Some Points in Dynamo and Motor Design."

Mr. A. P. Trotter disagreed with Mr. Esson's statement as to the inutility of, and the difficulties attending, calculations of the stray field, and said that since Professor Forbes gave his three lemmas in 1886 the work has been comparatively simple, and constituted in one case a part of drawing office routine. This predetermination is most important when any departure from ordinary designs is made, for in such cases one cannot be guided by previous experiment. Mr. Trotter also exhibited

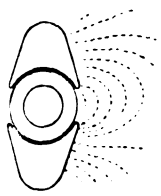


FIG. 1.

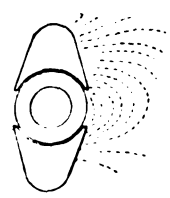


FIG. 2.

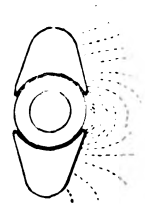


FIG. 3.

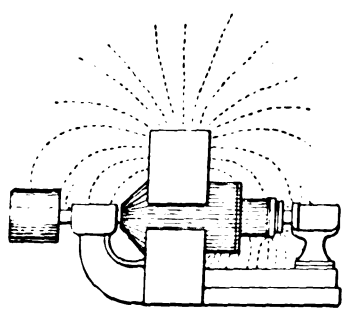


FIG. 4.

the accompanying diagrams of field distribution made from actual dynamos. A sheet of paper was cut to fit the machine and held in the plane in which the lines were to be plotted. A needle on a pivot, with an india-rubber stamp stuck on, was held in the field, and the position recorded by stamping an impression. Series of impressions represent lines of induction. On one of these diagrams the distorting effect of a large armature current can be easily seen.

Mr. Vignoles confirmed Mr. Trotter's remarks about the calculation of waste field by Mr. Ravenshaw.

Mr. S. Joyce, in speaking of Mr. Esson's rule for rise of temperature, said such rules could only give the temperature at the surface, and not that of the interior, which was probably much greater. As the difference in temperature between the inside and outside of the winding varies as the square of the depth, this difference may become excessive in large machines. The expression for the difference, on the assumption that the inside and outside surface are parallel planes, was given as $hD^2/2K$, where h = C.G.S. heat units generated per cubic centimetre, D = depth of winding, and K its thermal conductivity. For cylindrical surfaces of ordinary dimensions the difference is about 3 per cent. less. The quantity K may be calculated from the equation $K = Zd/2\delta$, where Z is the thermal conductivity of the insulating material, d the diameter of the covered wire, and δ the radial depth of insulation.

Mr. J. D. F. Andrews thought the heating of armature conductors could be got over in a simple way by paring down the pole corners so that the conductors came into and out of the field more gradually.

Mr. Stuart A. Russell, in referring to Mr. Esson's curve for maximum output, said he believed this was obtained on the assumption that the depth of winding inside the armature was equal to the depth outside. If the difference between these depths be taken into account, then in ordinary cylinder armatures, instead of the core being about 4 times the depth of the winding, it becomes $5\frac{1}{4}$ times. Concerning the design of motors, the speaker said he agreed with the authors of the papers, but the startling nature of the curves shown by Professor Ayrton had led him to make experiments on the subject. From them he concluded that the e.m.f. of a motor may be made greater than that of a dynamo by short-circuiting a number of sections, thereby increasing the armature induction, but that no advantage is gained, because the result is just the same whether the greater induction is produced by field magnet windings or by coils short circuited by the armature brushes. His experience with motors having thick brushes did not agree with Mr. Snell's, for in tramcar work he (the speaker) got the best results with brushes of ordinary thickness.

Mr. Wyles said no doubt need exist as to the possibility of making smooth commutator machines for high voltages, and that the difficulties experienced arose from the great differences in the insulation of similar machines. The insulation of some may be excellent, whereas that of others wound with equal care is comparatively bad. These differences are met with in machines of e.m.f.'s as low as 200 volts.

Mr. Geipel asked whether cross-induction could not be reduced by nicking the pole pieces in Mr. Swinburne's paper until they separated into two parts, and by laminating the magnets in a direction perpendicular to that of the cross lines. Referring to Mr. Esson's temperature limit of 75° C., he inquired whether any modification would be made for machines intended for tropical climates.

Dr. S. P. Thompson, in a communication read by Mr. Kapp, said that a good approximation to the back ampere turns was got by multiplying the number of conductors between the pole corners by half the armature current, and that he agreed with Mr. Swinburne as to the usual position of the brushes. He complained of Mr. Swinburne's use of "ergs" in measuring magnetic potential, and asked why, in naming the pole corners, he had reversed the ordinary usage. He also inquired why Mr. Esson took the load carried by armatures as proportional to the depth for armature core. Speaking of "leakage coefficients," he pointed out that this is not constant even for machines of the same type, but is less for the larger machines. As regards smooth commutator machines for high voltages, he said Messrs. Paterson & Cooper had made such machines successfully for some time, and that in Ball's so-called "unipolar dynamo" was an instance of a smooth commutator machine working 80 arcs in series.

Mr. MacWhirter objected to Mr. Swinburne's use of the symbol Ω for magnetic potential, for this is the recognised symbol for megohm. Speaking of the magnetic pull on armatures of single magnet machines, he said his firm found the method of placing the armature eccentrically very effective.

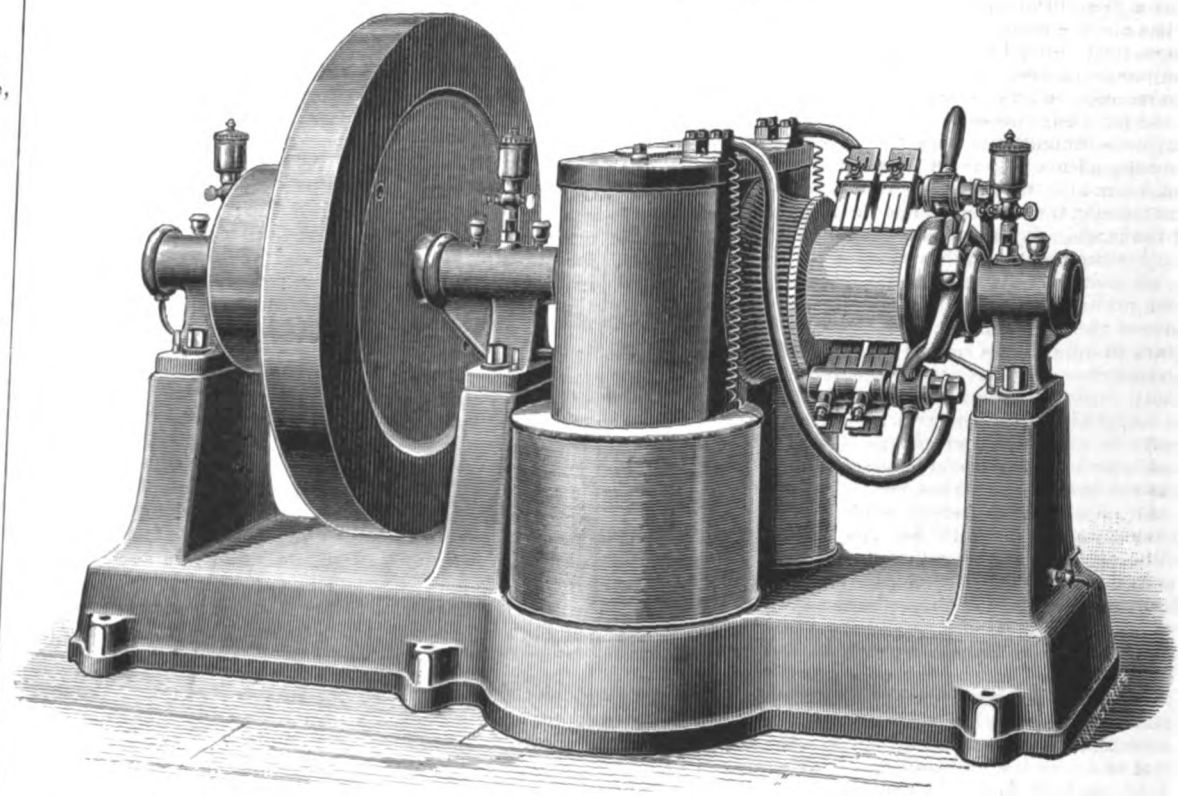
The President expressed his great appreciation of both papers under discussion, but, owing to the lateness of the hour, would only criticise a few points in Mr. Swinburne's. The rule given for lead of brushes seemed to him hardly correct, for in machines with which he was acquainted the lead was always less than half the angle between the pole corners. There were two points to which he wished to direct Mr. Swinburne's attention, viz., the effect of having a great or a small number of commutator bars, and of thick or thin brushes. Speaking of the term "magnetic resistance," he said there were two reasons why he did not use it. First, the generally accepted idea of "resistance" was such that $(flux)^2 \times resistance$ was a rate of doing work; so-called "magnetic resistance" did not satisfy this condition. Secondly, "coefficients of resistance" are generally constant, and express properties of the material or medium. "Magnetic resistance," however, is by no means constant, and he thought its use open to the same objections as "resistance of an electric arc," an expression which was very misleading.

Mr. Swinburne, in reply, said the main subject of his paper had not been discussed. Its object was to show how to obtain an expression for the lead of the brushes in terms of the polar angle, and thus determine the back induction before the machine was made. This was of much greater importance in regard to large machines. The greater part of his paper referred to such machines. Professor Ayrton, he said, had accused him of using "magnetic potential" where "difference of magnetic potential" was meant. This he denied, and pointed out that he had been careful to speak of difference of magnetic potential. Referring to "magnetic lag," he said the time lag discovered by Professor Ewing had no connection with the once supposed lag to which the lead of the brushes was wrongly attributed. As regards the results of experiments on machines run as generators and motors by Professor Ayrton, he pointed out that in those experiments where the e.m.f. became negative with a large armature current, the generator became a motor and the brushes were then in the wrong position. He also contended that in all cases where the e.m.f. of a motor increased with increase of armature current, the brushes were not in the proper position. He believed Mr. Esson's results on the Bürgin machine was due to the same cause, for in this machine, unless made specially as a motor, the brushes could not be put back far enough

AN IMPROVED DYNAMO.

CONSTRUCTED BY MESSRS. CHARLESWORTH, HALL, & CO., ENGINEERS, OLDHAM.

(*For description see opposite page.*)



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to run sparklessly. Probably Mr. Esson had been misled by not being aware that the commutator connections are skewed. Replying to the criticisms on his use of "ergs" in measuring magnetic potential, he said Sir W. Thomson was the first to introduce it, and as it had been used by Maxwell and others, he thought he might use it too. His objections to "magnetic resistance" were, first, that the term has no definite meaning; secondly, that the analogy whence it is derived is wrong; and thirdly, if used it is liable to lead to error, as has already been the case with regard to transformers. Magnetism, he said, was analogous to electrostatics, and permeability to specific inductive capacity—not to conductivity, as the advocates of magnetic resistance would have us suppose. In his opinion, four-pole drum machines would be used in the future for large power outputs. He was sorry to learn that Mr. Mordey had not been able to make a shunt Brush machine work successfully, for he himself had done so, and the inventor of the machine approved of the arrangement. As regards the position of the brushes relative to the pole corners, he pointed out that Dr. Thompson's observations agreed with his own, and not with those of the President. In answer to the President's inquiry why he did not integrate to infinity in a certain case, he said the integration had only been given as a rough approximation near enough to the truth to show that a comparatively weak field is required to reverse the current in the armature sections of direct current machines. If alternating machines were under consideration the treatment of the subject would be different.

Mr. Esson, in his reply, said Mr. Kapp's method of overcoming side pull had the disadvantage of not allowing the coils to be slipped over the poles, and that, even if adopted, the distribution of the field was not the same near the top brushes as near the bottom ones. He could not understand how Mr. Kapp saw any "dodge" in designing armatures to give large outputs, for the magnets were designed in accordance with the armatures with which they had to work. Neither could he understand Mr. Ravenshaw's remarks about the loading of armatures. In his opinion, the machines of a set could not be all in the same condition as regards balance of field, and he thought all Mr. Ravenshaw's dynamos were underloaded. He was glad to see that Professor Ayrton's remarks respecting the number of ampere turns required for compounding agreed with his own statement on the subject. Referring to Mr. Crompton's armature conductors, he said he had used stranded wire for the same purpose, but the section of his subdivided conductor was round, and not rectangular as in Mr. Crompton's. He would have been glad to learn something about the collection of large currents, for this seemed to be one of the most difficult problems at present. On the subject of motor construction Mr. Esson said Professor Ayrton's curves showed that it was difficult to prove either point conclusively.

PRACTICAL WORKING OF THE ELECTRICAL SUBWAYS IN NEW YORK.

(*From our New York Correspondent.*)

(*Continued from page* 283.)

Concerning the question of the relative durability of rubber compound and fibrous cables, sufficient time has not elapsed to enable one to arrive at a definite judgment. Many circuits have been running continuously for over nine months, and in some instances for over one year, without a defect of any kind, electrical or mechanical, having occurred, and the slighter defects that have occurred on other circuits have as yet been so few in either type of cable as not to certainly show any marked superiority of one type over another. Specimens of cable that have been examined, after nine or twelve months' service, show no physical or electrical signs of deterioration of the insulation. As regards the question as to which kind of cable will best withstand the heat from steam pipes adjacent to the subways, it would appear thus far that the lead-covered fibrous cable is superior to the homogeneous cable not lead-covered. Lead-covered rubber compound cables have not as yet been tried in the heated districts.

There are no concentric cables in these subways. The mains of multiple arc circuits are operated in separate lead covers in the same duct. It is contemplated by some of the companies to use one lead cover for such circuits hereafter. One objection to the use of concentric cables is the difficulty in making joints, where frequent connections for distribution are required.

One fibrous insulated cable, having eight conductors under one lead cover, was placed in the subways, but has not been operated as yet, trouble having been found in making perfect joints. It seems to be the general opinion that the use of multiple cables is not advisable in electric lighting.

On the subject of loss due to increased electrostatic capacity, or to increased self-induction of conductors in the subways, no perceptible difference in the operation of the circuits as compared with similar circuits overhead is noticeable. In wet, stormy weather, a decided improvement is observable—in fact, the condition of the weather does not affect subway circuits. This will be readily understood when it is stated that a recent test, made during the prevalence of a drenching rainstorm, of an arc circuit in the subways, four miles in length, showed an insulation resistance of 2,400 megohms per mile. The lamp connections were disconnected from the cable proper during the tests, so that the entire cable was under cover except at the pole.

Several forms of joints are used on the electric light cables in subways, among them one known as the "rubber" joint, sometimes termed the "half-marine" joint, made as follows:—First, the lead covering is removed for three inches from the end of the conductor. An inch of the insulation is then removed from the ends of the conductor; the ends of the conductor are then "sweated" together. Generally a split copper sleeve is placed over the ends. When a T-joint is to be made a T-sleeve is used. This facilitates the making of the joint by dispensing with filing the ends of the conductor and then wrapping them with small wire. No acid is used in the making of the joint. Resin is commonly used. After the wire has been spliced, the insulation is scarfed for about three-quarters of an inch, when a layer of pure rubber strip is wrapped around the wire spirally back and forth about three times, and each time the rubber is brought further up the scarfed insulation. A few layers of white rubber strip are then wound above the pure rubber strip, and after that a layer or two of pink rubber strip. A layer of fibrous rubber tape is then put on over all. Between each layer of rubber strip a small quantity of rubber solution is put on to make the rubber adhesive and practically homogeneous. A lead sleeve is then placed over the joint and wiped on to the lead covering. This joint can be made in about twenty minutes, exclusive of time taken in wiping the lead sleeve. This joint is used altogether on the "Bishop" and the "safety" cables; also, occasionally, on the "Waring" and "Cobb" cables. But as a rule the "Cobb" people make a special joint somewhat as follows: The ends of the conductors are spliced in the usual way, a hard rubber ferrule having first been placed over one end of the conductor and a brass ferrule over the other conductor, above the insulation. A machine, like a double vice, is then placed over the lead covering of the cable and made fast thereto. A tightening device next draws the ends of the vulcanite together, taking up slack in the cable. The vulcanite sleeve or ferrule is then welded by heat to the vulcanite tube, after which the brass ferrule is drawn over the tube. A mould is then placed around the joint, into which molten lead is poured, thus casting a solid lead sleeve. This is quickly cooled by the application to the mould of cold water. The mould is then removed and the joint is complete. This form of joint has been found satisfactory, and can be made in less time than a half-marine joint. The joint chiefly used on the "Waring" cable is made differently from either of the foregoing. After the conductor has been spliced as usual, and the lead covering has been cut back from the insulation, a few turns of tape is passed around the splice. A leaden sleeve is then put on over this and wiped firmly to the lead cover of the cable. When this has been done a couple of small holes are punctured in the lead sleeve, through which a boiling insulating compound, used in the manufacture of the cable, is poured, filling up the sleeve completely, after which the holes are closed by solder. These joints have been found to give excellent service on this form of cable. The time taken in making this joint is about thirty minutes.

(*To be continued.*)

ILLUMINATING WATER GAS.

The severe competition introduced by the adoption of electric lighting and other systems of public and private illuminating within the last few years has roused the gas engineers to seek improvements in gas manufacture with the view of maintaining the industry in its present position. It used to be frequently stated that the methods employed for the manufacture of coal gas had not differed essentially from those used in the earlier days of the industry, either in the form of apparatus and plant or in the distillation of the coal and the purification, storage, and distribution of the gas. In recent years, however, the gas engineer has effected important economies in the construction and use of his plant, and has called to his aid the knowledge which has been accumulated by the chemist, until at the present time we have many novel and ingenious processes emerging from their period of experimental trial which mark important departures from the primitive forms of manufacture. In addition to the competition of rival lighting systems, the increase in the price of coal and labour has contributed to this revolution in the industry, and many of the gas companies in England feel that it is absolutely necessary that considerable alterations in their old plant must be undertaken before long in order that they may, while complying with the conditions of their respective Acts with regard to quality and illuminating power of their product, give a fair return on the capital invested in their enterprise. The Parliamentary returns for 1888 show that the gas industry in the United Kingdom employed upwards of £62,000,000 of capital, and that the gas produced amounted to the large total of nearly 100,000,000,000 cubic feet obtained by carbonising 10,000,000 tons of coal. With such large figures as these statistics show that it is not surprising that thought is being directed towards effecting economies and improvements in the industry. Many of these departures have already been noticed in *Industries*, and those of our readers who are interested in the subject will easily call to mind the improvements effected by the Dinsmore and Loumis processes, by the recovery of sulphur and economies in manufacture effected by the use of the Claus kiln at Belfast and elsewhere, and the improvements in purification and increase in illuminating power by the use of oxygen gas at Ramsgate. Time alone can decide between these and other modifications of the original plan for the manufacture of coal gas and other processes which are based on entirely different systems. We illustrate on page 307 an experimental plant which has been erected at Knightsbridge and at work for some months for the manufacture of illuminating water gas on the Van Steenbergh system. This system has been in use for many years in America, where it and other similar processes have been employed in new cities which were not handicapped by having coal gas plant already erected. The arguments for and against the use of water gas as a source of heat have so recently been brought to the notice of the public that it is unnecessary to repeat them here. It must, however, be remembered that water gas, when used for illuminating purposes, requires some such appliance as the comb commonly used, or some other material which is heated to whiteness by the flame, such as is employed in the Welsbach system of incandescent gas lighting. Although these systems, based on the heat-giving properties of the gas being utilised for raising the temperature of some solid material to incandescence, have many advantages, yet the necessity of a burner of delicate construction and of special form undoubtedly militates against their rapid introduction.

Illuminating water gas as used in America, and of which the Van Steenbergh gas may be taken as a type, is water gas which has been charged with hydrocarbons which render it a fixed illuminant similar to coal gas, to which it agrees very closely in chemical composition. The gas manufactured by this system can be distributed and burnt in the same way as coal gas itself, and is characterised by giving a white light of great brilliancy and having an illuminating power equal to that obtained from cannel coal, or some 6 or 8 candles higher than that of ordinary coal gas. Although of the same candle-power as cannel gas, it differs from it in being of more uniform composition and burns with a flame which is free from smoke. Such carburetted water gas is now in use in one-third of the towns lighted by gas in America, and the gas appears to give as much satisfaction to the consumers as ordinary coal gas. The Van Steenbergh apparatus possesses the advantage over other similar processes in use, in its simplicity of construction, as only one generator is employed for producing the water gas and giving it an illuminating power. In other systems, the water gas is usually generated in one vessel, and the hydrocarbon oil volatilised and decomposed in a second, and the two gases thus separately produced lead into a mixing vessel where the gas is finally fixed for the holder. Some systems use only two vessels, the two gases being produced in one generator and rendered a permanent mixture in a second. The plant employed at Knightsbridge, as shown in our illustrations, consists of a tall cylindrical iron generator lined with fire brick, and in it the whole of the manufacture is conducted. It is half filled in the first instance with anthracite or coke, which is heated to whiteness by a powerful air blast introduced at the bottom of the generator. The producer gas and its waste heat can be utilised by leading the gases formed at this stage of the operations by a special tube at the top of the generator (this tube is not fixed to the small plant which we illustrate) to the furnace at the right which heats the boilers used for producing the steam required in the second operation. The time occupied in blowing and raising the fuel to the necessary temperature is roughly equal to that required for making the gas in the second operation. In one run, details of

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THE MANUFACTURE OF ILLUMINATING WATER GAS.

Plant Erected on Mr. Van Steenbergh's System in Knightsbridge, London.

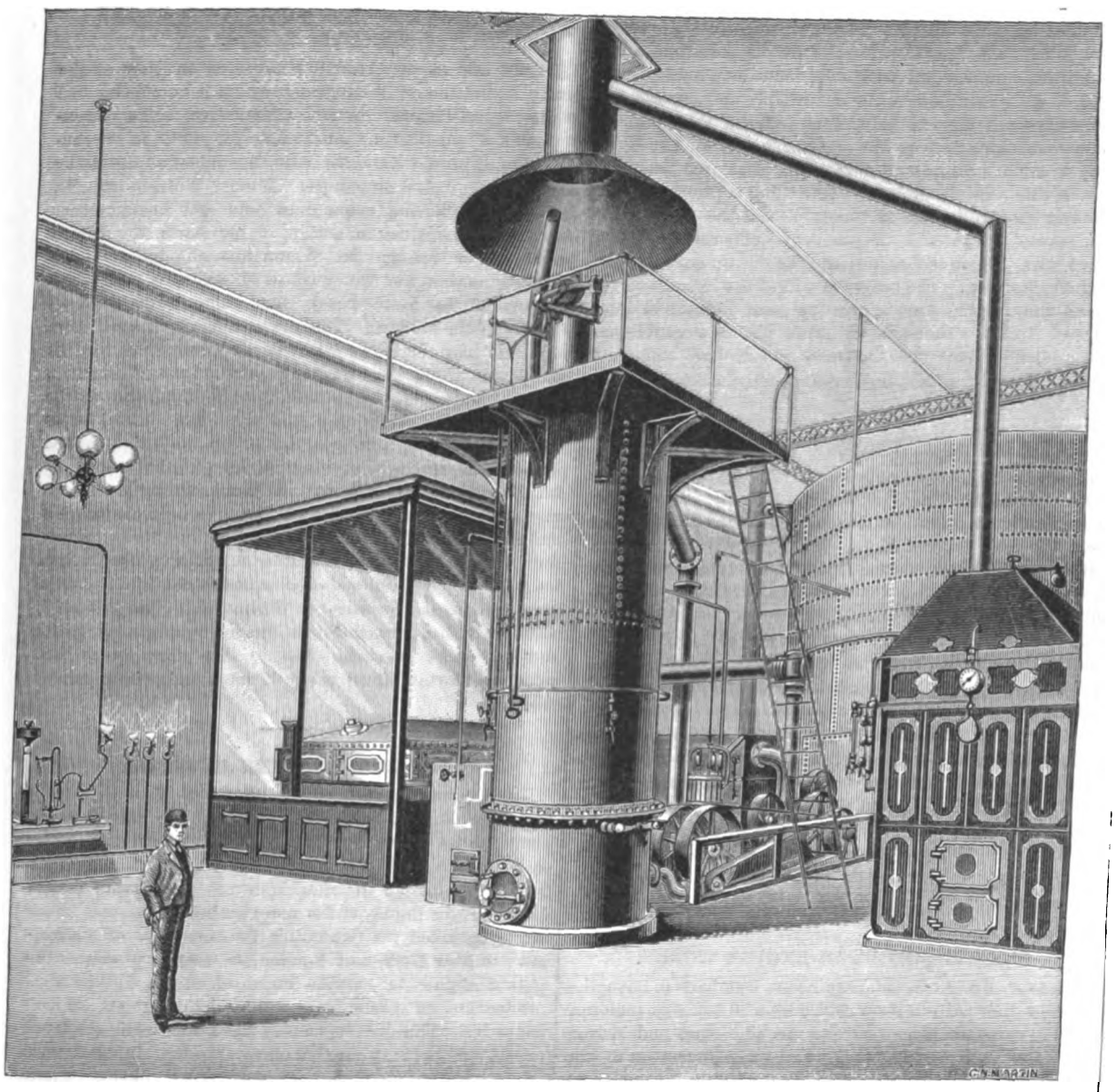


Fig. 1.—General View of Plant.

Fig. 4. Fig. 5.

Fig. 3

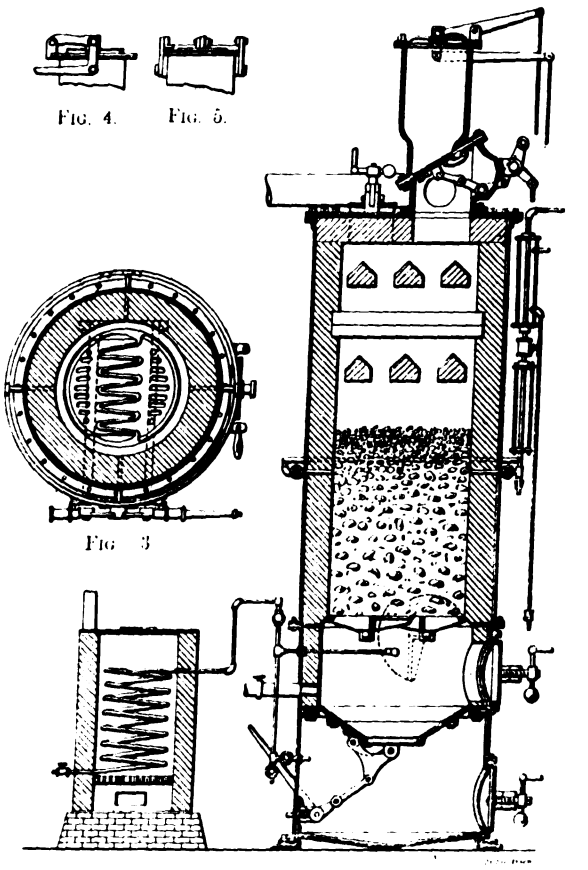


Fig. 2.

Table I.—*Giving Full Details of the Make of Carburetted Water Gas by Van Steenbergh's Plant (Feb. 11, 1890).*

Quantity of gas made	8,400 cubic feet
Time occupied—	
In blowing	58 minutes
In gas making	48 „
Fuel consumed—	
Anthracite	205lb.
Naphtha (70° Beaumé)	23 galls. 6 pts.
Illuminating power of gas made (corrected)	20·5 candles

Analysis of Gas.

	Unpurified. Per Cent.		Purified. Per Cent.
Hydrogen	—	...	40·33
Marsh gas	—	...	17·08
Illuminants	—	...	7·59
Carbonic oxide	—	...	25·00
Carbonic acid	2·15	...	0·50
Oxygen	—	...	0·17
Nitrogen	—	...	9·33
Sulphuretted hydrogen	2·84	...	nil
			100·00

Total sulphur (by Letheby test)	6·67 grains per 100 c. ft.	
Sulphuretted hydrogen in unpurified gas	23·80	„ „
Sulphuretted hydrogen in purified gas	nil	
Ammonia	nil	
Bisulphide of carbon	nil	

Consumption of Materials per 1,000 Cubic Feet of Gas Made.

Naphtha	2 galls. 6½ pts.
Anthracite	24½lb.

Table II.—*Showing the Composition and Illuminating Power of the Gas made by the Van Steenbergh Plant from Various Carbonaceous Fuels with 76° Naphtha.*

—	Foundry Coke.	Gas Coke. Unpurified.	Gas Coke. Purified.	Anthracite. Unpurified.	Anthracite. Purified.
Hydrogen	33·44	—	39·05	—	38·44
Marsh gas	23·38	—	26·71	—	19·30
Illuminants	11·14	—	9·27	—	7·49
Carbon-monoxide	19·00	—	13·50	—	23·81
Carbon-dioxide	2·24	6·01	1·02	2·16	0·42
Nitrogen	9·50	—	9·72	—	9·69
Oxygen	1·50	—	0·73	—	0·85
Sulphuretted hydrogen	nil	0·35	nil	trace	nil
	Candles.		Candles.		Candles.
Illuminating power (corrected)	22·4	—	22·9	—	21·8

which we give, it will be seen that when a quantity of gas equal to 8,400 cubic feet was made, the time occupied in blowing was 58 minutes, and in gas making 48 minutes. This second operation consists in introducing below the grate bars at the bottom of the generator a continuous jet of steam superheated by passing through a coil heated by a small furnace shown on the left in our illustration (Fig. 1). The mixture of hydrogen and carbonic oxide formed in this manner rises in the generator and meets in its passage upwards with the products of dissociation of liquid oil or naphtha which is injected into the generator near the top of the column of incandescent coke through tubes in the sides of the generator. The illuminating hydrocarbons produced from the oil here mix with the hydrogen and carbon-monoxide of the water gas produced below in the same apparatus; the mixed and fixed gas then passes out of the top of the generator by a pipe to the holder, washers, scrubbers, and purifiers, and is ready for consumption.

The inventor claims for this process a product of uniform quality and considerable economy in labour and fuel. The naphtha employed consists of the first runnings obtained in the distillation of American petroleum, and is of very little commercial value. There is only a limited demand for it in this country and America, and as it has been hitherto looked upon as a kind of waste product a new application for it should be received with satisfaction. The supply of it is practically unlimited, and the recent improvements in tank steamers for the transit of oil in bulk will facilitate its export to this country at a cheap rate. In America the fuel employed has been the harder kinds of Pennsylvanian anthracite, but the Welsh anthracite also gives highly satisfactory results. The annexed table shows that very good results are obtained by the use of foundry coke, and although gas coke does not apparently give so good a yield, its cost is much less, and as it will be probably in connection with existing gasworks that the new plant will be erected in this country gas coke will eventually be the fuel finally selected.

The experimental work at Knightsbridge has been under the supervision of Professor Lewes, of Greenwich, and he has devoted much attention to the composition of the gas obtained by the use of different qualities of fuel and oil. Tables I. and II. give full details of experimental runs with the Knightsbridge apparatus, and show the yield and quality of gas produced. From them it will be seen that the gas has an illuminating power varying between 20·5 and 22·9 candles due to illuminants of the gas ranging between 7·49 and 11·14 per cent. We give in Table III. for comparison Dr. Letheby's analyses of London gas, which, although made many years ago, represent the quality of common and cannel gas. At that time the common gas had an illuminating power of only 14 candles, and as the limit has been raised to 16 candles, it is now customary in most works to carbonise a certain amount of cannel coal in order to improve its illuminating power. It will be noticed that, although the Van Steenbergh gas contains a percentage of illuminants intermediate between that of common and cannel gas, the illuminating power is higher than could be attributed to it from the chemical composition. The quantity of carbon-monoxide varies between 13·0 and 25·0 per cent., which, as might be expected, is much higher than that of coal gas. This means, of course, that the gas is correspondingly more poisonous, but as the finished gas has a very characteristic odour as powerful as that of coal gas itself, there is therefore not so great an objection to its employment as is the case with the odourless water gas.

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Note to Table II.—The low carbonic oxide in the make from gas coke is due to the fuel never being so hot as with anthracite; and the result is an increase in the percentage of carbonic acid in the unpurified gas.

TABLE III.—*Letheby's Analysis of London Gas (for comparison).*

	14 Candle.		Cannel. 22 Candle.
Hydrogen	46·0	...	27·7
Marsh gas	39·5	...	50·0
Illuminants	3·8	...	13·0
Carbon-monoxide	7·5	...	6·8
Carbon-dioxide	0·7	...	0·1
Moisture	2·0	...	2·0
Nitrogen	0·5	...	0·4
	100·0		100·0

An especially noteworthy feature in the purified gas is the low percentage of sulphur compounds, and in this respect it has a very marked superiority over coal gas. The illuminating water gas also, according to Professor Lewes' report, does not lose its illuminating power on standing during cold weather more rapidly than a rich coal gas, although at present we have not seen any details of the experiments by which he has arrived at this conclusion. It is unfortunate that a gas possessing such very advantageous properties, and which can be manufactured so rapidly, should behave, at any rate, as badly as does coal gas in this respect. The loss of illuminating power, however, in this case can hardly be of the same nature as the loss of illuminating power in coal gas, as from the conditions of manufacture it seems unlikely that such complex hydrocarbons are present in the purified gas. We believe that the loss of illuminating power in coal gas is less an evil than the consequence of such loss causing an accumulation in and stoppage of the service pipes. An illuminating gas manufactured under these conditions could hardly give rise to naphthalene or hydrocarbons likely to condense to a solid or dense condition at low temperatures, so that the loss which Professor Lewes alludes to must be due to the condensation of liquid hydrocarbons or to some other cause.

Another important point to be remembered in connection with this process is the fact that there are no residual products, as practically all the fuel used is converted into gaseous bodies. We have as yet had no particulars given as to what becomes of the nitrogen present in the fuel; we assume, however, that it must exist as nitrogen in the finished product, as Professor Lewes states that no ammonia exists in the purified gas, and there would be a residual product if the gas passed through an acid purifier to remove this body. Of course, when gas coke is employed the amount of nitrogen lost is trivial, but in the event of other forms of fuel being used in the generator, the statement that there are no residuals would mean a waste of the combined nitrogen present in the fuel. The absence of all tar and condensable volatile products is certainly a very strong argument in favour of the process. Too much tar is produced for the demand, and, notwithstanding the cheapness of this residual, it apparently does not pay to convert it into dyestuffs or pharmaceutical products, these having a limiting demand. There is also a considerable saving in space occupied by the plant and in the handling and labour entailed in the removal of such residuals.

There seems no reason to doubt that this system of manufacture will give an illuminating gas at a cheaper rate than that made in the old-fashioned way in gas works, but we should not like to assign to it any position among the improved methods of gas-making. The Dinsmore system also converts hydrocarbons present in tar into permanent gas of a high illuminating value. In this method the gas manufacturer does not require to purchase any additional material, and recent statistics of this process show that a gas of 19 candle-power can be obtained at the rate of 10,000 cubic feet per ton of coal, with one-third of the carbonising plant required by the old system. This and other rival processes will naturally fight against the new comer, and it will be only possible to compare their relative merits after the apparatus has been erected on a larger scale, and a continuous make of gas extending over a long period has demonstrated its economic advantages.

Notes.

THE COTTON TRADE.

THE coal crisis of last week resulted in the lessening of the cloth production to a rather important extent, for upwards of 30,000 looms were stopped for four days. This stoppage will tend to relieve the cloth section, for stocks were beginning to show themselves in first hands. The position of weavers (employers) is still an unsatisfactory one. The margin between cotton and cloth and yarn and cloth has for some months been very narrow. Now, with a further advance in fuel, things are decidedly worse. Further, the India cloth season has been most discouraging, both to shippers and producers. Spinners are experiencing a very lean trade. At the beginning of the year the margin was profitable, but since the advance in raw American cotton from 5⅛d. to 6¼d., yarn has suffered very much. As things are to-day the difference between twist cotton and cop twist is not more than 2d. per lb. This means a definite loss on every pound turned out of the mill. One redeeming feature of the spinners' position is that most spinners are deeply bought in cotton at prices not far off ⅜d. to ½d. per lb. below the present quotations, and, in addition, spinners are well sold, some employers being fortified with contracts to the end of July or thereabouts. A few days ago Messrs. Neill Bros. reduced their American cotton estimate from the original figures of 7,600,000 bales of 480lb. each as a minimum to a little over 7,400,000 bales as this season's weight. One thing is pretty certain whatever may be the size of the crop, that the quantity of this season's growth is 3 per cent. superior to that of last year. There is less loss, and the cotton goes further in producing yarn. The proposed Bill of the operatives to amend the Factory Acts is creating great interest in employers' circles. Immediately after Easter a conference will probably take place between the United Spinners' Association and the Textile Workers' Association.

FRENCH EXHIBITION IN LONDON.

IT seems to have become a settled thing that we are to have an Exhibition at West Brompton every year. Foiled in their original intention of holding a Belgian Exhibition there this year, Colonel North, Mr. John Whitley, and Mr. Vincent Applin have turned their attention to getting over as many of the exhibits shown last year at Paris, and running a French Exhibition. They assume that it will be a great success, because only one or two per cent. of the British population went to Paris, while at least twenty per cent. desired to see the exhibits, and the latter, it is supposed, will now flock to Brompton. The Exhibition is to be opened on the 3rd May for a period of about six months, and the sections include minerals, metallurgy, machinery, railways, electricity, chemical products, and naval architecture. From the French circular sent out to probable exhibitors no indication is obtainable as to whether it is intended to entrust the electric lighting to French or to English contractors. For some reason not explained there is to be no machinery in motion.

ELECTROMOTORS IN ENGINE WORKS.

MESSRS. DENNY & CO., engineers, Dumbarton, have the tools in their pattern shop driven by a 20 h.p. electromotor. The dynamo is placed in the machine shop and driven from the ordinary shafting. From the generator to the motor in the pattern shop the current is conveyed through two cables about ⅜in. diameter. If this had not been done, a separate small engine and steam piping of great length would have been required. In the boiler shop of the same firm there is a still more interesting example of the application of electricity as a motive power. This is Rowan's patent electric boring machine, for drilling the rivet holes through boiler shells *in situ*. Anyone who has watched drilling tackle at work, especially in shipyards, must have noticed how much time was absorbed in fixing the clamp into position. Rowan's electric borer not only has a small motor to drive the drill, but holds itself up against the plate by means of a pair of powerful electromagnets. Messrs. Denny are about to put electromotors to other uses in their yard, amongst the earliest of which will be the driving of all the sewing machines in their large upholstering department, at present driven by the feet of the female operators.

MINING MACHINERY IN SOUTH AFRICA.

OUR Berlin correspondent lately wrote that some of the plant sent out by English engineers to mines in the Transvaal had proved unsatisfactory, and in an editorial letter another correspondent drew attention to similar complaints which had been made. It appears, however, that American engineers are also accused of not knowing how to transact business with South Africa. The *Engineering and Mining Journal*, of New York, asserts that American manufacturers cannot compete with our own in the market, owing to the judicious course adopted by English firms, in placing machinery, including even stamp mills, in stock at Johannesburg. The Americans will only send out to order, and raise difficulties in money matters. When they do sell, it is stated that they allow their machinery to be run by incompetent men, instead of sending some one out to see that the plant is properly set up and worked. It is stated that in consequence American machinery has got a bad name. This evidence tends to show that American competition is not to be feared at present, but it may be as well for makers to take heed of the warning as to German opposition which was given in our Berlin letter.

THE PHOTOGRAPHIC EXHIBITION AT THE CRYSTAL PALACE.

THERE are no very startling novelties on view at the yearly Exhibition of Photography which is now being held at the Crystal Palace. Several makers are trying the experiment of substituting aluminium for brass in the construction of tourist cameras, with the object of decreasing the weight of the apparatus. Messrs. Watson and Mr. Stanley are showing some new time and instantaneous shutters, which, when in action, do not cause the camera to vibrate or swing. Mr. Scorer has adopted a double eccentric motion for the purpose of bringing the lens to any part of the front board, thus doing away with the skewing of the bellows. The pictures occupy a much more important part relatively with the apparatus than they did last year. There is a tendency on the part of amateurs towards the platinotype process, but the results are on the whole decidedly indifferent; this may be accounted for by the fact that most amateurs use cheap and thinly-coated plates. The series of views of Moreton Hall, Cheshire, by Mr. Richard Keene, of Derby, are immeasurably superior to anything else in the Exhibition, both as regards choice of subject and technical treatment. The excellent contrasts and crispness and the remarkable definition in the shadows are evidently the results of over-exposure of a thickly-coated plate, such as Wratten & Wainwright's, or Edwards', together with a very slow development by sulpho-pyrogallol and carbonate of soda. We are also sorry to see that gelatino-chloride silver paper is not coming into greater use.

THE MANUFACTURE OF OZONE.

OUR German correspondent informs us that a company has been formed in Berlin for supplying the necessary plant for the conversion of oxygen into ozone on a larger scale than has hitherto been attempted, and that the idea is gaining favour in many quarters that ozone can be economically employed for many sanitary purposes. Steps are being taken for extending the operations of the company to New York and London, as they have secured the patent rights for certain improvements in the electrical production of ozone from atmospheric oxygen in most countries. The Berlin doctors have repeatedly employed ozone, with very satisfactory results, in individual cases, and recently the company above alluded to have placed on the market a so-called ozonised water which is stated to be a solution of ozone in that liquid. It is, however, well known that ozone is not very soluble in water, and that it readily undergoes decomposition, forming hydrogen peroxide and oxygen. The commercial name for this new antiseptic is "anti-bacterikon," and it possesses remarkable oxidising properties. When added to water containing any appreciable quantity of living organic matter in the dark, it at once causes a phosphorescent appearance, and the organisms are completely destroyed in a short time. Such ozonised water is stated to have a faint metallic taste, and is used for producing sterilised water, or sterilised fluids, for bacteriological research. At present the ozone is manufactured from oxygen obtained by heating pyrolusite in the old way, but, of course, with a greater demand the Brin's oxygen process could be employed. The conversion takes place in a Siemens tube, or series of Siemens tubes, which do not differ essentially from the original form of ozoniser. The electric discharge is made by a Ruhmkorf coil in the usual way, or an accumulator is employed and a mercury contact breaker. It is proposed that ozone should be produced in this manner in large manufactories, and thus contribute to their sanitary improvement. Dr. Förster, of Berlin, has recently urged the importance of endeavouring to supply a small quantity of ozone to the air of towns and other thickly populated districts, and the company believe that their system can be worked economically and at the same time produce very satisfactory results from a hygienic point of view. It has been pointed out that many epidemics—*e.g.*, influenza—appear to take place at those seasons of the year when the atmospheric ozone is at a minimum, and it is thus argued that an artificial supply of this gaseous oxidising agent would possibly prevent, and at any rate considerably modify, such outbreaks of disease.

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Patent Record.

(Compiled from "The Illustrated Official Journal (Patents).")

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

10th March, 1890.

3737. Bridge, J. ..... Machine for making coils or spirals.
3738. Revis & Marriott ..... Circular ribbed fabric machinery.
3740. Causer & Ward ..... Cartridge recappers.
3741. Wilkes, T. W. ..... Railway carriage door locks.
3744. Parry, R. ..... Brick machines.
3748. Pollitt & Mullin ..... Carding engines.
3754. Barrett, W. J. ..... Signalling on railways.
3755. Wotherspoon, J., Jun. ... Rolling metal bars.
3766. Jameson, J. T. ..... Slide valves.
3771. Steffenhagen, O. ..... Coupling for railway vehicles.
3772. Earsdon, J. ..... Water pressure engines.
3773. Heer, I. ..... Looms.
3774. Abel, C. D. ..... Gas motor engines (*The Gas Motoren Fabrik Deutz*).
3780. Haddan, H. J. ..... Machine for the production of motive power and cold (*Kortum*).
3785. Smith, C. ..... Stuffing boxes (*Agabeg*).
3789. Watts-Hughes & Viney Apparatus for the production of figures upon glass.
3790. Laumann, J. ..... Repeating firearms.
3791. Ashwell, J. ..... Railway chairs.
3792. Wise, W. L. ..... Knitting machine (*Dresdner Strick maschinen-fabrik Laue & Timaeus*).

11th March, 1890.

3798. Cammiss, E. ..... Brick moulds or dies.
3806. Mackay, F. N. ..... Apparatus for making ice.
3811. Bamber, H. K. ..... Hydraulic and other valves.
3815. Walker & Parker ..... Ring frames.
3817. Gedge, W. E. ..... Travelling cranes (*Wood*).
3818. Stiles & Perry ..... Signalling on railways.
3823. Arkwright, W. ..... Knitting machines.
3824. Jones, W. ..... Sewing machines.
3826. Pepper, J. E. ..... Coupling for pipes.
3828. Boult, A. J. ..... Piston packing (*Child*).
3831. Thompson, W. P. ..... Boilers (*Hörenz*).
3834. Haggard, R. A. ..... Apparatus for heating water.
3845. Barton & Higgins ..... Torpedo vessels.
3846. Lake, H. H. ..... Shrinking and fulling felt (*Husted*).
3848-9. Smith & Cooper ..... Looms.
3850. Tyler & De Vesian ..... Drilling machines.
3851. Albaret, A. B. ..... Sheaf binding mechanism.
3853. Lorimer, J. H. ..... Power transmitting devices
3854. Fowler, H. E. ..... Welding of metals.
3855. Puvrez, P. ..... Apparatus for bottling.
3858. Fowler, H. E. ..... Welding metals.

12th March, 1890.

3867. Wedgwood, A. D. ..... Machines for boring shafts.
3869. Calvert & Hunt ..... Looms.
3879. Pinkerton, W. ..... Railway points.
3881. Casey, G. ..... Carding engines.
3885. Cade, G. ..... Cock plugs.
3895. Crowley, R. J. ..... Signalling apparatus. (16th August, 1889).
3899. Patterson, E. ..... Pipe couplings.
3903. Haddan, H. J. ..... Circular loom (*Persil & Papleux*).
3912. Horn, W. W. ..... Hoisting apparatus (*Chamberlin*).
3915. Schwager, J. ..... Condensing apparatus.
3918. Justice, P. M. ..... Steam hammers (*Taylor*).
3921. Daelstaen, M. ..... Gas engines.

13th March, 1890.

3928. Boardman, J. ..... Mules and twiners.
3939. Jackson, J. P. ..... Filling and corking machines.
3940. Jackson, J. P. ..... Machines for filling bottles.
3944. Jerome & Stevens ..... Railway tie.
3945. Bertram, D. N. ..... Mechanism for surfacing paper.
3948. Martin, E. ..... Filtering machinery.
3956. Wolseley & Craven ... Joint for flexible shafts.
3962. Marchetti & Crossley Machinery for printing yarns.
3966. De Morgan, W. ..... Crushing apparatus.
3971. Dombrain, H. A. A. ..... Apparatus for cleansing wool.
3978. Mackenzie, W. ..... Printing machines.

14th March, 1890.

3988. Stretton, W. G. ..... Hay-turning machines.
3990. Dodd, J. ..... "Traverse motions" for spinning machinery.
3993. Fotheringham, R. M. ... Tubular steam boilers.
3994. Anderson, J. ..... Morticing machines.
3998. Smith, J. ..... Street-sweeping machines.
3999. Dawson, D. R. ..... Sewing machines.
4003. Eckersley, W. ..... Governor for gas engine.
4005. Yeomans, H. ..... Mechanical filter.
4008. Higginson, J. ..... Spinning mules.
4010. Barton, J. ..... Joint plate for tramway rails.
4019. Nightingale, G. P. ..... Branding machines.
4024. Foster, J. ..... Evaporating apparatus.
4027. Walker, W. T. ..... Gas storage apparatus.
4031. Williams, D. W. ..... Speed gear.
4037. Clarkson & Spurge ..... Pressure gauges.

15th March, 1890.

4044. Richards, T. P. ..... Rotary blowing fan.
4048. Clegg, R. ..... Self-acting mules.
4049. Calvert, S. ..... Apparatus for the manufacture of twine.
4051. Harrison, W. ..... Knitting machines.
4052. Harrison & Harrison ... Knitting machines.
4055. Arkwright, W. ..... Knitting machines.
4061. Weir & Weir ..... Safety valves.
4065. Garside, E. ..... Sizing machines.
4073. Berger, J. ..... Machine for cutting paper.
4074. Griffin, S. ..... Gas engine governor.
4076. Hearn & Donne ..... Type-writing machines.
4077. Mathewson, J. E. ..... Sand blast apparatus.
4081. Brooks & Edge ..... Grinding card flats.
4090. Horn, W. W. ..... Steam engine (*Payne*).
4093. Burn, C. ..... Hydro-atmospheric motor.
4097. Cox, C. J. ..... Machinery for "dressing" lace.

ELECTRICITY.

10th March, 1890.

3787. Libbey, H. W. ..... Electric railways.

11th March, 1890.

3805. Brierley, W. ..... Electrical terminals (*Arld*).
3839. Delany, P. B. ..... Receiving apparatus for cable telegraphy.
3840. Currie, S. C. C. ..... Alternating generators.
3841. Siemens Brothers & Co., Ld. ..... Electric conductors (*Taylor*).
3842. Siemens Brothers & Co., Ld. ..... Electrical transformers (*Taylor*).
3860. Halpin & Timmis ..... Electric light fittings.
3861. Death, B. ..... Incandescent lamps.

12th March, 1890.

3900. Pyke & Barnett ..... Electrical inductoria.
3913. Kapp, Johnson, & Phillips ..... Transformers.
3924. Lake, H. H. ..... Electric batteries (*Crosby Electric Company*).
3925. Young, J. L. ..... Telephone mouth-pieces.

13th March, 1890.

3937. Rawson & Snell ..... Electric signalling lanterns.
3947. Clegg, J. ..... Electric lamps.
3963. Scott, W. ..... Electrical switches.
3967. Stevenson, J. S. ..... Secondary battery elements.
3969. Siemens Brothers & Co., Ld. ..... Switch boards (*Taylor*).

14th March, 1890.

4000. Pieper, H., Fils ..... Electric regulators.
4004. Barnett, H. T. ..... Electric vacuum tubes.
4025. Goldston, A. A. ..... Incandescent lamps.
4028. FitzGerald, C. L. W. ... Transmitters for telephones.

15th March, 1890.

4043. Bosshardt, F. ..... Telephones (*Mattard*).
4053. Drake & Gorham ..... Safety devices for currents.
4086. Barley & Stevenson ... Coupling the shafts of dynamos.
4087. Cheswright, H. T. ..... Secondary batteries.

CHEMISTRY.

10th March, 1890.

3782. Pszczolka, L. ..... Obtaining uniform products from basic furnaces.
3786. Larrouy, G. ..... Litharge and red lead.
3788. Lindemann, M. G. ..... Treatment of dye woods.

11th March, 1890.

3829. Jarvis, G. A. ..... Reduction of sodium.
3852. Lake, H. H. ..... Explosives (*Emmens*).

14th March, 1890.

3992. Horsley & Wilson ..... Production of solutions containing sulphurous acid or its salts.
4021. Boult, A. J. ..... Solution of alkaline silicate (*Sievert*).
4030. Darby, J. H. ..... Manufacture of steel or iron.

15th March, 1890.

4095. Bergmann, E. ..... Production of cyanide compounds.

MISCELLANEOUS.

10th March, 1890.

3742. Lane, J. G. ..... Fastener for driving bands or belts.
3767. Wenzel, A. ..... Incandescent gas lamps.
3779. Edwards, E. ..... Ensilage presses (*Ahrens*).

11th March, 1890.

3819. Mance, H. C. ..... Signal rockets.
3822. Potter, R. ..... Register for speed of vessels.
3832. Gray, J. A. ..... Detaching ships' boats.

12th March, 1890.

3887. Thompson, W. P. ..... Ventilators (*Prichard*).
3907. Harvey, R. ..... Evaporating apparatus.
3909. Horn, W. W. ..... Gate for railway crossings (*Anthony*).

13th March, 1890.

3935. Howarth & White ..... Indicating the departure of trains.
3965. Sprunt, J. D. ..... Obtaining power from tidal waters.
3985. Möller, G. ..... Kilns for bricks.

14th March, 1890.

3991. Donovan & Donovan ... Detaching ships' boats.
3995. Dosmond & Rozes ..... Apparatus for preserving meat.
4012. Douse, T. R. ..... Fire extinguisher.
4013. Willingale, J. H. ..... Fire escape.

15th March, 1890.

4056. Williams, T. ..... Self-loading mud cart.
4085. Ezvetkovics & Hiller ... Weirs.
4096. Schuelke, J. ..... Regenerative lamps.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form, of such opposition.

Year 1888.

18131. Bullus. 18161. Morton.

1889.

2752. Sutcliffe.
4082. Shew.
4211. Dawson & Beal.
4301. Dale.
4379. Hartley.
4410. Edwards (*Decker*).
4697. Smallman.
4752. Whitehouse.
4840. Cunningham & Hutchison.
5164. Scribner.
5758. Middleton & Short.
5813. Farran & Crawford.
5850. James.
5952. Allen.
6102. Cornish.
6148. Cox.
6192. Mackie.
6358. De Choubersky.
6390. Nordenfelt.
6490. Harvey.
6738. Wallwork & Wells.
6765. Hale.
6777. Bedford.
6895. Taylor & Howard.
6989. Edwards (*Lange & Rohrmann*).
7031. Spiegelberg.
7089. Millar.
7145. Justice (*Forbes*).
7177. Cave.
7192. Mills (*Blacke*).
7361. Coniam.
7390. Horwood.
7410. Wills.
7510. Turner.
7576. Y Calleja.
7670. Johnson.
7718. Lipscombe.
7741. Hart.
7750. Hawkyard & Braddock.
7754. Cooke.
7784. Falconnet, Rubin, Rubin, & Sautier.
7812. Rose, Baird, & Baird.
7828. Anderson & Pollock.
7856. Johnson & Phillips.
7889. Taylor.
7939. Daniels.
7962. Tinne.
7976. De Ferranti.
7986. Marston.
7999. Barber.
8009. Stocks & Lord.
8037. Wickham.
8049. Davidson.
8051. Scott.
8066. Ford.
8088. Belge & Candy.
8122. Key.
8205. Wilkinson, Clarkson, & Heap.
8256. Lake (*Williamson*).
8264. Lake (*Leonhardt & Co.*).
8312. Kenway & Roberts.
8735. De Hundertmark.
8831. Howat.
8849. Lacoppe.
9697. Milne.
10010. Puech.
10021. Reynolds.
10180. Carmichael & Mackie.
10371. Okeden & Welsh.
11361. Boult (*Massey*).
11956. Haughton.
12560. Pitt (*Cassella & Co.*).
13249. Wright.
14800. Lucas.
14985. St. George.
15033. Wrigley.
15155. Dickinson.
15143. Adair.
4078. Garland.
4125. Rooper.
4295. Cotter.
4363. Pearson.
4399. Timmis.
4585. Pomroi.
4703. Nicholson & Jennings
4790. Betjemann.
4994. Perry & Jacobsen.
5138. Turner & Tomkinson.
5303. Fox.
5775. Denny.
5818. Sharp.
5915. Koernig.
5957. Boulton.
6103. Minns.
6168. Brock & Butt.
6235. Titscher.
6384. Goldston.
6450. Grassam.
6707. Woods.
6741. Eddy.
6770. Finch & Mackenzie.
6875. Williamson.
6949. Middlehurst.
7006. Desrumaux.
7007. Studders & Kohl.
7077. Chignell.
7120. Dobry.
7167. Berry & Briggs.
7179. Salb.
7290. Heys (*Sauré*).
7382. Lanchester & Lanchester.
7489. Alcock.
7557. Von Westphalen & Gross.
7703. Martin & Hickisson.
7724. Brown.
7742. Clifton.
7753. Hanna.
7782. Tilley.
7792. Broad & Fowler.
7797. Young.
7818. McPhail.
7841. Chilton.
7878. Martin.
7890. Taylor.
7953. Pearson & Godward.
7967. Boult (*Coste*).
7982. Clark.
7997. Simpkin.
8003. Stevens.
8036. Lawrence (*Lawrence*).
8048. MacMahon.
8050. Neild.
8054. Skinner & Lyth.
8072. Waygood (*Waygood*).
8099. Fletcher.
8157. Sellner.
8211. Lucas & Marshall.
8235. Barker & Haydon.
8263. Darwin.
8291. Miles & Spiers.
8647. Cox, Cox, Holland, & Holland.
8839. Huelser (*Kuntze*).
9686. Norcross.
9947. Fairweather (*The Acme Heel Trimmer Company*).
10263. Gardner & Sowerbutts.
11428. Thrupp.
12168. Lake (*Waters*).
12646. Bingham.
14221. Siebrath.
14874. Mick, Kursteiner, & Tanenz.
15063. James Renfrew Eldridge. (25th February, 1889.)

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16080. McConnico.
16243. Humphrey & Tennant.
16706. Bronner.
17040. Hannay.
17454. Clegg.
17887. Close.
18145. Archer.
18529. Walker.
19006. Jewell & Jewell.
19209. Tirlke-Allan.
19422. McMahon.
19650. Butler & Parrock.
19827. Nicoll.
20228. Pasfield.
20310. Boult (*Stanwood*).
20489. Ventris.
16151. Golyosy & Ehrlich.
16463. Ashford.
16920. Holt.
17080. Redman.
17496. Bluemel.
17983. Nixon.
18229. Charles Terrot.
18995. Field.
19152. Benest.
19309. Moody & Streatfeild.
19634. Gray, Sen., & Gray, Jun.
20051. Walton.
20240. Linford, Linford, & Oxley.
20736. Garland.
20960. Gibson.

1890.

72. Bruno.
479. Marshall.
556. Rothel.
648. Knight.
662. Southgate.
702. Haddan (*Elwood*).
1104. Goddard & Radford.
1300. Leigh (*De Brochocki*).
1458. Marshall.
1497. Lake (*Elliott*).
1839. Schmidt.
1868. Schoenau.
1892. Wheeler.
2001. Statham.
2050. Haddan (*Dow*).
2145. Young.
2164. Humphreys.
2197. Thompson (*Korenar & Zwicker*).
2231. Thomas.
2237. Calder.
2254. Heidler.
2304. Davison.
2330. Koerfer.
2441. Mackie.
2443. Mosley.
271. Justice (*Otis Bros. & Co.*).
555. Whitnear.
640. Watson & Hooper-Rastrick.
698. Lake (*Folmer & Schwing*).
942. Wenham & Vaughan.
1199. Woodville.
1437. Lake (*Barton*).
1487. Kaye.
1507. Hardingham (*McCormick*).
1886. Kimball.
1940. Walty.
2011. Conrad & Lilley.
2112. McFerran & Pirrie.
2158. Gibbons.
2192. Dunham.
2200. Bradley.
2203. Kuba.
2235. Lake (*Rose & Balston*).
2240. Loftie.
2282. Boult (*Dickson & Jones*).
2326. Robertshaw.
2378. Bailey.
2442. Gifford.
2453. McMahen.
2456. Desmond.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

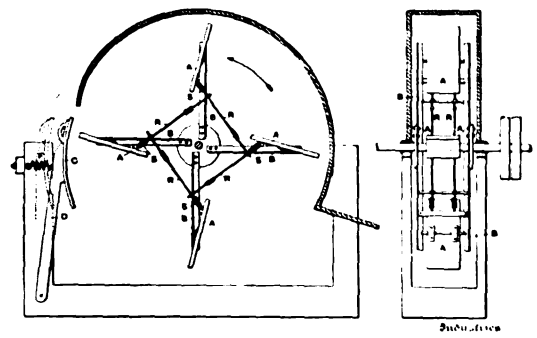
ENGINEERING.

Bush for Shafting.—*L. W. Thomas, Dover.*—The bush is designed for securing pulleys to shafting, &c. The bush is composed of two eccentric collars, which are halved. The collars are made to fit one within the other, and the inner surface of the smaller collar to fit the shaft to which it is applied. The halves of each collar are reversed, so that the thin edge of one half faces the stout edge of the other half. The stout parts of the outer collar overlap the thin parts of the inner collar, so that the outer surface of the whole, when placed upon the shafting, is concentric with the shafting. From the above description it may be seen that by sliding in a rotary direction the halves of the outer collar over the halves of the inner, the bush is radially increased or decreased according to the direction turned, yet the outer surface of the whole always remains concentric to the shafting. The pulley to be secured is bored to pass loosely over the shafting. The bush in its closed condition is inserted in the annular space between the bore of the wheel and the shaft. It is then expanded by sliding the outer halves over the inner until the pulley is tightly secured. The work upon the pulley tends to expand the bush and hold the pulley much tighter. Claims: (1) An improved bush for shafting or spindles, consisting of an inner and an outer eccentric wedge bush, each made in halves, and which are so combined concentrically when applied to a hole in a pulley, wheel, coupling, or other article, that the revolution of the pulley, wheel, coupling, or other article causes the outer pair of half bushes to turn upon the inner pair, thereby tightening up the bush upon the shaft or spindle; (2) refers to the bushes as illustrated in the specification.—No. 6679. April 18th, 1889,

Damping Warps in Looms.—*J. Lord, Todmorden, Yorkshire.*—The apparatus here described permits an easy regulation of the damping according to the varying state of humidity of the atmosphere, and enables the weaver to stop the action of the apparatus without having to remove it from the loom. It consists of a trough suspended by handles underneath the warp bearer, over which the warp passes at the back of the loom. In the trough is a roll made of perforated sheet metal, such as zinc or tinned copper. The roller is pivoted to the ends of the trough, one of the pivots being square part of its length, and resting in a square hole. The roller has a sufficient play longitudinally to permit the square or round part of its pivot being pushed into the square hole, and thus hold the roller stationary or permit it to revolve. Other ordinarily used means for fixing a roller in its position and releasing it for the purpose of turning it round may be used instead of that described. A piece of cloth is attached to the roller and hangs over the edge of the trough, and has attached at its end a rod, roller, or brush. The trough is filled with water through a suitable funnel at one end, and the cloth, after being wound on the roller and thoroughly wetted, is unwound till it rests upon the side of the warp beam and damps the warp as it is unwound. The water taken from the cloth is replaced from the trough by capillary action. By turning the perforated roller, a greater or shorter length of contact between the cloth and warp, and consequent variation of the dampness of the latter, is attained; while by winding the cloth on to the roller till the rod, roller, or brush at the end of the cloth is stopped upon the edge of the trough, the damping can be entirely stopped. Claim: The arrangement of trough, perforated roller, with locking device and cloth attached to the same, as described.—No. 10600. July 1st, 1889. 6*d*.

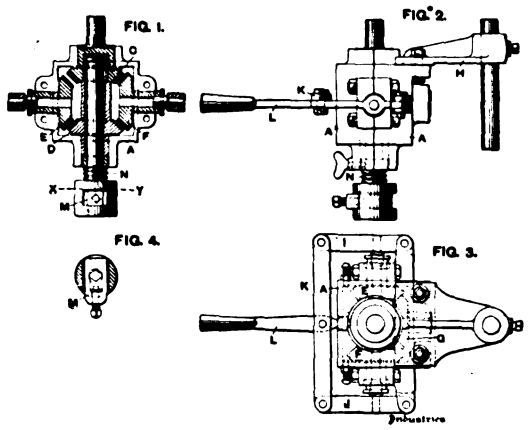
Machines for Scutching Flax.—*R. H. Hayward, Crewkerne, Somersetshire.*—The machine is designed for scutching flax and other fibrous material. The improvements consist of a spring striking board and spring feed board arranged to be fed by hand. The illustrations show Fig. 1 a side elevation of the scutching machine, and Fig. 2 an end elevation of the same. To the back of the "strikers" A are connected the springs S for giving elasticity to the blows of the strikers. These springs are attached to rods R, which connect them to the rigid arms B. The rods R are adjustable to regulate the tension upon the springs. The feed board C is supported upon arms D, which are pivoted to the frame of the machine. A spring F serves to draw the feed board back, and retain it in its normal position shown by dotted lines. The feed takes place over the top edge of the feed board, and is regulated by the operator pressing in the board by his knee or hand. The arms B carrying the "strikers" are revolved in the direction of the arrow by suitable means such as shown. The machine is cased in, and, by the motion of the "strikers," causes a current of air, which tends to keep the

FIG. 1. FIG. 2.



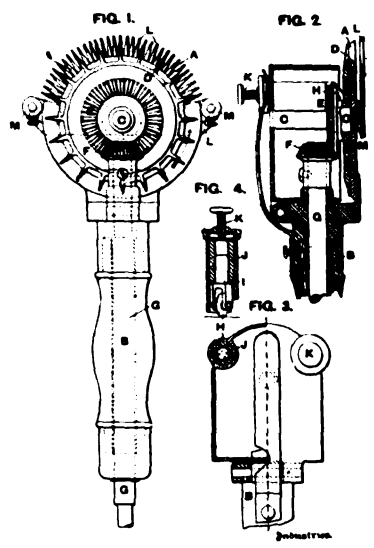
fibres straight and carry off dust and skimp. Claims: (1) In a machine for scutching flax or the like fibrous material the combination with a spring feed board such as C of spring strikers such as A so as to give elasticity to the force of the blow delivered by the latter substantially in the manner and for the purposes hereinbefore described and illustrated; (2) in a machine for scutching flax or the like fibrous materials the application of a spring or springs to the "striker" ("swingle" or "sword") so as to allow the latter to "give" according to the resistance offered by the fibrous material being struck—instead of delivering a dead blow as heretofore—substantially as and for the purposes hereinbefore set forth; (3) the movable spring feed board such as C substantially as and for the purposes hereinbefore set forth.—No. 4551. March 15th, 1889. 8*d*.

Tapping Metals.—*J. Miley, Keighley, Yorkshire.*—This specification describes a drilling machine attachment for the purpose of tapping metal holes. Referring to the illustrations, Fig. 1 shows a front sectional elevation of the appliance, Fig. 2 a side view, Fig. 3 a plan, Fig. 4 a section upon the line X Y (Fig. 1). The appliance is inclosed in a square case A, in which are bearings to support the spindles of five mitre wheels C, D, E, F, and G. The mitre wheel C is formed in one piece with its shank, which enters the socket of an ordinary drilling machine mandrel. The spindle wheel G supports the case of the appliance, but the case is prevented from turning with the wheel by a bracket H fixed to the framing of the machine. The lower mitre wheel D is connected by a feather to a mandrel, which carries suitable dies for holding the taps. The wheels E and F are connected to levers I, J, which are coupled together by the link K and the whole operated by the hand-lever L, so that the mitre wheels E and F may be put into or out of gear with the wheel G

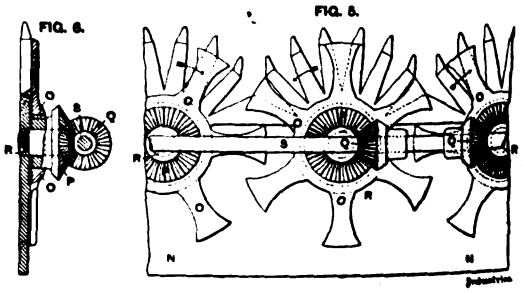


as required by the hand-lever L, and thus reverse the motion of the tap mandrel. The last of the wheels G is always in gear with the spindle wheel C, but clears the tap mandrel wheel D. The method of working the machine is as follows: The apparatus being attached to the machine spindle, and the tap fixed in the holder M, the hole to be tapped is brought under the tap and the latter inserted. The machine spindle is then screwed or fed down until the spring N is compressed. The machine spindle may be revolving while brought down, as the tapping spindle is not rotated as long as the reversing handle is not moved, both wheels E and F being out of gear. The handle L is then moved to the side required for driving the tap for tapping, and when the tap has entered the hole far enough its rotation is reversed by shifting the handle to the other side, and the tap screwed out of the hole. Claims: (1) The arrangement or construction of self-contained apparatus for tapping holes in metals attachable to drilling machine and similar spindles substantially as described and illustrated by the drawings; (2) an apparatus attachable to drilling machine and similar spindles for tapping holes in metals containing a bevel wheel C attachable to said spindles and a bevel wheel D with long boss containing a tapping spindle in sliding connection with the same in combination with three other bevel carrier wheels and reversing mechanism so arranged that the wheel D is driven from the wheel C either through one or through two carrier wheels according to the position of the reversing handle; (3) in apparatus for tapping metals arranged as specified in the preceding claim the arrangement of the carrier wheels alternately put into gear with the wheel D and of the reversing mechanism in such a manner that each carrier wheel works itself and remains out of gear with the wheel D unless held in gear by hand by means of the reversing handle as described and illustrated by the drawings.—No. 5320. March 28th, 1889. 8*d*.

Clipping Apparatus.—*A. Muir, Glasgow.*—These improvements, although particularly applicable to appliances for clipping the hair of animals, may be also adapted to reaping and such like machines. The movable cutting part of the clipper is a disc with serrated edge. The movable disc is made to revolve about its axis with its surface in close contact with a second disc, which constitutes the lower cutter. The invention will be more fully understood by reference to the accompanying illustrations. Fig. 1 is a back view with a part removed, Fig. 2 is a sectional side elevation, Figs. 3 and 4 details, and Figs. 5 and 6 the improvements as applied to reaping machines. The stationery cutting disc A is firmly attached to the socket of the handle B. In close contact with A is the movable cutting disc D, which is suitably mounted upon the spindle C, and revolved by mitre wheels E and F. The shaft G of the mitre wheel F is connected



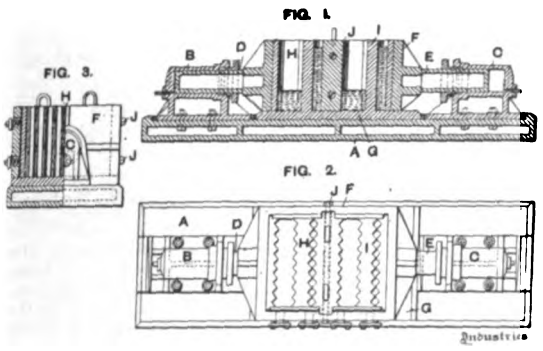
to and driven by a flexible shaft or other suitable means. To keep the movable disc D in close contact with the fixed disc A rollers H are caused to bear upon the back of D. These rollers are pressed forward by helical springs or by india-rubber collars J and washers I (Fig. 4); the pressure, which is a yielding pressure, may be adjusted by the thumb-screw K. In cases where the hair is desired to be cut at special lengths, as, for instance, the human hair, a depth-regulating comb L is attached to the front of the clipper as shown. The comb L is fixed to the clipper by studs, which enter the eyelets M and permit its adjustment at any distance from the front of the clipper. In applying the improvements to reaping machines the front edge of a bed-plate N is formed by casting. This bed-plate extends across the machine, and has upon its top side a series of pins R, which constitute the supporting spindles for the movable cutters



O and their driving wheels P. The wheels P are geared to the wheels Q, which are mounted upon the shaft S driven by gearing connected to the driving wheels of the machine. Claims: (1) In the improvements in apparatus for clipping horses, sheep, and other animals, and which are also applicable to reaping machines and the like, the employment of circular discs having teeth formed on or fixed to them, and which are caused to revolve over the bed-plates or lower cutters, which are also formed with suitable teeth arranged as an arc of a circle, substantially as described and shown in the accompanying drawings; (2) the general arrangement, combination, and construction of the various parts constituting the improvements as applied to clipping horses, sheep, human hair, and such like, all substantially as and for the purposes hereinbefore described and shown in Figs. 1, 2, 3, and 4 of the accompanying drawings; (3) the general arrangement, combination, and construction of the various parts constituting the improvements as applied to reaping and grass-cutting machines and machines of a like nature, all substantially as and for the purposes hereinbefore described and shown in Figs. 5 and 6 of the accompanying drawings.—No. 4775. March 19th, 1889. 8*d*.

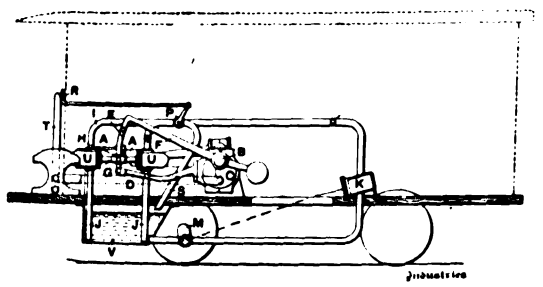
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CASTING INGOTS.—*H. Aiken, Homestead, Pennsylvania, U.S.A.*—This method of casting ingots, blooms, slabs, &c., is to facilitate the pouring of the metals direct from large ladles into the moulds, and so reduce loss of time and labour. The apparatus employed in the method consists of a series of moulds, which are capable of being increased in horizontal dimension to permit the metal being poured without difficulty into them from a large ladle, and afterwards the horizontal dimensions may be decreased to reduce the cross-sectional area before the metal sets. Besides decreasing the cross-sectional area, the metal may be divided into a series of sections, which may be readily separated when cold. One form of the apparatus is shown in the accompanying illustrations. Fig. 1 is a sectional elevation, Fig. 2 a plan, and Fig. 3 an end elevation, partly in section. At the ends of a suitable bed A are secured the fluid pressure cylinders B, C, provided with pistons D. E. The pistons D, E are connected to or bear against the ends



of a rectangular frame F. The frame F rests upon a plate G, having partitions H and I, which extend across the frame F and divide it into three receptacles. The frame F is also provided with a partition J which subdivides the central space into two. All the partitions have serrated faces, and it will be seen from the drawings that by shifting the frame F to the left or to the right, two of the spaces are enlarged in cross-sectional area and two reduced. In working the apparatus the metal is poured into the enlarged spaces, and the frame F shifted to the right or left, as the case may be, to reduce the sectional area. When the metal has set in these first two spaces, metal is poured into the others and the solidified metal in the shape of ingots removed from the first. The frame F is shifted to the right or the left by admitting the working fluid to one of the cylinders. Ten claims are made.—No. 19890. February 1st, 1889. 8*d*.

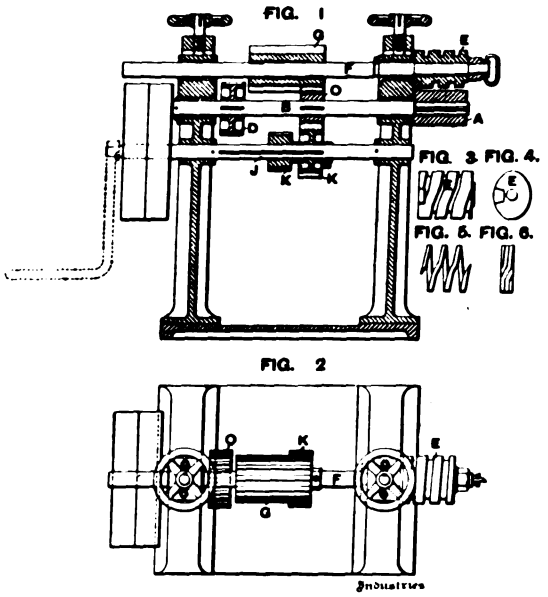
EMPLOYMENT OF GAS ENGINES FOR LOCOMOTION.—*E. F. Piers, Manchester.*—The difficulty attendant upon the employment of gas or petroleum engines for locomotive work is the want of means for readily starting them. In this invention the engine is kept continually running, and by a system of pumps has its power utilised for propulsion as desired. A method of carrying out the invention is shown in the illustration. B is the crank shaft of the gas motor A. To the shaft B is fixed the eccentric C, whose rod D is pivoted to the end of a lever E having its other end pivoted to a lever F. The lever F is supported by the shaft B, and its position adjusted by the hand lever T. U are pumps whose pistons are connected by the rod G having a block H through which the lever E slides. When the vehicle is in motion and the engine at work, the motion of the eccentric works the pumps, and draws water from the tank V up the suction pipes J into the pumps. The water is then forced by the pumps along the pipes I to a motor cylinder K, whose piston is connected to the crank of an axle shaft M, and thus drives the vehicle. When the vehicle is at rest the engines and pumps are still kept at work, but the water as it is forced from the pumps instead of passing through the motor cylinder K is returned by the cock P through



the pipe S to the tank. The stroke of the pumps is varied as desired by the hand lever T and the cock P is controlled by the rod R. Claims: (1) For working tramcars and other vehicles, or other machinery requiring to be frequently stopped and started, the combination of a gas engine, petroleum engine, or the like, a force pump or force pumps, worked by the said engine for forcing motive fluid into a second engine connected with and for giving motion to the driving mechanism of the car or other machine as described; (2) the combination of a gas engine or the like a force pump or force pumps operated thereby for forcing motive fluid into a second engine the passage from the pump or pumps to the second engine, being provided with a valve or valves by means of which the motive fluid may be directed into or cut off from the second engine as required as and for the purpose described; (3) the means for working the force pump or force pumps from the crank shaft of the gas or like engine and for regulating the strokes of the pump or pumps as and for the purpose described.—No. 2144. February 6th, 1889. 8*d*.

STEAM BOILERS.—*M. Hutchison, Cambuslang, Lanarkshire.*—This refers to a feed-water heating appliance in which the water is heated by live steam within the boiler without the feed water and steam mixing. It also circulates the water in the boiler. According to one arrangement of this invention a closed feed-water chamber is fitted to extend across and high up in the steam space of the boiler. At the ends of this chamber is fitted or connected tube plates carrying a series of tubes extending from end to end of this chamber. Over the tube plates are fitted pocket chambers or separators, into which the steam of the boiler enters and passes into and heats the tubes. The feed water is passed into the tube chamber and circulates outside the tubes, thus becoming heated by the steam within the tubes. The feed water as it becomes heated passes down vertical pipes to a horizontal perforated pipe at the bottom of the boiler and is distributed in the water of the boiler. Another arrangement is to surround the tubes with the steam in the boiler, and pass the feed water through the tubes. The ends of the tubes are enclosed in small chambers, to one of which the feed water is supplied, and then passed through the tubes to the other chamber, and from there to the distributing pipe already explained. Three claims are made.—No. 6820. April 23rd, 1889. 8*d*.

MANUFACTURE OF CHAINS.—*A. G. D. Crawshay, London.*—The chain is constructed, according to this invention, in such a manner that the strength of each link is rendered in a great measure independent of the weld. Instead of forming the link by one coil of rod of the finished thickness of the link, as is usual, the link is formed out of several coils of rod of less thickness than the finished link, and the coils welded together side by side to form the link. The machine for constructing these chains is shown in the accompanying illustrations. Fig. 1 is a sectional side elevation, Fig. 2 a plan, Figs. 3 and 4 are details, Figs. 5 and 6 show the different forms of the link in construction. The machine shown produces the link in the form shown in Fig. 5. Its convolutions are afterwards closed, as shown in Fig. 6, and then welded together between suitable dies. In the machine, A is the mandrel upon which the rod is wound. The rod is guided in its convolution around the mandrel A by a spirally grooved and rotating mandrel E. The mandrels A and E are of an elliptical cross section. They are attached to the shafts B and F, which are geared together, and to the driving shaft J by the toothed wheels G, O, and K. The toothed wheel K is made to slide upon the shaft J, and is connected to a second toothed wheel, which may be put into gear with the wheel D to reduce the speed of the shafts F B relative to the driving shaft J. The groove in the mandrel E is not truly helical, but has a por-

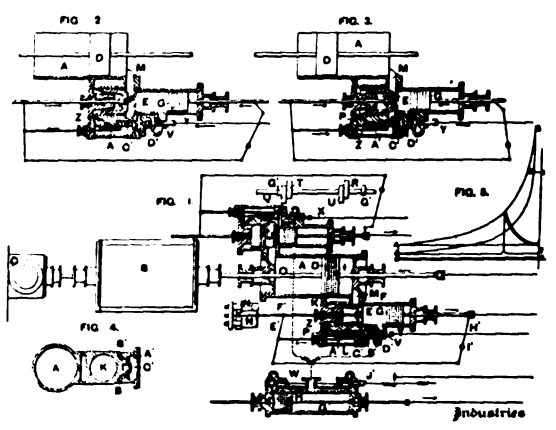


tion of quicker pitch in each turn, to form a set off or joggle in each convolution of the link and in line with the scarfed ends of the link. The bar to be operated upon, having its ends tapered off or scarfed, is fixed by one end to the mandrel A. The mandrels are then revolved, and the bar wound upon the lower mandrel A. guided by the groove in E, to take the shape as shown in Fig. 5. The link so formed is passed in the manner of a split ring upon the last link of the chain being formed, and the convolutions are welded together by dies that operate upon half the link at a time. Claims: (1) The herein described process of manufacturing chains by first coiling a bar of metal helically with joggles to suit the scarfs of the ends and with the convolutions separated, then engaging with the coil a link previously made, flattening the coil, and finally shaping the link by suitable tools or dies; (2) for coiling a bar to form a link in the manner above referred to, the machine substantially as herein described with reference to Figs. 1 to 4 inclusive.—No. 3127. February 21st, 1889. 8*d*.

PROPELLING VESSELS.—*W. Blair, Paisley, Renfrewshire.*—A circular frame with floats at its circumference, in construction similar to a paddle wheel, is attached to the ship at its stern. The wheel is supported with its axis vertical, and it is wholly immersed in the water. Its shaft is geared by bevelled or mitre wheels to the propeller shaft of the ship's engines. A second and similarly constructed wheel may be fixed to the propeller shaft with its axis horizontal. The floats on the wheels are so constructed that by the rotation of the wheels upon their axes, the resistance of the water against the motion of the floats propels the vessel. Claim: The use of a paddle-like circular frame wholly immersed in water in connection with the shafts, wheels, &c., as described.—No. 5535. April 1st, 1889. 6*d*.

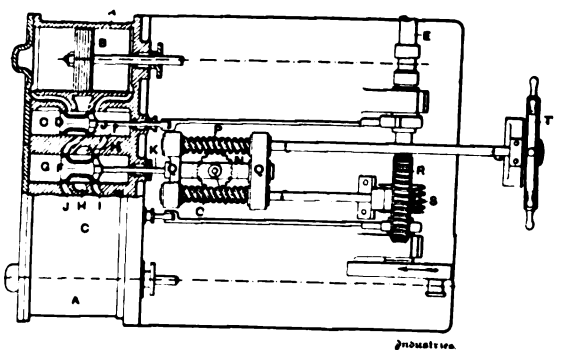
MACHINERY FOR ROLLING METAL.—*H. & D. E. Jones, Neath.*—In this invention use is made of inclined or wedge-shaped blocks instead of the usual set screws and accessories for pressing down the riders which hold down the top roll. The upper cross part of the frame standards are constructed with an under flat face for one side of a wedge block to bear against. The under side of this block is made inclined, and presses upon the top of the rider, which is also inclined to correspond to the incline of the block, but set in opposite directions. The wedge-shaped blocks are connected by metal straps to a screwed rod, which passes through the screwed boss of a hand wheel. By turning the hand wheel the wedge-shaped block can be shifted and so force the top roller down. One claim is made.—No. 351. January 8th, 1890. 6*d*.

STEAM ENGINES.—*G. Schimming, Berlin.*—The inventor overcomes the difficulties attendant upon the use of superheated steam by superheating it in the cylinder itself. This is done by mixing with the steam an exploded mixture of hydrocarbon and air. Fig. 1 is a horizontal section through the apparatus; Figs. 2 and 3, similar sections through one explosive cylinder; Fig. 4, a cross section through the high-pressure steam cylinder, &c.; and Fig. 5, indicator diagrams. A is the high-pressure cylinder, and D its piston; B the low-pressure cylinder, and C the air pump. Upon the high-pressure cylinder A are situated the explosion cylinders E and J, having pistons G and separated from the steam cylinder by piston valves F. Steam is admitted from the boilers to the high-pressure cylinder A by the valves I and O, the valves opening at the commencement of the piston stroke and closing when it has completed one-fifth of its stroke. The explosive chambers are filled with a mixture of air and gas in the following manner. The piston H draws gas and air into the gas compressor cylinder through the slide valve W, and upon the return stroke passes out at the same valve to the explosion chamber.



The action of the engine is as follows:—The explosive mixture is passed from the compressor to the explosion chamber E, and there exploded. By the force of the explosion the piston F is driven back and the heated charge admitted and mixed with a charge of steam in the cylinder A. The back of the piston F is in communication with the steam in the boiler, so that as the force of the exploded charge lessens the valve F closes. At the end of the stroke the same cycle of operations is repeated by the explosion cylinder J. Claims: (1) The method of superheating the steam for operating prime movers by the introduction of inflammable gases or other inflammable substances suitably mixed with air into explosion chambers, igniting such mixture in said explosion chambers and mingling the products of the explosion of said mixture with the steam serving to operate such prime movers; (2) in an apparatus for superheating steam and applying the same to steam engines, the automatic valve for opening and closing the communication between steam and explosion cylinders; (3) the improved apparatus for superheating steam and applying the same to steam engines.—No. 4796. March 19th, 1889. 8*d*.

STEAM STEERING GEAR.—*W. H. Harfield, London.*—This invention refers to the valve gear of the engines used for steering ships. In the accompanying illustration is shown the plan of an engine fitted with valve gear in accordance with this invention. The admission of steam to the steam chests C, and thus to the cylinders A, is controlled by the central valve F. The valve F is connected to a slide, which carries a toothed wheel N, geared to two screws O, P. The screw P can be revolved by the steering wheel T, and the screw O is revolved by the motion of the crank shaft E transferred through the worm gearing R, S. The



operation of the gear is as follows:—Suppose that the steering wheel is turned in the direction of the arrows, the worm P is revolved and causes the wheel N to turn upon its stud and roll upon the other worm towards the right. The slide and the valve F are thus moved to the right, opening the ports I and admitting steam to the cylinders. The worm gearing R, S then revolves the screw O in the direction of the arrow and returns the valve to its normal position. The engine works concurrently with the movements of the steerman, that is to say, if the steerman's action is quick, the volume of steam admitted to the cylinder is sufficient to rapidly work the gear and *vice versa*. Claims: (1) In engines for use in steering ships the combination of two worms or screws with a worm wheel for exerting a counteracting effect upon a valve which controls the admission of steam to the cylinders; (2) the manufacture and use of steering gear, the engines of which are provided with the improved mechanism described and illustrated.—No. 5018. March 22nd, 1889. 8*d*.

CUTTING METAL BARS.—*C. J. Westwood, London.*—A form of shearing machine is here described for cutting bars of irregular section, such as tee, channel, and bulb bars. The knives of this machine are partly shaped to the cross section of the bars, so that when the two knives are placed together and opened they form an aperture of approximately the shape and size of a cross-

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section of the bar to be cut. The bar to be cut is passed into this aperture, and the knives closed upon each other by hydraulic, steam, or other suitable power. Claims: (1) In means for cutting or cropping metal bars of irregular sections, making the shearing edges of the stationary and of the movable blocks with a cut-away portion, or piercing, or aperture, which, when the opposing shearing edges are brought opposite to each other, will together form cutting edges providing an aperture into which the metal bars to be cut are to be inserted, and will thereby be supported whilst the cutting or cropping will proceed as and for the purpose set forth; (2) the means for cutting or cropping metal bars constructed and operating as set forth.—No. 13,015. August 17th, 1889. 8*d*.

RATCHET BRACES.—*T. Bass, London.*—This is a double-acting ratchet brace, in which the operation is continuous by the movement of one handle only. The brace is provided with two handles or levers, one being held stationary whilst the other is made to work the brace. The stationary handle is rigidly connected to a frame supported upon the spindle of the brace. The movable lever is pivoted to the same frame, and has two arms projecting approximately at right angles to its length from its point of attachment. To the ends of these arms are pivoted two spring pawls, which engage in the teeth of the ratchet. By this construction the pawls engage alternately with and revolve the ratchet, as the lever is moved to and fro upon its pivot, and the frame is held stationary by the other lever or handle. Claim: The manufacture and use of the improved ratchet brace hereinbefore described.—No. 4196. March 9th, 1889. 6*d*.

ELECTRICITY.

METERING ELECTRIC ENERGY.—*W. H. Scott and Laurence, Paris, & Scott, Limited, Norwich.*—This meter mainly consists of a heavy timing pendulum, which makes and breaks periodically the electric current actuating the metering part proper, and of a coiled conductor suspended upon a frame and oscillated in the manner of a pendulum by the action of an electromagnet. By the oscillation of the conductor coil the indicator wheels are driven. In the accompanying illustration Fig. 1 is a front view, Fig. 2 a side view, and Fig. 3 a plan of the appliance. The heavy timing pendulum G is suspended upon an iron rod F in close proximity

FIG. 2.

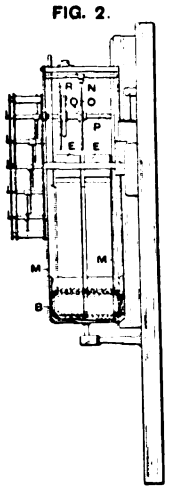


FIG. 1.

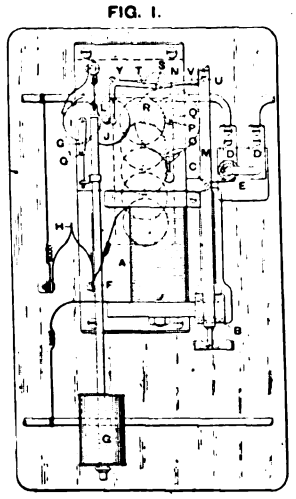
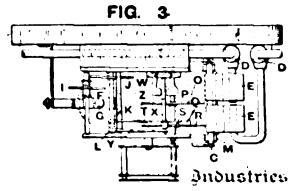


FIG. 3.



Industries

to the poles of an electromagnet A. The electromagnet A is in a shunt circuit to the mains. By the oscillation of the pendulum the shunt circuit of the magnet is broken at the spring contacts H, and its motion is communicated by a pawl and lever G^2 to a ratchet wheel I. The ratchet wheel I is geared to the wheel J, whose axle supports a cam L. The coiled conductor B is suspended upon the frame M and electrically connected to the top main by the flexible copper strips E. Close to its point of suspension the frame M carries a pawl V engaging with the teeth of a fine ratchet wheel O. This ratchet wheel O is fixed to the same spindle as the coil spring Q whose other end is attached to the toothed wheel R. The wheel R is loose upon its spindle, but held stationary normally by the catch S. The action of the appliance is as follows:—On a current passing through the mains the electromagnet becomes vitalised and the pendulum is attracted to it. The contacts H are thus broken and the pendulum is released and oscillates. The vitalisation of the magnet also attracts the coiled conductor, and causes it to partially rotate the ratchet wheel O, wind up the spring Q, and drive the indicator wheels. By the make and break movement of the pendulum, this action continues until the coiled spring is so tightly wound that its resistance to further winding equilibrates the attractive force of the magnet, which varies as the current in the mains. The pendulum, however, still continues to beat, and the cam L revolves and coming into contact with bell crank lever Y lifts the catch S out of the wheel R, and permits the spring Q to uncoil. When the cam has passed the bell cranked lever, the catch falls into the toothed wheel again, and the above-described action is repeated, the motion of the coiled conductor winding up the spring and driving the indicator wheels. Claims: (1) In combination with electric meters a wattmeter or electro dynamo meter arrangement, in which the force produced being proportional to the current flowing in the series coil or to the watts between terminals is caused to wind up a ratchet wheel against the force of a coiled spring, the other end of which spring is fastened to a toothed wheel which is free on the same spindle, so that the spring can be periodically let down and locked again in any position it may take up; (2) the arrangement and combination of parts constituting the apparatus for metering electric currents substantially as hereinbefore described and illustrated in Figures 1 to 3 of the accompanying drawings; and (3) constituting a modification.—No. 3402. February 26th, 1889. 8*d*.

HOLDERS FOR INCANDESCENT LAMPS.—*P. A. Newton, London.* (*A. Swan, U.S.A.*)—The holder is composed of insulating material, such as papier maché, moulded preferably to the form of a truncated cone. The base of the cone is recessed to receive the base of the lamp through which pass the insulated wires leading from the carbon filament to insulated contact plates on its surface. The holder is pierced with ducts or passages for the leading wires from the mains. In some cases the leading wires lie in the recess of the truncated cone, and constitutes, with the plates upon the surface of the lamp base, the means of connection between the lamp filament and the mains when the base of the lamp is screwed into the recess of the cone. Should it be desired to provide a switch for putting out the lamp, a spring contact can be arranged in connection with one terminal operated by a key. The holder is finished off with a metallic cap piece screwed thereto, which may more or less fully envelop the holder. In pendant lamps the electric cable may pass through a hole in the summit of the cap piece, and, being knotted below, support the lamp. A suitable shade for the light is attached to the lower part of the socket. Nineteen claims are made for this lamp-holder.—No. 5066. March 23rd, 1889. 8*d*.

INCANDESCENT ELECTRIC LAMPS.—*J. W. Edmundson, Gateshead-on-Tyne.*—As is well known, the surface of a carbon conductor forming the illuminating part of an incandescent electric lamp becomes gradually disintegrated by use, and the carbon thus detached settles upon and blackens the glass of the lamp. In order to remedy this defect the inventor prepares carbon conductors by coating them with a metallic deposit. A suitable metal for the purpose is chromium, as its fusing point is very high. Chromium combines with the carbon of the conductor, forming a highly conductive hard surface; it fills up the pores and produces a smooth grey surface not liable to disintegration. The deposit may be produced by painting the surface of the carbon with a solution of chromium chloride, the chromium chloride being dissolved in spirits of wine. After painting the carbon is warmed by passing a current of electricity through it, or by placing it in an oven, until the coating is quite dry. The carbon is then enclosed in a vessel, from which the air is removed, and a current of electricity passed through, heating the carbon to incandescence. The coating upon the carbon is thus decomposed, and the chlorine passing off, the chromium is absorbed by the carbon. This may be repeated until the required coating is obtained. Claims: (1) For an incandescent electric lamp, a carbon conductor coated with a metallic deposit; (2) coating carbon conductors for incandescent electric lamps with chromium in the manner described.—No. 3363. February 25th, 1889. 4*d*.

ELECTRIC INDICATORS.—*B. C. C. Cant, Walthamstow, Essex.*—The instrument is usually termed an electric mechanical throw-back or annunciator. It is joined in circuit with an electric bell and push; the electric current, passing through two magnets, sets free a flag made of brass or other suitable material, by the attraction of an armature. The improvement consists of a new form of armature. The armature has on one side a small lug, which engages with a lug upon the signal or flag, and holds the signal up. When the magnet is vitalised the armature is attracted by it, and the lug upon the armature is withdrawn from under the lug upon the signal, letting it drop and indicate the circuit made. Any suitable mechanical means may be provided to replace the flag after indication. One claim is made.—No. 7600. May 7th, 1889. 6*d*.

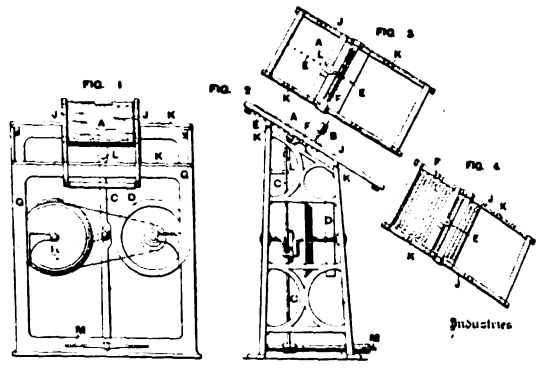
CHEMISTRY.

GREEN AND VIOLET COLOURING MATTERS.—*C. D. Abel, London.* (*The Actiengesellschaft für Anilenfabrikation, Berlin.*)—These colouring matters are manufactured by first treating methylbenzyle-aniline and ethylbenzyle-aniline with sulphuric acid monochlorhydrine, or fuming sulphuric acid, and so obtaining sulphuric acids of these bases. These acids are readily condensed with aromatic aldehydes forming leuco-sulphonic acids, which by oxidation are converted into green and violet colouring matters. Claims: (1) The production of methylbenzyle-aniline-sulphonic acid and ethylbenzyle-aniline-sulphonic acid by sulphuration of methylbenzyle-aniline and ethylbenzyle-aniline with fuming sulphuric acid and sulphuric acid-monochlorhydrine; (2) the production of leuco-sulphonic acids by condensation of the sulphonic acids of methyl and ethyl benzyle-aniline with aromatic aldehydes; (3) the conversion of the leuco-sulphonic acids, referred to in claim (2), by oxidation into green and violet colouring matters.—No. 7550. May 6, 1889. 6*d*.

WHITE LEAD.—*R. W. E. MacIvor, London; A. Darlington, London; G. Paul, Edinburgh; & J. Allan, London.*—These improvements are based upon those described in a previous specification, No. 10426 of 1888. In the present invention the white lead, or carbonate of lead, is produced by first treating oxide of lead—that is to say, litharge or massicot—with a solution of acetate of ammonia, whereby the oxide of lead is transformed into hydrate of lead, and then converting this into carbonate of lead by the injection of carbonic acid. The hydrate of lead readily unites with carbonic acid to yield the final product of carbonate of lead. The rapidity with which the oxide of lead is converted into hydrate depends upon the strength of the acetate of ammonia solution—the weaker the solution the slower the convertion; a strength between 5 per cent. and 25 per cent. may be used with advantage. The carbonic acid is introduced into the mass of hydroxide of lead formed by the oxide of lead and acetate of ammonia, either by a series of concentric rings perforated with small holes in the bottom of the vat or by passing the carbonic acid down a hollow shaft to which are attached stirrers, and through perforated tubes attached to the stirrers. Claims: (1) The improvements in the production of white lead or carbonate of lead, consisting in the treatment of oxide of lead—that is to say, litharge or massicot—with a solution of acetate of ammonia in a closed vessel, the contents being agitated by a mechanical stirrer whilst carbonic acid gas is admitted by pipes arranged as described; (2) the improvements in the production of white lead or carbonate of lead, consisting in the treatment of oxide of lead—that is to say, litharge or massicot—by agitation with a solution of acetate of ammonia in a closed vessel connected with a cistern charged with acetic acid, whereby any free ammonia carried over during the operation may be absorbed, carbonic acid gas being also supplied to the vessel; (3) the process as described for the production of white lead or carbonate of lead from oxide of lead—that is to say, litharge or massicot—by treating the same in a closed vessel with a solution of acetate of ammonia of suitable strength as set forth.—No. 6815. April 23rd, 1889. 8*d*.

MISCELLANEOUS.

SOUND RECORDING APPARATUS.—*J. Gale, London.*—In phonographs, graphophones, and such like sound recorders, use is usually made of cylinders covered with tinfoil or wax for receiving, as the cylinders revolve, the impressions made by the scribers. By the present invention the cylinder is replaced by a flat surface, which is made to oscillate and move downwards at regular intervals by the mechanism shown in the accompanying illustrations. Fig. 1 is a front elevation of the apparatus, Fig. 2 a side elevation, Fig. 3 an under view, and Fig. 4 an under view of a modification. A is the tablet forming the recording or receiving medium, and it is preferably of rectangular shape. The tablet is mounted upon a frame J, which is capable of being slidden longitudinally on V-shaped guides K by the rocking lever C attached to the frame J at L. The lever C is rocked by the treadle M, and its motion is steadied by the fly wheel D, which receives motion from the rocking lever C in a manner that may be readily understood from the illustrations. The downward movement of the tablet A at the end of each stroke is caused by the pins E attached to it running in the guides F. The guides F are stationary, and connected to the framing G. A modification of these guides is shown in Fig. 4; there the guides are attached to the back of A, and a single pin E is fixed to the framing G of the machine. The usual mouthpieces, disc needles, cutters, &c., used in sound-recording instruments are used in combination



with the above-described machine. From the motion of the tablet A it may be seen that the impressions made by the scriber B upon it will be in parallel lines, and proceeding from the top downwards. Claims: (1) In instruments and apparatus for recording and repeating speech and other sounds the recording or receiving tablet A having a plain flat surface and receiving longitudinal and transverse motions substantially as set forth; (2) in instruments and apparatus for recording and repeating speech and other sounds the tablet A, the frame J sliding in guides K, the grooves or slots F and pins E, together with mechanism for reciprocating the frame A substantially as set forth; (3) in instruments and apparatus for recording and repeating speech and other sounds the combination with the receiving or recording tablet A, having a plain flat surface, of the mechanism for giving motion to same as described and illustrated.—No. 5507. March 30th, 1889. 8*d*.

INDICATING THE PRESENCE OF FIRE-DAMP.—*J. Pitkin, London, & J. T. Niblett, Greenwich.*—A small instrument is described in this specification for use in mines to indicate the presence of fire-damp, or in gas mains to indicate the escape of gas. The invention is based upon the property certain metals have of evolving heat in the presence of hydrogen gas. One of these metals is spongy platinum or platinum black. The instrument consists of a thermometer to which platinum black is applied in such a manner that if the instrument be taken into the presence of fire-damp the increased temperature of the platinum black will at once be indicated by the thermometer. Two thermometers are preferably placed side by side and the bulb of one covered with the platinum black, so that the difference of temperature due to the presence of fire-damp may be readily seen. The platinum black is applied in a pasty condition and held in place by a covering of silk ribbon or thread. Claims: (1) The treatment of thermometers as above described with metallic substances, having the property of evolving heat in the presence of hydrogen gas or its gaseous compounds, overlaid with a covering of fibrous material, such as silk; (2) the construction and arrangement of instruments for indicating the presence of hydrogen gas or its gaseous compounds as described.—No. 4629. March 16th, 1889. 8d.

Copies of the British specifications may be obtained on application to H. READER LACK, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every 10d. or fraction of 10d. Remittances exceeding one shilling must be made by Post Office Order.*

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THE INSTITUTION OF NAVAL ARCHITECTS.

(*Continued from page* 304.)

Mr. W. H. White then proceeded with the fourth section of his paper, "Notes on Recent Naval Manœuvres."

It is very much the fashion, he said, to criticise adversely the steaming powers of warships, and to contrast them unfavourably with those of mercantile vessels. This is done without reference to the essential differences between the services that have to be performed by war and merchant ships, or recognition of the inherent difficulties attaching to warship propulsion. A merchant ship is built and engined for the purpose of steaming continuously at certain maximum speeds, and to cover certain distances from port to port. Also their regular return to port enables constant attention to be given to desirable repairs or adjustments.

On the other hand, most of a warship's cruising and passages are done at low speeds, requiring only a small proportion of the power she possesses. For example, the "Howe" can be driven at nine knots for less than 1,200 h.p., not *one-sixth* of the power she can develop with natural draught for a few hours. Yet she always has to carry engines and boilers capable of giving her a speed of over 15 knots with natural draught, and over 16½ knots with forced draught. The "waste work" inevitable under circumstances of this kind must be considerable at low cruising speeds, although every effort may be made to diminish it by using only one of the twin-screws or by other devices. In the "Blake" and "Blenheim," with engines of over 13,000 h.p. natural draught, four sets of engines have been adopted, with special disconnecting arrangements, to permit of throwing out the forward sets when cruising at low speeds. In this great range of power and small development under ordinary conditions is to be found, doubtless, the cause of not a few of the difficulties which arise with warship machinery. Such difficulties would disappear if the engines were continuously worked at high speeds like those of merchant ships.

When a warship forms a unit in a fleet the case is still more difficult. Suppose the fleet is ordered to manœuvre at 9 knots. Every commanding officer would be compelled to have command of steam equivalent to a possible margin of speed of 2 to 3 knots, in order to ensure keeping station. In an actual vessel the case might stand as follows:—

9	knots.....	1,000	h.p.	50	revolutions.
11	„	1,800	„	60	„
12¼	„	3,000	„	70	„

In order to secure the ready command of 10 revolutions above the average ordered, 80 per cent. more power is needed to be available whenever ordered; and to have command of 20 revolutions, 200 per cent. margin of power is needed. Standing on the bridge, and taking observations continuously as to his relative position, the commanding officer is frequently obliged to vary the speed of the engines, and the engineer officers have to be ready to obey promptly the constant flow of orders from the deck.

There have been several allegations of *structural weakness* in some of the ships engaged in the manœuvres. For these allegations there is no foundation whatever in any of the reports received. As an example of the loose way in which these statements are made, it may be mentioned that a short time ago an officer from one dockyard was sent to another to take notes of certain small fittings in ships of the "Medea" class, in order that similar fittings might be carried out in the "Medea" and "Medusa." It was immediately announced that he had gone to obtain particulars of structural strengthenings required in consequence of original weakness of construction. This erroneous statement was circulated far and wide; but it had no foundation whatever, as all the vessels of the class have proved to be amply strong, and almost entirely free from vibration, even when developing the full forced draught power.

Experience in these manœuvres has led to alterations, or rather to additions, in certain classes of ships, which may be grouped under three heads:—

(*a*) Additional ventilation has been found desirable, especially to engine and boiler rooms placed under protective decks; this is caused by the increasing pressures of steam, greater powers, and multiplied auxiliary machinery.

(*b*) Greater facilities for intercommunication between engine-rooms and boilers at a low level in the ships have been proved to be absolutely necessary for safety and good working, and are being provided.

(*c*) Improved arrangements for the transport of coal from the upper bunkers to the fires in ships with protective decks, have been shown to be desirable by the hard continuous steaming done during the manœuvres. The principle now adopted is to stow at least half the coal, and often a larger proportion, in bunkers below the protective deck and adjacent to the stoke-holds. For the bunkers above, longitudinal transport has been arranged; so that all the coal can be readily carried where required and dropped into lower bunkers near the fires.

The discussion on the paper was opened by Admiral Mayne, the officer who was alluded to in the paper as having characterised forced draught as "an invention of the evil one." The same opinion was still held by this gentleman, with all the tenacity of which a sailor is capable. It was contended that forced draught acted like a blow pipe on the tube plates, and that no one should make use of the appliance except in an extreme emergency and to save his ship, the risk of breakdown to the boilers being too great.

Sir E. J. Reed was in accord with Mr. White generally on all the points brought forward. Some surprise was expressed by him with regard to the first proposition, on the influence of size and weight upon the seagoing qualities of ships. It was a truism to say that the big ship must be the best for withstanding heavy seas. To know also that any change had taken place recently from small vessels to large ones in the Navy came as news to him. If some of the ships built while the construction of our national fleet was in his hands were small, this was because they were wholly protected by armour. While not being aware that large ships

200-TON HYDRAULIC RIVETING PLANT.

Designed and Constructed by Messrs. Anderson & Gallwey

(W. Payne-Gallwey, Engineer), London.

(*For description see page* 316.)

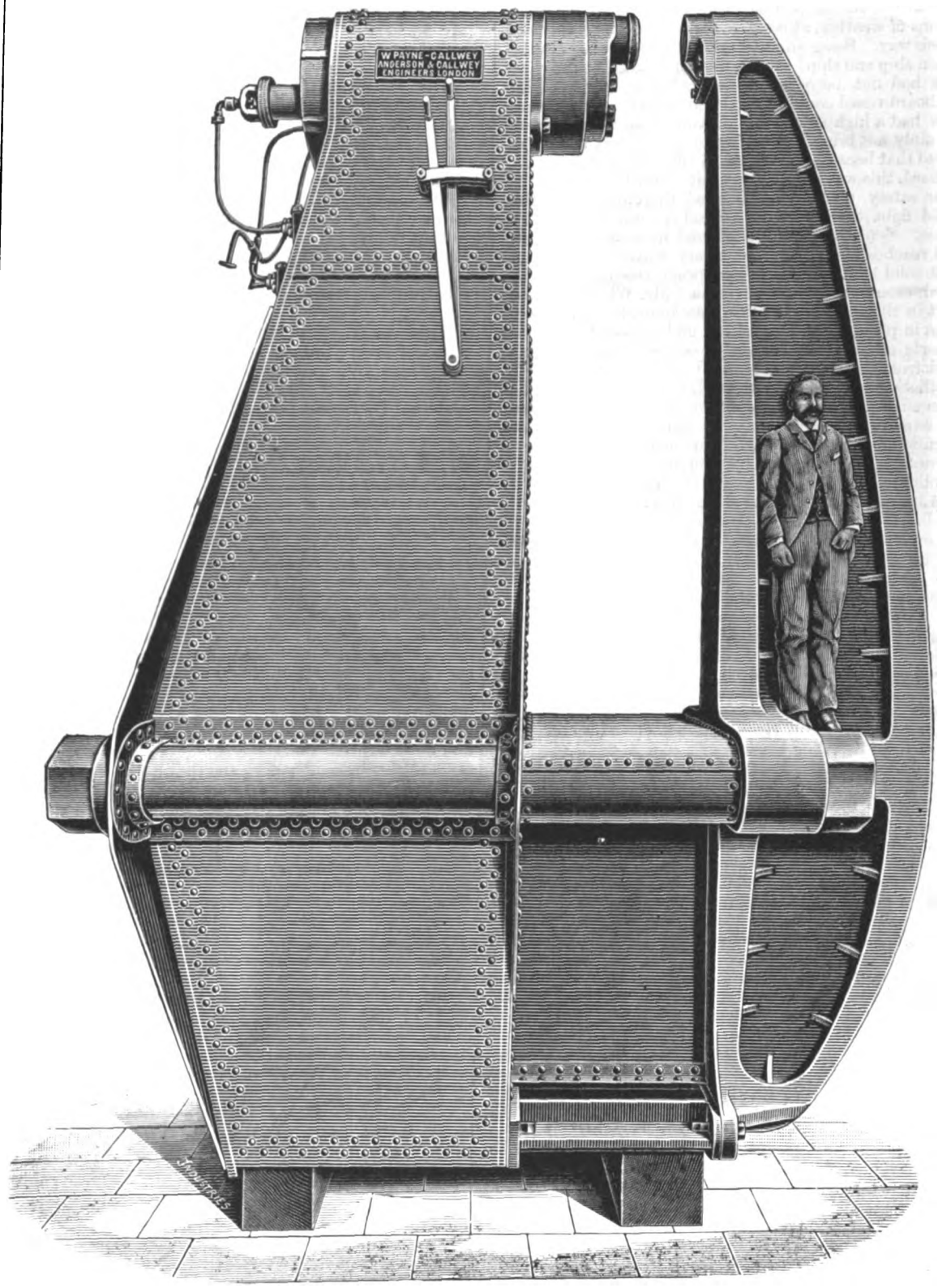


Fig. 1.—View of Riveter Before being Placed in Position.

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behaved better than small ones, he was glad to know that the days of the longer vessels were not numbered. This was referred to because the Board, when introducing the "Nile" and "Trafalgar" designs, described them as the last of their type. There could be no doubt, however, that Mr. White's new ships would be the best in the Navy. When considering the "Medea" class of ships, the experience gained in the past did not appear to have been taken into account by the Department. These vessels were low in the waist, and not covered in from end to end, yet he was responsible for two fast cruisers built in the same way, and they had been shown to be undesirable. As to measured mile trials, it was absolutely necessary to have a standard of comparison between ships, and all the conditions of weather, stoking, &c., could only be obtained in this way. Sea-going trials did not furnish this test between ship and ship. There was one feature in the paper that had not been mentioned before—viz., that a low freeboard vessel could be driven at the same speed as one that had a high side. The measured mile trial would certainly not bring this feature out. It was hastily inferred that because the "Admiral" class buried themselves forward, this was a detriment, but is must be known that their safety was not endangered thereby. That they could fight their guns in a head sea was important to know. Some doubt was expressed here, as information had reached the speaker, of a very contrary nature, and that solid bodies of water had swept the low deck forward, even entering the barbette. Mr. White explained that in this instance the ship was unfinished and had no guns in place. Sir E. J. Reed understood that certain reports of naval officers on these vessels had been kept back from Parliament on account of the actual behaviour of these vessels. He was in favour of these autumn manœuvres. In his time no money could be obtained for experiments whatever. He congratulated the Admiralty on their change of policy in this respect, and for permitting the subject to be brought up for discussion in public.

Admiral Morant confirmed Mr. White's views as to the "Admiral" class of ships. During the manœuvres he was living on board the "Anson." In a gale of wind on the north coast of Scotland, while going at 9 knots against the sea, and with hatches battened down, there was no time at which the guns could not have been fought. As to habitability, improved ventilation had removed a stuffiness existing in the after parts. A leakage that existed in the fore parts had since been remedied. Artificial ventilation was wanted in the stokeholds, but not forced draught. An instance was quoted where two hours' use of this system in a ship had necessitated the fires being drawn. He would not close his stokeholds for fear of disabling his ship at a critical moment.

Admiral Sir J. Willes considered the manœuvres reflected great credit on the Service generally, the temporary crews being quite new to their work. He thought that what was wanted was a steady gun platform, otherwise the ships would be rendered partly useless for their work, even though they possessed a high speed. Officers would also be chary of going into action with forced draught, owing to the risks involved.

Captain Long mentioned the exigencies of a naval service, and the impossibility of having a big ship everywhere. A high freeboard implied a bad target, and high speed produced large waves. It was desirable therefore to have as low a freeboard as possible. The question was then asked if the forward bulkhead on these vessels could not be constructed to meet the sea better. In common with other naval officers, a verdict was recorded in favour of high speed and against forced draught. While saying this it was argued that some mechanical means must be used for increasing the draught, but this was not to be on the usual plan.

Admiral Sir Vesey Hamilton followed in much the same vein, and commended the Admiralty for returning in some measure to old usages in sending our constructors to sea. It was only by studying the performances of ships at sea that improvements in design could be arrived at, practice, he said, being the highest kind of science after all.

Mr. Baden Powell spoke of the steering question in some of the large ships. He referred to one ship, the "Ajax," which it was not safe to approach within a half-mile, and of the straight keels of the "Admiral" class, an adverse opinion was expressed as to their answering their helms well. There was also a doubt in his mind if a good draught could be had were the funnel shot away altogether.

At this point the discussion left somewhat the purely naval channel, and turned rather into an engineering one. Mr. Fothergill is known to have a special knowledge of forced draught. His experience was that the application of the system was generally at fault. A ½in. draught was no more than what a common chimney gave. It was when we came to 2in. in a closed stokehold, that harm was done by opening the fire doors, and by the rush of cold air on to the tube plates. Why not close the ash-pits instead of boxing in the holds? He had steamers working on this system running to India with ¾in. and ⅞in. pressure for thirty days continuously. He had no trouble in any way, and burnt 40lb. per square foot of grate in an exceptional case. For economical reasons, the actual figure was somewhat lower.

Mr. McFarlane Gray here mentioned the possibility of misunderstanding arising in the matter of these draughts. Instead of a ½in. forced draught being the same as that generated in an ordinary funnel it generally meant ½in. in excess of that due to the atmosphere. The funnel itself would give a ½in., therefore a ½in. draught really signified a total of 1in. As regards forced draught, what was wanted was some means of making fireclay stick to the tube plates and so protect them.

Mr. Sennett said he was associated with Mr. White in the design of the ships alluded to in the paper. Some misconception occurred with reference to the term forced draught. Mechanical draught would be better. In the old days if a funnel were shot away it would be a serious matter. Now the fans would be brought into use, and no difficulty arose. If any trouble had been found it was not due to the system itself, but rather to the excessive use of it by some captains. It must be remembered that forced draught did away with ventilators, and that vessels like the "City of New York" (Holt's line) and those sailing from Holyhead all worked successfully with closed stokeholds. The novelty was in making all the air brought in by the fans go through the fires.

Mr. Durston, the Engineer-in-Chief of the Navy, said that at full power they adopted 1in. air pressure, and were now at the Admiralty making experiments as to the use of fireclay on the tube plates. The authorities were always willing to try any likely system that might be brought to their notice.

Admiral De Horsey hoped the discussion would lead to some practical solution of this forced draught question. Some engineers said the air pressure must be ½in., and others put it down as 2in. If the limit could be fixed, why not fit a valve to blow off like a safety valve does on a boiler? He deprecated the horse-power attributed to a ship being at the forced draught rate if the use of the appliance were prohibited by the Admiralty. He would like to leave out forced draught if he could not, according to the regulations, use it.

Mr. Seaton said he had just come to London behind a locomotive using forced draught. He felt no apprehension. It was no new thing on railways. When the Great Western first adopted it, they had troubles. As the engine stopped and the temperature fell, the tube plates began to leak. All this had been got over, and no doubt the same would be the case when the subject was better understood in marine boilers. We wanted a remedy, and must not condemn the system. The Admiralty would not use North country coal, and they did not design suitable boilers for burning Welsh. The furnaces and combustion chambers were too small, and the grate area too large. The higher the pressure the smaller should be the area of the grate. As to admitting cold air when opening the fire doors, there were mechanical stokers, most certain in their action, which would prevent trouble on this head. As regards screw propellers, those for smooth water were not always suitable when tried on a long voyage in rough weather. He thought the Admiralty used sizes which were not large enough for cruising purposes.

Mr. Martell had doubts, when comparing the scantlings of these ships with merchant ships, if they were equal to the strains required of them. That they held together so well was very creditable to the department responsible for their design, considering the great spacing there was between their frames.

Mr. Archibald Denny said his firm had had experience with forced draught at ½in. to 1in. air pressure for nearly two years. The boilers were in a perfect state still. At the trial a pressure of 6in. even was reached, and no troubles arose.

Mr. Yarrow mentioned the using of fireclay some years ago on the tube plates. The difficulty was to get it to expand and contract with the metal. On this account the use of it did not meet with success. As to the 9in. air pressure that had been mentioned, Mr. Yarrow had used 8in. and not been troubled with leakage in any way. This was on a boiler of 1,800 h.p. in use in the Navy. All that was required was a good design of boiler for the work. No special device was necessary.

Mr. White, in his reply, referred to strictures that had been made on the "Rattlesnake," and the so-called strengthenings that had been built in the vessel, due, as it was said, to faulty design originally. To show the error that had been made, Mr. White mentioned the cost of the strengthening of the bulkhead, which was in the wake of the engines, at between £100 and £200. The vessel of the "Sharpshooter" class did on trial vibrate considerably, it was admitted, but on inquiring into the cause it was found that certain pillars had not been embodied in the vessel such as the design indicated. For one-third the midship part of the ship she was without any vertical support. This was stated to be the result of the complexity of the system under which work is carried out under Government. As to the vibration in the "Barham," the answer was found in the fact that this vessel had never yet had her engines turned, but probably the critic was referring to one ship of this class only, it being the practice of the Admiralty to refer to ships of a class without always particularising their names. As to the scantlings of men-of-war, it was rightly contended that no comparison could be made with merchant ships. In the former case you have to support weights, in the latter to carry them in holds, the difference being great subdivision of strengthenings on the one hand to none at all on the other. Clearly, therefore, the scantlings in a warship may be lighter than in that of the unsupported box-form carrier of cargo. Mr. White spoke next of the large guns being used at sea on a low freeboard vessel, and the effect of hydraulic machinery for pointing these massive pieces of ordnance on the object at all variations of the helm and movement of the vessel. The guns of the "Trafalgar" had been fired only 3ft. 9in. above the deck, and no mishap had resulted, as some critics foretold. The steadiness of the platform in the latest ships had been remarkable, for though a totally different distribution of weights had come about under new conditions Mr. White declared himself able to cope with ships of a past era in this respect, notably the "Hercules" and "Sultan." The size of the cruisers has increased as extra speed was desired, till now we find the "Blake" to be of 9,000 tons displacement. If a speed was required equal to the "Teutonic," which is 15,000 tons displacement, the only question was said to be the bill to be paid for this size of vessel. On the forced draught question Mr. White expressed himself as, speaking from a naval officer's point of view, in favour of forced draught, but as wishing to use it only in case of emergency. Here he felt he was undoubtedly on sure ground, for every particle of power that can be got out of the engines would be wanted in an action, and it was only then that a commander of a man-of-war ought to use the auxiliary that was placed in his hands. As to sending naval constructors to sea, this in future would be the rule. The work of the Department was, however, stated to be so great that it is unlikely that many officers in responsible positions would be permitted to see what fleet manœuvring means.

The first paper read on Thursday, the 27th ult., was by Rear-Admiral Colomb, on "The Washington Maritime Conference."

The invitations to attend the Conference were widely spread, and twenty-eight Powers sent one or more delegates. Most of the great Powers sent several delegates, and Great Britain was represented by Mr. C. Hall, Q.C., Rear-Admirals Sir George Nares, K.C.B., F.R.S., Sir Robert Molyneux, K.C.B., and N. Bowden-Smith, Mr. Thomas Gray, C.B., Captain Wyatt, of the P. & O. Service, and Captain Kendall, of the City of Dublin Mail Service.

The programme proposed for consideration stood thus: I.—Marine signals or other means of plainly indicating the direction in which vessels are moving in fog, mist, falling snow, and thick weather, and at night. Rules for the prevention of collision, and rules of the road. II.—Regulations to determine the seaworthiness of vessels. III.—Draught to which vessels should be restricted when loaded. IV.—Uniform regulations regarding the designating and marking of vessels. V.—Saving life and property from shipwreck. VI.—Necessary qualifications for officers and seamen, including tests for sight and colour-blindness. VII.—Lanes for steamers on frequented routes. VIII.—Night signals for communicating information at sea. IX.—Warnings of approaching storms. X.—Reporting, marking, and removing dangerous wrecks or obstructions to navigation. XI.—Notice of changes in lights, buoys, and other day and night marks. XII.—A uniform system of buoys and beacons. XIII.—The establishment of a permanent International Maritime Commission.

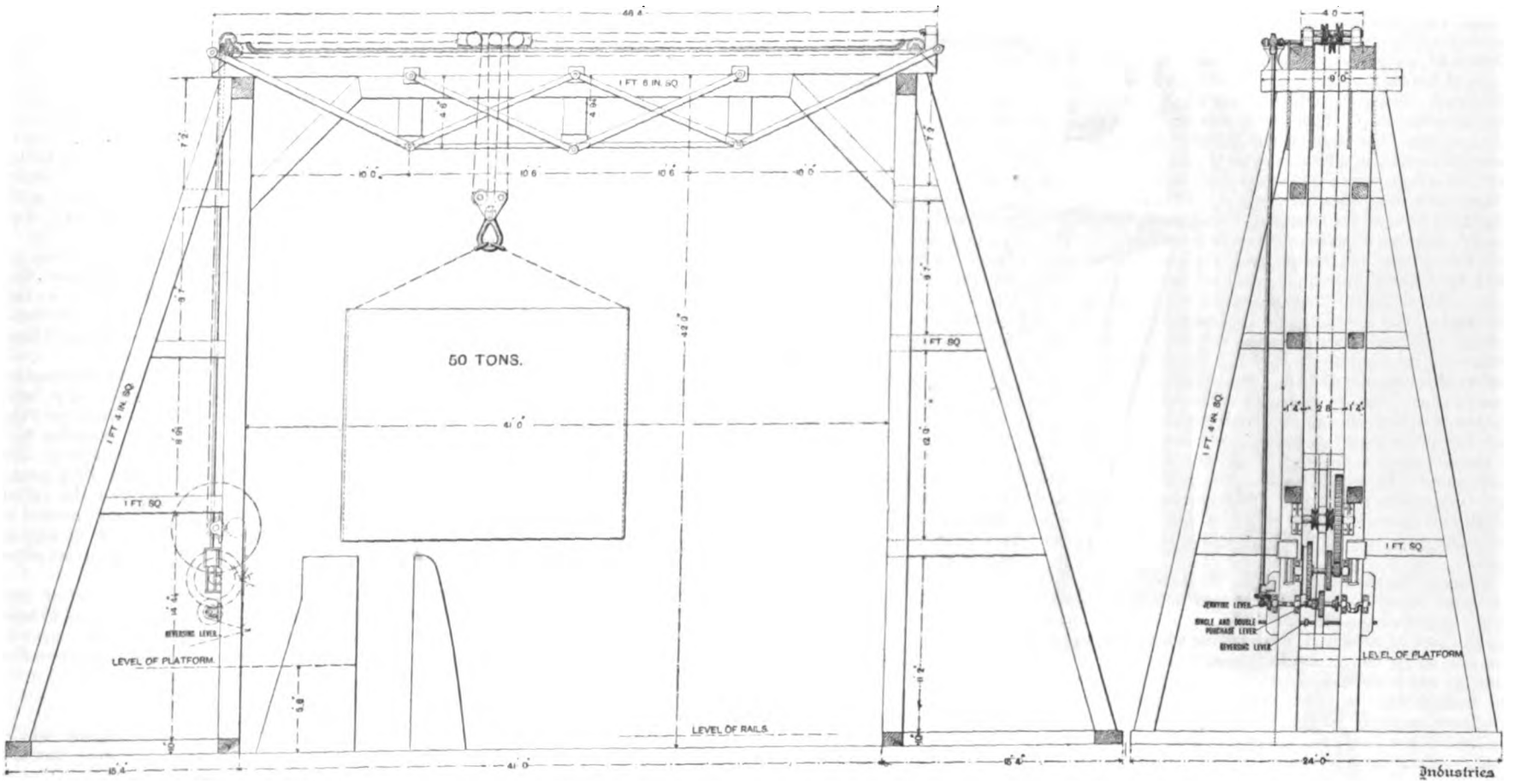
There is evidently a double character discernible in the matters proposed for discussion in this programme. There are some divisions which can only be treated internationally as often concerning the ships of different nations equally at the same time. There are others which may be offered for international discussion, with a view to improvement of system, but which are not directly of international importance. Such are: II., Determining the seaworthiness of vessels: III., Draught to which vessels should be loaded: V., Saving life and property from shipwreck; VI., Qualifications for officers and seamen. Of these four subjects it may be said that uniformity of system amongst the nations is not so important as a good system; and that nothing would be gained by calling on a minority of Powers to give up better systems and take to worse because the majority had agreed to do it. But of most of the other subjects it may be said that uniformity is the essence of any system adopted, and that even some sacrifices in efficiency

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200-TON HYDRAULIC RIVETING PLANT.

DESIGNED AND CONSTRUCTED BY MESSRS. ANDERSON & GALLWEY (W. PAYNE-GALLWEY, ENGINEER), LONDON.

(*For description see page* 316.)



FIGS. 2 AND 3.—SIDE AND END VIEWS OF TRAVELLING CRANE FOR CARRYING WORK TO BE RIVETED.

might be made, if in no other way could uniformity be secured.

Discussions on the rule of the road at sea, and on the prevention of collisions at sea generally, are so familiar, and differences of opinion are so frankly expressed as between seamen and landsmen, and as amongst seamen themselves, that there is a general impression existing that the whole thing is very abstruse, and terribly complicated. It certainly does contain matter for close and clear thinking, and for highly technical and carefully chosen language. It is a subject, however, not complex in itself, and resting on very clear and determinate principles.

All that was authoritatively laid down on the subject of preventing collisions came before the "Conference on the International Regulations for Preventing Collisions at Sea," extended over twenty-six articles, eleven of them being actual "Rules of the Road," three being of a special and exempting character, and the remainder dealing with signals necessary for carrying out the rules, many of which embraced several sub-sections, and which contained a great many fundamental and highly technical terms, the meaning of which all the Admiralty lawyers on the Conference knew had never been, and perhaps never could be, defined. That such terms should have crept in as the basis of an international law of the highest importance to life and property is, perhaps, not less strange than that they should never have appeared officially until 1863. But the fact that the terms were in the law, and were made the basis of the law when it was first formulated internationally, was a fact which the Conference could not get over.

It was stated that the Conference found the rules hinging on a series of indefinable terms. These terms have all made their appearance since 1856, and were unknown to the rules for preventing collisions before that date. They are as follow:—

1. "Risk of collision." "It was utterly impossible for the Legislature to have determined or described what should constitute risk of a collision," said the Judge of the Admiralty Court in the case of the "Mangerton."*

2. "Keep out of the way of." This phrase has no meaning, except the general one, "not to get into collision with," as it specifies no particular act. If no collision follows the act it is right whatever it is; if collision follows, it is *primâ facie* wrong, whatever it is.*

3. "Wind aft." "A further question arises," says Marsden,† the great authority on the law, "as to how the dividing line between 'running free' and having 'the wind aft' is to be drawn. These difficulties will be found discussed at length in the 'Privateer,' a recent Irish case. In that case the Court appears to have been of opinion that a ship may at the same time be 'running free' and have 'the wind aft.'"

4. "Meeting nearly end-on." "The meaning of 'nearly end on'" says Marsden,‡ "has not been exactly defined. Vessels upon parallel courses, each with the other nearly right ahead, and vessels upon courses making with each other an angle of two, or even three, points have been held to be meeting 'nearly end-on.' But in a case where the courses of the two ships were within a point of being directly opposite, the Privy Council decided that the ships were 'crossing,' and not meeting ('nearly end-on')."

5. "Crossing." This is the converse of "nearly end-on," and the indefinable point, as above, is where "nearly end-on" ends and "crossing" begins.

6. "Overtaking." Marsden says: "There is nothing in the regulations to indicate how one ship must bear from another in order to be an 'overtaking' ship. . . . . Under the regulations of 1863 a rule was suggested by Brett, L.J., in the 'Franconia.' . . . . In a subsequent case, however, doubts were expressed in the Court of Appeal as to the correctness of the rule suggested by Brett, L.J."

Now, the whole law is in motion or not in motion, according to whether there is or is not a something called "risk of collision," and yet no one can decide what that something is. The separate action of each ship, and therefore their presumed mutual action, depends upon whether or no the wind is "aft," whether or no the ships are "nearly end-on," whether or no they are "crossing," or whether or no one ship is "overtaking" the other. And yet, as may be seen, the "whether or no" must be in each case entirely a matter of guesswork at the moment. There are only three definite actions prescribed in the ten "steering and sailing rules": (1) To "alter course to starboard"; (2) to "keep the course"; (3) in narrow channels, to "keep to that side of the fairway or mid-channel which lies on the starboard side of such ship."

So much, he said, for the matter of the law as coming before the Conference for revision. He then dealt with its manner, and it is obvious that any regulations for preventing collisions must consist of two parts: (1) Rules which deal with the motions prescribed to ships on approaching each other; and (2) signals to enable ships to ascertain the situation and make the proper movements. In the existing regulations the cart is before the horse. The signals are put in the primary, and the rules which either dictate, or ought to dictate, the signals, come in the secondary place.

Now as regards the facts on which the law is, or ought to be, founded, and which should be in full view of anybody undertaking its revision: What, he asked, is the law wanted for? when is it required for the mutual safety of two ships? and when are any two ships safe without it? The answer is that in the open sea, or in any space of water where ships are presumably free to act under a law relating to the two ships only, the law is never required unless the two ships are steering for the same point. If they are not steering for the same point law is not required, because both ships are already in perfect safety. If this is so, then what sort of a law is required? The appeal here is to history, and until 1840 history had but one answer. The law provided that one of the two ships, designated by facts which were known to, or presumably known to, both, should be given the right to go on steering for the point, and that the other ship was forbidden, absolutely, to steer for that point, or for any other point in the path which the first ship was pursuing. Of course there were limitations. Although the ships were steering for the same point, one might be so near it, and the other so far from it, that it would be impossible for both to arrive at it at nearly the same time. In such a case no law was required, and no movements were necessary. But by the law, in all cases where each ship was steering for the same point, and where there was the least doubt about the times of arriving there, the ship which had not the right to go on, was bound to steer so as not to pass in front of the other ship. This was the answer which the history of maritime law had given to the question up to 1840. There was then an innovation made with regard

* Swab. Ad. 120.

* See the Court of Appeal in the case of the "Memnon."
† P. 361. ‡ P. 374.

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200-TON HYDRAULIC RIVETING PLANT.

DESIGNED AND CONSTRUCTED BY MESSRS. ANDERSON & GALLWEY (W. PAYNE-GALLWEY, ENGINEER), LONDON.

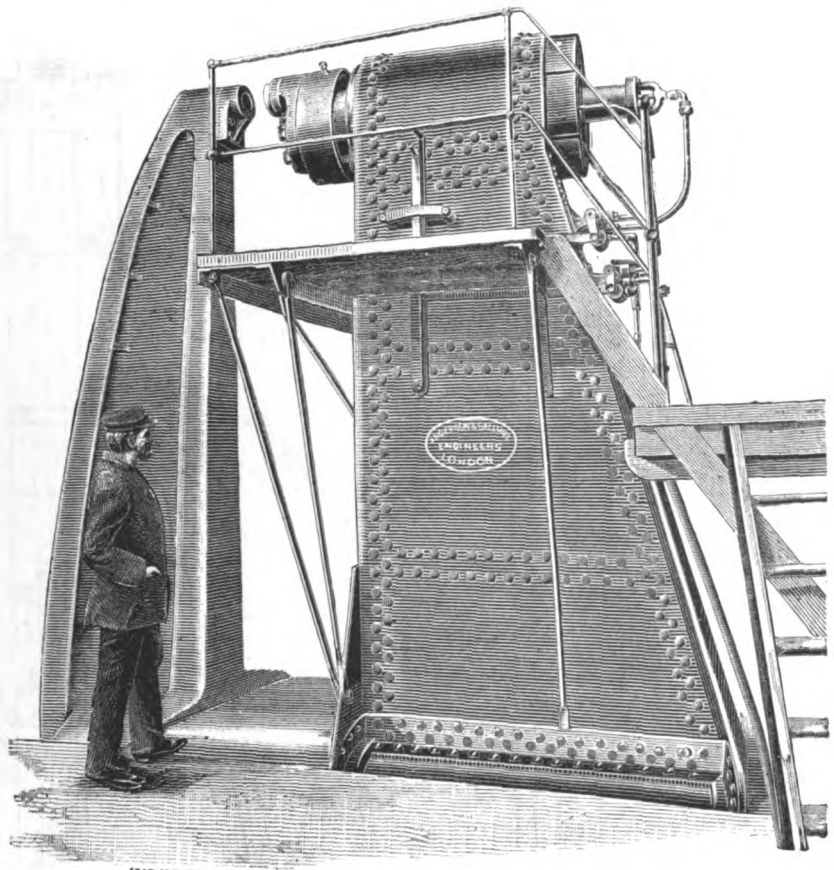


FIG. 4.—VIEW OF RIVETER AS ARRANGED FOR WORK.

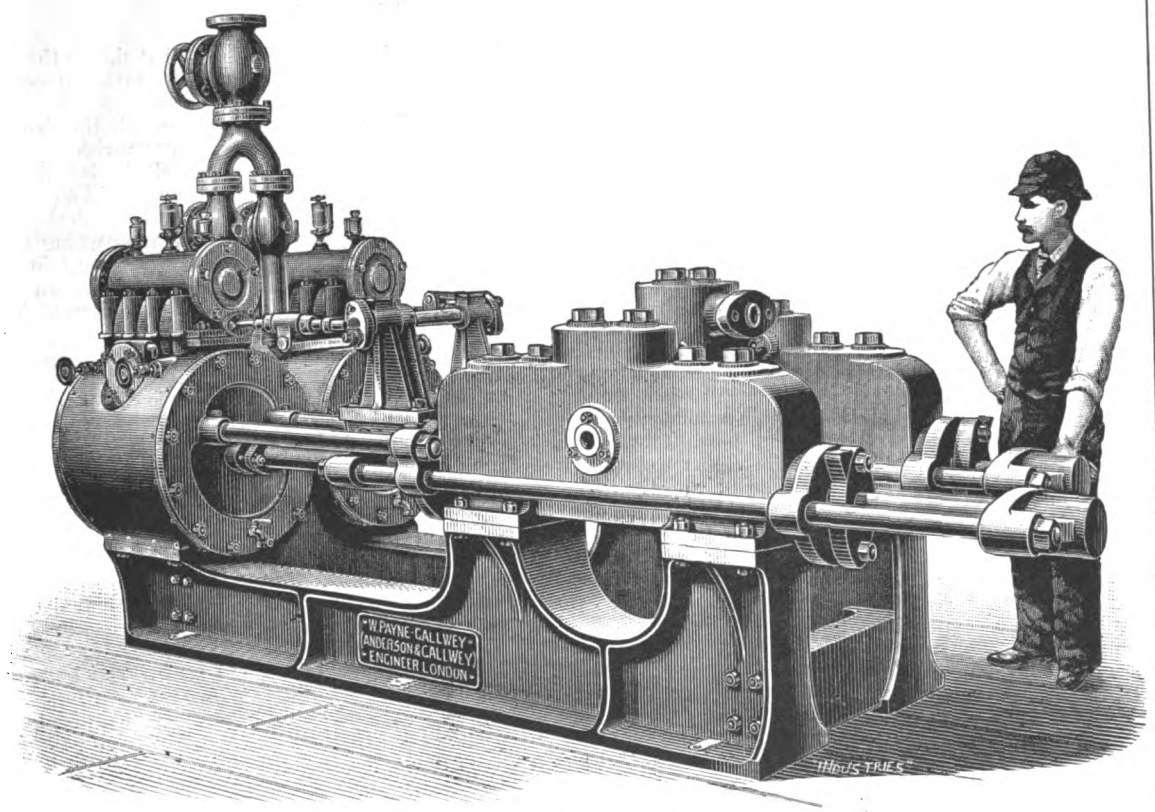


FIG. 5.—DUPLEX PUMP USED FOR CHARGING HYDRAULIC ACCUMULATOR.

to steamers, and a new law appeared which conflicted with the old one in principle, but had the excuse that possibly no way had then been thought of of making the condition of each ship known to the other at night; and also that provision for an exceptional case was mistaken as provision for the general case. This innovation and breach of principle proceeded to swallow up, after the manner of such things, the whole of the old principles, so that by new British laws promulgated in 1854 the old principle absolutely disappeared until 1863. In 1863 there was only the shadow of it left, and the best work of the Conference has been to give substance to the shadow, and to bring us nearer to where we were in 1839.

So much, he said, for the principles of law as applied generally. A question properly before the Conference was, or might have been, whether the simple and general rules of the old law were sufficient for modern times.

To answer this question, the author directed attention to diagrams representing the conditions of approach in ships before they came into collision. It may be said broadly that the danger of collision chiefly arose when ships' courses crossed at a small angle. It seems, then, that if the general principle of law mentioned is suitable for all such cases, but that provision for other cases confuse it, there may be a question whether the other cases had not better be left alone as exceptional. It becomes evident that the mean conditions under which collisions now occur, and against which the law ought to provide, are a crossing angle of about three points of the compass. Make the angle a little larger, say about four points, and we have the crossing angle for ships close-hauled on opposite tacks. It was convenient to take this common case, because it is just the same case now as it was 200 years ago, and the only thing that differs is the law for preventing the ships from coming into collision. This law, when it disappeared from the Royal Naval Signal Books as late as 1868, was thus:—

"When any ships under sail on different tacks, by continuing their course must pass near each other, the ship on the starboard tack is invariably to keep to the wind, and the ship upon the port tack is upon all occasions to give way and pass to leeward, taking care to bear up in sufficient time for that purpose."

As to the qualifications for officers and seamen, the Conference dealt wholly with the question of colour-blindness, on account of its danger with reference to the red and green side lights. He never knew himself a case of collision where colour-blindness was in question. The statements were generally perfectly clear that wrong helm was given deliberately in the face of the colour seen; and as no authoritative teaching had existed to show that it mattered what colour was seen as long as danger was denoted, he had never been able to lay stress on the colour-blind question.

The opinion of the Conference seemed to have been against any decided line being taken with regard to lanes of route for the avoidance of collision. Here again he had never been strong, as he had observed before that collisions did not occur often on any waters which would be included in the lanes proposed. As to the general question of signalling, the Conference agreed that the "system of long and short flashes from a white light"—that was, the existing flashing system—"was better than any employment of coloured lights," and they proposed one or two official signals on that system. They also proposed to insert in the International Signal Book what they called the "Morse Code," meaning presumably the common telegraphic alphabet as used with the flashing system. The maritime countries were invited to consider the establishment of a uniform system of storm warnings. A good many resolutions relating to the notice and removal of derelicts and other obstructions to navigation, as well as notices of changes in lights, buoys, &c., were submitted to the Powers; but, so far as he knew, our own Hydrographical Office already acted in the way proposed A uniform system of buoys and beacons was roughly specified and proposed for adoption. Unquestionably a uniform system was of international importance. The establishment of a permanent international maritime commission was, however, considered "not expedient" for the present. In conclusion, he thought the Conference had done as much as could have been hoped for at its hands. Should such a Conference ever re-assemble, he did not think it should be so numerous. He supposed that some limited number of well-chosen delegates from the four or five Powers most concerned in maritime questions might be found to avoid mistakes as well as the late Conference did, and yet, perhaps, to take still more definite steps in the path of improvement.

(*To be continued.*)

200-TON HYDRAULIC RIVETING PLANT.

THERE is probably no method of working machine tools which is capable of receiving more widespread application than that which embodies in some shape the hydraulic principle. Massive forgings are now operated upon with tools of this character, and, with boiler makers especially, such tools have become not only a useful, but an absolute, necessity in these competitive days. Therefore, to our engineering readers the following description of the largest plant of hydraulic riveting machinery yet erected will be of special interest, and, as an illustration of the growing demands made upon boiler makers to deal with larger and heavier work, it can scarcely fail to indicate the advance of modern engineering.

The plant we illustrate has been designed and erected by Mr. W. Payne-Gallwey, of Messrs. Anderson & Gallwey, of 274–277, Strand, London, for a company of engi-

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neers and boiler makers in Holland. Some time ago this latter company received an extensive order for some very large marine boilers, and in order that the work should be done as efficiently as possible and also to prepare themselves for similar orders in the future, they determined on having a new hydraulic riveter which should have such a power and size of gap as to be able to deal with the very largest work ever required or likely in the future to be required. The gap of this machine has therefore been made 12ft. deep, and has been given a closing power of 200 tons. It is capable of closing rivets up to 3in. diameter, though most of the work at present will not require rivets of more than 1½in. diameter.

In Fig. 1 (page 313) we show a view of the riveter before it was placed on its foundation, and in Fig. 4 (page 316) a view of the machine when arranged for work; Figs. 2 and 3 (page 315) are side and end views of the travelling crane which is used for bringing the work over the riveter; Figs. 5, 6, 7, 8, 9, 10, and 11 (pages 316, 317, and 320) show various appliances for obtaining the necessary water pressure for the boilers and riveting plant. Figs. 12 and 13 (page 324) give general views of the installation.

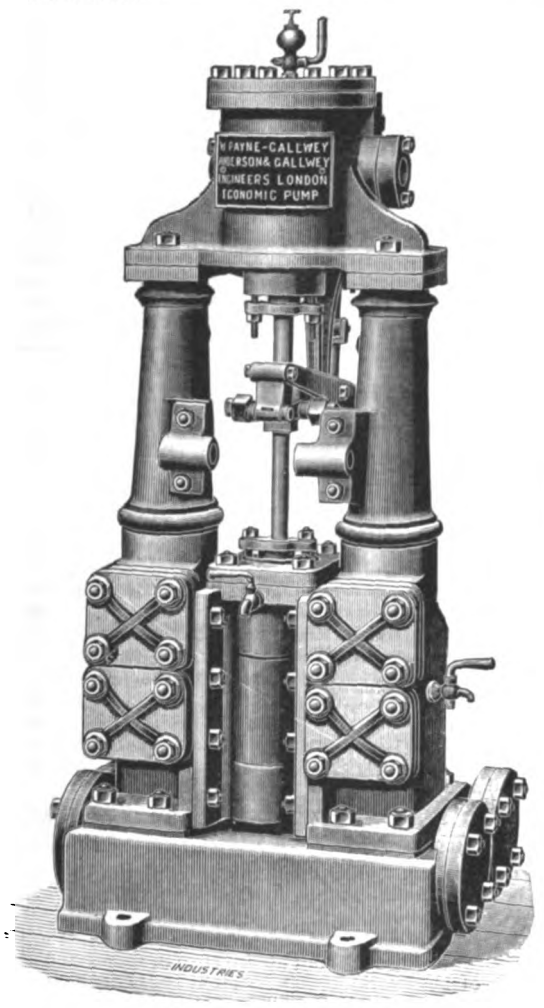


Fig. 6.—Boiler Force Pump.

The nature of the ground upon which the plant is erected was so treacherous, that the customary mode of making the machine framing of a massive casting had to be abandoned, and a new method of designing the main framing had to be arranged.

After much thought had been given to the matter, it was decided to build the frame of steel plates 1½in. thick, and to stiffen them with angles and internal bulkheads. The reduction in weight accomplished by this novel arrangement is very considerable, while the rigidity and stability are very great, as may be judged from Figs. 1 and 4. In the construction of this framing, the rivet holes were drilled in position and the rivets were closed by one of Messrs. Anderson & Gallwey's "Eagle" riveters. The holder up or hob is of solid cast steel, and weighs about 13 tons. It is secured to the frame by two forged steel bolts 8in. diameter, whose threads are swelled up and cut of saw-toothed section, the thrust face of the threads being vertical. Between the hob and main frame there is a distance piece, which is made of plates of box section. The cylinders and rams are all of cast steel. The main or rivet-closing ram is hollow, and within it is the plate-closing ram; by this arrangement a pressure of 100 tons is first brought to bear on the plates to close them; then another 100 tons is put on the rivet; and afterwards the entire pressure of 200 tons is put upon the rivet head and plate.

The steam travelling crane shown in illustrations Figs. 2 and 3 spans the great riveter and the large shop in which it is mounted. It is composed of an oak gantry which has a 41ft. span and is 50ft. high; it is designed to raise and manipulate a complete marine boiler weighing anything up to 50 tons. The power is obtained from two engines, whose cylinders are 8in. diameter by 10in. stroke; double 1in. chains are used, and they work through cast steel pitch wheels. The cross beams are of oak 18in. square, trussed with eye bars.

The hydraulic power is supplied by the duplex horizontal direct-acting pumping engines shown in Fig. 5, page 316. These pumps have two high-pressure steam cylinders, each 22in. diameter by 18in. stroke. The pump ends are 3¼in. diameter, and have double rams connected by side rods. The output is 70 gallons per minute, at a pressure of 1,500lb. per square inch. Two steel locomotive type boilers, shown in Figs. 12 and 13, page 324, supply steam to the pumps and to the crane; each is capable of working the entire plant independently, and can do duty equal to about 130 i.h.p. The exhaust steam is partly used in a feed heater of the horizontal multitubular type, and the rest is discharged up a special upcast pipe, or into the chimney. The accumulator for the riveter is of large proportions, and the tower in which it works and is guided is illustrated in Fig. 7. This tower is a structure composed of 12in. by 6in. rolled joists, stiffened with T braces and angular struts. The whole stands on a base made of 12in. by 6in. joists, which are stiffened at the top and bottom by ½in. plates. Its stability is such as to allow of the canting of the whole, with its loaded counterweight box containing 100 tons, at an angle of 15°, this precaution being taken on account of the treacherous nature of the foundations. Some idea for the necessity of this provision may be gained when it is stated that it has to stand within a few yards from a river bank, and that upwards of eighty 70ft. piles have been driven to obtain a firm base. The accumulator ram is 14in. in diameter, and works in a cast-steel cylinder allowing a 10ft. stroke. The boiler force pump (Fig. 6) is supplied with a lever for hand working in accordance with the requirements of the Dutch law.

The complete plant presents a very massive appearance, and certainly reflects great credit upon the designer. Large as this installation is, Mr. Payne-Gallwey is, we understand, about to eclipse even this his latest effort, and we hope ere long to have the opportunity of describing some other very large machinery on which he is now engaged.

200-TON HYDRAULIC RIVETING PLANT.

Designed and Constructed by Messrs. Anderson & Gallwey

(W. Payne-Gallwey, Engineer), London.

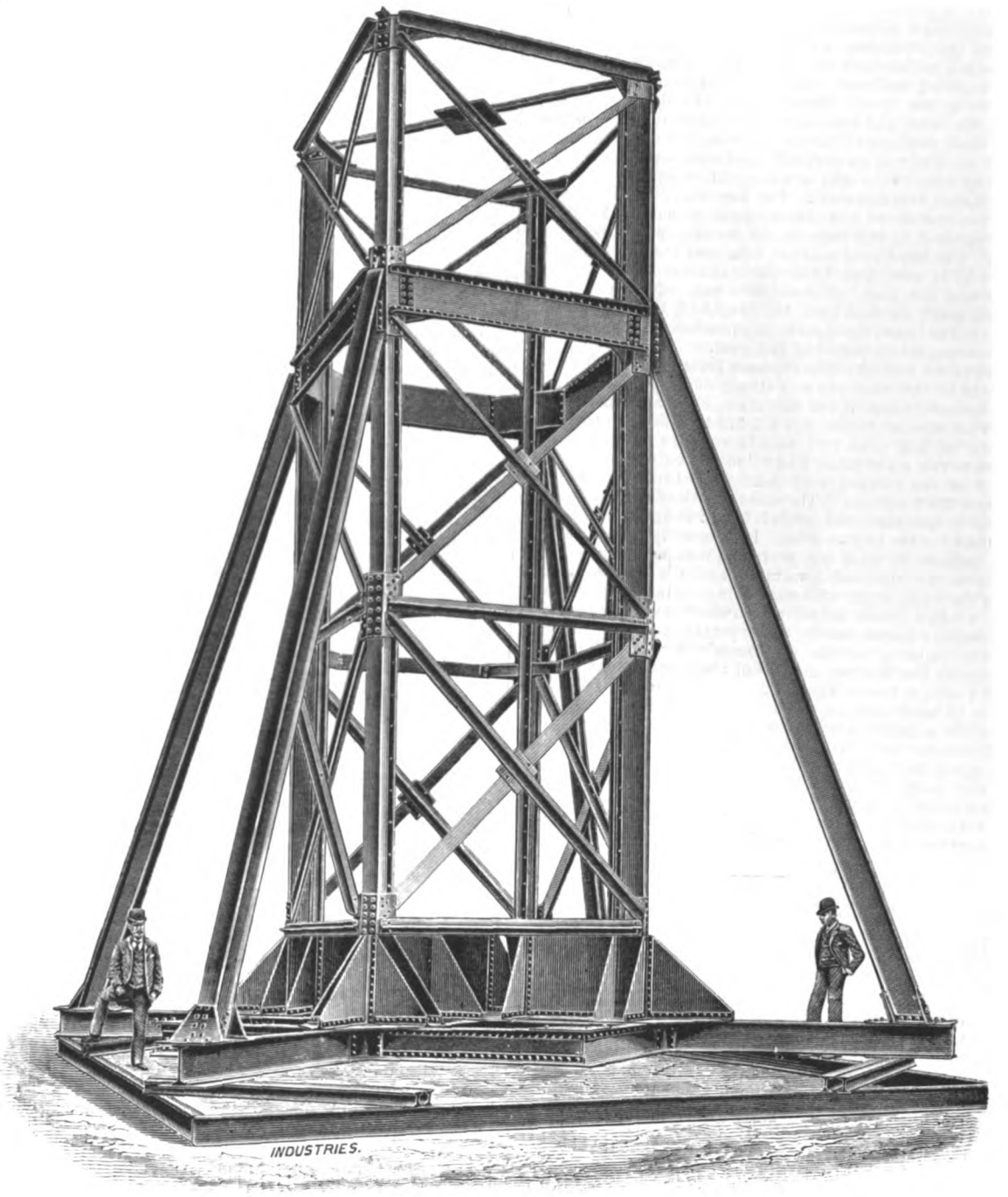


Fig. 7.—Framing Connected with Hydraulic Accumulator.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

(FOR LATEST TELEGRAPHIC DESPATCHES SEE PAGE 321.)

PARIS, 1st April, 1890.

IRON.—Though there is an appearance of firmness in the iron markets, in reality the position is less strong than it was at the beginning of last month. Here in Paris not even the appearance is kept up. The merchants are willing to make large concessions to buyers, so that iron may be bought several francs a ton below the official quotations. Prices are maintained in the provincial markets, but the shrinkage of business continues. There is considerable activity in the Haute Marne, where the demand is very brisk for wire and wire-nails. In other districts buyers limit their dealings to the strict necessities of the moment. If the price of coal be reduced—and there are symptoms of a giving way—there will be a drop of several francs a ton for finished iron and steel. The imports of pig iron in the first two months of the current year amounted to 19,485 tons, against 23,066 tons in the corresponding period of 1889. The imports of finished iron and steel were respectively 3,547 tons and 1,132 tons, against 3,707 tons and 1,426 tons last year. The exports were—Pig iron, 39,016 (2,932) tons; finished iron, 14,282 (3,329) tons; and steel, 6,646 (6,123) tons, the figures in parentheses being those for the corresponding period of last year.

STATE OF TRADE.—The Customs returns for the first two months of the year show a steady development of trade. The declared value of the imports in February amounted to 393·4 millions of francs, against 372·1 millions in the same month of last year. Of this increase 20 millions are set down to raw materials. The value of the exports in February of the current year amounted to 277·0 millions against 259·9 millions in the same month of 1889. The increase in manufactured goods is from 246·5 millions to 264·9 millions for the two months. It is worthy of notice that the imports of wool ten years ago were valued at only 30 millions for the first two months of the year, while this year the value is 82 millions. The growing importance of the woollen goods industry is hereby made manifest. A noteworthy feature among the exports is the great increase in the value of articles of women's dress (ready-made), which for the first two months of the current year appears as 8·4 million francs, against 2·5 millions in 1889. The exports of machinery for the same periods show an increase from 5·2 million francs to 7·8 millions.

COLLIERS AND MILITARY SERVICE.—M. de Freycinet has given an assurance that the colliers will not, in case of war, be called on for military service, the supply of coal being regarded as too important a matter to be interrupted in such circumstances. Coal being declared contraband of war, the foreign supply would be wholly cut off.

BERLIN, 31st March, 1890.

IRON.—The number of blast furnaces now in blast in the Upper Silesian district is thirty, the weekly output of which is from 2,700 to 3,000 tons, a quantity insufficient to meet the requirements of consumers. Hence the market is very firm. Makers of finished iron and steel have plenty to do. Fresh orders come in freely. Prices are therefore easily kept up. At the machine works of the Donnersmarckhütte a number of Schmidt's patent tubular boilers are being constructed for export to China, Japan, and Australia. Business in the Berlin market is becoming more active. The tone of affairs generally is strong and hopeful.

THE FRANKFORT EXHIBITION.—The programme of the International Electrical Exhibition, to be held next year at Frankfort on-the-Main, has just been issued. There will be twelve sections, as follow:—(1) Motors for electrical purposes (steam, water, air, and gas); (2) generation of electricity; (3) conduction of electricity—all means of conducting and auxiliary apparatus; (4) electrical accumulators and transferring apparatus; (5) electrical power transmission in its application to industrial purposes of all kinds; (6) electrical lighting, with special division for installations of all sorts; (7) telegraphy and telephony; (8) electric signalling; (9) electro-metallurgy and electrolysis; (10) surveying instruments, apparatus, acoustical and optical instruments relating to electro-technics, and means of instruction; (11) application of electricity in medicine and surgery; (12) electro-technical literature.

GERMANY'S FLOATING EXHIBITION.—The success of this undertaking is now fully assured. So far, 360 large manufacturers have taken part in it, and the support of many others is in prospect. The plans of this exhibition steamer have been finished, and tenders have been invited from three first-class German shipbuilders for its construction, which is to take about a year. The dimensions are to be—length, 570ft.; breadth, 70ft.; and depth, 45ft. The largest ship at present afloat, the "City of New York," is 560ft. long, by 63ft. wide, and 44ft. deep. Hamburg was at first intended as the starting-point of the Floating Exhibition, but Bremerhafen has now been chosen.

THE WATER POWER OF THE RHINE.—Several manufacturers of Winterthur are now engaged in a scheme for tapping the energy of the Rhine at the Schaffhausen waterfall. Water to supply 1,500 h.p. is to be withdrawn from the river, and its energy will be transmitted as a current of electricity to the factories at Winterthur. At present the scheme is somewhat limited, but no doubt in case of its success an extension will be thought advisable. The manufacturers for whom the work has been carried out congratulate themselves on their independence of coal strikes.

GAS ENGINES.—As an indication of the profitable nature of the gas engine business, it is interesting to note that the Gas Motoren Fabrik Deutz, the holders of the "Otto" patent for Germany, have made a profit last year of 1¼ million marks. They will pay a dividend of 36 per cent. as compared with 31 per cent. for the previous year.

LABOUR.—Labour complications continue to disturb all the great industries of the country, and to give rise to much anxiety. From all parts we hear of fresh strikes. A large number of the textile hands in the Chemnitz district are idle. Some serious strikes have occurred among the coal miners of Westphalia, which are likely to develop into another grave conflict between the colliery owners and their men in that locality. Everywhere there is manifested a feeling of discontent and a determination to advance further the rate of wages.

PRICES OF LOCOMOTIVES.—The following are the tenders for the locomotives received here on the 17th inst. For 35 express engines with tenders:—The Hannoverische Maschinenbau-Actiengesellschaft tendered for 10, at 50,900 marks; Henschel, of Cassel, for 13, at 50,900 marks; and A. Borsig, of Berlin, for 12, at 51,000 marks. For 45 ordinary passenger engines with tenders:—Henschel tendered for 13, at 48,850 marks; the Elsässiche Machinenfabrik, at Gravenstaden, for 17, at 48,900 marks; the Berlin Maschinenbau-Actiengesellschaft, 15, at 48,950 marks. For 140 ordinary goods engines with tenders: Schichau, of Elbing, tendered for 20, at 43,500 marks; Henschel, for 39, at 45,350 marks; the Hannover Maschinenfabrik, for 25, at 45,390 marks; the Stettin Vulcan Works, for 25, at 45,400 marks; the Berlin Maschinenbau-Actiengesellschaft for 40, at 45,420 marks; and the Maschinenfabrik Hohenzollern, of Düsseldorf, for five, at 45,450 marks each.

THE ZINC-WHITE INDUSTRY.—The high prices of zinc have seriously restricted the trade in zinc-white. The total production of the Silesian district last year amounted to only 715 tons, against 2,369 tons in 1888. Among the substitutes for zinc-white, zinc dust, which is sold at three-fourths the price of the metal, is being more and more largely used. Another substitute, soap-stone, used from time immemorial in China and Japan for painting metal-work, is also growing in favour here.

VIENNA, 31st March 1890.

THE IRON MARKET.—There is no change to be noted in the iron market, and the improving situation which began last year is continued. Last year's returns show that the production of pig iron was far behind the demand, and that the import of pig has increased in comparison with the previous years. However, most of the finished iron has still to be imported. The following is a table of the imports of the last two years:—

	Tons. 1888.	Tons. 1889.
Pig iron	62,820	81,134
Crude iron	4,180	12,008
Ingots	1,412	1,961
Rails	500	1,376
Wires	993	1,342
Foundry iron	1,919	2,169
Wrought-iron tubes	1,502	2,067
Railway wheels	383	678
Wire ropes	127	230
Bar iron	8,500	4,300
Sheets and plates	202	106
The exports were as follow:—		
Pig iron	6,336	7,519
Crude iron	2,833	978
Foundry wares	2,153	2,389
Ordinary iron and steel ware.	5,863	7,048
Wrought-iron tubes	237	559
Nails	543	1,047
Boilers	113	340
Wire	716	885
Rails	724	939
Sheets and plates	2,034	1,853
Screws	115	85

THE COAL MARKET.—The situation of the coal market continues firm, and prices are still increasing. The export steadily advances. The export coal traffic has reached such a height that the Bohemian Members of Parliament are bringing in a Bill for its regulation, in order to protect home industries from the scarcity of fuel. Another sign of the situation of the market is the fact that the Bustehrad Railway, which is principally occupied with coal traffic, is doubling the tracks of some of its lines.

ELECTRICAL ENGINEERING.—At the Jubilee Exhibition, to be held at Prague, there will be engines of 1,000 h.p. for supplying the electric current. It is intended to use 350 arc lamps and 650 glow lamps, and the remainder of the current will be employed for driving certain machines.—On the Budapest electric tramway the electric light is being used; the current for supplying the lamps is obtained from the accumulators on the cars.—Two large central electric lighting stations are about to be erected, one at Fiume and the other at Linz.—It is proposed to connect the towns of Fiume and Abazzia by means of an electric tramway.

PAPER.—The paper trade has been excellent all through the empire during the past year. The home demand has been good, but the export to eastern countries has been better. The Leykam Josephsthal Company is paying a dividend of 7 per cent. on last year's trade.

BRUSSELS, 1st April, 1890.

THE IRON MARKET.—The position of the iron market has slightly improved. Several new orders for exportation have come to hand, and have filled up the gap which was beginning to make itself apparent. In merchant bars some business has passed at 11·5fr. In sheets the trade continues fairly good, and buyers do not make any difficulty about a price of 22fr. It is proposed to put into blast some more blast furnaces in the Charleroi district, a step which will be welcomed by collieries and rolling mills. The Société des Forges have finished the construction of the two-storey iron house for the Congo. The building will be erected at Oiseau before it is sent to its destination, and it is expected to be ready by the 10th inst. La Société des Conduits d'Eau of Liége have just sent off 500 tons of steel water mains to Denmark. To-morrow the tenders will be opened for the supply of 2,600 tons of steel rails of the Vignoles type, 52 kilogs. per metre, for the State railways.

THE COAL MARKET.—The coal market continues to be very animated. Concessions, however, are more easily gained from the sellers in the renewal of orders; in fact, one might safely count on the new prices being a shade lower than the former ones. Some impatience is manifested as to the result of the adjudication of the State Railways on the tenders for the 75 lots of 2,000 tons each of locomotive coal; and it is probable that business will be retarded in order that the state of the market shall be fully ascertained before any further contracts are entered into. It was decided a short time ago that the railways should have sufficient fuel in stock to last for 75 days; now, however, the Administration has thought proper to reduce this to 30 days. Close burning coal is quoted at 15fr., and *fines demi-grasses* at 16fr.; coke is still at 35fr.

THE GLASS TRADE.—The state of the glass market does not improve; prices lack firmness, and further concessions are being granted. The scheme for the regulation of the trade in glass with the United States has unexpectedly collapsed on account of unforeseen opposition, and the consideration of the project stands adjourned for the present.

DÜSSELDORF, 1st April, 1890.

IRON.—The uncertainty of the situation arising out of political changes and recent developments of the labour question has caused a serious shrinkage of business in the iron markets. There is hardly anything doing in pig iron. The absence of buyers has not yet led to weakness in manufacturers' prices, because the blast-furnace owners are sold far forward, many of them to the end of the year; but the merchants are giving way. Forge and foundry pig may now be bought from second hands several shillings a ton below manufacturers' prices. The market for finished iron and steel continues active, but the volume of business transacted is considerably less than it was a month ago.

COLLIERS' WAGES.—Troubles are again breaking out in the coal mining industry. Partial strikes have occurred in several places, and these interruptions of the work of production tend to become more numerous and more serious. The latest of these disturbances reported from the mining district is a strike at the "Consolidation Colliery" at Schalke, one of the largest and best managed mines in the country. The men demand an advance in wages and a reduction of the working day to eight hours, including the time occupied in winding. The published accounts of the company show that the average wages of all underground hands, after the cost of blasting powder, timber, and oil had been deducted, were in the first quarter of 1889, 3·08 marks, in the second quarter 3·32 marks, in the third quarter 3·49 marks, and in the fourth quarter 3·58 marks per shift, an increase of about 16¼ per cent. in the year. A further increase has taken place since the beginning of the current year, making the rise in a little over twelvemonths upwards of 20 per cent. This is an average for all hands, be it observed. The advance in heavers and putters' wages in the same time is but little short of 40 per cent. The men now demand a further rise of no less than 50 per cent.

COMPETITION IN THE IRON TRADE.—The relative state of the iron trade in Germany, Belgium, and France, as manifested in the ability of manufacturers to compete one with another in foreign markets, is significantly shown by the recent tendering for 150 Martin steel tyres of 866mm. and 140 of 900mm. diameter for the Roumanian State railways. The prices are f.o.b. Galatz, except in the case of Dietrich & Co., of Niederbronn, whose price is free on trucks at the frontier railway station of Verciorova. German firms: Reinische Stahlwerke, at Ruhrort, 17,085fr.; Phœnix Actiengesellschaft, at Laar, near Ruhrort, 18,760fr.; Bergwerks and Hütten-Verein, at Hörde, 20,415fr.; Oberbilker Stahlwerk, at Oberbilk and Düsseldorf, 21,574fr.; Union Actiengesellschaft, at Dortmund, 22,110fr.; Fried. Krupp, of Essen, 25,579fr.; Georgs-Marien Bergwerks & Hütten-Verein, at Osnabrück, 23,852fr. Belgian firms: Société John Cockerill, at Seraing, 18,961fr.; Société des Aciéries d'Angleur, at Renory, 20,100fr. French firms: Société des Aciéries et Forges, at Firminy, 19,095fr.; Schneider & Co., of Creusot, 19,430fr.; Compagnies des Hauts-Fourneaux, &c., at St. Chamond, 20,100fr. Dietrich & Co., of Niederbronn, in Alsatia, tendered 20,740fr.

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HIGHER PRICES FOR PAPER.—At a meeting of paper-makers held here a few days ago, at which nineteen firms were represented, it was resolved unanimously to advance the prices of packing paper forthwith to cover the additional cost of the raw materials of manufacture, which have increased fully 15 per cent. in price within the last six months. The rates for paper are to be advanced in a like proportion. The trade in packing paper with England is large and constantly growing.

LILLE, 1st April, 1890.

IRON.—The iron market continues quiet and the prospect discouraging. The fresh orders coming to hand are not sufficient to keep the works going. It is hoped that the early spring which we are now enjoying will stimulate the business in building iron. Prices are as follow:—For bars and joists, 156s. to 160s.; common plates, 196s.; steel plates, 216s. a ton Manufacturers maintain these rates firmly, but merchants are ready to make some concession to tempt buyers. Founders are well provided with work. On the whole, the tone of the market is weaker than it was a fortnight ago.

TEXTILE MANUFACTURES.—The situation of the linen goods trade continues satisfactory. The demand is brisker than usual at this time of the year, and there are indications of greater activity as the spring advances—greater, that is, than the average of past years, for some falling off in the demand may now be expected. In the ordinary course of things the busy season comes to an end with the month of March. From Roubaix we learn that business in woollen goods is very slack. Of fresh orders to close the season there are practically none. The prospects for next winter's trade are said to be very good.

FLAX AND YARNS.—The flax market continues animated for home-grown produce. The demand is brisk, and as there is not a large stock on offer, prices remain firm. The market is quiet for Russian produce, with no alteration in prices. For tows of good quality full prices are easily obtained. Yarns are in brisker demand. Jute yarns are still an active market, at former prices.

AMSTERDAM, 31st March, 1890.

THE AMSTERDAM WATERWORKS.—The Town Council of Amsterdam will be asked to continue the Commission appointed for the supervision of the concession of the Water Works Company.

ELECTRIC LIGHTING AT AMSTERDAM. The well known firm of electricians, Messrs. Siemens & Halske, of Berlin, have withdrawn their tender for the electric lighting of the greater part of the Dutch capital.

NEW AGRICULTURAL COMPANY.—The Official Gazette has published the articles of Association, as approved by the King, of the Netherland South African Agricultural Company, established at Amsterdam, with the object of promoting land cultivation, cattle rearing, and dairying in the South African Republic. The capital is 2,000,000 guilders.

THE PETROLEUM TRADE AT AMSTERDAM.—The "petroleum harbour" at Amsterdam does not seem to have answered the purpose for which it was established at very great expense. At least, the town authorities have laid a proposal before the Town Council to let the whole of the property, if possible, to a syndicate or combination, that will endeavour to establish a petroleum depot and trade there as originally intended.

THE MAILS TO EAST AFRICA.—It was rumoured that Rotterdam had been selected as the Dutch port of call for the steamers in the new subsidised German mail service between Hamburg and East African ports. This rumour has proved premature, the German Government having come as yet to no final decision on the point. The Rhenish provinces and Southern Germany are in favour of Rotterdam, but the Hamburg people seem to prefer Amsterdam

LABOURERS' DWELLINGS IN AMSTERDAM.—The Amsterdam Association of Labourers' Dwellings is enabled to pay for the past year a dividend of 2½ per cent. upon the ordinary shares. At the end of 1889 the society still owed the city of Amsterdam upwards of one million guilders for advances made, upon which it had to pay interest at a rate of nearly 5 per cent. Last year it received 91,000 guilders in rents, and 15,000 guilders was repaid to the city of Amsterdam. This is one of the largest, but not one of the most prosperous, building societies of Holland.

INCOME TAX REJECTED.—The Second Chamber of the States-General has rejected by a very narrow majority the Income Tax Bill, which had been introduced by some private members. They were supported by the Liberal party, but opposed by the Government and its adherents, although the Ministers had to admit that a readjustment of taxation, so as to increase the land tax and to get at the holders of securities to bearer, was urgently required, as urgently as the reorganisation of the communal finances and the lightening of the salt tax. The Government has also a Bill pending imposing customs dues on foreign goods imported *ad valorem*.

THE WATER QUESTION AT AMSTERDAM.—The Hill Water Supply Company, an English company which has contracted to supply the Dutch capital with water collected in the Dunes near Haarlem, has been called upon to remove the defects in the system of distribution and to increase the supply, thereby avoiding the recurrence of the "water famine" of last year. It will be recollected that a special committee reported that the company was evading the stipulations of its charter by using a low pressure in the Dunes, and thereby preventing a "waste" of water, but in reality creating an artificial scarcity caused by a defective system of collecting and intercepting the hill water. It was proposed to increase the pressure, and provide for a better distribution of water from the Dunes to Amsterdam. The Hill Water Supply Company has been "invited" to do both things, and it has signified its willingness to execute the necessary works, which are to be done under the supervision of the town authorities.

COPENHAGEN, 29th March, 1890.

SHIPBUILDING IN NORWAY.—Last year the Norwegians considerably increased their merchant fleet. At the beginning of the present year there were in the course of construction in Norway 36 steamers, with an aggregate tonnage of 15,775 tons, and 33 sailing vessels, with a tonnage of 15,330 tons.

STEAM TRAMWAY IN DENMARK.—The steam tram from Copenhagen along the Sound as far as Klompenborg, about six miles, is not doing well. The receipts for last year amounted to 177,099kr., but as the expenses were 187,474kr., there was a loss on the year of 10,375kr., against 18,722kr. for the previous year and 7,788kr. for 1887. On the other hand the Copenhagen horse tramways are as a rule doing well—some of them very well indeed.

GRAIN ELEVATORS AT ST. PETERSBURG.—On account of the unsatisfactory and antiquated state of the St. Petersburg quays, there has for years been a decided want of despatch in the loading and discharge of vessels. Several attempts have been made to bring about improvements in this respect, among others by an American syndicate, which offered to supply the whole of Russia with grain elevators. The matter was allowed to rest, however, till two Russian gentlemen, last spring, obtained a concession for the erection of elevators at St. Petersburg. They have lost no time in setting about the work, and one elevator building has already been ready for some months. Its capacity is considerable—45,000,000lb. of grain.

SHIPBUILDING AND ENGINEERING.—The Burmeister & Wain Engineering and Shipbuilding Company, Copenhagen, the largest establishment of its kind in Denmark, held its annual meeting on the 15th inst. The business during the past year showed a very considerable advance. New vessels had been built with an aggregate tonnage of 6,643 tons against 2,200 tons for the previous year. The gross profits on the year were 801,000kr., and the net profits amounted to 496,036kr.—The United Steamship Company, of Copenhagen, have issued their report for last year, from which the following particulars will be of interest: The amount of freights during 1889 was 13,923,044kr. The expenses for all the vessels for repair, overhauling, &c., were 799,175kr., and working expenses amounted to 9,650,066kr., making a total of 10,449,241kr. Marine and fire insurance incurred an expenditure of 238,214kr., managing expenses amounted to 259,433kr., and in interest has been paid 318,394kr. The surplus on the year, therefore, amounts to 2,952,044kr., of which 1,129,838kr. is net profit.

MADRID, 31st March, 1890.

RAILWAY CONCESSION.—A concession has been granted to Messrs. Murrieta, of London, to establish a railway to go from some mines in the vicinity of Baracaldo to the River Galindo for shipment of iron ores.

THE VINE DISEASE IN SPAIN.—The increase in the number of vineyards in Spain attacked by phylloxera is shown by the following table:—

Provinces.	Hectares.
Gerona	26,516
Barcelona	2,569
Tarragona	439
Malaga	84,000
Granada	9,429
Leon	8,310
Almeria	3,214
Orense (Galicia)	2,529
Salamanca	326
Total	137,332

The value of the crops lost annually is calculated at about £1,250,000. Much has been done to stop the disease, but nothing successful has been found so far. Lately some new ideas on mineral manures of M. Georges Ville, the well-known French professor, seem to offer more hopes than anything previous as a cure or preservative.

ANTIMONY ORES.—The first lot of antimony ore, of great yield, from the Zalamea de la Serena Mines, in Estremadura, has been despatched from the mines for England. A large sample of this ore, sent to Germany, was analysed, and found to contain 15 grammes of gold per ton. As a rule, all the ores of that place, both antimony and silver lead, have shown more or less gold, but the company do not yet look upon their property as a gold mine.

RAILWAYS IN CUBA.—The largest concession for a system of railways that has ever been made in one lot by the Spanish Government is to be made shortly for a number of lines to be called the "Central Railway of Cuba." The estimates for this line come up to the large sum of £4,950,000. The Government invites tenders, guaranteeing 8 per cent. interest. The conditions are of a rather complicated character, but the belief is that Mr. Ivo Bosch, the Catalonian banker, will tender for the concession. Mr. Bosch took up the Porto Rico railways and the Linares and Almeria line. His plan is supposed to be to issue a great number of debentures in proportion to the cost of the work.

NEW YORK, 22nd March, 1890.

THE COAL MARKET.—The anthracite coal trade is still in a dull and depressed condition, but prices are no weaker than they were last week. The cold weather has caused a good demand on retailers and improved the trade somewhat. The decrease in the output for February is a good feature in the present condition of the trade. The official figures show about 1,800,000 tons, or 200,000 tons less than the allotment. The production of coal since the 1st of January is 400,000 tons below the average consumption for January and February during the past four years. The production for 1890 to date is 600,000 tons less than for the same period in 1889, and the whole of that year was nearly 3,000,000 tons less than 1888. These facts must tell on the trade in time, and the market is sure to take 35,000,000 tons during the current year. The present dull season is likely to continue until July, as stocks are large, but there seems to be no reason why the trade in the latter half of the year should not be active and at good prices.

NEW LINE OF STEAMERS TO JAPAN.—Contracts providing for a monthly line of steamers between Portland, Oregon, and Asiatic ports were executed on the 3rd inst. in San Francisco by the Union Pacific Railway officials and Frank Upton, of Kobe, Japan. The first steamer will arrive in Portland in June with a cargo of new crop tea.

SUBSIDIES RECOMMENDED FOR STEAMERS.—The report of the Pan-American Committee on communications across the Atlantic was presented to the Conference a day or two ago. The committee recommend that aid be given one or more lines of steamers between ports in the United States and those of Brazil, Monte Video, and Buenos Ayres. The conditions imposed are that the companies receiving Government aid shall establish a fast bi-monthly service between the ports named, with steamers having passenger and freight accommodations, and carrying the mails. The speed of steamers is to be at least sixteen knots per hour, and the tonnage not less than 5,000. The committee also recommends an auxiliary line of freight steamers twice a month, having a speed of twelve knots. Brazil and the United States are to pay one-half each of the amount the lines receive. The contracts are to last ten years, and will take into consideration that existing between Brazil and the present line.

TRYING NAVAL GUNS.—A test has been made of the "Vesuvius" gun for throwing cartridges charged with gun-cotton. Several dummy shots were fired, and then one loaded cartridge from each gun, each shot striking over a mile away from the vessel. The cartridges weighed 504½lb. to 510½lb., and carried something over 200lb. of gun-cotton. The first of the cruiser "Baltimore's" 8in. guns has been tested at the naval proving grounds, Annapolis. A charge of 110lb. of American brown powder gave to the projectile of 250lb. weight an initial velocity of 2,130ft. per second, the pressure being only 13 tons per sq. in.

THE IRON AND STEEL TRADE.—There has been no improvement in the outlook for the iron trade during the past week. Consumers are not inclined to take more than is absolutely necessary while the market is in its present unsettled condition, and producers are finding the cost of manufacturing continually increasing. A continuation of the present condition of affairs will send prices below the paying point, while a moderate demand would be very likely to send them up again. But little is doing in pig iron, as neither buyers nor sellers are willing to name figures on good-sized lots or for later delivery that are at all near the market. Several of the heavier consumers will need iron soon, but it is doubtful whether they will take more than sufficient to cover present needs. In manufactured iron matters are in about the same condition. In bar iron a few large orders have made the demand a little heavier, but prices are unchanged. A number of mills are running out their old orders, and are becoming anxious for new business. The demand for plates is fair, but prices are falling off. Makers claim that there is plenty of business for the near future. Steel rails are dull. There is considerable unwillingness to pay the high prices asked for large lots, and buyers continue to make their contracts only for their month's supply. Mills have plenty of other work on hand, and can afford to wait.

PHILADELPHIA, March 21st, 1890.

A LARGE STEEL OUTPUT.—The Scranton Steel Works last week exceeded the record in America in the manufacture of steel ingots by 414 tons with two 6½-ton converters, the total output being 5,456¾ tons against the previous run of the Lackawanna Iron and Coal Company's output of 5,042¾ tons with two 7-ton converters. The company also record the largest turn and day record during the week, the former being 800 tons, and the latter 1,400 tons.

A FAST RUN.—Some days ago the Pennsylvania Railroad Company ran a special train from New York to Washington, a distance of 231 miles, in 4 hours 19 minutes, including stoppages, making the fastest run ever made between the two cities. The time to Philadelphia was 94 minutes, and the distance 90 miles. The occasion was the transportation of a theatrical company playing in New York to take part in a benefit for the Actors' Fund in Washington. The company played in New York again the same evening.

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200-TON HYDRAULIC RIVETING PLANT.

DESIGNED AND CONSTRUCTED BY MESSRS. ANDERSON & GALLWEY (W. PAYNE-GALLWEY, ENGINEER), LONDON.

(*For description see page* 316.)

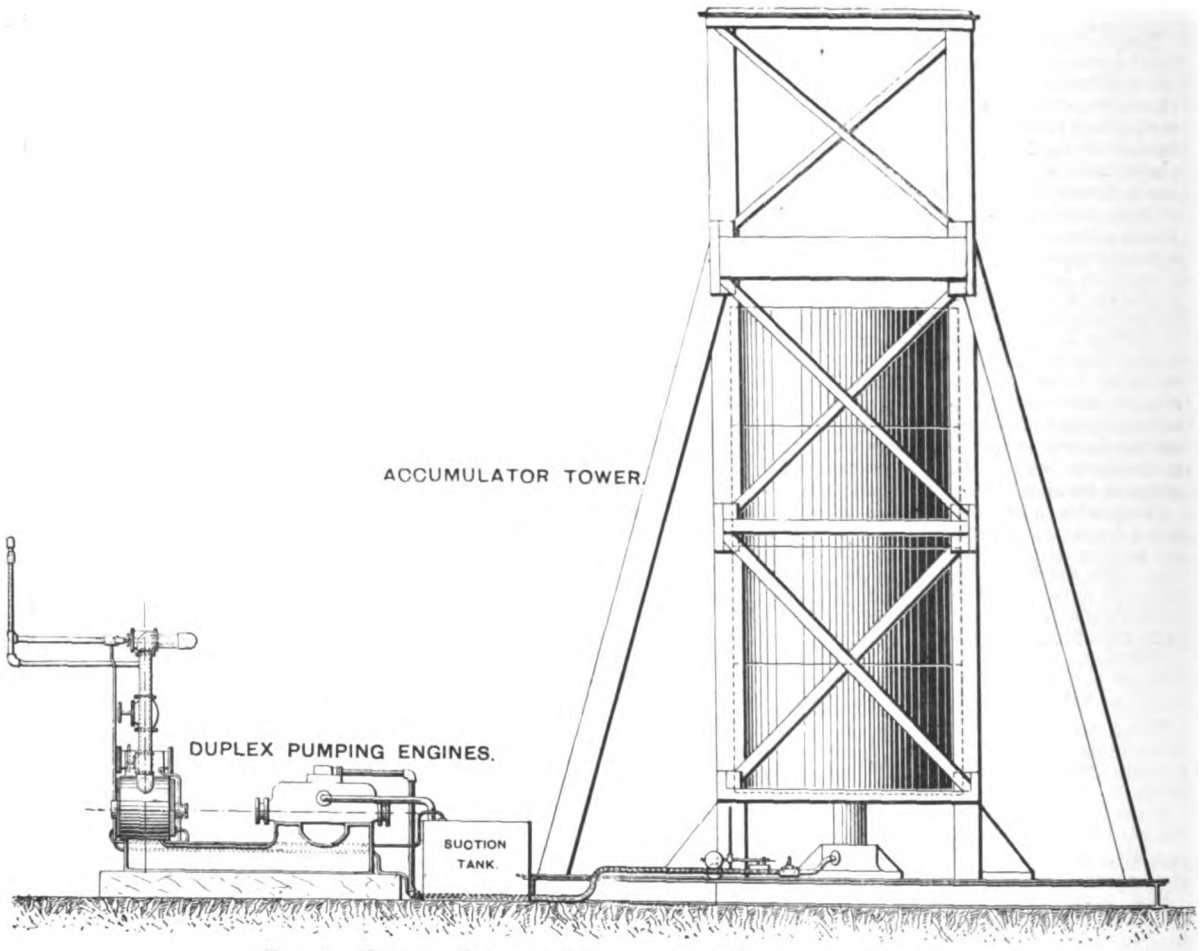


FIG. 9.—VIEW OF PUMPING ENGINES AND ACCUMULATOR TOWER.

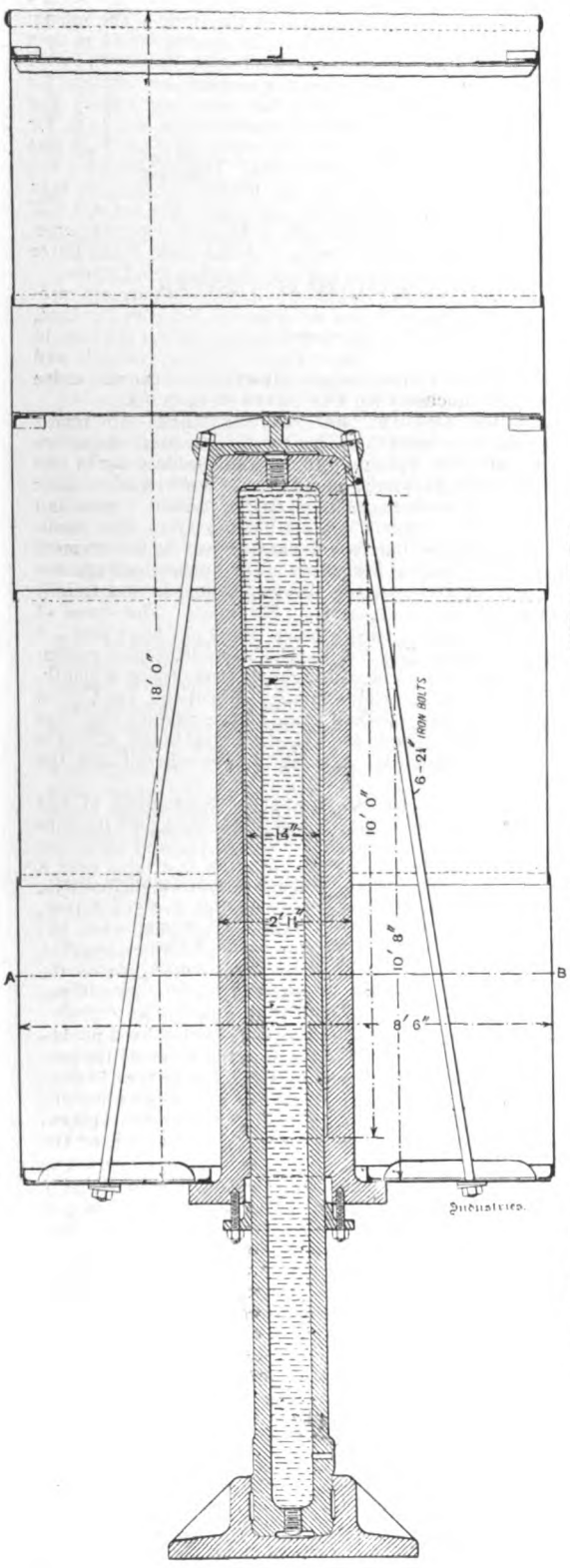


FIG. 8.—SECTIONAL ELEVATION OF ACCUMULATOR.

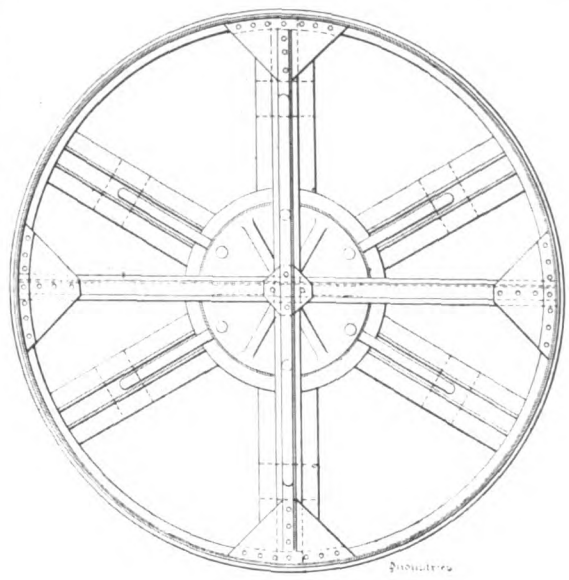


FIG. 10.—TOP PLAN OF ACCUMULATOR.

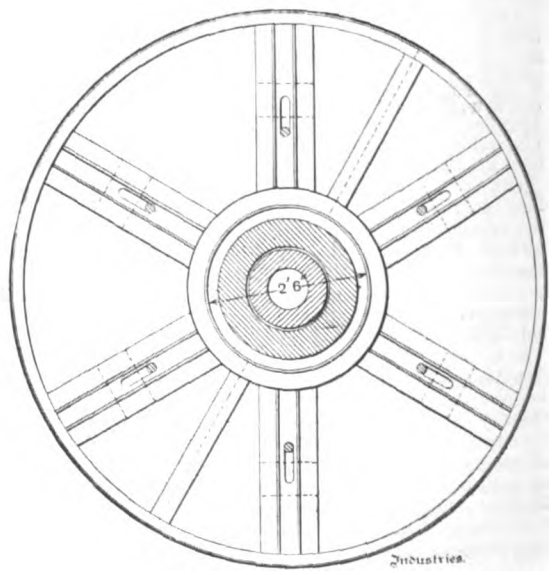


FIG. 11.—SECTION THROUGH A B.

THE EDINBURGH EXHIBITION.

SINCE our last report great progress has been made with this undertaking, and it is confidently expected that it will be quite ready for the opening on the 1st of May. The principal buildings are now completed, with the exception of the internal decorations, and will very shortly be ready for the reception of exhibits. It is perhaps rather soon to express an opinion as to the general appearance of the structure, but it is certainly not very ornate; in fact, the Machinery Hall is severely plain, and, with its long corrugated roof, looks more like an engineer's workshop than anything else. The interior is of a totally different character, and nothing but admiration is expressed, especially for the design of the trussed wood roof. On the whole, perhaps the Executive were right in reducing the cost of the buildings by having as little decoration as possible, and the money saved by this policy will doubtless be spent in a way more appreciated by a Scotchman. The annexes and various auxiliary buildings are also in a forward state, while the grounds and approaches are being rapidly got into order. As we have previously mentioned, a complete covered way, partly in the form of a verandah, extends from the main entrance to the extreme end of the range of buildings, a distance of about half a mile, and will form a delightful promenade when the weather is not favourable for outside amusements. A large staff is at work in connection with the electric light installation, and the boilers have been built in place. Messrs. Brown Brothers, of Edinburgh, are providing one of their combined steam and hydraulic derricks, to lift three tons; it will command the railway siding, and assist in discharging exhibits.

BREAKDOWN OF THE "CITY OF PARIS."

AT the end of last week considerable anxiety was felt about the safety of the Inman liner the "City of Paris," which was several days overdue; and as the weather had not been stormy, it was feared that the machinery had broken down or a collision had taken place. Telegrams from all parts of the world were received making inquiries about the ship, but it was not till Saturday morning that the news was wired from Crookhaven that

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the "Paris" was in tow and everyone safe on board. The captain's report, handed to the Press by the Inman agent, is as follows:—"On Tuesday, the 25th inst., at 5.30 p.m., when 216 miles east of the Fastnet, the starboard engine broke down from an unknown cause. The cylinders went to pieces, injuring the bulkhead and breaking the injection and water-pipe connection, allowing a considerable quantity of water into both engine-rooms in the adjacent section. No one on board was injured." It was soon evident to all that the accident was serious, and that it might be followed by grave consequences, as the vessel at once began to fill, and it required all the efforts of the crew to keep the water from increasing. For two days after the accident the ship drifted aimlessly about without sighting another vessel, but on Friday morning the White Star "Adriatic," bound from Liverpool to New York, was sighted, and its captain offered to take off her passengers and take them to New York, but this was declined. The "Adriatic" then steamed away, and sent to their assistance the London steamer "Aldersgate," bound from New Orleans laden with cotton. At the same time the chief officer, Mr. Passo, was despatched in the life-boat to Crookhaven, so as to communicate with Liverpool for help. The American liner "Ohio" also bore down upon them, and a considerable number of tugs, and all, with the exception of the "Ohio," accompanied the "City of Paris" to the entrance of Queenstown Harbour. While at Queenstown a thorough examination of the ship was made by divers, by whom it was discovered that there was no hole in the bottom as was expected. From their searches it appeared that the sea had gained admittance to the holds owing to the bursting of the injection pipes which fed the condenser with sea water. These pipes were at once plugged, and the water pumped out of the holds. In a short time the vessel drew her natural draught again, and she was at once propelled to Liverpool by her uninjured port engines. The repairing work will unfortunately be tedious and expensive, and she will hardly be able to resume service this season.

Notices of Meetings.

THIS WEEK.

SHEFFIELD SOCIETY OF ENGINEERS.—Saturday, April 5. Lecture by B. H. Thwaite, C.E., of Liverpool, "On the Development of the Open-Hearth Steel Furnace."

NEXT WEEK.

ROYAL INSTITUTION.—Monday, April 7, at 5 p.m. General Monthly Meeting.

THE INSTITUTION OF CIVIL ENGINEERS. Tuesday, April 8. No Meeting. Friday, April 11, at 7.30 p.m. Paper to be read: "Description of the Roof over the Carlisle Markets," by Mr. F. P. Reynolds. Tuesday, April 15, at 8 p.m. Paper to be read: "The Application of Electricity to Welding, Stamping, and Other Cognate Purposes," by Sir Frederick Bramwell.

THE INSTITUTION OF ELECTRICAL ENGINEERS.—Thursday, April 10, at 8 p.m. Papers to be read: "On Signalling Across Rivers in India," by Mr. W. T. Melhuish; "The Diathermancy of Air in Relation to the Efficiency of Incandescent Lamps," by Mr. Frederick Higgins.

PRICES CURRENT, 2ND APRIL, 1890.

Quotations at per ton, unless otherwise specified.

METALS.

Spelter:	Ordinary	£23	0	0	to £23	5	0
Copper:	British Cakes and Ingots	54	0	0	„	55	0	0
„	Chili Bars, G.O.B.'s	47	12	6	„	48	0	0
„	Other sorts, G.M.B.'s (equal to Chili Bars)	47	12	6	„	48	0	0
„	Manufactured (strong)	61	0	0	„	.....		
Lead:	Common Pig	13	12	6	„	13	15	0
„	English Sheet	14	2	6	„	14	5	0
Tin:	Straits	90	2	6	„	90	10	0
„	Australian	90	2	6	„	91	0	0
„	English Ingots	95	0	0	„	.....		

Messrs. Carrick & Brocklebank, Manchester, report as follows:—

COPPER during the past week showed a decidedly stronger tone, which was attributed to the scarcity of cash warrants offering, together with an improved demand. The highest point was reached on the 27th ult, when quotations were £48 15s. to £49 cash, but the improvement was not maintained, and values have since receded, to-day's prices being £47 12s. 6d. to £48, with a steady trade reported. Manufactured still £61 sheets and £64 bottoms, with small business doing.

TIN continues without animation, business done being unimportant. Quotations for foreign are about 5s. easier. To-day's prices, £90 2s 6d. to £90 10s. cash.

LEAD continues quiet, with no practicable change in prices.

SPELTER: Small business doing and prices unchanged.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	7 0 0	.....	7 10 0	f.o.t. wks.
„ Angles	6 15 0	.....	7 5 0	„
„ Plates	7 0 0	.....	7 10 0	„
Staffordshire Bars (cheaper makes)	8 15 0	.....	9 5 0	London.
„ Angles	8 15 0	.....	9 5 0	„
Crown Sheets	8 12 6	.....	9 2 6	„
„ Hoops	8 2 6	.....	8 12 6	„
"Siemens-Martin" Steel Boiler Plates			9 15 0	„
„ Ship and Girder			8 15 0	„

Market easy.

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	77/-	..... 66/-

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

PIG IRON.

Middlesbro' Warrants, No. 3	49/9	Cash
Scotch Warrants, m/n	49/-	„
Hematite Warrants, m/n	58/3	„

Stocks in Stores { Scotch ..... 823,688 —Dec. for wk. endg. 29th, 9,500 Tns.
Middlesbro' 149,848.—Dec. „ „ 5,567 „
Hematite ... 204,528.—Dec. „ „ 1,867 „

Exclusive of stocks in makers' yards.

	No. 1.		No. 3.		
Coltness	72/-	.....	64/-	f.o.t.	Glasgow.
Gartsherrie	70/3	.....	64/6	„	„
Langloan	73/-	.....	66/-	„	„
Summerlee	70/6	.....	65/-	„	„
Glengarnock	73/-	.....	66/-	„	„
G.M.B. ex Store	49/6	.....	49/3	„	„

CHEMICALS.

		£	s.	d.		£	s.	d.
Acid:	Carbolic Crystals ..... lb.	0	0	10½	to	0	1	0
„	„ Liquid ..... gal.	0	1	2	—	.....		
„	Citric ..... lb.	0	1	7	—	.....		
„	Oxalic ..... „	0	0	3½	—	.....		
„	Sulphuric ..... ton	1	12	0	—	.....		
„	Tartaric ..... lb.	0	1	4½	—	.....		
Alum:	Lump (powder 10/- ex.) ... ton	4	17	6	—	.....		
Ammonia:	Carbonate ..... lb.	0	0	3½	—	.....		
„	Muriate (Grey) ..... ton	22	15	0	—	.....		
„	„ (White) ..... „	26	10	0	—	.....		
„	Sulphate ..... „	11	17	6	—	.....		
„	Liquor ..... lb.	0	0	3½	—	.....		
Antimony	..... ton	.....			—	.....		
Bleaching Powder	..... „	5	10	0	—	5	12	6
Bisulphide of Carbon	..... „	13	10	0	—	.....		
Borax	..... „	30	0	0	—	.....		
Benzole	(90 %) ..... gal.	0	3	4	—	.....		
„	(50/90 %) ..... „	0	2	5	—	.....		
Copper Sulphate	..... ton	26	10	0	—	27	0	0
Copperas	..... „	2	0	0	—	.....		
Kieserit	..... „	.....			—	.....		
Lead:	Nitrate ..... „	22	10	0	—	.....		
„	White Sugar ..... „	24	0	0	—	.....		
„	Brown „ ..... „	19	0	0	—	.....		
Potash:	Bichromate ..... lb.	0	0	4	—	.....		
„	Caustic ..... ton	22	0	0	—	.....		
„	Carbonate ..... „	19	10	0	—	.....		
„	Chlorate ..... lb.	0	0	5	—	.....		
„	Prussiate (Yellow) ..... „	0	0	9½	—	.....		
„	Sulphate (Basis 90 %) ..... ton	9	10	0	—	.....		
Precipitate:	Red ..... lb.	0	3	1	—	.....		
„	White ..... „	0	3	2	—	.....		
Salts:	Epsom { Bags ..... ton	3	0	0	—	.....		
	Epsom { Casks ..... „	3	15	0	—	.....		
„	Glauber ..... „	1	10	0	—	.....		
Sulphur:	Sublimed Flowers ..... „	9	0	0	—	.....		
„	Recovered ..... „	4	10	0	—	.....		
Soda:	Ash ..... deg.	0	0	1½	—	.....		
„	Caustic (White 70%) ..... ton	11	0	0	—	11	10	0
„	„ „ 60%) ..... „	10	0	0	—	10	10	0
„	„ (Cream 60%) ..... „	9	10	0	—	10	0	0
„	Crystals ..... „	3	0	0	—	.....		
„	Bicarbonate ..... „	5	15	0	—	.....		
„	Hyposulphite ..... „	6	5	0	—	.....		
Solvent Naphtha	..... gal.	0	4	0	—	.....		
Tartar, Cream of	..... cwt.	5	12	6	—	.....		
Zinc Sulphate	..... ton	7	10	0	—	.....		

Messrs. S. W. Royse & Co., Manchester, report as follows:—

CHEMICALS: Prices of caustic soda, soda ash, and soda crystals remain unchanged, demand being very strong and supplies limited. Bleaching powder is quiet. Rather more business is doing in acetates of lime at lower prices. Acetate of soda is more inquired for, and high figures are asked. Acetates of lead dull. Benzoles are again easier. Only a moderate business is being done in sulphate of ammonia, and prices are barely steady.

OILS.

			£	s.	d.
Cocoanut:	Cochin	per ton	28	10	0
„	Ceylon	„	25	5	0
Cottonseed	.....	„	22	5	0
Cod	.....	„	21	0	0
Lard	.....	„	37	0	0
Linseed	.....	„	22	15	0
Palm, Lagos	.....	„	24	10	0
Rapeseed:	English	„	32	5	0
Seal:	Pale	„	28	0	0
„	Brown	„	22	0	0
Sperm	.....	„	46	0	0
Whale	.....	„	24	0	0
Turpentine	.....	per cwt.	1	10	3
Coal	.....	per gal.			
Petroleum	(Refined)	„	0	0	5½
„	Spirit	„			

SHIPBUILDING NOTES.

ON the 21st ult. Messrs. John Blumer & Co., North Dock, Sunderland, launched the steel screw steamer "Trinidad," built to the order of the Trinidad Steamship Company, Limited, London. The vessel has been specially designed for the iron ore trade. Water ballast tanks on the Macintyre principle are fitted to each hold. The principal dimensions are:—Length, 240ft.; breadth, moulded, 34ft.; depth, moulded, 18ft. 1in. The deck erections consist of long raised quarter-deck, short bridge-house, and top-gallant forecastle. The engines and boilers have been constructed by Messrs. Alley & Maclellan, Glasgow.

ON the 22nd ult. Messrs. John Priestman & Co., Southwick, Sunderland, launched the screw steamer "Siam," built to the order of Messrs. Russel & Spence, Glasgow, for Jan Kinching, Siamese Consul-General, Singapore. The vessel is of the awning-deck type, and of the following dimensions: Length, 258ft.; breadth, extreme, 36ft.; depth, moulded, 22ft. 10in. The main deck is of iron sheathed with wood, and the upper deck and houses of teak. The engines and boilers have been constructed by Messrs. Hutson, Corbett, & Co., Glasgow.

ON the 22nd ult. Messrs. Ropner & Son launched from their North Shore Shipyard at Stockton a steel screw steamer, built to the order of Messrs. R. Ropner & Co., of West Hartlepool. Her dimensions are as follow:—Length over all, 282ft. 6in.; breadth, 38in. 10in.; depth, moulded, 21ft. 11in.; and deadweight capacity, 3,300 tons. She has a short poop, raised quarter-deck, long bridge extending to foremast, short well, topgallant forecastle, cellular bottom for water ballast, four steam winches, multitubular donkey boiler, and steam steering gear. She is built on the web-frame principle, and her holds will give large stowage for cargo. She will be fitted with triple expansion engines by Messrs. Blair & Co., Limited. As she left the ways she was christened "Newby."

ON the 24th ult. the Blyth Shipbuilding Company, Ld., launched from their building yard at Blyth a steel cargo steamer. This vessel is 228ft. long, 32ft. broad, and 16ft. 4in. deep, and has been constructed on the cellular bottom principle for water ballast. There are powerful steam winches to each cargo hold for the rapid loading and discharging of cargo, and a patent windlass on forecastle deck for working the anchors. The steering arrangements consists of a compact hand and steam steering gear fitted up in wheelhouse on the bridge. The engines are of the triple-expansion type, with cylinders 16½in., 26½in., and 43½in. in diameter by 33in. stroke, and they will be made by the North Eastern Engineering Company, Ld., of Wallsend. As the vessel left the ways she was named the "Matteo Premuda."

ON the 20th ult. Messrs. Robert Thompson & Sons, Southwick, Sunderland, launched the steel screw steamer "Ona," built to the order of Messrs. Bailey & Leatham, Hull. The vessel has a straight stem, elliptical stern, short full poop, raised quarter-deck from poop to after end of engine-room, and partial awning deck to stern. The principal dimensions are:—Length, 280ft.; breadth, moulded, 38ft. 10in.; depth of hold, 19ft. 6in. The four large cargo hatchways are provided with steam winches, and the deck machinery also comprises steam steering gear and a direct steam windlass. The engines are of the triple expansion type, the cylinders being 21in., 35in. and 57½in. in diameter and 39in. stroke, and have been constructed by Messrs. Geo. Clark, Limited, Southwick.

FOREIGN TELEGRAPHIC ADVICES.

As we had to publish earlier than usual this week on account of the Easter holidays we were obliged to go to press without the latest telegraphic despatches from our Continental correspondents.

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HOME INDUSTRIES.

LONDON, 3rd April, 1890.

THE MONEY MARKET.—Money has been in strong demand all the week. The necessity for tiding over the holidays has given rise to applications for accommodation which have exceeded the capacity of Lombard Street to supply. The Bank of England has been largely borrowed from, and rates have been well sustained at 3½ per cent. and over. Extensive purchases of gold for Germany have not caused any alarm, as enough has been forthcoming to provide for them, and at the same time to reinforce the bullion in the Bank of England. Discount rates have consequently been easier, and allotments of Treasury Bills at low rates have given the key to this market. A renewed firmness in silver has been observable. The stock markets have been pervaded with a holiday tone all the week; business has been limited, and prices well sustained. The spell of good weather has strengthened home railway stocks. Foreign securities, after a depression produced by fears of trouble on the Berlin Bourse at the settlement at the end of the month, improved when these fears were seen to be exaggerated, if not groundless. The American railway market is uncertain in tone in the absence of any controlling influence in one direction or another. Grand Trunk and Mexican Railway stocks are rather in disfavour. The panic in South African gold shares has ceased, but, though prices show a disposition to re-act slightly, there is no sustained recovery. Nitrate shares are not in request. There is no feature to note in industrial and miscellaneous securities.

COMPANIES.—The following companies have been registered since our last report:—Samuel Webster & Sons, Ld., with a capital of £175,000, to carry on the business of brewers; The Ship "Penrhyn Castle" Co., with a capital of £16,600; The Haswell Gaslight and Coke Co., Ld., with a capital of £5,000; The Ryecroft Mills Co., Ld., with a capital of £50,000, to carry on a business of cotton spinners at Ashton-under-Lyne; William Pearce, Ld., with a capital of £40,000, to carry on business as lead and glass merchants; Fuller's Earth Union, Ld., with a capital of £100,000; Swansea United Breweries, Ld., with a capital of £50,000; The Lightwood Colliery Co., Ld., with a capital of £20,000; The Temple Normanton Colliery Co., Ld., with a capital of £16,000; The Electric Meter Co., Ld., with a capital of £50,000; The East Halkyn Mining Co., Ld., with a capital of £15,000; The Simplex Brake Co., Ld., with a capital of £5,000; Read, Holliday, & Sons, Ld., with a capital of £200,000, to carry on the business of Read, Holliday, & Sons, as chemical manufacturers, &c; Adnams & Co., Ld., with a capital of £35,000, to carry on business as brewers; The Bear Creek Oil and Shipping Co., Ld., with a capital of £50,000; The Anglo-Continental Coal Co., Ld., with a capital of £10,000; The St. George's Ironworks, Ld., with a capital of £5,000; The Atacama Mineral Co., with a capital of £30,000; The Caledonian (Transvaal) Gold Mining and Prospecting Co., Ld., with a capital of £80,000; Hitchman & Co., Ld., with a capital £50,000, to carry on business as brewers; The Springfield Breweries Co., Ld., with a capital of £105,000; The Carmarthen United Breweries Co., Ld., with a capital of £50,000; The Bennett Steamship Co., Ld., with a capital of £100,000; The Damaraland Mining Co., Ld., with a capital of £100,000.

SHIPPING.—During the last fortnight freights have ruled low, and there has been a decline in many instances. There is a discouraging outlook all round. Mediterranean and Baltic business is very poor. From America a fair trade has been done, but the rates are falling slowly. The prices of new steamers are lower, but are still beyond the earning power valuation. Builders are becoming anxious about their orders, but their prices are still too high for prospective owners.

POLICE SIGNALLING.—We have received a pamphlet on Morgan's automatic electric signalling system, by Mr. Ernest de Vere Hill. This is a very complete system of telegraphic communication between the central office and the police on duty. Certain lamp posts, say one in each street, are fitted up so that the police, who have keys, can communicate with the station, and the station can signal for the nearest policeman and communicate with him. The public can also call for police or signal any message to headquarters.

THE GUILD AND SCHOOL OF HANDICRAFT.—The following is the list of Easter free lectures to be delivered at the workshop of the Guild School of Handicraft, 34, Commercial Street, London, E.:—April 3rd, 8 p.m., Mr. Henry Holiday, on "Looking Backward, in its Relation to Life, Taste, and Art;" April 10th, 8 p.m., Mr. T. Cobden Sanderson, on "Bookbinding;" April 17th, 8 p.m., Mr. W. B. Richmond, A.R.A., on "Gesso;" April 24th, 8 p.m., Mr. Sterling Lee, on "A Talk on Sculpture," with practical illustrations; May 1st, 8 p.m., Mr. E. Prioleau Warren, on "Parlour Architecture." Evening classes will be held as follows:—Carpentry, Tuesday, 8 p.m.; Decoration (men), Wednesday, 8 p.m.; Decoration (boys), Thursday, 7.30 p.m.; Clay Modelling and Wood Carving, Thursday, 8 p.m.; Repoussé Metal Work and Clay Modelling, Friday, 8 p.m.; Ruskin Reading Class, Thursday, 8.30 p.m.; Teachers' Carpentry Class, Wednesday, 6 p.m.

A NEW METHOD OF MOUNTING GUNS.—A successful trial of Sir W. G. Armstrong, Mitchell, & Co.'s new mode of mounting guns to be fired *en barbette* took place on Saturday, off the Isle of Wight, on board Her Majesty's screw gunboat "Handy," a vessel specially appropriated for gun trials. Particular importance attached to the proceedings on this occasion, the invention to be tested being designed to meet a defect which has been much felt in regard to the existing method of mounting heavy guns in barbette ships. Several novel features accompany the main design, the total result being practically a new departure in naval gunnery. The gun not only returns automatically into the firing position after each discharge, according to the Vavasseur recoil system, but is capable of being elevated so as to fire at angles up to forty degrees, or double that allowed by any previous mountings for such a gun, the calibre of the piece in this instance being 9·2in., and the weight 22 tons. The carriage on which the gun is mounted is also fitted with a steel shield, 6in. thick, which is attached to the mounting, and trains with it. The construction is such that the port through which the gun fires is completely filled by the gun at all angles of elevation, thus preventing the entry of projectiles or splinters. The mounting is intended for use in barbette batteries on the upper deck, and no similar carriage has hitherto been provided with any shield or screen capable of resisting the fire of anything more than machine guns, whereas the shield now devised will effectually protect the gun and gunners from all rapid-firing guns at present in use in the Service. The elevated fire is valuable as affording the means of attacking coast batteries placed on high ground at short range. At present elevated land batteries protecting a narrow passage or a harbour can fire down on ships attempting to pass them without being open to attack themselves. At the trial which took place on Saturday fifteen rounds were fired at angles ranging up to the maximum of forty degrees with perfect success in every respect.

MANCHESTER, 3rd April, 1890.

THE FOURNESS REGENERATIVE LAMP.—The Fourness Regenerative Lamp Company have acquired the business lately carried on by the Fourness Regenerative Lamp Company, Limited, at Pritchard Street, Oxford Street, Manchester, and are now prepared to execute orders for these well-known lamps. The business will be carried on at the above address by the new company, who have had a large experience in this class of gas lamps.

OPENING OF THE DEE RAILWAY.—The new line of railway extending from Chester, via the Dee Bridge, to a junction with the Wrexham, Mold, and Connah's Quay Railway was opened for traffic on the 31st ult. This route brings the coal fields of the Wrexham district into better communication with Lancashire and Yorkshire.

THE TECHNICAL INSTRUCTION ACT.—The Special Committee of the Manchester City Council has presented a report with reference to the Technical Instruction Act. They recommend its immediate adoption as being readily applicable to the wants of the city, and also recommend their reappointment as a special committee to carry it into effect.

ELECTRIC LIGHTING.—A number of circulars have been issued to various firms in Bolton asking them to express their willingness or otherwise to adopt the electric light. 1,178 inquiries were sent out, of which 449 brought out replies, 45 of these being favourable, and 80 of a doubtful character. The Town Clerk is applying for powers, but this is intended more to protect the interests of the Corporation than with a view of immediate action.

THE THIRLMERE WATER WORKS.—A tunnel, 3,040 yards long, through Moor How hill, has been successfully pierced. This forms part of the aqueduct in connection with this water scheme. It is pierced almost entirely through hard rock, and has taken nearly four years to construct. The contracts for the remainder of the work are now making satisfactory progress, and the laying of the pipes is being proceeded with in some of the sections.

COTTON MILL DIVIDENDS.—During the month of March forty-two mills in the Oldham district have published the results of the quarterly stocktakings. They comprise 2,800,000 spindles, and have made a gross profit during three months' working of £61,346, which has yielded an average dividend of 8 per cent. Spinners do not anticipate a continuance of these good results unless the condition of manufacturers improves, as they are now badly placed for remunerative business.

THE ENGINEERING TRADES.—The general condition of these trades, although satisfactory so far as old orders are concerned, is not quite so good in the amount of new business coming forward. There is a perceptible lull in the advance of orders in almost all departments at present, but there are indications that it is only temporary. Boiler makers perhaps are less troubled than others. Machine makers are not obtaining anything like so much new business, and are in some cases becoming anxious. There is a strike of moulders in Bolton, and it is rather disturbing that district.

THE LINEN AND JUTE TRADES.—The reduced lists issued about the last week in February by manufacturers of fine makes of linens have not improved business, and there is very little doing at the present time. Coarse makes are cheaper, and the fall in Dunfermline goods ranges from 4 to 5 per cent. Tows being weaker in proportion than line yarns, the drop in articles made from the former is greater. The shipping demand is rather quiet, but some buyers from the States arrived on the "City of Paris," and more activity in our market is therefore anticipated. Business with American houses in the future will, it is feared, be curtailed considerably, owing to the oppressive restrictions of the McKinley Tariff Bill, which empowers the Customs officials to fine or imprison importers, without trial by jury, for what they may consider under-valuation. The rate on brown and bleached linens, ducks, canvas, and handkerchiefs is to stand at 50 per cent. *ad valorem;* on linen (or part linen) collars and cuffs, 30 cents per dozen, and 35 per cent. *ad val.* Hessians are a shade weaker, but not sufficiently so to result in any appreciable change in quotations. The home trade, as previously indicated, is generally quiet. There is a prospect of a more extensive distribution ere long, however, not only in linens, but in all descriptions of dry goods, and the settlement this week of the Liverpool dock strike has already given a fillip to the vast shipping trade of the city. The business passing in German and French specialties is of an average character. Owing to the practice on the part of foreign manufacturers of selling to the retail as well as the wholesale, it is not easy to trace with accuracy the extent of this trade, which is chiefly in goods of the expensive class.

GLASGOW, 3rd April, 1890.

ENGINEERING.—The locomotive works in Glasgow are well employed. Messrs. Dubs & Co. are extremely busy, and Messrs. Sharp, Stewart, & Co. have orders to keep them going for many months ahead.

SHIPBUILDING.—An order, which is understood to have come through a London firm, has been placed with Messrs. Lobnitz & Co., Renfrew, for three large dredgers. Some of the smaller shipbuilding yards on the Clyde, having got to the end of their orders, are beginning to feel the pinch of hard times. Inquiries are very scarce.

ELEVATING FERRIES.—The elevating ferry which is now being constructed for the Clyde Trust will soon be in its place. The Works Committee of the Trust have been instructed to make provision on either side of the river for the reception of the ferry steamer. Some modifications on the original plans for the "dolphins" have been made, the design being that these should interfere as little as possible with the shipping.

SCOTTISH RAILWAYS.—Although there is an impression that business is not so brisk as it was, the railway traffic returns show that the volume of goods passing over the lines is increasing rather than diminishing. The first three months of 1889 showed large increases over the corresponding months of the previous year; and now the returns for January till March, 1890, show quite a remarkable increase over these figures. The absence of any serious labour troubles and the working off of orders placed some months ago are the proximate causes of this result. The fall in Scottish Railway stock, especially in Caledonian, has occurred in spite of this increase of traffic, and has been due to assumed uncertainty as to the Conversion Bill now before Parliament, and to speculative over-buying.

GLASGOW COMPANIES.—The directors of the Pollok Patents Gold Extracting Company have announced the distribution of a bonus of 2s. 6d. per share (5s. paid), payable on the 8th inst. This bonus is available owing to the successful floating of the Australasian Company under the wing of the Pollok Company. The shares of the new company formed by the amalgamation of A. & J. Stewart, Limited, and the Clydesdale Iron Company are already at a premium of about 12s.

(From our own Correspondents.)

LIVERPOOL, 2nd April, 1890.

LIVERPOOL ENGINEERS.—It was feared that the strike which took place among the engineers at Tyneside would extend to Liverpool. The Amalgamated Society of Engineers demanded a short time ago an advance of 2s. per week for Union men working in Liverpool and the district. The General Association of Master Engineers have intimated through the secretary that they are willing to pay the advance on and after the 10th July.

THE DOCK STRIKE.—This unfortunate strike of the dock labourers has now happily terminated, and work is resumed along the whole line of docks. The reconciliation has been effected by the able, impartial, and practical mediation of Mr. Michael Davitt. He at once grasped the situation, and, instead of hurling abusive invectives at the shipowners, he calmly approached both masters and men and obtained concessions on both sides, and the strike is now ended. The conditions agreed upon through his intercession are: (1) A regular dinner hour from 12 to 1, and if the men work during this hour they are to have an extra hour's pay; (2) the men need not work more than nine hours at night, all beyond this time being paid as overtime at a special rate; (3) union and non-union men to work harmoniously together; (4) weekly labour to be offered to the men, with a week's notice on either side, the men to deposit a week's wages by instalments; 5) the men on strike to be taken back as they are required and are not to wear their badges in working hours; (6) the union not to boycott Liverpool ships in other ports.

SHEFFIELD, 2nd April, 1890.

THE COAL AND COKE TRADES.—Business continues to be fairly good, although by no means brisk. One of the main reasons for the quieter tone is that the heaviest consumers of coal and coke had laid in a good stock of fuel, which is not yet exhausted. Prices are firm, although the production is evidently overtaking the demand, and they cannot continue long as they are. House coal is quoted at 14s. to 16s.; slack, 6s. to 7s.; smudge, 4s. to 6s. There is a

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good demand for coke; best qualities are in special request for steel melting. With a view to economise steam-raising fuel several firms here are adopting special feeding apparatus to their boilers. A mixture of 25 per cent. of coke with smudge, machine-fed into the furnaces, has given every satisfaction.

THE IRON AND STEEL TRADES.—The iron market is rather unsteady, owing in a great measure to the results of speculation in the North and North-East of England. In steel there is no perceptible reduction in the output, and work goes on steadily night and day. A new works has been started by Messrs. Hampton & Facer, for the purpose of working out a new system of ingot casting. The products of the works will be of best quality, of all sizes, and chemical compositions. Mr. Hampton has been well-known both in connection with Messrs. Davey Brothers, and afterwards with Messrs. Steel, Peach, & Tozer, Phœnix Bessemer Works, Rotherham.

ENGINEERING.—So far the threatened dispute about the 2s. advance to turners, fitters, and machine men generally, has been settled satisfactorily; all the leading firms have granted the advance, and the others are not likely to cause much trouble.

NORTH STAFFORDSHIRE, 2ND APRIL, 1890.

THE IRON TRADE.—It would be affectation to disguise the fact that manufacturers begin to recognise a complete collapse of the revival in trade which originated only twelve months ago. Inquiries and orders are in the nature of exceptions in the morning's budget, and consumers who are in the market are resuming the attitude of the last decade. How finished iron producers will fare for the next three months is a puzzle for themselves. The sliding scale gives their workmen an advance of 7½ per cent. from last Monday, coal is dearer owing to the advance in colliers' wages, and prices are falling enormously. In some cases heavy sales forward at remunerative figures have been entered, but in others anticipation of higher prices have made producers over cautious, and in such instances books are getting bare of orders.

THE COAL TRADE.—Prices for coals for domestic consumption have advanced in consequence of the rise in colliers' wages, but the demand for manufacturing fuel shows signs of diminution, and there is some weakness becoming apparent in the matter of prices.

LEICESTER, 2ND APRIL, 1890.

WOOL SPINNING AND YARN TRADES.—No great change has marked the wool market during the last fortnight. There is a tendency to increased firmness in prices, and as the stocks are light, especially of the choicer growths of wool, this firmness will continue. The business done has been very limited, and users are buying very cautiously. The spinning trade is not satisfactory; new business does not come to hand very freely, as buyers are waiting for the prices to become settled. As the conditions of the mills vary so much the quotations are irregular. Yarn merchants are having a quiet time just now.

HOSIERY TRADE.—This industry opens slowly. Generally the condition of trade is considered healthy, but the demand on the producing powers of the machinery is light. It is the current opinion that the trade will soon revive. Some of the causes of this inactivity are the heavy production of last year and the uncertainty of feeling with regard to the yarn market. The latter cause much affects the yarn merchants, and is the cause of their restricted turnover.

BOOT AND SHOE TRADE.—A busy time has lately prevailed, and it has culminated this week in the endeavour to fill orders on hand before the holidays. The demand has taxed the machinery, and the general complaint lately has been the scarcity of labour. Leather merchants are not doing much, despite the activity in the manufacturing department. Consumers are using up stocks, and as the condition of the market offers no inducement to buy they only purchase for very immediate wants.

SWANSEA, 2ND APRIL, 1890.

TINPLATES.—A decided check to the downward course of prices has been given by the recent "stop-week," and buyers are coming forward with more reasonable views than have prevailed for some time past. The completion of old contracts for steel bars at low prices is also having a natural effect on the supply of low-priced tinplates, and if masters and men could only continue to work amicably together the trade might soon recover from the effects of the recent depression. Unfortunately the air is full of rumours that threaten another crisis at no distant date. The proposal of the Manufacturers' Association to "revise" the standard of 1877, which still governs the rate of wages, has been met in the most determined manner by the men's union, who interpret the intended "revision" to mean a "reduction," and at their behest notices to terminate contracts are to be sent in at the earliest possible moment. A strike has also been going on at the Melingriffith Works, due to the endeavour of the company to lower the standard of Canada plates, which the men will not work at anything except 54 sheets per box. The owners of the most important works that carried on operations during the recent stop-week have decided to have one of their own later on. 350 mills out of a possible 450 were idle during the first week in March.

GOLD MINING IN WALES.—It seems reasonable for Mr. Pritchard Morgan to complain that, after spending £140,000 in developing the industry of gold mining in Wales, such delay should occur before trying the Crown injunction by which his company has been prevented from continuing operations since 1888. He urges that the subjects of the Crown are freely allowed, nay, encouraged, to drive for gold and silver in every other part of her Majesty's possessions except in Great Britain, where royalties are claimed on the gross production, whether obtained at a loss or at a profit. It is interesting to note that the mine in question has already produced gold to the value of £50,000, and that this precious metal and silver in the United Kingdom are for the most part to be found in Wales and Ireland.

NAKED LIGHTS IN MINES.—The protest of the Cwmbran colliers against the recommendation of her Majesty's inspector of mines that locked lamps should be used in that colliery renders the action of the management a difficult one. The men say that the introduction of lamps in place of naked lights would be an injustice, and would not add to their safety, but rather that increased loss of life from falls of roof and sides would follow.

NEW PATENT FUEL WORKS.—Detailed plans have been approved by the directors of the Barry Dock and Railways for the construction of an extensive patent fuel works at Barry Dock.

CARDIFF, 2ND APRIL, 1890.

IRON AND STEEL.—The pig iron market has shown a further weakness in consequence of the unexpected drop in warrants, caused chiefly by the inability of large owners to hold out any longer. Notwithstanding this, stocks are decreasing, which is a sure indication that ironmasters are reliable when they profess to be well sold forward at high prices. Certain it is that if ironmakers had to buy raw material, coal, coke, iron ore, &c., at to-day's prices, and sell also at to-day's figures, they would be clear losers of 15s. per ton. It is inevitable that things must adjust themselves soon, or trade will be completely paralysed. Coal is certainly the last thing that low iron prices will influence as far as South Wales is concerned, as the value is influenced entirely by the foreign inquiry, which at present seems to be stronger than ever. Coke cannot be brought down as long as coal rules so high, and from recent accounts from Spain, whence the bulk of hematite ore is drawn, the price seems to be still advancing on account of the abnormally high demand. At Portugalete, one of the principal loading places in the Bilbao River, steamers have to wait in turn about ten days before the loading can be commenced. Rubio ore is quoted at 10s. to 10s. 6d. f.o.b. Bilbao, which, with the freight, makes its value 16s. to 16s. 6d. c.i.f. Cardiff or Newport. Steel tin bars are nominally quoted at £7 5s. to £7 10s., but no business of importance has been done at these figures, both sellers and buyers preferring to wait the issue of the quarterly meetings next week.

COAL AND COKE.—The arrivals of tonnage during the past few days have been exceedingly numerous, and in consequence there is a decidedly firm tone noticeable in the steam coal trade. The demand for the coaling depôts in the Mediterranean is not quite so heavy on account of the poor prospects for the Black Sea business during the approaching season, but, with this exception, there is a steady influx of orders and inquiries from all other directions. Large steam is quoted at: 16s. 3d. to 16s. 9d., first quality; 15s. 6d. to 16s., second quality; 14s. 9d. to 15s., third quality; 14s. 3d. to 14s. 9d., inferior quality. There is less excitement in the market for small steam, which, however, is still quoted firm at 9s. 9d. to 10s. 3d. House coal is steady. New orders for coke are infinitesimal, but, having substantial contracts to carry out, makers have made no reduction in their prices.

BARROW-IN-FURNESS, 2ND APRIL, 1890.

DEPRESSION IN HEMATITE IRON.—An unexpected depression has set in in the hematite pig iron trade, and prices have dropped fully 6s. per ton on the week. Makers of hematite have been doing no new business of late, as they have been quoting all along fully 10s. per ton above the price at which buyers could obtain warrant iron. This is one of the effects of overstocking. Makers are not only about to restrict the output of pig iron at their works by the further blowing out of furnaces, but it is reported on good authority that they intend to buy largely of warrants, as a cheaper means of making steel than is at the command of smelters.

STOPPAGE OF THE MOSS BAY IRON AND STEEL WORKS.—Owing to financial difficulties and the impossibility of making a profit at present prices the managing director and the secretary of the company issued circulars to the shareholders on Monday morning, saying it would be necessary to stop the works and damp down the furnaces. The men were acquainted with the decision of the management when they went to work on Monday morning.

STEEL.—There is a quiet tone in the steel trade. Orders are coming to hand very slowly, and there is not much disposition on the part of buyers to place contracts at present. It is indeed probable that makers will soon be wanting orders, and that buyers will be able to place forward contracts at cheaper prices; but in the meantime, with iron ore, coke, and labour at present prices, makers cannot possibly hope to make steel at lower prices than they have been quoting. Heavy rails are 5 15s. to £6 per ton, steel plates at £8, and angles at £7 10s. per ton net f.o.b.

IRON ORE.—There is an easier tone in the iron ore trade, but prices remain firm at 13s. 6d. to 17s. per ton net at mines.

MIDDLESBROUGH, 2ND APRIL, 1890.

PIG IRON.—There was a very meagre attendance on 'Change at the weekly market held yesterday, and no great disposition to do business was shown. Prices have fallen 3s. since last week, and buyers are waiting for still lower prices. Sellers are asking 49s. 6d. for No. 3 G.M.B. prompt delivery. Warrants are quoted at from 49s. to 49s. 6d. There is a great drain upon the public stores, as the makers are holding to their prices. In hematite East Coast brands are quoted at 75s. per ton for mixed numbers makers' iron, but 70s. has been taken. West Coast hematite has fallen to 58s. 7d., on account of the Moss Bay failure, which will place their stock upon the market. The stock in Connal's store on the last day of March amounted to 151,288 tons, as against 161,060 tons a week back, showing a decrease over the week of 9,772 tons.

SHIPMENTS OF PIG IRON.—The shipments are improving as compared with February, but are far behind those of March of last year. For the month of March this year they amount to 60,683 tons, as against 87,314 tons during March last year. Of the 60,683 tons, 16,986 went coastwise, as against 53,420 last year, and 43,697 went abroad, as against 33,894 last year. The fall in coastwise shipments is, of course, accounted for by the fall of Scotch prices to the level of Cleveland.

MANUFACTURED IRON AND STEEL.—Both iron and steel are tending to dulness. The works are busy, but new orders are not coming in fast enough to take the place of the old which are being worked off. Prices are lower. Iron ship plates are at £6 12s. 6d., angles £6 12s. 6d., bars £6 15s. per ton; steel ship plates £7 12s. 6d., angles £7 12s. 6d., rails £5 17s. 6d. per ton, all less the usual discount. The exports of manufactured iron for the month of March are nearly 10,000 tons in advance of those of last March. The steel exports are less.

PURCHASE OF IRON WORKS.—Under the direction of the Court of Chancery, the West Stockton Ironworks have been sold as a going concern to the British General Investment Trust, Limited, at the price of £75,000. These works have been kept steadily going for some years, and are likely to be a very profitable investment.

NEWCASTLE, 2ND APRIL, 1890.

THE IRON TRADE.—Quietude is still the prevailing feature in the iron trade, and, though manufacturers of the finished material are still kept busy, a less satisfactory state of matters must soon be experienced unless new orders are received to replace those that are now being worked up. Buyers, however, are loth to operate, the expectation of a further fall in prices being no doubt the main cause of their hesitancy. The demand for thin sheets, though not so brisk as it was a year ago, is still sufficient to keep the mills engaged in the manufacture fully employed. In the galvanising works there is a good business doing.

STEEL WORKS.—Orders are still very plentiful at the steel works of Messrs. John Spencer & Sons, Newburn, much of the work in hand being for railway service in different parts of the country. The new steel plate mills are rapidly approaching completion. The steel works of the Palmer's Company at Jarrow are quite exceptionally busy, the company's own requirements for shipbuilding and boiler making purposes being at this moment unusually heavy.

ENGINEERING.—Messrs. John Abbott & Co, Gateshead, have several large colonial orders for hydraulic machinery in progress, and their works are consequently very busy. The marine engine department of Messrs. Black & Hawthorn's works is kept briskly going, there being several sets of engines in hand for vessels building on the Tyne and Wear. Messrs. Allen & Robson, the agents in Newcastle for Purves' patent ribbed furnaces, are doing a large business in this line, one of the most important orders lately supplied by them being 24 of these furnaces for the boilers of the Russian passenger steamer "Orel," built and engined by Messrs. Hawthorn, Leslie, & Co. This firm (Messrs. Allen & Robson) have just taken up the agency for a new "sure-grip tackle block," the principal feature of which is that rope is used as the suspensory medium, instead of chain. It seems to be a decided improvement on the descriptions of safety hoisting blocks at present in use, and should soon command a large sale.

ELECTRIC LIGHTING.—The new wing which has been added to the electric lighting works of Messrs. J. H. Holmes & Co., at Stepney, having been fitted up with effective machinery, is now in full operation, and forms, in conjunction with the older works, one of the largest and best-appointed electric light engineering establishments in the kingdom. The firm have orders for over twenty steamship installations, besides a number of land installations, the total number of dynamos now in progress or on order being no less than one hundred and fifty. Among these are several coupled on the direct system with single and compound engines, which arrangement is understood to combine many advantages. Among the most important orders lately received by the firm is one for a 2,000-light installation in a South American meat factory.

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200-TON HYDRAULIC RIVETING PLANT.

DESIGNED AND CONSTRUCTED BY MESSRS. ANDERSON & GALLWEY, (W. PAYNE-GALLWEY, ENGINEER), LONDON.

(*For description see page* 316.)

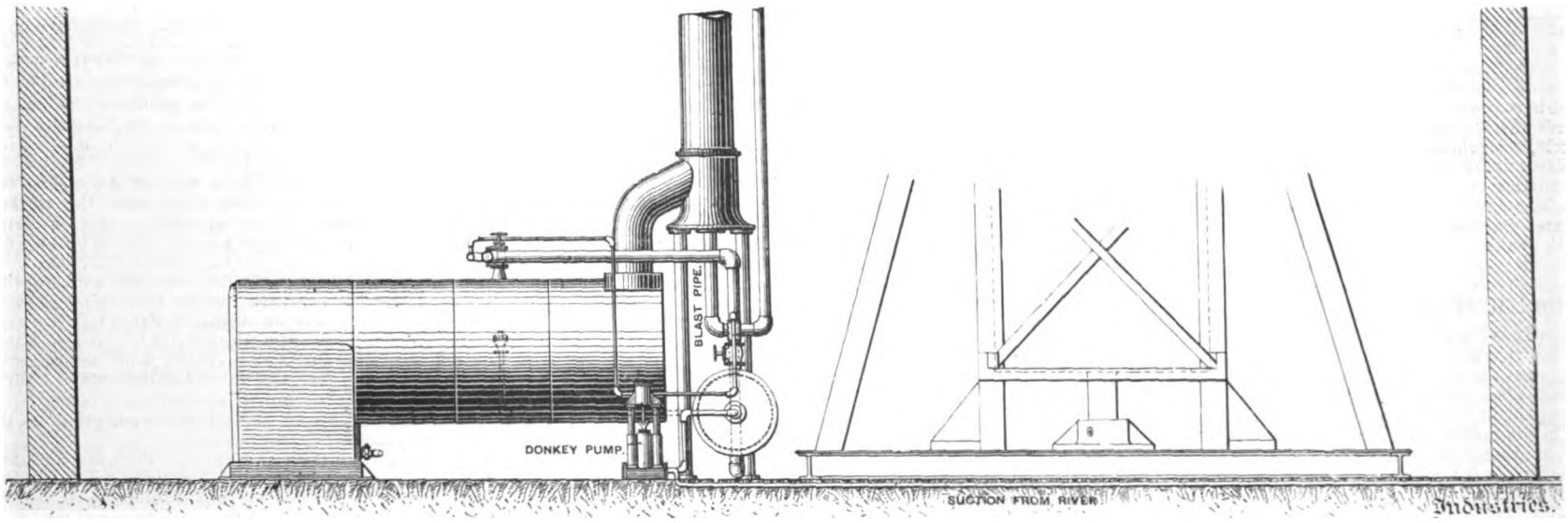


FIG. 12.—SECTIONAL ELEVATION THROUGH X X.

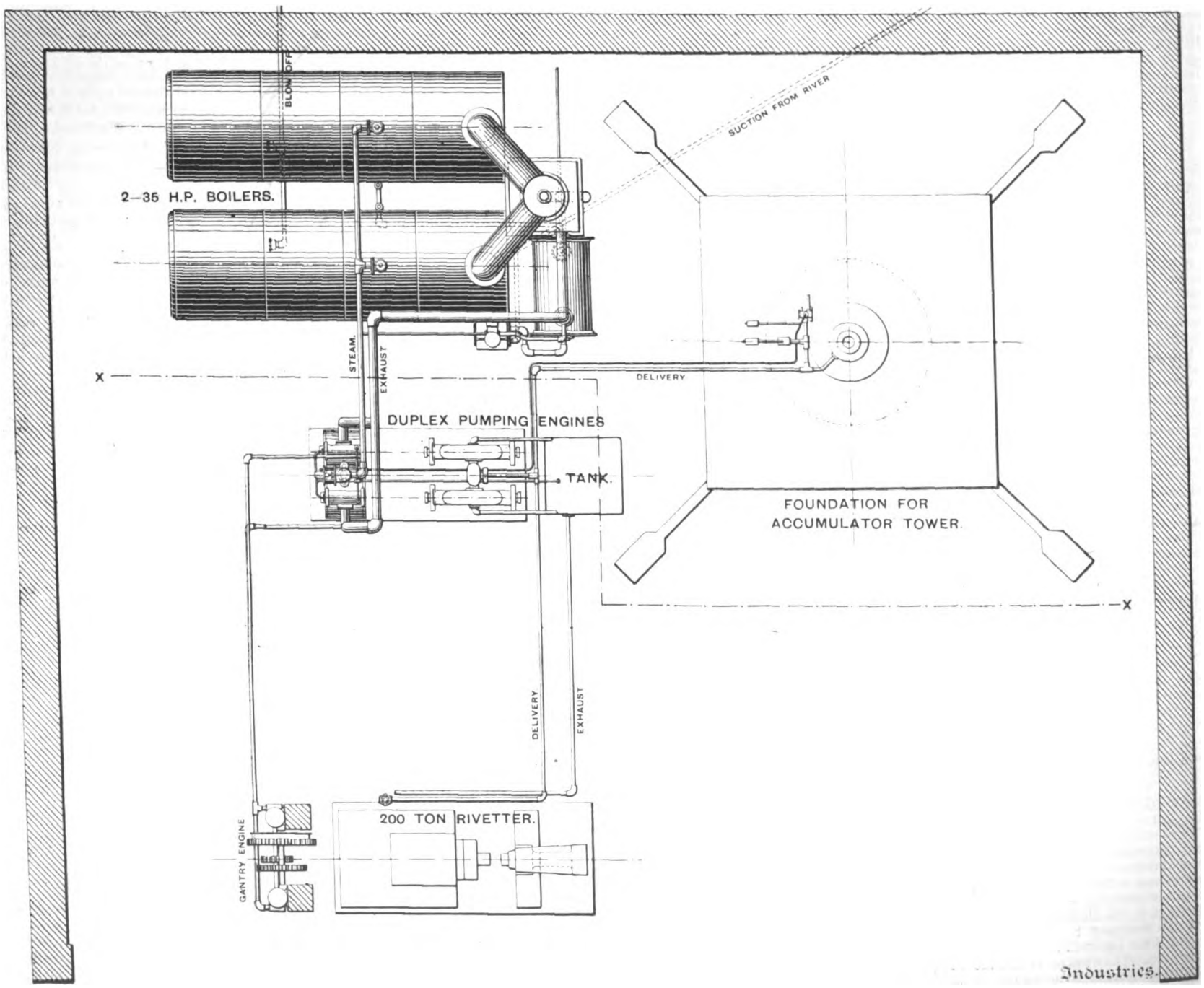


FIG. 13.—GENERAL PLAN OF COMPLETE PLANT.

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

Contents.

	PAGE
The Institution of Naval Architects	313
200-Ton Hydraulic Riveting Plant (*Illus.*)	316
Foreign Industries (Corres.)	318-319
The Edinburgh Exhibition	320
Breakdown of the "City of Paris"	320
Notices of Meetings	321
Prices Current	321
Shipbuilding Notes	321
Home Industries (Corres.)	322-323
The Institution of Naval Architects	325
The Opening up of Western China	326
Condensation and Re-Evaporation in Marine Engine Cylinders	326
Legal Proceedings	327
Cotton Mills in China	327
Letters to the Editor:— Thomson Electric Welding	327
Compressed Air Tramcars	327
The Melting of Steel with Water Gas	327
Books Received	328
Reviews	328
Welch's Improved Mixer (*Illus.*)	329
Board of Trade Rules on Life Saving Appliances	329
Patent Folding Trucks (*Illus.*)	330
The Thwaite "Simplex" Gas Generator (*Illus.*)	330
Practical Working of the Electrical Subways in New York (Corres.)	330
The Institution of Electrical Engineers	331
Notes	332
"Industries" Patent Record:— Applications and Acceptances	333-334
Illustrated Abridgments	334-336

To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

We cannot undertake to return manuscripts or drawings, and must request correspondents to keep copies.

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FRIDAY, 4TH APRIL, 1890.

THE INSTITUTION OF NAVAL ARCHITECTS.

IT is now thirty years since the Institution of Naval Architects was founded, and in looking over the range of "Transactions" which it has published, and examining their contents, we can say that it has fully justified its existence. We think that few Institutions can show such a high standard in the papers which have been read before it, containing as they do, not only an account of all that is best in current practice, but also of investigations which led to developments in that practice. The meeting at which the Institution was established was held on the evening of the 16th of January, 1860, in the Hall in which the members have always met since, that of the Society of Arts. About forty gentlemen were invited to attend, but as many resided in remote parts of the country, and as others had official duties to perform at considerable distances from town, a large attendance was not anticipated. On looking over the roll we find that eighteen attended, a great many of whom have now passed over to the majority. Mr. (now Sir) E. J. Reed was the first Secretary, and gave an introductory and explanatory statement of the objects of the Institution. He stated that the want of an Institution which should have for its exclusive aim the improvement of ships, and of all that specially appertains to them, had long been felt by many professional men, but that previous attempts had always ended in failure. At that time, however, the state of the Navy was the subject of much anxiety to the public, and it was felt that if the establishment of such an Institution was ever to be effected that was the right time to set about it; the matter was therefore again revived, and the Institution of Naval Architects safely launched, and it has ever since continued to increase in prosperity. Its list of members contains the names of all the most distinguished naval architects and marine engineers in this country, and many of those of other countries, while among its associates are many who have taken a prominent place among those interested in naval and shipping matters. Mr. Reed pointed out the necessity for the Institution not only directing its attention to the improvement of ships, but also to all that specially appertains to them. He said no Institution having for its object only the improvement in the forms of ships, or of the actual building of ships, or of the fittings of ships, or indeed of any single branch of the naval architect's study, could ever be successful; because, in the first place, there was not a sufficient number of persons to constitute an effective institution engaged in any one branch; and secondly, because no single feature or portion of a ship could be properly studied apart from others. Hence it was seen that the scope of the Institution must of necessity be wide enough to embrace the consideration of all that is part of or belongs specially to a ship. While it was considered proper to so far recognise the naval architects—to whom alone the ship, as a great complex whole, is a subject of study—in giving their distinctive name to the Institution, it was felt that, if it was to be a vital and vitalising body, it must draw into association with itself persons from all the classes connected with ships, and especially shipbuilders, men of science, seamen, engineers, mastmakers, riggers, smiths, and others. At first only naval architects proper were admitted as members, and all the others as associates; but it was soon found that marine engineers were worthy of the position of full membership, and now they form a very important part of the Institution—in fact, as some of the naval architects complained at recent meetings, they seemed to monopolise more than a fair share of the time.

The broad basis on which the Institution was founded ensured its success and brought to its meetings men whose papers and discussions form a mine of study to the student of naval architecture. During the first half of its existence the Transactions of the Institution were enriched with many papers which are now among the classics of the subject. The very first volume, for instance, contained an admirable *résumé* of the state of the mathematical theory of Naval Architecture at the time by Dr. Woolley, and thus afforded the members a good starting point for their discussions. In it also John Scott Russell gave an account of his Wave Line Principle of Ship Construction, which even now is worthy of careful study. Professor Airy discoursed on the correction of Compasses in Iron Ships, while Mr. Barnes began his series of papers on different subjects connected with naval architecture with which he enriched the Transactions. It would be invidious, even if it were possible, in our limited space to give a list of all those whose papers we considered specially worthy of notice, but there are two whose names we cannot pass over—we mean Professor Rankine and William Froude, whose mathematical and experimental investigations make the early volumes of the Transactions invaluable. During recent years, although there has not been anything very distinctive, the papers have embraced a wider field, and almost every part of naval architecture and marine engineering has received attention.

The meeting of the Institution which was held last week, we are afraid, had scarcely a programme which came up to the high average of preceding years, not only as regards quantity, but also quality. This may be accounted for by the extremely busy state of trade during last year, which may have prevented members from putting on paper the results either of their study or experience. As we mentioned in our report of the meeting last week, the President stated that the characteristics of the work of last year had been large production but moderate profits, while the proportion of vessels built of iron had gone down to 8 per cent. He condemned the Load Line Bill, but, as we have already pointed out (see *Industries* of the 7th ult.), it is possible to make provisions which will prevent the evils which he anticipates, and we understand that those in charge of the Bill have been able to meet almost all possible objections. We are strongly of opinion that nothing should be done which handicaps British shipping, but we also think that it is unnecessary to do this in order to protect the lives of seamen. The most important paper read before the meeting was undoubtedly that by Mr. White, the Director of Naval Construction, in which he gave some "Notes on the Recent Naval Manœuvres." As this bears to a considerable extent upon our leading article of last week, we will make a few remarks upon it. The opening sentence of Mr. White's paper confirms our opinion of the general character of the programme, for he states that it

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was written at the request of the Council, because they found themselves less favourably placed than in former years in relation to papers offered for reading and discussion, and they had urgently asked him to contribute to the programme of the meetings. We hope that the members will take a note of this, and in future make it unnecessary for the Council to hunt for papers. Mr. White, in his capacity of Naval Constructor, had been requested by the First Lord of the Admiralty to go afloat last August, and to remain with the fleet during the manœuvres. He had thus excellent opportunities for observing the operations of mimic warfare and fleet manœuvring, especially as the weather was bad during a good part of the time, and it is pleasant to find that, on the whole, his observations are to be read with satisfaction. We have given in another place a *résumé* of his paper, and therefore need only mention a few of his most important conclusions. On the subject of the influence of size and weight upon the sea-going qualities of ships, he differed entirely from the opinions which were expressed by Sir N. Barnaby before the Institution of Civil Engineers last year, and he said he was confirmed in his views by those of the majority of the naval officers with whom he had consulted. Sir Nathaniel had said that he agreed with those naval officers who thought it did not much matter as regards fighting qualities whether a ship was 3,200 tons or 14,000 tons, for the weather that would render it impossible to fight with the one would do the same with the other. Mr. White states that even the limited experience of the recent manœuvres proves that, for fighting in a seaway, ships of 3,000 tons and upwards are not practically on an equal footing. The possibility of any ship continuing to fight and maintaining good speed depends largely upon her length and size, as well as on her freeboard and the disposition of her armament. For instance, the vessels of the "Medea" class proved good sea boats, but it was obvious when they were seen in rough weather alongside a belted cruiser of 5,600 tons, or the "Warspite" of 8,400 tons, that these latter had very superior powers of maintaining speed and fighting because of their greater size and weight, while, if one of these latter had been alongside of one of the new battle-ships of 14,000 tons, Mr. White thinks that her advantages relatively to the "Warspite" would probably have been no less marked. With regard to the speed, Mr. White said it had been proposed that war cruisers should be built equalling the Atlantic "greyhounds" in speed and coal endurance, but surpassing them in armament and protection. To do this must involve still greater displacement and cost, and Mr. White is of opinion that we may well hesitate in embarking on such a course, so long as we possess, not merely a vast superiority in swift merchant steamers available as auxiliaries to the regular fleet, but also larger war cruisers than are to be found in foreign navies. Mr. White discussed at length the influence of freeboard, height of guns above water, and disposition of armament upon fighting qualities at sea. We must refer to the paper for details, but, speaking broadly, the recent manœuvres confirm the conclusion generally reached beforehand—namely, that low freeboard forward puts a practical limit upon the power of driving ships against a head sea, while it entails a sensible increase in the expenditure of power required to maintain a given speed in a moderate sea, as compared with the expenditure in high-ended ships of similar form and equal size.

The lessons derived from the manœuvres have led to certain alterations, or rather additions, in certain classes of ships—such as improved ventilation in engine and boiler rooms, greater facilities for intercommunication between engine rooms and boiler rooms, and improved arrangements for the transport of coal from the upper bunkers to the fires in ships. It is very satisfactory to find Mr. White stating that there is no foundation whatever in any of the reports about structural weakness in some of the ships engaged in the manœuvres. The contradiction of such reports can only be done by the publication of such information as is found in Mr. White's paper, and the discussion of it before such a body as the Institution of Naval Architects, and we trust that Mr. White will be encouraged by the Admiralty to continue the custom which he has introduced. It would also save the officials of the Admiralty from a considerable amount of correspondence and unfair criticism. The recent letter of Lord Randolph Churchill to one of our daily contemporaries is an illustration of what we mean. His lordship thought he had discovered a piece of official blundering and red tape about the purchase of certain boiler tubes, and immediately he wrote a letter to the daily papers. Mr. Forwood, the Parliamentary Secretary to the Admiralty, replied, explaining the actual facts, and proved that his lordship had depended too much on the information of a naval officer, which is too often apt to be indefinite and sometimes exaggerated. We need not enter into the details of the case, and only mention it to show the desirability of correct information being furnished on all points about which there is likely to be any discussion. We can imagine subjects on which the Admiralty may consider it proper to keep their own counsel, but in matters which refer to the science and art of engineering or ship-building it is highly advisable that they should aid the professors of shipbuilding with all the information at their command.

THE OPENING UP OF WESTERN CHINA.

A SPECIAL meeting of the Glasgow Chamber of Commerce was held on Wednesday in last week for the purpose of hearing an address by Mr. Archibald Little, F.R.G.S., on "The Upper Yangtse and the Opening of Western China." As Mr. Little is possibly better acquainted with that part of the world than any other British subject, a few of his most important remarks will be of interest to our readers.

After explaining something of the geography of the district, and of the history of its relations to western countries till the time of the Chefoo Convention, Mr. Little explained that the province chiefly affected by that treaty was Szchuen, which was in extent about double the size of Great Britain and Ireland, and whose population was estimated at 50 or 60 millions, this population being, according to the accounts of travellers and his own experience, the most prosperous in China. The great question was how to reach this magnificent country and exchange goods with it by the most economical and shortest route. Three main routes were proposed. There was the short cut by Bhamo to Yunnunfoo, 350 miles by an air line or 967 miles by road, over mountains and ravines, with total ascents equal to 26,000ft. Then Mr. Holt Hallett had shown an admirable route for a railway from Moulmein, but it would be long before it was carried out, whereas by the Yangtse the approach was practical and simple, and, notwithstanding the long length of rapids, boats with heavy machinery were towed up successfully. A very large native trade went on by land routes from different districts, and the goods were carried chiefly by coolies and pack-horses. Since the French got to Tonkin they had tried to open another route, and last year a stern-wheeler 105ft. long succeeded in going to Laokin from Hanoi in eight steaming days; but this could only be done at the height of the freshets in July, and the river was scarcely navigable at any other time, whereas the Yangtse was navigable all the year round. The province of which Chun-King was the commercial centre was one of the most fertile in the world; it was like one vast garden, and was the only part of China Mr. Little had seen where the country was cultivated to the mountain tops. Within the past few years the Chinese had practically given up growing winter wheat, and had taken to the growing of the poppy, and now the production of native opium was very nearly equal to that imported. The chief exports from Szchuen were silk, silk piece goods, and silk waste. Two tons of musk were exported last year, and, in addition, spelter, copper, iron, and coal. Salt was the largest article of export, and its manufacture or preparation was entirely in the hands of a guild, similar to those which existed in Europe in the Middle Ages.

Szchuen was chiefly interesting to the merchants of this country as being unsuited to the growth of cotton, whereas the coast provinces of China produced large quantities of cotton. About one-tenth of the cotton goods, and one-fifth of the woollens, which came to Shanghai, went to Tchang, at the foot of the rapids, and thence found their way to Szchuen, and as Mr. Little remarked, when one found a country so rich, the people so well to do, so anxious to purchase products from outside, and having so much to exchange, one felt desirous to improve the means of communication. In the matter of railways, Mr. Little confirmed the opinions we have often expressed, that the Chinese seemed determined to carry on the work in their own way, with their own money, and by their own men. One of the most progressive Viceroys, who had lately been sent to the province of which Hankow was the centre, had said that before railways were built they must have Chinese iron. Iron must be got out of the mines, rails must be forged, machinery must be made, and everything must be done in China. Whether that would be the case ultimately, it was impossible to say at the present moment. Mr. Little then gave an account of the attempt which he had made to open up navigation, and of which we have given details on previous occasions. As we mentioned, the end of that attempt was the purchase of Mr. Little's steamer, and at present negotiations were being conducted between the Chinese and our Foreign Office for the opening of the port of Chun-King, provided we would not attempt the navigation of the Yangtse for a term of years, and in the meantime foreign subjects might reside at Chun-King; and, on the whole, this seemed a fair compromise, for at the end of the specified time trade would be largely developed. Mr. Little then gave some details of the mineral resources of China, especially of the province of Yunnun. The whole of the copper for the coinage of China, which was a copper coinage, was exported by land, and afterwards by water, down the Yangtse, so that there was not only an enormously rich agricultural country and an active and wealthy population, but almost inexhaustible mineral resources. The basin of Szchuen had been estimated as the largest coalfield in the world. Coal was entirely used by the people, but it was worked in a hand-to-mouth way. Gold was also found in considerable quantities, being washed from the sand brought down by the rivers in winter, showing that there must be very rich gold-bearing mountains.

Mr. Little explained that his chief object in addressing the Chamber was to beg of those interested in the foreign trade not to remain idle or apathetic, or to think that they had done enough for China. What they had to do was to get our Minister in China and our Foreign Office here to open up new markets. Step by step we had got nineteen ports opened in China, and when Chun-King was opened it would make the twentieth—another Shanghai. He believed the people were anxious to have the country opened up to trade. Whenever one passed the mountains nothing was more striking than the friendliness and kindness of the people. The officials did not care much for change, but the people had great weight with them, and we should exert ourselves and do all we could to aid them in opening up Western China to foreign trade.

CONDENSATION AND RE-EVAPORATION IN MARINE ENGINE CYLINDERS.

AT the last meeting of the Institution of Engineers and Shipbuilders in Scotland, a paper was read by Mr. Edward C. Peck, on the loss by condensation and re-evaporation in marine engine cylinders. The chief object of the paper was to consider a suggestion whereby the efficiency of marine engines might be increased without increasing expansion. The author pointed out that condensation and re-evaporation in the cylinders had long been recognised as a great source of loss, and it was generally held that, by breaking up the operation of expansion in two, three, or four cylinders, we had overcome the difficulty. This, he thought, was still doubtful. The action of the steam on the walls, cover, and piston of the cylinder had received very able investigation, but he thought that the ports, and what occurs within them, have not had their full share of attention. The conduction of heat into and out of a metal surface is dependent upon the rate of circulation of the heating or cooling medium over it, and this circulation is of greater moment as the difference of temperature between the two becomes less. Now, the steam passes into and out of the cylinder without actually circulating over its surfaces; the vapour in contact with the cylinder remains in contact, or at most cannot possibly pass over its surface at a greater speed than that due to the piston speed, while in the case of the ports the whole volume is passed through an area (which has generally a very large proportionate perimeter) at about ten times the piston speed. The circulation over the cylinder surfaces is practically *nil*, and conduction is further impeded by the condensed water clinging to them, but it is extremely rapid and efficient in the ports, where the high speed steam maintains the surfaces clear of water and makes them in the best state for parting with or taking up heat; better conditions, in fact, could hardly be obtained for promoting condensation and evaporation. While the cylinder walls probably do not rise much above or fall much below a certain mean temperature, each port gets thoroughly heated up to the initial and then thoroughly cooled down

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to the terminal temperature at every revolution. Steam jacketing may do a great deal to lessen condensation and re-evaporation in the cylinder, but it obviously cannot deal with the serious mischief which thus occurs in the ports; it is in the latter where the heaviest losses occur. There can be no doubt that, especially in the quadruple expansion engine, where this heating or cooling action takes place sixteen times per revolution, we have a state of things which demands a remedy, and any successful attempt to eliminate it would be amply repaid by increased efficiency.

Mr. Peck pointed out that the high efficiency of the Corliss type of engine is probably not so much due to careful jacketing and the facility for obtaining a correct distribution as to the separate steam and exhaust ports adopted, and he suggests the adoption of separate steam and exhaust ports for marine engines. He is aware that there might be increased complication, and probably also greater first cost, but he thinks that the steam valves, link motion, and reversing gear would be at least 25 per cent. lighter. Moreover, in the adoption of separate valves there would be another direct advantage. In our present piston valves there is a constant leakage in each valve from steam to exhaust side to an extent proportionate to the size of the valve, which is at least one-third larger than that necessary for steam alone. In addition to this there is the constant loss by conduction through the thin body of the valve from steam to exhaust side. The greatest gain in efficiency, however, would be from the reduction of initial condensation and subsequent re-evaporation, and Mr. Peck thinks that this might be so great as to lead to the substitution of a two-cylinder compound for a triple, and at least postpone the further advance in complication involved in quadruple engines.

We think Mr. Peck's suggestions worthy of the consideration of marine engineers. We are not overlooking that in the early days of the Corliss valve gear it was applied to marine engines, but both that form of gear and many others have been much developed during recent years, and one might now be designed which would not only effect the chief object in view, but be also sufficiently simple to allow it to be applied to marine practice. The main feature in the engines shown in the recent Paris Exhibition was the great variety in the valve gears, and we think that if the matter were taken up in the direction suggested by Mr. Peck it might lead to good results. We shall be glad to have the experience and opinions of marine engineers on the subject.

Legal Proceedings.

MORGAN AND CO. *v.* WINDOVER AND CO.

The House of Lords, consisting of the Lord Chancellor, Lord Watson, Lord Herschell, and Lord Morris, gave judgment in this patent action on the 11th ult. in favour of Windover & Co. The patent of Morgan was dated in 1876, and the invention was for improvements in carriages. The Court of Appeal upheld his patent, as reported in *Industries*, Vol. III., p. 351.

The House of Lords reversed this decision, and declared the patent invalid on the ground of there being no "patentable invention."

The facts sufficiently appear from the judgment of Lord Watson, who said:—"At the date of the patent there were in common use three different arrangements of springs for supporting the body of a four-wheeled carriage. In one of these the body was suspended from the upper extremities of four C-shaped springs, the lower ends of the two front springs being secured to a platform or framework termed a perch, having a rigid connection with the fore-axle. In another the body rested directly upon four elliptical springs, two being in rigid connection with each axle. In the third arrangement the front of the body rested upon two elliptical springs similar in shape and adjustment to those used in the preceding class, whilst the back part rested upon two composite springs, which were for above half their length elliptical, and for the other half C-shaped. These composite springs rested upon and were fastened to the axle in the same manner as elliptical springs, their elliptical ends being placed below the body of the carriage. The sole object of employing springs is to prevent or mitigate jolting, and thereby promote the comfort of persons occupying the interior of the vehicle. The advantage which C-shaped springs, properly so-called, possess over elliptical, is that when the carriage is shaken, from any cause, they allow the body to sway horizontally as well as vertically, whereas elliptical springs only permit of vertical play. The witnesses appear to be agreed that composite springs such as I have described do permit of some degree of horizontal play in all directions, and are so calculated to produce easier motion than elliptical springs. One feature was common to the second and third of these arrangements. In both a 'full-lock' (which implies the capability of turning the fore wheels either to the right or to the left until they are nearly at right angles to the line of the body) can be obtained without using a perch, which is indispensable in the case of genuine C-spring carriages, and adds greatly to the weight of the machine. In 1876, some years after these composite springs came into use for supporting the back part of a carriage, Mr. Morgan took out a patent for the 'improvements in carriages' which the respondents claim as his invention. The leading claim in the specification is for 'the mode herein described of supporting the front of a carriage by C-springs, having their lower parts fixed to the axle, and their bows connected by links or loops to bearings fixed to the bottom bed of the under carriage substantially as and for the purposes herein shown and described.' On referring to the letter-press and drawings, it becomes apparent that the invention substantially consists in the substitution of composite for elliptical springs in the fore part of the carriage, so as to make the whole body rest upon four composite springs, instead of resting upon four elliptical, or upon two elliptical and two composite springs. For that purpose the patentee employs the same composite springs which were previously in use, and attaches them to the fore-axle in the same manner in which they were previously attached to the hind-axle, with this immaterial difference, that the C end of the spring is turned forward so that its elliptical end may be placed below the body of the carriage as in the case of the hindmost springs.

"The learned Judges of the Court of Appeal do not appear to me to have sufficiently considered the principle enunciated by Lord Westbury and accepted by this House, in Harwood *v.* Great Northern Railway Company (XI. House of Lord Cases, 682), to the effect that there cannot be a patent 'for a well-known mechanical contrivance merely when it is applied in a manner and to a purpose which is not quite the same but is analogous to the manner or the purpose in or to which it has hitherto been notoriously applied.'

"The springs described in the specification differ in no respect from carriage springs then in common use. The purpose to which they are applied is not only analogous to, but might fairly be described as identical with, the purpose which they previously served—viz., that of giving support to the body of a carriage. These circumstances are, in my opinion, fatal to the validity of the patent, unless it has been shown that inventive faculty has been displayed in the adaptation of composite springs to their new position in the front of the vehicle. But nothing of that sort has been shown. No mechanical contrivance or adjustment is specified or required in order to make the substituted springs fit into their new position or to render them efficient when they are placed there. On these grounds I am of opinion that the specification does not disclose a patentable invention."

The other learned Judges gave judgment to the same effect.

COTTON MILLS IN CHINA.

It is reported that the Chinese are about to make a vigorous effort for the erection of cotton mills, and for the production of cotton yarns and cloths by native labour. The Governor of Canton has presented a petition to the Emperor, advocating the establishment in Canton of cotton mills under Government supervision, and the purchase of machinery for reeling yarn and weaving cloth, with a view to the improvement of trade and the prevention of the outflow of money. He points out that since the commencement of trade with foreign nations a very large proportion of the import trade has been in foreign cloth and foreign yarn. He also states, what is now becoming very evident, that India and Ceylon are robbing China of her tea trade, and, further, that the silk trade is suffering very seriously, and he thinks that the only way to counteract these is to establish cotton mills in different parts of the country under Government supervision. Arrangements have already been made for one in the province of Kwang-Tung, to be carried on by a mercantile company with the assistance and, to a certain extent, under the direction of the Government, and machinery for it to the value of £87,000 has been purchased. The Governor of Canton points out that the various kinds of Chinese cotton are only suitable for the manufacture of three kinds of cloth, and that an admixture of foreign cotton is necessary for the manufacture of the seven kinds most in demand; that admixture is only about 30 per cent., and the low wages in China compared with the high rates abroad will enable much greater profits to be realised than in foreign countries. If the experiment should prove successful Government mills will also be erected at Shanghai and Hong-Kong, and later on at Tientsin and other parts of the empire. If this movement develops it will have a most important effect on our foreign trade, and we shall watch it carefully.

Letters to the Editor.

THOMSON ELECTRIC WELDING.

To the Editor of "Industries."

Sir,—Considerable prominence has been given, both in the United States and here, to a very favourable report which has been made by a Naval Board of the United States upon the potentialities of the Thomson electric welding process for naval purposes. It is a magnificent puff on the face of it, but its value tends to depreciate upon further examination. The subject of electric welding, to be investigated thoroughly, should have been submitted to a Board of electricians and engineers, but upon looking at the composition of the Board in question I find it to have consisted of Commander George A. Converse, A. S. Greene, Assistant Naval Constructor S. W. Armistead, and Ensign Gilbert Wilkes. The Commander, the Assistant Naval Constructor, and the Ensign, together with Mr. Greene, whose occupation is not defined, but who may be

"A bo'sun tight
Or a midshipmite,"

are possibly excellent persons in their own line, but what can they be expected to know of electricity or of welding? To entrust an inquiry of this kind to such a Board is a mere farce.

It seems from this that eccentricities in Government officials are not confined to Great Britain.

Yours, &c.,
N. D. O.

London, 31st March, 1890.

COMPRESSED AIR TRAMCARS.

To the Editor of "Industries."

Sir,—Your recent description of a low-pressure compressed air tramcar which has been tried at Chester is of interest, but to make the information of real value there should be some further details as to the cost of the system. I see that the car was only an experimental one, and the engineers are therefore hardly in a position to give quite accurate data as to expenses, but a rough estimate can no doubt be supplied. What forms an important factor in such a system where a new roadway is required is the expense of laying this. The figures, therefore, required before a judgment can be formed as to the value of the invention, are the cost per mile of laying the permanent way with its accessories, the cost of laying down the machinery for a line of given length, and the expense of running the same. If Messrs. Hughes & Lancaster could give a comparison between the expense of horse, electric, and steam traction as compared with their own system it would be of use to many interested parties.

Yours, &c.,
Car.

Portsmouth, 27th March, 1890.

To the Editor of "Industries."

Sir,—Almost coincident with your account of the new departure in compressed air tramcars there appears an American consular report from Consul-General Rathbone, of Paris, on a compressed air tramway motor which has been tried for two years on the Nogentais tramway near Paris. His description is very vague, as is usually the case when consuls refer to technical matters, but it contains a few scraps of information.

He states that air is compressed to forty or forty-five atmospheres; the reservoirs of the motor are charged at this pressure: the air to be used is reduced to a pressure of five to ten atmospheres, and at the same time heated to a high temperature and charged with moisture in a vessel called the heater (*rouillotte*); from there it passes to a double expansion engine, where it acts like steam in moving a piston rod. There is a saving of nearly 30 per cent. in favour of this system as against the Parisian omnibus service.

Various advantages are claimed, including several which are self-evident, but I give them as put down. They are, that the motor does not emit smoke or hot gases, and is almost noiseless; that a greater speed is attained than with horses when necessary; that a special track or overhead appliance is unnecessary; that, being very light, it can be easily handled on steep grades; that it is simple in form and does not frighten horses, and the machinery on the platform is almost invisible from outside; that a possible explosion of air reservoirs is less dangerous than of steam or superheated water; that maintenance in repair is very simple; that only one person is necessary for managing the machinery, and he is not necessarily a skilled engineer; and that in crowded days or times of day the number of passenger places may be easily augmented by the addition of one or even two tenders or ordinary cars, without a motor, thus making a short train.

Yours, &c.,
A. W.

London, 2nd April, 1890.

THE MELTING OF STEEL WITH WATER GAS.

To the Editor of "Industries."

Sir,—From the notices of the experiments made at the Leeds Forge in melting steel with water gas, which appeared in some technical journals last week, it may be inferred that the steel was made on the open-hearth of a Siemens furnace (with four regenerators), and that the fuel employed was a mixture of producer and water gas. A charge was made, it appears, in five hours with a consumption of fuel equivalent to 5 cwt. per ton of steel produced.

These figures are very interesting to steel makers, but it would be well if they could be supplemented by information on the following points, viz.:—Whether the water gas employed was mixed with gas from a Siemens producer, or with the gas, sometimes called "producer gas," which is made in the water gas apparatus; also whether the consumption given as 5 cwt. represents the fuel consumed in the production of water gas or of producer gas or of both combined.

No one will doubt that gas made in the Siemens producer may

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be enriched by the addition of water gas (hydrogen and carbonic oxide free from nitrogen), and that by using such enriched gas in the Siemens furnace a higher temperature may be obtained than by using producer gas alone; but it may be questioned whether this can be done profitably both as regards cost of fuel and wear and tear of furnaces.

With regard to the melting of a charge in five hours at the Leeds Forge, in the Siemens crucible steel melting furnace, which was introduced about 1867, five to six charges have always been made per 24 hours in regular work; and if similar materials —viz., pig iron and puddled bar, or scrap, be used in an open-hearth furnace—steel should be melted as quickly in one case as in the other; and this indeed has been reported from the Continent. If the puddled bar is charged red hot, the working should be even more rapid, as in pot furnaces cold materials are exclusively employed. The notices concerning the use of water gas at the Leeds Forge refer to the fusion of pig iron and scrap, and it follows from what has been said that there is no evidence of improvement by the use of water gas, as, of course, the melting of steel in crucibles, and on the open-hearth, to which reference has been made, is effected with gas from the ordinary Siemens producers.

The statement that the normal production of puddled iron in an ordinary puddling furnace is as low as 14 cwt. per shift can only be looked upon as a clerical error, inasmuch as 32 cwt. per shift is the usual figure for a forge mixture, and the consumption of fuel 25 cwt. per ton of puddled bar, as may be found on reference to the standard works on iron and steel of Percy or Bauermann. A return which I have seen from the Pather Works, Glasgow, of the day and night shifts on the 24th of last month confirms these figures, the production of bar iron from an ordinary puddling furnace being given as 32 cwt. per shift, and the consumption of fuel 23 cwt. per ton of puddled bar. At the same works a double Siemens furnace of the new type has lately been set to work for puddling iron, and the production is returned as 3¼ tons of puddled bar per shift, which is fully equal to the ordinary furnace, whilst the consumption of fuel is reduced to 6 cwt. per ton of puddled bar. It would be interesting to learn the consumption of fuel in puddling with water gas.

Yours, &c.,
"GAS."

London, April 1st, 1890.

Books Received.

On a University Faculty of Engineering. Reprinted from "The Transactions of the Institution of Engineers and Shipbuilders in Scotland." By HENRY DYER, C.E., M.A.

Engineering Estimates, Costs, and Accounts: A Guide to Commercial Engineering. By a GENERAL MANAGER. London: Crosby Lockwood & Co.

Civil and Mechanical Engineering, Popularly and Socially Considered. By J. W. C. HALDANE. London: E. & F. N. Spon.

Dictionary of Applied Chemistry. By T. E. THORPE, B.Sc., Ph.D., F.R.S. Vol. I. London: Longmans Green, & Co.

The Paper Trade Directory of Great Britain for 1890 Edited by "THE DOCTOR." London: *Paper Making*, 66, Ludgate Hill.

Graphical Statics. By LUIGI CREMONA. Translated by THOMAS HUDSON BEAN. Oxford: The Clarendon Press.

Transactions of the North-East Coast Institution of Engineers and Shipbuilders. Vol. VI. Parts III. and IV.

Cleveland Institute of Engineers, January 29th, 1889: *Proceedings.*

A Treatise on Chemistry. Vol. III. *The Chemistry of the Hydro-Carbons and their Derivatives; or, Organic Chemistry.* Part II. By Sir H. E. ROSCOE, F.R.S., and C. SCHORLEMMER, F.R.S. London: Macmillan & Co.

The Ether Theory of 1839 *is the true history of the Leyden Jar.* Part I. By JAMES JOHNSTONE. Edinburgh: James Gemmell.

Reviews.

APPLIED MECHANICS. By James H. Cotterill, F.R.S., Professor of Applied Mechanics in the Royal Naval College, Greenwich. Second Edition. London: MACMILLAN & Co. 1890.

The first edition of Professor Cotterill's work on applied mechanics was published fully five years ago, and although the standard adopted by the writer has prevented it from becoming a popular treatise, it has been recognised by all teachers of the subject as, on the whole, the most complete and generally useful work of the kind we have in English. When, however, we speak of complete, it is, of course, understood that it is with the limitations commonly given to the term Applied Mechanics, for in its widest sense it includes all engineering science. In its restricted sense it is applied to the more theoretical parts of that science, and would be more correctly designated the "Dynamics of Construction and of Machines." Professor Cotterill belongs to the Cambridge school of mathematicians, which is very conservative of old terms, and "Mechanics" is often used by them when "Dynamics" would be employed by those whose education had been less formal. True conservatism, however, is generally found by going a little further back than people usually do, and in the case of the term we are discussing we are quite safe in adopting the signification given to it by Newton, who defined it as "the science of machines." Professor Cotterill's sub-title for his book is "An Elementary General Introduction to the Theory of Structures and Machines." We would suggest that when he brings out another edition that he call it simply a treatise on the "Dynamics of Construction and of Machines." Professor Cotterill in this, as well as in his treatise on the steam engine, takes up the work of Rankine, and carries it a step further, and at the same time simplifies it; and of course the name of Applied Mechanics is taken from Rankine. But it must be remembered that when Rankine wrote we had, practically, no treatises on the science of engineering in English, and Rankine, in many cases, adopted the nomenclature and methods of French writers. At the same time he widely extended the field of the science of engineering and placed it on a firm basis, and during the thirty years which have elapsed since Rankine's first treatise appeared immense developments have been made in every direction, and writers of the standing of Professor Cotterill should try to establish a systematic method of nomenclature.

The book itself gives an excellent introduction to the science both of structures and machines, and the selection of the subjects is one which will be most useful to all classes of engineering students. Towards the end some of the sections are unduly compressed, which the author himself admits, and says that, should the book continue to be found useful, he will, in a future edition, dwell at greater length on some of the more important sections.

We need not enter into details of the contents of the book, as they give in outline the course of instruction which the author has been in the habit of giving at the Royal Naval College, and cover the ground usually understood to be included under the name. The part on Structures is an excellent introduction to the subject, while that on Machines gives not only Rankine's method of treating the dynamics of the problems involved, but also Reuleaux's system of Kinematics, although in a much simpler form than in that writer's own works, which are too diffuse for the average British student. The section on Stiffness and Strength of Materials is, on the whole, the most generally useful treatment of the subject with which we are acquainted, while those on Hydraulics and Thermodynamics, although good in their way, are, as we have already said, too condensed to be in proportion to the other parts of the book. An Appendix gives notes and references which will be useful to those who wish to continue their studies in the higher departments. Throughout the treatise there is a large number of well-selected numerical and graphical examples, which are of great assistance to the students, for the author never gives an abstract rule without illustrating it by one or more well-chosen calculations or constructions. It is quite evident that Professor Cotterill is not only an authority on his own subjects, but is also one who has studied the difficulties of beginners, and taken them on in such a way as to enable them to overcome difficulties for themselves; in short, the book is the work of an educator, and not of a crammer.

THE SCIENCE OF METROLOGY, OR NATURAL WEIGHTS AND MEASURES. A Challenge to the Metric System. By Hon. E. Noel. London: STANFORD. 1889.

The Hon. E. Noel has endeavoured to show in this challenge and book of many names that "by very little alteration, and by a little amending, the existing English measures can be welded into a system *scientifically* as well as practically superior to the metric." We praise the author for his bold attempt, especially as he admits in the preface that he is neither a man of science nor a mathematician, and lays no claim to technical knowledge, but regret that we must unhesitatingly condemn any such patching up of our present system of weights and measures as he proposes. We admit there are advantages in a duodecimal notation which are missing when ten is the basis of notation, but no one proposes to make any such radical change as would give to these advantages any practical value, although the author seems inclined to prophesy a Utopia of this description in a future century. While making fun of the great metric system, he states that it has been adopted by every country of Europe and America, except the British Isles and their dependencies, Russia, the United States, and Turkey, and adds that if no worthy competitor appears in the field it may become the system of the whole civilised world. It is precisely this rapid development of the metric system that is its main argument for universal adoption, and we fail to see the advantages to be gained by first altering our present weights and measures as the author proposes, then inducing Russia to alter hers to suit the author's, and finally making a gigantic fight with the forlorn hope of ousting the metric system from the countries in which it is already firmly established. The novelty of the author's system appears to lie in the supposed advantages of a mixed duodecimal and decimal division of the standards in order to suit the requirements of persons who prefer "to halve and quarter," to dividing decimally. The author does not seem prepared to admit that ·5 conveys the idea of half-one as nearly as ½, and that children with an entire ignorance of decimal notation accept 5 as half-ten. We entirely agree with the author that a reform of the English measures is wanted, but hope that the time is gone for a natural preference for a national system to restrain our adoption of the measures which have already been found of such commercial utility by so many nations. We purposely abstain from urging the advantages to be derived from an adoption of the metric system on the grounds of applied science and from the fact that many derived units in daily use in all countries where electricity is employed would cease to have a meaning if a new universal system were adopted, as we believe that only those who, like Mr. Noel, are neither men of science, mathematicians, nor technologists, can possibly find points of agreement with his somewhat wild scehem.

THE WORKS MANAGER'S HAND-BOOK. Fourth Edition. By Walter S. Hutton. London: CROSBY LOCKWOOD & SON. 1890.

A book of this class, and of such size, which runs through three editions in a comparatively short time, has got beyond the stage of requiring a formal review; the constituency for which it was written has already settled its position in current engineering literature, by giving it a place among those works which ought to be found in the library or drawing office of all works managers who keep themselves up with the wants of the times. As, moreover, we noticed the last edition, we have another reason for not entering into a lengthened examination of its contents on the present occasion. For the benefit of those who have not seen our previous notice, we may say that the book is divided into six sections, the first of which is taken up with stationary and locomotive steam engines; the second, with hydraulics and its applications; the third, with millwork; the fourth, with steam boilers and their fittings; the fifth, with heating, warming, and ventilating; and the sixth, with the strength of materials and with workshop practice. In each of these room has been found for new matter by the excisions from the original work, and the whole has been brought up to date by a great many emendations and alterations. The first section has been for the most part re-written and improved by the addition of numerous illustrations and a variety of new matter relating to steam and gas engines. The second section, which treats of hydraulics, has been enlarged and illustrated, and much useful information regarding pumps and water supply has been added. Altogether, the alterations and improvements which have been made on it will add much to its utility as a book of reference, not only to those in charge of works, but also to all interested in mechanical engineering. Every engineer should of course, as far as possible, make their own hand-books from the results of their own experience, but there is no reason why they should not take advantage of the work of others, and those who utilise what is to be found in Mr. Hutton's book will have an excellent foundation from which to start.

THE PRACTICAL ENGINEER'S HAND-BOOK. Third Edition. By Walter S. Hutton. London: CROSBY LOCKWOOD & SON. 1890.

This volume is designed as a companion to the work by the same author which we have just noticed, and for the same reasons given above a very few sentences will be sufficient for our present purposes. It may, in a sense, be looked upon as the theoretical and experimental basis on which the other is laid, although it by no means excludes the practical, and the two together contain information on almost every point which is likely to come within the range of ordinary mechanical engineering practice. This edition does not differ in any material respects from the one which preceded it, although it has been carefully revised, and some new matter added to it by way of completeness. The information is conveyed in simple language, as far as possible freed from mathematical formulæ, and in a concise and condensed form, and it is illustrated by well-executed engravings which elucidate and shorten description. On the whole we think that the two books by Mr. Hutton which we have noticed will be found to contain more useful information, arranged in an orderly manner, on all the chief departments of mechanical engineering than any similar books in the English language, and we have no doubt they will be largely taken advantage of, both by practical men and by students of engineering. To the notice of the latter we would especially commend them, as they will serve to show them the shape in which their information requires to be put in order that it may be useful in everyday work. Both books are furnished with very complete indices, which make their contents easily available.

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WELCH'S IMPROVED MIXER.

We illustrate herewith an improved apparatus made by Messrs. Francis B. Welch & Co., engineers, Manchester, for mixing thick and sticky substances. It will be seen that the vessel is mounted on three legs, and is provided with pulleys and mitre gearing for rotating the



internal stirrers. While in the mixer the substance is rendered more mobile by the heat from a coil which is arranged inside. Two outlets are fixed in the bottom of the mixer in order to facilitate the withdrawal of the contents.

BOARD OF TRADE RULES ON LIFE SAVING APPLIANCES.

The following is a synopsis of the Rules made by the Board of Trade under the "Merchant Shipping (Life Saving Appliances) Act, 1888," 51 and 52 Vict., c. 24. It was originally intended that these Rules should come into force on 31st March, 1890; but the date of their coming into operation has been postponed. In the effort to make the clauses quite clear, a rearrangement of their order has been found necessary:—

GENERAL EXPLANATIONS.

I. The Rules for *Steamers* of each class are kept distinct from the Rules for *Sailing Ships* of each class.

II. Each class is described in a self-contained section, and the expressions "as provided for above" and "as described above" have reference to the preceding matter in that section only.

III. The term "approved," whenever used descriptively, signifies that the article so described must conform to the requirements detailed under the General Rules.

GENERAL RULES.

I. Boats.

All boats shall be properly equipped as provided by these Rules.

Cubic Capacity of boats shall be ascertained as in measuring ships for tonnage capacity, by Stirling's rule, but in lieu of the application of that rule the following approximate measurement may be adopted for general purposes, and when no question requiring absolutely correct adjustment is raised:—

The length and breadth of boat outside and the depth inside (if the oars are pulled iff rowlocks the bottom of the rowlock is to be considered the gunwale of the boat for ascertaining her depth) multiplied together and by ·6 gives the capacity in cubic feet. Thus a boat 28ft. long, 8ft. 6in. broad, and 3ft. 6in. deep, will be regarded as having a capacity of 28 × 8·5 × 3·5 × ·6 = 499·8, or 500 cubic feet.

Construction and Buoyancy.—Properly constructed boats shall be of the following classes:—

Class A.—A life boat of wood or metal having for every 10 cubic feet of her capacity at least 1½ cubic feet of strong serviceable inclosed air and water tight compartments.

Class B.—A life boat of wood or metal having inside and outside buoyancy apparatus together equal in efficiency to the buoyancy apparatus provided for in boats of Class A. At least one half of the buoyancy apparatus must be attached to the outside of the boat.

Class C.—A life boat of wood or metal, having some buoyancy apparatus equal in efficiency to half the buoyancy apparatus provided for in boats of Class A or Class B; one half of the buoyancy apparatus to be attached to the outside of the boat.

Class D.—A properly constructed boat of wood or metal.

Class E.—A boat of approved form or material which may be collapsible.

Carrying Capability.—The number of persons a boat of Class A may carry shall be arrived at by dividing the capacity in cubic feet by 10, thus a boat of 500ft. of cubic capacity may carry 50 adult persons. The space in the boat shall be sufficient for the seating of the persons carried, and for the proper use of the oars.

The number of persons the boats of other classes (B, C, D, and E) may carry shall be according to the cubic capacity divided by 8.

Lowering and Disengaging Appliances.—Appliances for getting the boats into the water must fulfil the following conditions:—The boats placed under davits must be attached to the davit tackles and kept ready for service at any moment, and means to be provided for speedily detaching them from the lower blocks of the tackle. Hooks must not be attached to the lower tackle blocks. The davits to be of sufficient strength, and so spaced, that the boats can be swung out with facility; the points of attachment of the boats to the davits to be sufficiently away from the ends of the boats to ensure their being easily swung clear of the davits; the boats' chocks to be such as can be expeditiously removed; the davits, falls, blocks, eye-bolts, rings, and the whole of the tackling to be of sufficient strength; the boats' falls to be long enough to lower the boat into the water with safety when the vessel is light; the life-lines fitted to the davits to be long enough to reach the water when vessel is light.

Equipments for Collapsible or other Boats.—To be properly equipped, each boat shall be provided with the following:—

Full complement of oars (single-banked) and two spare oars.

Two plugs for each plug-hole, attached with lanyards or chains; and one set and a half of thole-pins or crutches, attached to the boat by sound lanyards.

A sea anchor, a baler, a rudder and tiller, or yoke and yoke lines, a painter of sufficient length, and a boat hook. The rudder and baler to be attached to the boat by sufficiently long lanyards and kept ready for use.

A vessel kept filled with fresh water.

Additional Equipments for Boats of Classes A and B.—To be properly equipped, each boat of these classes, in addition to the requisites specified above, shall be provided with the following (but not more than four boats in any one ship require to have this outfit):—

Two hatchets or tomahawks, one to be kept in each end of the boat and attached thereto by a lanyard.

A mast or masts, and at least one good sail, and proper gear for each.

A life-line, in loops run round the outside of the boat and securely made fast.

An efficient compass.

One gallon of vegetable or animal oil, in a vessel of an approved pattern, for distribution on the water during rough weather.

A lantern, trimmed, with oil in its receiver sufficient to burn eight hours.

II. Life Rafts.

Carrying Capability.—The number of persons any approved life raft for use at sea may carry shall be determined with reference to each separate type of life raft approved by the Board of Trade; provided always, that for every person so carried there shall be at least 3 cubic feet of strong and serviceable inclosed air-tight compartments, such that water cannot find its way into them. Any approved life raft of other construction may be used provided that it has equivalent buoyancy to that hereinbefore described. Every such approved life raft shall be marked in such a way as to plainly indicate the number of adult persons it can carry.

Equipment.—Life rafts shall be fully provided with a suitable equipment.

III. Buoyant Apparatus.

Approved buoyant apparatus shall be deemed sufficient for a number of persons, to be ascertained by dividing the number of pounds of iron which it is capable of supporting in fresh water by 32. Such buoyant apparatus must not require to be inflated before use, must be of approved construction, and marked in such a way as plainly to indicate the number of persons it is sufficient to support.

IV. Life Belts.

An approved life belt shall mean a belt which does not require to be inflated before use, and which is capable at least of floating in the water for twenty-four hours with 10lb. of iron suspended from it.

V. Life Buoys.

An approved life buoy shall mean either

A life buoy built of solid cork and fitted with life-lines and loops securely seized to the life buoy, and capable of floating in the water for at least twenty-four hours with 32lb. of iron suspended from it; or

A strong life buoy of any other approved pattern and material provided that it has buoyant properties equal to above, and provided also that it does not require inflation before use, is not stuffed with rushes, cork, or other shavings, loose granulated cork or other loose material.

VI. Position of Life Belts and Life Buoys.

All life belts and life buoys shall be so placed as to be readily accessible to the persons on board, and so that their position may be known to those for whom they are intended.

VII. Steamers.

Class 1.—*Rules for Steamers carrying Emigrant Passengers subject to all the provisions of the Passengers Act.*

Steamers of this class shall carry boats in number and capacity not less than are given in the following table, placed under davits and having proper appliances for getting them into the water, but no steamer of this class shall be required to carry more boats so placed than will furnish sufficient accommodation for all persons on board. The boats are to be equipped and of the description defined in the foregoing General Rules.

TABLE FOR STEAMSHIPS OF CLASS 1.

Gross Tonnage. 1.	Minimum Number of Boats to be placed under Davits. 2.	Total Minimum Cubic Contents of Boats to be placed under Davits. L. × B. × D × ·6. 3.
9,000 and upwards	14 ...	5,250
8,500 and under 9,000.....	14 ...	5,100
8,000 ,, 8,500.....	14 ...	5,000
7,750 ,, 8,000.....	12 ...	4,700
7,500 ,, 7,750.....	12 ...	4,600
7,250 ,, 7,500.....	12 ...	4,500
7,000 ,, 7,250.....	12 ...	4,400
6,750 ,, 7,000.....	12 ...	4,300
6,500 ,, 6,750.....	12 ...	4,200
6,250 ,, 6,500.....	12 ...	4,100
6,000 ,, 6,250.....	12 ...	4,000
5,750 ,, 6,000.....	10 ...	3,700
5,500 ,, 5,750.....	10 ...	3,600
5,250 ,, 5,500.....	10 ...	3,500
5,000 ,, 5,250.....	10 ...	3,400
4,750 ,, 5,000.....	10 ...	3,300
4,500 ,, 4,750.....	8 ...	2,900
4,250 ,, 4,500.....	8 ...	2,900
4,000 ,, 4,250.....	8 ...	2,800
3,750 ,, 4,000.....	8 ...	2,700
3,500 ,, 3,750.....	8 ...	2,600
3,250 ,, 3,500.....	8 ...	2,500
3,000 ,, 3,250.....	8 ...	2,400
2,750 ,, 3,000.....	6 ...	2,100
2,500 ,, 2,750.....	6 ...	2,050
2,250 ,, 2,500.....	6 ...	2,000
2,000 ,, 2,250.....	6 ...	1,900
1,750 ,, 2,000.....	6 ...	1,800
1,500 ,, 1,750.....	6 ...	1,700
1,250 ,, 1,500.....	6 ...	1,500
1,000 ,, 1,250.....	4 ...	1,200
750 ,, 1,000.....	4 ...	1,000
500 ,, 750.....	4 ...	800
250 ,, 500.....	2 ...	400
150 ,, 250.....	2 ...	300

Note.—Where in vessels already fitted the required *cubic contents* of boats placed under davits is provided, although by a smaller *number* of boats than the *minimum* required by this table, such boats shall be regarded as complying with these rules.

Masters or owners of steamers of this class claiming to carry a smaller number of boats than is indicated in the following table must declare before the collector, or other officer of Customs at the time of clearance, that the boats actually placed under davits are sufficient to accommodate all persons on board, allowing 10 cubic feet of boat capacity for each Statute adult.

Not less than half the number of boats placed under davits shall be life boats properly constructed of wood or metal, each having for every 10 cubic feet of its cubic capacity at least 1½ cubic feet of strong enclosed air-tight compartments, such that water cannot find its way into them, or they may be life boats properly constructed of wood or metal having inside and outside buoyancy apparatus together equal in efficiency to the buoyancy apparatus described above. (At least one-half of the buoyancy apparatus to be attached to the outside of the boat).

The remaining boats may also be of above description, or they may, in the option of the shipowner, have some buoyancy apparatus, equal in efficiency to one-half the buoyancy apparatus above described, such consisting of inside air-tight compartments as above described, or of apparatus attached to the inside and outside of the boat (at least one-half being to the outside). Two of said remaining boats may, however, simply be properly constructed boats of wood or metal.

If the boats placed under davits in accordance with the foregoing table do not furnish sufficient accommodation for all persons on board, then additional wood, metal, collapsible or other boats of a suitable description (whether placed under davits or otherwise) or "approved" life rafts, shall be carried. Such additional boats or rafts shall be of at least such carrying capacity, that they and the boats placed under davits provide together, in the aggregate, double the minimum cubic contents required by column 3 of Table. All such additional boats or rafts shall be placed as conveniently for being available as the ship's arrangements admit of, having regard to the avoidance of undue encumbrance of the deck, and to the safety of the ship for her voyage.

When steamers are divided into efficient water-tight compartments, so that, with any two of them in free communication with the sea, the vessel will remain afloat in moderate weather, they shall only be required to carry *additional boats* or life rafts of *one-half* the capacity required by preceding paragraph.

In addition to life boats and life rafts steamers of this class shall carry not less than one "approved" life buoy for every boat placed under davits. They shall also carry "approved" life belts or other similar "approved" articles of equal buoyancy suitable for being worn on the person, so that there may be at least one for each person on board the ship.

Class 2.—*Rules for Foreign-going Steamships carrying Passenger Certificates under the Merchant Shipping Acts.*

Steamships of this class shall be subject to the same requirements as those in Class 1.

Class 3.—*Rules for Foreign-going Steamships not Certified to Carry Passengers.*

Steamships of this class shall carry on each side, at least, such boats of wood or metal, placed under davits, that the boats on each side shall be sufficient to accommodate all persons

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on board. One boat on each side shall be properly constructed of wood or metal, having for every 10 cubic feet of her capacity at least 1½ cubic feet of strong and serviceable enclosed air-tight and water-tight compartments; or it may be a life boat, properly constructed of wood or metal, having inside and outside buoyancy apparatus together equal in efficiency to the buoyancy apparatus provided for above, at least one-half of which shall be attached to the outside.

Steamships of this class shall carry "approved" life belts, as required for steamships of Class 1.

They shall also carry not less than six "approved" life buoys.

CLASS 4A.—*Rules for Steamships having Passenger Certificates, under the Merchants' Shipping Acts, authorising them to carry Passengers anywhere within the Home Trade Limits—that is to say, between Places in the United Kingdom or between the United Kingdom and Ports in Europe between the River Elbe and Brest.*

Steamships of this class shall carry boats placed under davits, in accordance with the rules and table provided for steamships in Class 1.

If the boats placed under davits in accordance with this requirement do not furnish sufficient accommodation for all persons on board, then additional approved boats or approved life rafts shall be supplied as for steamers of Class 1.

Provided that if (having regard to the avoidance of undue encumbrance of the deck and to the safety of the steamer for her voyage) it is not practicable for a steamer of this class to carry additional "approved" life boats or "approved" life rafts as are required for steamers of Class 1, the deficiency so caused may be made up by an equivalent supply of "approved" buoyant deck seats or other "approved" buoyant deck fittings to the satisfaction of the Board of Trade officer.

Steamships of this class shall carry not less than six "approved" life buoys.

They shall also carry, in addition to the boats and appliances required above, "approved" life belts, or other similar approved articles of equal buoyancy, suitable for being worn on the person, so that there may be at least one for each person on board.

CLASS 4B.—*Rules for Steamships in the same Trades not Certified to carry Passengers.*

Steamships of this class shall carry, on each side, at least so many and such boats of wood or metal placed under davits that the boats on each side of the ship shall be sufficient to accommodate all persons on board. The boats shall have proper appliances for getting them into the water, and one on each side shall be a life boat properly constructed of wood or metal, having for every 10 cubic feet of her capacity at least 1½ cubic feet of strong and serviceable enclosed air-tight compartments, such that water cannot find its way into them, or it may be a life boat properly constructed of wood or metal, having inside and outside buoyancy apparatus together equal in efficiency to the buoyancy apparatus provided for above, at least one-half of which shall be attached to the outside of the boat.

Steamships of this class shall carry "approved" life belts, as for steamships of Class 1. They shall also carry not less than four "approved" life buoys.

CLASS 5.—*Rules for Steamships having Passenger Certificates authorising them to carry Passengers within certain specified Limits of the Home Trade—that is to say, on short specified Passages along the coasts of the United Kingdom, or between Great Britain and Ireland, or between Great Britain or Ireland and the Isle of Man.*

Steamships of this class shall, according to their tonnage, carry boats placed under davits, as required by the foregoing Table, for ships in Class 1.

If the boats placed under davits, in accordance with the above requirements, do not furnish sufficient accommodation for all persons on board, then additional boats or "approved" life rafts shall be supplied as for ships of Class 1.

Provided that if (having regard to the avoidance of undue encumbrance of the deck, and to the safety of the ship for her voyage) it is not practicable for a steamship of this class to carry additional "approved" boats or "approved" life rafts as required for steamships of Class 1, the deficiency so caused may be made up by an equivalent supply of approved buoyant deck-seats or other approved buoyant deck-fittings to the satisfaction of the Board of Trade officer.

Steamships of this class shall also carry "approved" life belts or other similar approved articles of equal buoyancy, suitable for being worn on the person, so that there may be at least one for each person on board the ship.

They shall also be provided with at least one "approved" life buoy for each boat of wood or metal carried, but in no case shall less than six "approved" life buoys be provided.

CLASS 6.—*Rules for Steamships carrying Passengers on Short Excursions or Pleasure Trips to Sea, or in Estuaries or Mouths of Rivers during Daylight or across the Straits of Dover.*

Steamships of this class shall carry at least two boats, placed under davits, and with proper appliances for getting them into the water. Such boats to be properly constructed life boats of wood or metal, having for every 10 cubic feet of their capacity at least 1½ cubic feet of strong and serviceable enclosed air-tight compartments, such that water cannot find its way into them; or they may be life boats properly constructed of wood or metal, having inside and outside buoyancy apparatus, together equal in efficiency to the buoyancy apparatus provided for above, at least one-half of which shall be attached to the outside.

Steamships of this class shall also carry other boats, "approved" buoyant apparatus, [and] [or] "approved" life belts sufficient (with the boats) to keep afloat all the persons on board the steamer.

They shall also carry at least four "approved" life buoys.

CLASS 7.—*Rules for Steamships carrying Passengers on Rivers and Lakes, or on Lakes only, but not going to sea or into rough waters.*

Steamships of this class shall carry one boat in such a position that it can readily be got into the water. They shall also carry "approved" buoyant apparatus or "approved" life belts, and "approved" life buoys at least sufficient (together with the boat) to keep afloat all persons on board (a discretion to be exercised by the Board of Trade officer to relieve ferry boats in narrow waters from the operation of this rule).

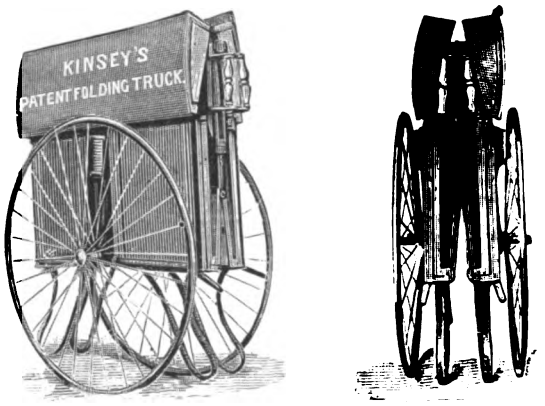
(To be continued.)

PATENT FOLDING TRUCKS.

IN our notice on the late Ironmongers' Exhibition at the Agricultural Hall, we referred briefly to the patent folding trucks exhibited by the Folding Truck and Carriage Co., Bellevue Street, Swansea. We now illustrate one of these in the form of a covered truck, Fig. 1 showing it in use, and Figs. 2 and 3 being a side and end view respectively when the same is folded up. The blocks are self-explanatory.



FIG. 1.—VIEW OF TRUCK IN USE.



FIGS. 2 AND 3.—VIEWS OF TRUCK FOLDED.

THE THWAITE "SIMPLEX" GAS GENERATOR.

THE illustrations on page 331 show a vertical section and a front elevation of the Thwaite "Simplex" Gas Generator. Its simplicity of construction, economy, and regularity of working, and the ease of effecting the difficult work of clinkering, are its salient characteristics. One of the features of this generator is the means by which the air for partial combustion is heated. On referring to the illustrations it will be observed that the side of the vessel just round its hottest part is provided with an annular space through which the air is blown in by means of a steam-jet air-injector. In its passage around this cavity the air is heated by contact with the side plates, and it also is heated by the cast-iron hollow fire-bar bearer plate. By means of a drop or curtain wall shown in the section the volatile hydrocarbons are compelled to flow through the hot and incandescent portion of the fuel, and are thus rendered more permanent. This "Simplex" generator has a wide field of application for heating purposes where economy of fuel, equable working, and regularity of heat and smokeless combustion are valued. In proportion to its size it is very powerful, and the cost of repairs is exceedingly light. By its means a high annealing temperature in a furnace is maintained at a cost of about 1d. per hour in fuel. The generator is the invention of Mr. B. H. Thwaite, of Liverpool, and is manufactured by the Gaseous and Liquid Fuel Supply Company, Limited, of 25, Market Street, Manchester.

PRACTICAL WORKING OF THE ELECTRICAL SUBWAYS IN NEW YORK.

(From our New York Correspondent.)

(Concluded from page 306.)

THE use of lead covering is not required by the subway rules. In addition to being a protection against the attack of acids and gases, it is considered a safeguard against accidents to men working in the man-holes amongst "live" wires. If a defect should occur in the insulation in the man-hole, the presence of a ground furnished by the lead covering would make the defect known at the regular test, which, if the defect were of a serious nature, would ensure its being located and eliminated. Whereas, if the conductor were not lead covered, there is a probability that a defect in the insulation might occur which would not be indicated by the test, but which might expose the conductor and render it impossible for workmen in the man-holes to make contact therewith. It would be quite possible for a workman to handle the lead covering of even a defective conductor without injury since the lead covering is grounded throughout the length of the subway. It is a fact that live electric light wires conveying the alternating and high tension arc currents are handled and moved about in the man-holes by means of the lead covering without the slightest indication that such wires are alive. It is quite a common occurrence to start up alternating circuits immediately after a rubber joint has been made in order to save time, and then to have the plumber adjust and wipe the sleeve on to the lead cover while the current is in full operation. No shocks whatever due to induced currents in the lead covering are felt by the workmen in handling the lead-covered cables conveying the alternating current. It is quite conceivable that such shocks might be noticed, where the cables are suspended from point to point and insulated. In that case, any one handling the lead covering of the conductors would doubtless receive the accumulated induced charge.

The requirements of the rules of the Subway Compans as regards insulation are such that none but a first-clas insulation can well be employed on the conductors conveying currents of high electromotive force. These rule require an initial insulation of 50 megohms per mile per 100 volts electromotive force employed on the circuit, and a minimum of 5 megohms per mile per 100 volts. The initial test is made when the conductor is first laid in the subway and prior to the turning on of the current. The minimum requirement is allowed after the circuit has been in use. This insulation requirement refers to the conductor proper in the subway, and does not include the lamps, aërial connections, or converters. The rule does not apply to conductors conveying currents of less than 100 volts e.m.f. In the case of alternating circuits, the uniform electromotive force employed in this city being 1,000 volts, the conductors to be employed in this service are required to show an initial insulation resistance of 150 megohms per mile, and a minimum insulation resistance afterwards of at least 50 megohms per mile.

The average e.m.f. of the arc light circuits in the subways is about 2,000 volts; but in some instances it runs up to 3,500 volts. In the latter case, the initial insulation resistance required by the rules is 525 megohms per mile; minimum, 175 megohms per mile. Experience in the New York subways has shown that it is vastly easier to maintain the insulation resistance at 150 and even 500 megohms per mile than it has been in the past in other cities to maintain them at one megohm per mile. The high tension electric light conductors are tested weekly for insulation resistance. The tests are made by the direct deflection method, a Thomson reflecting galvanometer being used, and as a rule 100 volt chloride of silver battery is employed as a testing battery.

The subway conductors are, as a rule, tested exclusive of arc lamps, converter, and inside wiring, but frequently also the tests are made inclusive of arc lamps and converters. The latter are only accepted when the results fairly indicate that the fall of insulation is due to the lamps or converters. Tests of circuits are not made inclusive of house wiring, because of the generally low results of trial tests. Some such tests showed an insulation resistance of the house wiring of less than 1,000 ohms.

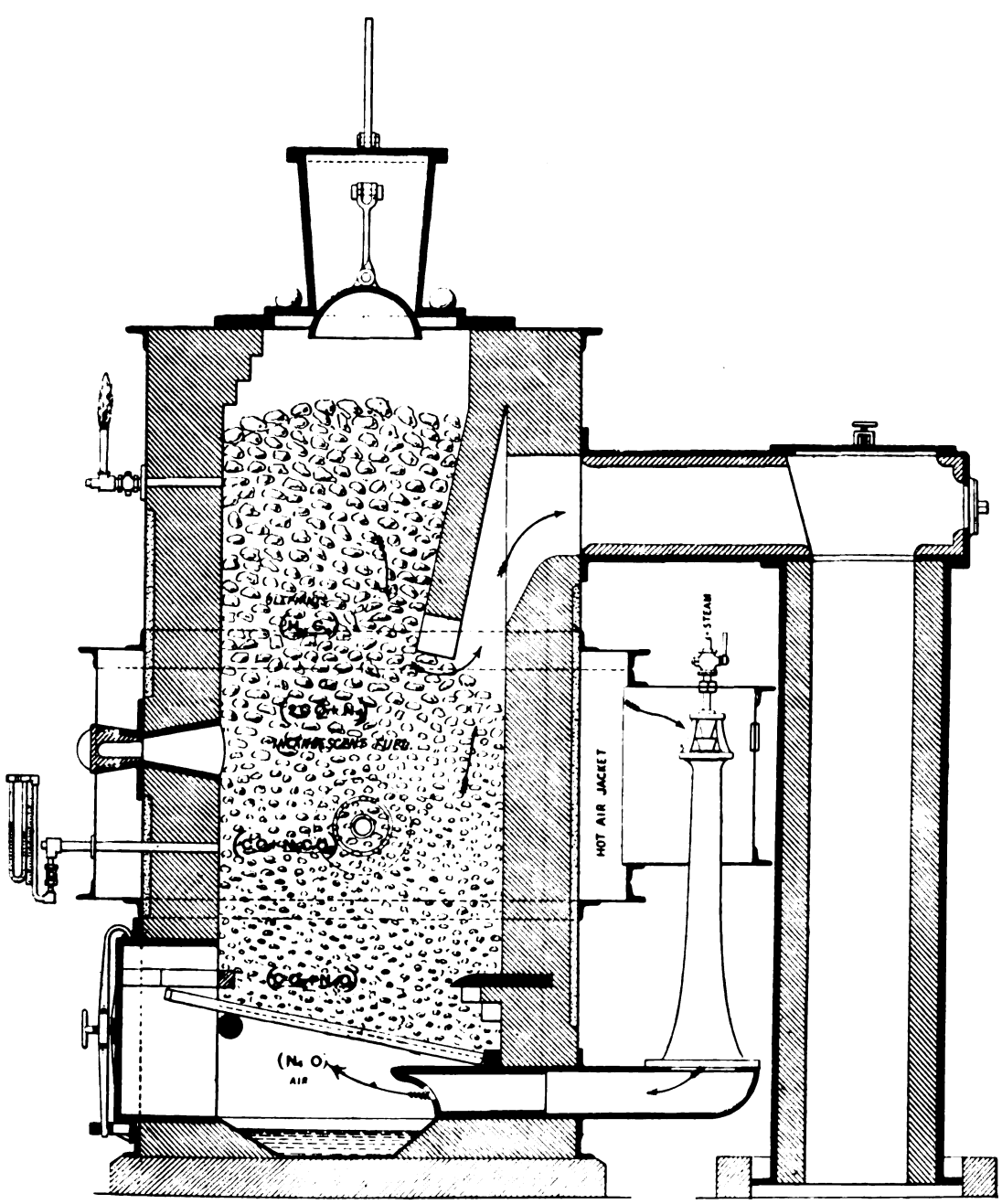
Tests with converters included in some cases show very fair insulation. One circuit, with 34 converters included, showed 11 megohms insulation resistance. Another, with 11 converters included, gave a total insulation resistance of 159 megohms. It is not uncommon to get an insulation resistance of from two to five megohms with 30 and 40 converters in circuit. These tests did not include aërial portions of circuits. It should be said that the insulation of the converters and connections is being constantly improved.

About 130 miles of the subway electric light conduc-

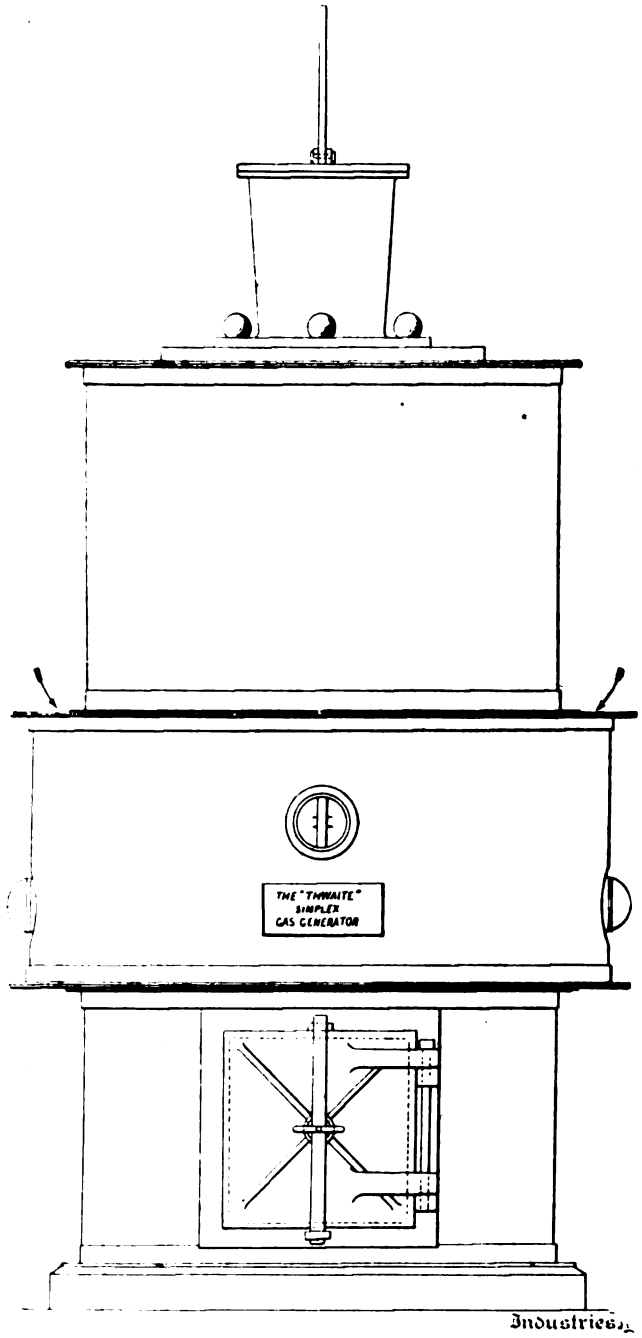
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THE "SIMPLEX" GAS GENERATOR.

DESIGNED AND CONSTRUCTED BY MR. B. H. THWAITE, ENGINEER, LIVERPOOL.



VERTICAL SECTION THROUGH GENERATOR



FRONT VIEW OF GENERATOR.

tors referred to are employed as carriers of alternate current for incandescent lighting, and about 60 miles as carriers of arc light circuits and incandescent continuous current. These circuits vary in length from 1 mile to 11 miles; the longest arc light circuit is 10 miles in length; the longest alternating circuit is 11 miles in length. In 10 miles of alternating or arc circuit there are from 450 to 500 joints. The greateat number of converters on one subway circuit is 65. There are 14 arc light circuits and 25 alternating circuits in the subways. Quite recently an alternating circuit for arc lamps has been installed in the subways, which is intended to be the pioneer of numerous such circuits.

The presence of gas is the most serious defect of electrical subways in cities. The ducts used in the subways are not only joined together as nearly hermetically as possible, but, except in the case of distributing ducts, they are laid in a solid body of cement from man-hole to man-hole. Whatever may be the mode by which point the gas enters the subways, its unwelcome presence is acknowledged, and while it is self-evident to anyone who will investigate the matter for himself, and is actually admitted by the gas companies, that the gas emanates from the gas mains in the streets, nevertheless the subway enginers have been constantly at work devising means to remove the intruder. Various methods of ventilating the subways have been suggested and tried, the most successful of which thus far has been the ventilation of the subways by the use of blowers stationed at intervals along the subways, and arrangements are now in progress to place fifteen such blowers in operation to cover the entire subway system. As the ducts become filled with cables, however, the free passage of air through them is prevented, and in this way the utility of the blowers is diminished. In order to evade this difficulty a 6in. wrought-iron pipe has been laid above the subway ducts in the more recently constructed subways. This large iron pipe has openings at each man-hole. It has been frequently suggested that good results might follow a suction method of ventilation, but experience has shown that this would rather aggravate the evil, as it would draw into the subway all the accumulated gas in the streets, besides inviting a larger leakage from the gas mains.

Experience has led to the following conclusions:—That it is possible to successfully operate all classes of underground electric conductors in cities. That, at least for conductors conveying high tension currents underground, it is advisable to set the standard of insulation high. That regular insulation tests of the conductors are very valuable. That liberal thickness of insulation is desirable for high tension currents. That it is unadvisable to place underground new types of cable or insulation until they have been subjected to tests and conditions analogous to those to which they will be subjected underground. That for electric lighting conductors—especially distributing mains—many conductors under one cover are not advisable, owing chiefly to the difficulty in making joints in such cables. That all sharp edges in ducts should be avoided. That until the gas light companies are required, like the electric light companies, to maintain their mains in a fairly sound condition underground, a means of ventilating the subways should be provided at the time the subways are contracted for. That while other features may be accessories thereto. the employment of smooth strong conduits, accessible ducts for distribution of the current, first-class insulation, constant expert attention to details, and thorough organisation in every department are essential to the production of a successful electrical underground system.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

AT the meeting of this Institution on the 27th ult. a paper was read, on "Alternating *v.* Continuous Currents in Relation to the Human Body," by Mr. H. Newman Lawrence and Dr. Arthur Harries, of which the following is a brief abstract:—

The experiments and observations upon which our contribution is based form part of a series of data connected with investigations upon which we are engaged with the hope of solving some of the physiological problems occurring in the course of our electro-therapeutic work at the Institute of Medical Electricity. The results obtained led us to note how strongly they bore on the question now before us. They differ from the experiments of D'Arsonval, Harold P. Browne, and others, in the important point that they deal, not with the bodies of rabbits,

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dogs, and horses, or other animals (from which conclusions regarding human life have to be evolved), but directly with the human body. Our experiments have not been made with the powerful currents dealt with in electric lighting and distribution of power. We have used small currents, for the most part at low e.m.f., and have directed our attention to—1st, the determination of the resistance of the human body and skin to the passage of currents under certain conditions; and, 2nd, a comparison of the sensations produced in the human body by passage of the two forms of current. Our experiments have been made with the skin *normally dry* and *moist*, and we have selected measurements taken from hand to hand, as the hands are the parts most likely to come into contact with wires and other conductors. We find the—

Average Resistance				Ohms.
To the continuous current, moist with *salt* and water				= 9,557
,,	alternating	,,	,,	= 1,405
,,	continuous	,,	,, distilled water	=15,250
,,	alternating	,,	,, ,,	= 1,722
,,	continuous	,,	dry	=38,140
,,	alternating	,,	,,	= 4,155

When this difference between alternating and direct currents became apparent we thought it well to confirm our experiments by repeating them as far as possible under conditions such as would occur in actual working. The continuous-current tests were made with a Wheatstone bridge of Post Office pattern and a mirror galvanometer. The alternating-currents tests were made with one of Kohlrausch's rheometers, in which the balance is observed through a telephone. The *alternating* currents obtained from the induction coil of the instrument had a periodic frequency of about 300 per second. These results indicate that the resistance of the human body to continuous current is 6·8 times greater than it is to alternating currents when the skin is moistened, and 8·3 times greater when the skin is in its normal condition and not moistened by artificial means. The sensitiveness of persons to the *continuous* current varies very much, quite independently of variation of resistance. But we find that most people (and we have tested some hundreds) can bear without discomfort the passage of 10 milliamperes for a short time, and therefore for the purposes of this paper we will consider that amount of current-strength as the maximum which may be passed through the body without producing unpleasant sensations. With alternating *currents*, however, a very different state of things is disclosed; for having in the course of our therapeutic work found the great need for accurately measuring the alternating currents from induction coils, we obtained from Germany (after failing to find a suitable instrument of English make) a galvanometer recording milliamperes of alternating currents, and on putting it in circuit with a patient, were surprised to note that before the needle indicated the passage of a single milliampere the patient complained that the current was too strong, and practically unbearable. This, of course, led to further investigation, with the result that, though we tested a large number of persons of varied age and of both sexes, we found only a few who could bear with comfort the passage of one milliampere of alternating currents.

We can therefore confidently state that, as far as sensations are concerned, the human body can bear with ease at least five times as much of continuous-current strength as of alternating current strength. When this fact is taken in connection with the great difference in the resistance offered by the body to the two forms of current, it leads to the conclusion that the danger of unpleasant consequences, and possibly (if not probably) of loss of life, when currents of equal voltage are handled, is 34 times ($6{\cdot}8 \times 5$) greater with moist hands, and 41·5 times ($8{\cdot}3 \times 5$) greater with dry hands, when alternating currents are used than when the continuous current is employed. These figures we will adopt as representing the *danger-ratio*. As a practical example of this conclusion we may take the Board of Trade limit of pressure at which currents may enter houses, viz, 200 volts, and assume that a man having an average resistance handles naked wires within the house.

$$\text{With the continuous current (dry hands)} \left.\right\} C = \frac{200}{14{,}475} = 13{\cdot}5 \text{ milliamperes.}$$

He thus receives *only* 13·5 milliamperes, which is little more than, as shown above, he can take with perfect impunity.

$$\text{With alternating currents (dry hands)} \left.\right\} C = \frac{200}{1{,}740} = 115 \text{ milliamperes.}$$

He thus receives 57 times more current than he can bear without discomfort, and the danger of physiological shock is correspondingly increased.

In the discussion which followed, Professor Forbes said that the tests made and the results obtained had little bearing on the practical question of safety in the use of electricity for lighting and power purposes, for the conclusions arrived at in the paper were not in accord with actual experience. The sensations, he said, depend not on the mean current, but the maximum value of the current or volts; and in the case of an induction coil the volts on break were immensely greater (20 to 50 times) than the maximum occurring in a well-designed alternator which would send the same mean current through the body as that indicated by the measuring instrument used.

Mr. Kapp found he could bear 100 volts continuous with about the same discomfort as 40 volts alternating.

Major Cardew said shocks received from old Wilde machines were very severe, even when the volts were small; whilst from a modern alternator 100 volts may be taken without great discomfort. Referring to the Board of Trade regulations, he informed the authors that permission to use 200 volts alternating on consumers' circuits had never been granted.

Mr. Sayers thought sensation depends greatly on the shape of the e.m.f. curve and on the frequency of alternation.

Mr. Crompton said he had recently tested the resistances of individuals by Evershed's ohmmeter, 100 volts being used in all cases. As a rule he found the resistance to fall from 30,000 or 40,000 to 25,000 by continued application, and in some cases 10,000 or 11,000 ohms were indicated.

Mr. Joyce said that, even if the difference in the e.m.f. curves of induction coils and alternators in producing sensations were admitted, yet from the results in the paper one could see that there is a great difference between the resistances of the body to alternating and continuous currents. This of itself meant a serious difference in the "danger ratio."

Mr. W. H. Preece believed there had been more nonsense talked about this subject, particularly on the other side of the Atlantic, than on any other with which he was acquainted. Speaking of the so-called "dangers of electricity," he said the difficulty was to kill rather than to prevent being killed, and that the question was not one of high or low potentials, or alternating *v.* continuous currents, but of overhead *v.* underground mains, and bad or good workmanship and insulation.

Dr. Harries said he had anticipated more discussion on the physiological points raised. He remarked that the high voltage on breaks means little if the resistance be high. As regards the effect of frequency, he stated that the greater the frequency the less unpleasant a given current becomes.

Replying to the electrical points, Mr. Lawrence said the frequency of the alternating currents was about the same in all the experiments, and that from greater frequencies he would expect less effect.

Mr. Alex. Siemens (who was in the chair) said he had experienced the pain-alleviating properties of the electric current in the case of teeth extraction.

Notes.

A FRESH FIND OF SALT IN CHESHIRE.

THE *Chester Chronicle* reports that the sinking and tunnelling of the last nine months on Mr. Podmore's farm at Middlewich, Cheshire, has resulted in finding a plentiful supply of brine containing 2lb. 10oz. of salt per gallon. The work has been under the direction of Mr. Murgatroyd, of Stockport, and, before finding the brine, evidence had been obtained of two beds of salt of considerable thickness—the second deposit containing amber rock-salt of very fine quality. The property is, undoubtedly, of great value, and it is proposed to set up works immediately for evaporating the brine, and also to sink a shaft for mining the second bed of rock-salt.

ASSOCIATION OF SANITARY INSPECTORS.

THE position of sanitary inspector is beginning to be recognised as of some importance, and as almost all the County Councils are taking steps to have the sanitary affairs of their districts placed under proper supervision, it is likely that soon a distinct profession may be organised. In fact, that to a certain extent has been done, for we have already the Association of Public Sanitary Inspectors of Great Britain. The Council of this Association is naturally anxious to improve the positions of its members, and it is of opinion that the conditions under which sanitary inspectors are appointed and discharge their duties are inimical to the interests of the public health, and that those conditions are due to the defective state of sanitary law. The Council has recommended that the influence of the Association should be directed to secure the following amendments in sanitary law: That every candidate for the position of sanitary inspector shall have a general knowledge of the building trades, and in addition shall possess a certificate in sanitary science; that sanitary inspectors shall be elected to a permanent tenure of office, and shall only be dismissible for misconduct or proved incompetence, with right of appeal to the Local Government Board, with various other stipulations regarding salary and duties. In consequence of the probable demand for sanitary inspectors we understand that numerous classes in sanitation are being started in different parts of the country.

THE WOOD SUPPLY OF GREAT BRITAIN.

FROM a paper recently read by Dr. W. Schlich we learn that about twelve million pounds sterling are paid every year for timber by the British Empire, and the author pointed out that the United Kingdom had waste land amounting to over 26,000,000 acres, one-fourth of which would be sufficient to produce all the ordinary timber now imported into the country. Part of this was, of course, wanted for other purposes, but still, if systematic forest management were introduced, a great deal of timber might be produced. The author urged that, in spite of the constitutional aversion of Englishmen to State interference in anything like an industry, it was most essential that energetic steps should be taken to prevent the serious consequences that would arise from a failure of the wood supply of the Empire. Nominal interference only would be disastrous. The forests must be treated in a systematic manner, and the State should either set aside certain areas for forest purposes or by legislation take upon itself the management of communal and even private woodland. He pointed out the great improvement which had recently taken place in India since the Forests Departments had been reorganised, and a competent staff of officers provided, to be reinforced by those educated at Cooper's Hill College. Dr. Schlich also placed before his hearers an exhaustive account of the action of the Australian colonies with regard to the regulation of wooded lands by the State, contending that in no case had sufficient steps been taken to ensure a lasting and continuous supply of timber.

SCOTCH RAILWAY RETURNS.

THE proposed changes in the management of the Scotch railways cause unusual interest to be attached to the returns which have been recently issued, are receiving a considerable amount of attention. During the half-year there has been an increase in the traffic of each railway by the following amounts:—

North British	£59,930
Caledonian	48,574
South-Western	8,338
	£116,842

On the other hand, there has been an increase in the working expenses by the following amounts:—

Caledonian	£51,454
North British	36,512
South-Western	15,358
	£103,324

which show a most remarkable difference in the dividend values of the various increases, and further that for some reasons, or others, the North British has been able to do its half-year's work very much cheaper than either the Caledonian or the South-Western. Various special items have no doubt entered into the accounts of the two latter during the past half-year, but they are not in themselves sufficient to account for the difference, the reasons for which will no doubt receive the careful attention of some of the shareholders.

THE PRESENT CONDITION OF PANAMA.

THE effects of the collapse of the Panama Canal scheme on Panama and Colon are described in a recent interesting report from the American Consul at the latter port. The decadence of Colon, he says, and the almost entire prostration of all business since the collapse of the canal become more and more apparent. It very often happens that not a single vessel is to be found in the harbour, where but a short time since vessels were obliged to anchor out for days waiting for dock room at which to unload their cargoes. The local traffic of the isthmus while the work on the canal was proceeding had reached vast proportions. The route for about fifty miles was a vast bivouac, where the most energetic of all nationalities and races had congregated to amass wealth, and many, especially the Chinese, have done so. Wages were high, princely salaries were paid, money was easily made and freely expended. Daytime was not enough; the nights themselves were turned into day, and, literally speaking, the twenty-four hours of the day were a constant draft on various industries. Forty towns sprang up on the line in almost as many miles, every one of them a real beehive of people of all races and tongues. Now the people have all gone and business is dead. Colon and Panama still live, but that is all—merely bye-way stations for the traffic across the isthmus eastward and westward between two hemispheres. In Colon rents have fallen off 500 per cent. in three months, and are still on a decline. The Panama railroad, which in 1888 paid 23·50 per cent. dividend, will in 1889 pay only 9 per cent. This line in 1888 carried 1,300,000 passengers (4,000 every day); this year it will carry probably 500,000, if so many. But the transit traffic has not suffered; local traffic only has been affected, but this to such an extent that nearly two-thirds of the business houses in Colon are closed, and bankrupt sales are of daily occurrence.

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Patent Record.

(Compiled from "The Illustrated Official Journal (Patents)."

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

17th March, 1890.

4104. Roberts, A., Jun. ..... Lathes.
4107. Bradshaw, A..... Lubricators.
4110. Hartley, G..... Mules.
4117. Rhodes, Rhodes, & Rhodes..... Grooved pulleys.
4119. De Baere, P. ..... Rock boring apparatus.
4122. Jackson, E..... Band sawing machinery.
4126. Berg, E. ..... Indicator.
4127. Dewar, A. ..... Projectiles.
4128. Walker & Stephenson (trading as John Perry)..... Washing machines for fibres.
4131. McEwen, J..... Water gauges.
4133. Roberts & Belden ..... Grinding and amalgamating pans.
4139. Glüser, H. ..... Water gauge.
4144. Morrell, J..... Brakes for vehicles.
4147. Müller, E. ..... Wood working machinery.
4148. Pol & Künzel ..... Car brakes.
4152. Picking & Hopkins ..... Drying machines.
4153. Simonet, M. H. ..... Crushing machine.
4154. Shepherd, G. H. ..... Lawn mowers.
4157. Wallwork, R. ..... Machinery for finishing hats.
4158. Brigham, M. E. ..... Paper box making machinery.
4162. Newton, H. E. ..... Boilers and furnaces (*Cartwright*).
4164. Abel, C. D. ..... Governing gas engines (*Gas Motoren Fabrik Deutz*).
4166. Cornero, C..... Propelling and steering ships.
4167. Marshall, J. ..... Thrashing machines.
4168. Spanoghe, J.-E..... Screw propellers.
4169. Edwards, E. ..... Stuffing boxes (*Gminder*).
4176. Parkinson & Parkinson Sieves for grading grain.

18th March, 1890.

4184. Howe, C. J..... Disengaging boats.
4194. Hahn, J. ..... Railway brakes, signal, and switch operating mechanism.
4195. Hawksley, G. W..... Furnace bars.
4196. Barlow & Barlow ..... Jacquard harness.
4201. Teague, T. ..... Smelting furnaces.
4203. Vicars, Vicars, & Vicars Mechanical stokers.
4209. Smith & Sutton..... Apparatus for cutting cloth.
4214. Ballach, A..... Sowing machines.
4217. Van Vestraut, L..... Apparatus for charging inclined gas retorts.
4229. Melendy, B. H. ..... Dough-kneading machines.
4230. Powell & Bennett ..... Expanding pulleys.
4234. Sorel, E. E. A. ..... Manufacture of wheels.
4236. Smith, W. E. ..... Apparatus for burning liquid fuel (*Bray*).
4239. Apostoloff, L. ..... Submarine vessels. (10th September, 1889).
4240. Seymour, C. J. ..... Elevators and conveyors.
4242. Searles, J. E..... Disintegrating machines.
4244. Galloway & Beckwith Expansion valves.
4245. Rowe, G. E..... Mowing and reaping machines.
4247. Scott & Tagg..... Ships' boats.
4249. Kesterton, H. ..... Explosion engines.
4250. Marshall & Wigram ... Engine valves.
4257. Thompson, W. P. ..... Brush-making machines (*Young & Robinson*).
4262. Thomson, J..... Water meters.

19th March, 1890.

4268. Ingram, G. ..... Locomotive engines.
4274. Crawshaw, R..... Looms.
4276. Preston, N. A. ..... Bearing for railway axles.
4281. Smith, Smith, & Smith... Apparatus for washing wool.
4282. Whyatt, H. J..... Machines for veluring hats.
4284. Johnson, W. ..... Fan for smiths' forges.
4288. Firth, A. ..... Lifting machinery.
4296. Burrell, F. J. ..... Compound locomotive engines.
4297. Burrell, F. J. ..... Undertype compound steam engines.
4299. Lees & Lees ..... Machines for mortising timber.
4302. Sproule, R. F. ..... Printing machines.
4307. Gill & Bradley..... Paper-cutting machines.
4309. Foster, J..... Evaporating and distilling apparatus.
4320. Jones, C. J..... Boilers.
4323. Hanneborg, O. B. H. ... Machines for making drains.
4325. Edwards, J. D. ..... Permanent way.
4326. Sahlström & Hill ..... Burner for liquid fuel.
4327. Tonnar, F. ..... Apparatus for manufacturing plush fabrics.

20th March, 1890.

4328. Scott & Thornton ..... Reducing valve.
4331. Gillibrand, R. T..... Boiler furnaces.
4333. Lindsay & Allan ..... Whip rails of looms.
4334. Lindsay & Lindsay ..... Let-off mechanism of looms.
4335. Baines & Baines ..... High-pressure valve cocks.
4336. Forknall, T..... Machinery for perforating paper.
4337. Bolton, R. ..... Cranes.
4338. Waters & Woodman ... Brush-making machinery.
4356. Wilkinson, A. J. ..... Pottery ovens.
4360. Robertson, J..... Machinery for glazing paper.
4361. Armitage, R. ..... Apparatus for winding yarn.
4362. Binns, J. P..... Gas engines.
4363. Sewell, S. J. ..... Brakes.
4367. Burrows, G. W..... Apparatus for washing bottles.
4368. Pullan, Mann, & Gill... Brick-making machinery.
4374. Engeldow & The Engineering Joint Stock Company ..... Heating apparatus.
4375. Morris, A. ..... Typewriters.
4379. Heslop, W. ..... Metal boats.
4380. Miles & Arter ..... Potato-planting machines.
4381. Arter, A. C. ..... Reaping and mowing machines.
4386. Von Ehrenwerth, J. ... Producing iron.
4387. McNaught & McNaught Barring engines.
4389. Lawrence, H..... Slide valves.
4392. English, T..... Mounting heavy guns.
4393. Lacoste, J. ..... Liquid meter.
4398. Boult, A. J..... Tidal motors (*Rankin*).
4401. Kenyon, Barnes, & Kenyon ..... Vices.
4402. Boult, A. J. ..... Pulverisers (*Meyer*).

21st March, 1890.

4410. Harrison, J. ..... Elliptical springs.
4411. Dienst, L. ..... Looms.
4416. Haddow, J. ..... Friction calenders.
4421. Field, E. ..... Steam engines.
4422. Stern & Brune..... Strengthening soft metal pipes.
4431. Howson & Milnes..... Boiler furnaces.
4432. Field, E. ..... Steam engines.
4433. Bell, W. ..... Valve gear.
4438. Hart & Baynes ..... Machines for cleaning cotton.
4442. Anderton & Barlow ... Locking screw bolts.
4443. Reid, W. ..... Reducing valves.
4454. Felstead & Smith..... Brake.
4455. Bauermeister, A. ..... Presses for preparing cement.
4457. Edwards, E. ..... Coke ovens (*Stroehmer*).
4459. Cussons, H. R. ..... Pumping apparatus.
4461. Hornsby & Smith ..... Sheat-binding apparatus.
4464. Peckham, E. ..... Bogie tramway trucks.
4465. Kirk, J. H. ..... Looms.
4466. Lake, H. H..... Regulating the pressure of fluids (*Jay et Jalliffier*).
4467. Carey, W. ..... Pipe couplings.
4471. Lake, H. H..... Training guns (*Maxim*).
4472. Tuerk, F. W. ..... Rotary fans.
4474. Gibson & Lilley ..... Pulley blocks.
4475. Lay & Owen ..... Machinery for manufacture of ropes.

22nd March, 1890.

4478. Wear, S. ..... Sieving apparatus.
4479. Presland & Pallant ... Compensating crank.
4483. Fowler, A. B..... Heel finishing machines.
4486. Muir, A. ..... Planing machines.
4487. Snelgrove, W. ..... Drain-clearing apparatus.
4488. Orr, M. L. ..... Machinery for washing bottles.
4493. Weir & Denholm ..... Harrow.
4495. Hetherington, J. M. ... Spinning machinery.
4497. Bradley, I. ..... Hot water apparatus.
4498. Marlow, C..... Machine for polishing glass.
4500. Brownlow, R. S. ..... Apparatus for removing solid matters from water.
4503. Thomas, F. ..... Lowering ships' boats.
4504. Lee, E. P. ..... Kilns for burning bricks.
4509. Rylands & Stoner ..... Machinery for manufacture of glass bottles.
4514. Preston & Co., Ld. ..... Compressed air tramcars (*Fitzgerald*).
4516. Aston, Aston, & Aston Presses for stamping metals.
4517. Barfoot & Langham ... Knitting machines.
4518. Thompson, W. P. ..... Apparatus for heading bolts (*Seaton & Seaton*).
4521. Leonard, H. S. ..... Machine for husking seeds (*Canterbury (N.Z.) Seed Company*).
4522. Morris, R. ..... Magazines for rifles.
4523. Abel, C. D. ..... Gas engines (*Gas Motoren Fabrik Deutz*).
4528. Schoone, C. I..... Stone cutting machine. (22nd August, 1889.)
4531. Downing, G. C. ..... Lubricator for air-compressers (*Lalance & Elsner*).
4532. Lawrance, E. G. ..... Evaporating liquors (*Pick*).

ELECTRICITY.

17th March, 1890.

4103. Campbell, J. ..... Arc lamps.
4116. Young, F. J. ..... Magneto call bells.
4125. Berg, E. ..... Electric bell.

18th March, 1890.

4189. Suter, F. ..... Electric switch.
4191. Farrall, T. D. ..... Generating heat, steam, and light by electricity.
4220. Holden, H. C. L. ..... Electric switches.
4231. Gray, W. E..... Arc lamps.
4232. Gray, W. E ..... Incandescent lamps.
4235. Rees, J. P. ..... Filaments for electric lamps.
4242. Siemens, A. ..... Electric railway signals.
4246. Forbes, Sir C. S. ..... Primary batteries.
4260. Thompson, W. P. ..... Electrical distribution (*Young*).

19th March, 1890.

4275. Kingdon, J. A. ..... Electrical switches.

20th March, 1890.

4350. Barnett, H. T. ..... Electric switch.
4366. Parker, T. H. ..... Electrical thermometers.
4383-4. Pitkin & Holden ..... Secondary batteries.
4405. Sayers, W. B..... Dynamos and motors.

21st March, 1890.

4407. McGrew, J. B. ..... Electric railways.

22nd March, 1890.

4533. Lake, H. H..... Safety devices for electric circuits (*The Thomson-Houston International Electric Co.*).

CHEMISTRY.

17th March, 1890.

4120. Laing, J. ..... Distillation of mineral oils.
4137. Piekenbrock, F. (of the Firm of Graf & Co.)... Producing "ozone oil."
4151. Candy, F. C. ..... Purification of sewage, &c.
4171. Negrier, C. S. ..... Concentrating sulphuric acid.
4181. Spitzer, S. ..... Manufacture of starch.

18th March, 1890.

4197. Müller & Adkins..... Lighting gas.
4223. Von Langer & Cooper... Water gas.
4224. Von Langer & Cooper... Enrichment of water gas.
4243. Schückher, W. ..... Explosive.

19th March, 1890.

4324. Kelman, J. A..... Manufacture of gas.

20th March, 1890.

4355. Hancock & Craig ..... Gas from mineral oils.
4382. Willcox, B. ..... Derivatives of phenyl-amido-acetic acid (*Farbenfabriken vormals Friedrich Bayer & Co.*).
4394. Ricard, F. ..... The ammonia soda process.

21st March, 1890.

4409. Muller & Webber ..... Aniline black.
4420. Beilly & Henderson ... Extraction of metals.
4434-5. Meldrum & Meldrum Distillation of ammonia.
4450. Turnbull, Stockdale, & Duerr ..... Mordanting cotton.
4473. Lake, H. H..... Carbonic acid (*Jay et Jalliffier*).

22nd March, 1890.

4519. Precht, H. ..... Potash.

MISCELLANEOUS.

17th March, 1890.

4111. Scotter, R. ..... Ships' berths.
4113. Bennett & Hides ..... Water pits and fountains.
4180. Oliver, G. H. ..... Separating dust from air.

18th March, 1890.

4185. Barr & Stroud ..... Range finders.
4208. Thomason, J. ..... Gas valve.
4218. May, A. ..... Removing paint.
4225. Von Langer & Cooper... Valves for hot gases.
4238. Etrich, I..... Spindles.
4259. Thompson, W. P. ..... Ring throstles (*Koldt*).

19th March, 1890.

4283. Hookham, G. ..... Rifle bullets.
4311. Warren, F. P. ..... Life saving appliances.
4312. Carriger, J. H. ..... Washing machine.

20th March, 1890.

4354. Eichhorn & Jasper ..... Hydrometers.
4365. Bolden, N. F..... Fire escape.

21st March, 1890.

4462. Bartlett, J. ..... Ventilators.

22nd March, 1890.

4491. Walton & Walton ..... Filtering oil.
4529. Leigh, H. H. ..... High-pressure flexible tubing (*Dubault & Chicard*).

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form, of such opposition.

Year 1889.

1017. McFarlane.
3726. Mandleberg, Rothband, & Mandleberg.
4881. Parker.
4943. Keartland.
5062. Hodder & Swain.
5161. McInnes.
5339. Lewes.
5356. Hart.
5401. Hughes.
5674. Mabbutt.
6129. Fox & Blass.
6360. Rieger.
6494. Steinhart.
6578. Hookham.
6636. McPhail.
6685. Goodwin.
6737. Delamarre.
6968. Hargreaves, Robinson, & Hargreaves.
2784. Perkes.
4737. King (*Cutmore*).
4755. Abraham & Abraham.
4936. Hartley.
5043. Horrocks.
5146. Jackson.
5235. Peak.
5346. Hillman.
5396. Hillman.
5617. Stutchbury.
5801. Kohl.
6250. Whitty.
6396. Courteen.
6544. Goldston.
6616. Weightman.
6675. Watel.
6723. Hurst.
6936. Franzel.
7118. Shaw.
7144. Leat.

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7226. Brooke & Brooke.
7260. Walker.
7265. Robinson & Perry.
7479. Wilds.
7498. Edwards.
7706. Favell.
7744. Dutton.
7783. Langer & Hahn.
7911. Hodges & Phillips.
7977. Pitt (*Cassella & Co.*).
8010. Costigan.
8063. Holt.
8087. Drake.
8139. Newton & Quiggin.
8140. Eyland.
8158. Butenschön.
8182. Burford.
8184. Hicks.
8191. Kristen.
8215. Cleminson.
8249. Anderson.
8268. Beaumont.
8297. Bachschmid.
8310. Swalwell.
8355. Smith.
8370. Case.
8373. Johnson (*The Badische Anilin & Soda Fabrik*).
8407. Wain.
8413. Wadsworth & Haddow.
8418. Parker.
8444. Macdonald.
8492. Riley.
8494. Tillam & Harrison.
8522. Hale.
8532. Elphick.
8543. Twynam.
8571. Hodgkinson.
8608. Cousens.
8681. Lake (*Goldsmith & Wright*).
8687. Varaldi.
8722. Mark.
8795. Ford.
8821. Rummelhoff & Ahrends.
8917. Dodd.
9066. Harvey & Brooke.
9280. Hirschler.
9387. Scott.
9428. Johnson (*The Badische Anilin & Soda Fabrik*).
9429. Johnson (*The Badische Anilin & Soda Fabrik*).
9674. Bowden.
10762. Clark.
11403. Procter, Middleton, Fraser, & Carter.
12314. Southgate.
13199. Fancourt.
14886. Nawell.
15914. Steel, Peech, & Tozer, Ld., & Oakes.
18001. Garrett & Webster.
19102. Young.
20093. Hicks.
20570. Fisher & Russell.
20682. Fleck, Fleck, & Schrader.
7236. Collett & Hollingworth.
7317. Plater.
7490. Boult (*Schulhof*).
7537. Congreve & Brownsword.
7759. Peyman.
7891. Taylor.
7922. Knox.
7989. Devis.
8019. Macdonald.
8064. Reed & Palmer.
8129. Ingham, Illingworth, & Momberg.
8145. Gildea.
8168. Donnelly, McLaren, & Trask.
8187. Haug.
8213 Lowrie & Hall.
8246. Ellis.
8253. Thirion.
8285. Cuttriss.
8308. Lee-Warner.
8322. Harvey.
8367. Lansley.
8371. Case.
8391. Scott.
8399. Lane.
8410. Wallace.
8414. Harrison.
8429. Bosse.
8457. Spear.
8493. Barber-Starkey.
8496. Faulkner & Lloyd.
8527. Black & Rennoldson.
8534. Lacon.
8556. Macdonald.
8602. Wallis.
8658. Osmond.
8682. Lake (*Goldsmith & Wright*).
8705. Frost.
8758. Cox & Ham.
8817. Staempfli.
8847. Threlfall.
8881. Longdon.
9056. Krüger.
9267. Alexandre de Pont, Silvius de Pont, Herbert Lushington Storey, & Isaac Henry Storey.
9542. Cross.
9575. Hargreaves.
10441. Eisenmann.
11149. George Rogers & John Rogers.
12247. Lochmann.
12733. Brooks.
14567. Thomerson.
15910. Wells.
16686. Piat.
16842. Burtinshaw.
18568. Clamp.
19657. Davies.
20239. Gardner.
20623. Gibbs.
20788. Houssier.

1890.

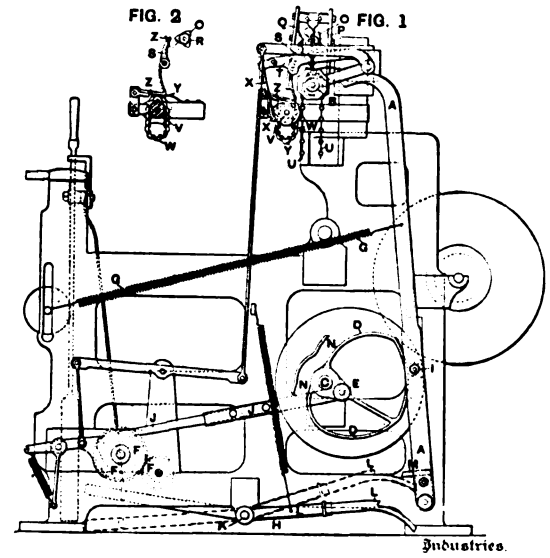
28. Cresswell & Heslop.
817. Macmillan.
1035. Szarbinowski.
1181. Horn (*Haren*).
1358. Boult (*Von Pittler*).
1508. Hardingham (*McCormick*).
1553. Holmes.
1965. Legge.
2166. Deimel.
2221. Carter.
2288. Doughty.
2364. Davis.
2370. Boult (*Dixon*).
2464. Dorman & Smith.
2551. Clamond.
2577. Meissner & Ribbach.
2583. Bailey.
2611. Popplewell (*Conried*).
2621. Watel.
2627. Boult (*Bertrand & Bray*).
2647. Lake (*Beckfeld & Schmid*).
2649. Summerton & Brown.
2697. Schneider.
2771. Hughes (*Welch*).
2786. Bowden.
2811. Prince (*Parker*).
2817. Götze & Sendowski.
220. Cutlan.
914. Bacon & Morgan.
1111. Moore.
1218. Kerby.
1422. Vale (*The Chemische Fabriks Actiengesellschaft*).
1653. Kennedy.
2003. Jensen (*Christensen*).
2199. Currie.
2234. Nutting.
2258. Rose, Rose, Rose, & Godman.
2402. Butterworth.
2508. Westerdahl.
2566. Allison (*Rand & Githens*).
2609. Rogers.
2614. Brooks & Barlow.
2624. Gordon.
2646. Annin.
2648. Lake (*Schmid & Beckfeld*).
2691. Brown & Sutcliffe.
2729. Ventris.
2781. Ott.
2795. Tweedale, Hill, & Lapish.
2819. Lütcke.
2825. White.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

Steam Boilers.—*W. J. Jobling, Newcastle-upon-Tyne.*—Special reference is made to marine boilers. The improvements are to adapt boilers to the use of high-pressure steam, yet obviate the necessity of using plates of exceptional thickness. The boiler is formed of a number of cylindrical vessels, disposed horizontally, and connected together by water tubes. In constructing a boiler of five vessels, three will be disposed side by side, with spaces between them to form the furnace. The vessels rest in cradles built upon the ship's "floors," and the furnace bottoms are carried over the "floors." The other two vessels are fixed above the three first, and joined to them by water tubes. The top vessels have tubes passing through them from end to end, but the lower vessels have one or more flues. The flames and gases pass along the outside of the vessels to the back end; there they divide, and return to the front through the flues of the lower vessels. It next passes upwards to the tubes of the top vessels, and through them to the back again and away to the chimney. Claim: The construction of steam boilers comprising a series of cylindrical shells, of comparatively small diameter, traversed longitudinally by fire flues or tubes, or by a combination of flues and tubes, the said shells being so disposed that furnaces, combustion chambers, and flues, or any of them, may be constructed externally to them, with the objects of securing strength to contain very high pressures, facilitating construction, and obtaining evaporative efficiency.—No. 6535. April 16th, 1889. 8*d*.

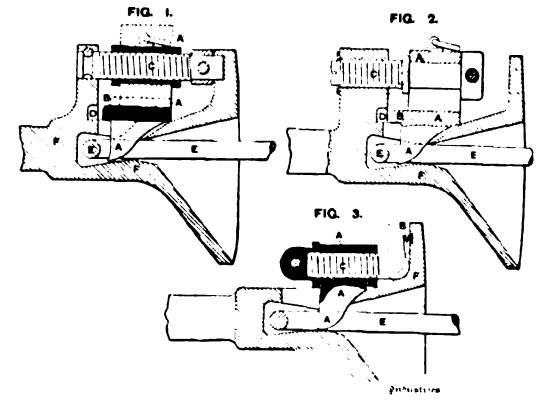
Looms.—*W. H. Crompton & W. Horrocks, Radcliffe, Lancashire.*—The object of this invention is to improve the mechanism which governs the shuttle changes in looms—firstly, by making its motion positive, yet so sensitive that immediately the weft thread breaks it is thrown out of gear and prevents the necessity of setting back the pattern chain; and, secondly, by using fewer cards or links for a pattern when a repeat frequently occurs. Fig. 1 is an elevation of part of a "Whitesmith's" loom with the above improvements introduced. Fig. 2 is a detail. In making the first improvement the lever A, which actuates the pattern barrel B, is worked by a bowl I travelling round the edge of the cam D; the bowl I being fixed to the lever A. The cam D is either mounted upon the tappet shaft C or fixed fast to the crank pin E. The crank pin E carries the long catch levers J employed in these looms for pulling round the wheels F which work the drop boxes. The bowl I is held against the cam during part of its revolution by a spring G, but during the effective part of its revolution the cam passes between guides N to give the lever A a positive motion. As soon, however, as the weft thread breaks, an arm or lever H, pivoted at K, is raised, and causes the catch L to engage with the catch M, and prevent the bowl I entering



the guides N of the cam, and consequently prevents the pattern barrel being worked. The second improvement is made by the addition of an extra pattern barrel and chain to those ordinarily employed. In this class of loom a small cam wheel O (Figs. 1 and 2) reverses the motion of the pattern barrel B by alternately disengaging the driving catches P, Q. The cam wheel O is driven by a ratchet wheel R and pawl S, the latter being supported upon an arm T worked by the pattern chain U. According to this invention the motion of this cam wheel O is governed by an extra pattern barrel V and chain W, which are actuated by a catch X upon the lever T. The chain N has enlarged parts or "risers" Y, which come under a "lifter" Z as the barrel V is revolved and lifts the pawl S out of the ratchet wheel R. The reversing catch is thus thrown out of gear, and the pattern chain U will proceed to a different part. Claims: (1) The combination with the pattern barrel lever and frame of a "Whitesmith's" or similar loom of a bowl, spring, and cam, partly single and partly double, revolving with the crank or eccentric (on the tappet shaft) which actuates the long catch levers; (2) the combination with the pattern barrel lever and frame of the spring, bowl, and cam, partly single and partly double, together with the means for automatically preventing the action of the said cam on the pattern barrel lever when the loom is stopped; (3) the combination with the main pattern barrel and chain which actuates the changes of shuttles, and the cam or wheel for reversing the motion of the said barrel and chain, of an extra barrel and chain for automatically preventing the action of the said cam or wheel when the "repeat" is no longer required.—No. 6040. April 9th, 1889. 8*d*.

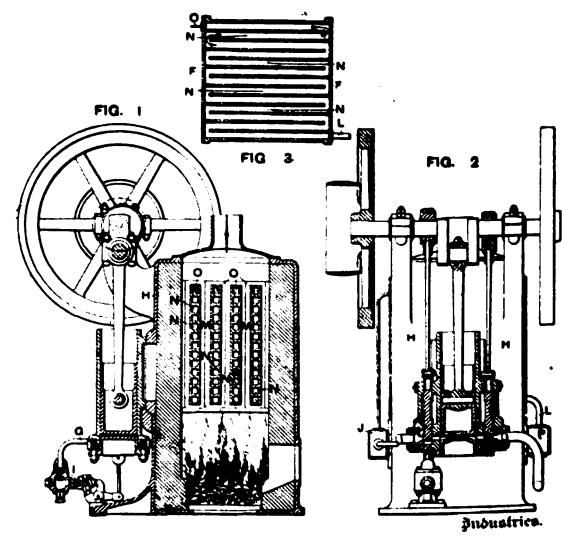
Grinding Card Flats.—*J. Jones, Dukinfield.*—This describes an apparatus to be applied to carding engines for the purpose of grinding the surface of the card teeth of endless or travelling flats. It consists of a fixing which is secured to the horn-bracket and is slotted to receive a bracket capable of sliding in a vertical direction. This sliding bracket carries at its upper part the journal of the emery grinding roller. It also carries an adjustable surface piece for compensating for the bevel of the working surface of the iron flat. This surface piece is adjustable in a slot of the sliding bracket, so that the distance between it and the centre of the grinding roller can be regulated. The surface piece rests upon the working surface of the iron flat, and causes the centre of the grinding roller to maintain a constant distance from the surface of the wire. Claim: The improved apparatus as described for grinding the flats of carding engines, especially the particular construction and use of the surface piece or guiding plate adjustable on the roller bracket for obtaining the necessary bevelling motion from the working surface of the flat, whether in combination with a fixed lifting bracket or with a weighted lever.—No. 6621. April 18th, 1889. 6*d*.

Railway Couplings.—*A. E. Schurr, Romford, Essex.*—Three forms of this coupling are shown in the accompanying illustrations. The coupling consists of a bell mouth block F slotted at the top to admit a catch A which acts as a detent to a link E when it is thrust into the bell-mouthed block; the link E is attached to the end of the opposite vehicle. The catch A is supported by



a screw C which is hinged in Fig. 3 to permit the catch A to rise and fall, but in Figs. 1 and 2 the screw is fixed, the catch being slotted to give it the necessary freedom upwards and downwards. By turning the screw C the catch A may be shifted to the back of the block F and so lock the link E in the coupling; the link being locked in the first two figures by the shoulder B entering the recess D, and in the third case by reason of the position in which C is hinged. In a modified form the catch A is constructed to be forced backwards for the purpose of locking the link by a lever instead of a screw as illustrated. Six claims are made for the coupling described and several modifications.—No. 5864. April 5th, 1889. 8*d*.

Steam Engines.—*L. Bénier, Paris.*—The inventor describes a novel form of steam engine and boiler. The boiler or evaporating apparatus is based on the following combination:—1. Making the boiler of cast iron; 2, causing the water to be delivered at the top of the boiler; 3, making the water run in thin streams over all or a part of the inside walls of the boiler and removing the excess. In the Figs. 1, 2, and 3 the boiler and engine are shown. The boiler is placed within a cast-iron frame H isolated from the hot gases and from the furnace by a lining of refractory earth. The boiler is formed of four similar parts M, but the number may be varied. Each part M is formed of cast iron provided on its exterior with vertical ribs, between which pass the heated gases from the furnace. The parts M are provided with internal horizontal passages N, each passage communicating at one end with the passage immediately above it, and at the other end with the passage immediately below it, so that on water passing into the upper part through the pipe O it traverses successively all the passages N and passes out through the pipe L in the form of steam, which pipe conveys it to a collector P. A door F, fixed by bolts to each end of each part M, allows of the conduits being inspected and removed. The small feed pump I continuously forces water into the boiler during the working of the motor; its discharge is calculated so as to introduce the necessary quantity of water to enable the required quantity of steam to be produced for keeping the engine working at the normal speed, otherwise there would remain water in excess. Further, the supply of water introduced can, in this case, be decreased by any suitable means. The water forced in by the pump passes through the pipe G to a collector J, whence the small pipes O conduct it into the series of passages M, the total section of the small pipes O being smaller than that of the pipe G; each series M receives the same quantity of water.



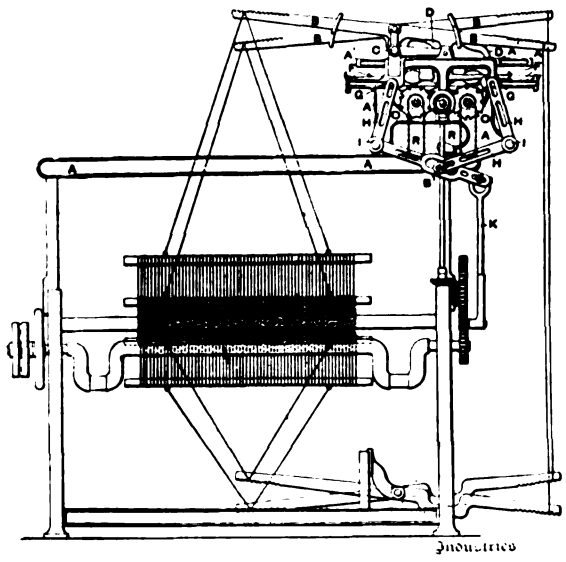
The motor, which is specially constructed to be combined with the boiler just described, is arranged to receive in the cylinder the mixture of water and steam coming from the boiler. The cylinder is vertical and open at its upper part. The piston is very long and forms a slide, and is connected directly by a connecting rod to the driving shaft which is carried in brackets cast on the frame H. The distributing valves, that is to say, the inlet and outlet valves, are represented by two slide valves not enclosed in a box.

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The inlet openings, and especially the outlet opening, should be placed at the lower part of the cylinder to allow of the water introduced escaping easily. In some cases the two slide valves may be replaced by two other valves. The speed can be regulated as in an ordinary steam engine by a governor which operates a valve or other suitable regulating device. Claims: (1) A boiler in which the water introduced at the upper part flows in thin streams over the whole or a part of the walls of the boiler, the heated surface being provided with ribs, the boiler being constructed of one or more series of tubes such as M; (2) the combination of the boiler with the motor.—No. 20753. December 24th, 1889. 8*d*.

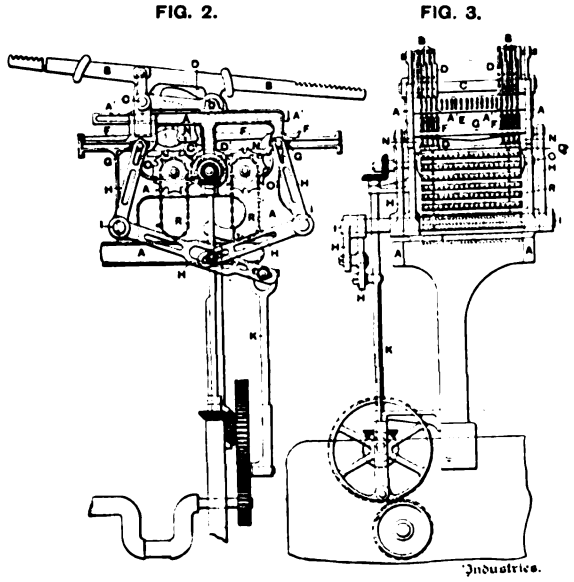
SHEDDING MOTION FOR LOOMS.—*S. Walker & G. Leek, Radcliffe, Lancashire.*—The object of the invention is to provide pattern shedding mechanism for looms for weaving various kinds of fancy cloths, having a positive up and down motion of the "jacks" or levers which actuate the healds. In the illustrations Fig. 1 is a front elevation of part of a loom fitted with the

FIG. 1.



improved mechanism, Fig. 2 is an enlarged view of the same, and Fig. 3 a side elevation of the same. As each "jack" or lever B is alike and actuated by similar mechanism, a description of the working of one "jack" will suffice for all. The "jacks" B are supported upon the shaft C in the frame A, and are raised and lowered by means of a roller fixed to a projection on B, and working in the groove of a cam D. The cam, which has a to and fro motion in a horizontal line, is supported by the slides A^1 in the guide bars E. To the underside of the cam D are secured two hooks F, which point in opposite directions, and engage in reciprocating sliding knives or bars G as required. The motion of the sliding bars G is produced by the bell-crank levers H, which are pivoted to the frame at I, and have an oscillating motion transferred to them, through the connecting rod K, from a moving part of the loom. The hooks F rest upon the ends of a bar or lever N, which is held down upon its fulcrums C^1, D^1, by a spring at its centre; its ends are raised and lowered by pattern chains R upon the barrels O. The pattern barrels are revolved by suitable gearing as shown. The action of the mechanism is as follows:—The slide knives G are continually oscillated in their guides by the levers H, but normally do not engage with hooks F. As the pattern chains, however, are revolved upon their barrels O, the pins in the chain raise and depress the ends of lever N upon which the hooks F rest. By

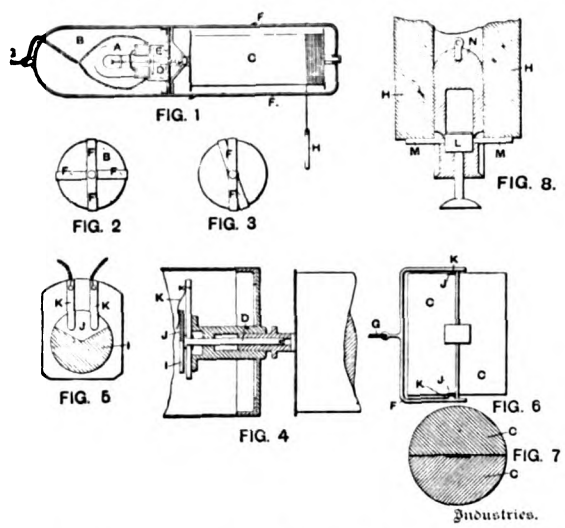
FIG. 2. FIG. 3.



these means the hooks upon the depressed end engage with one of the sliding knives G and shift the cam D, thus raising or lowering the "jack" B. Claims: (1) A shedding apparatus or mechanism for looms having a reciprocating sliding cam or tappet to actuate the "jacks" or heald levers moved as required by two continuously reciprocating knife bars with which two hooks carried by the cam are caused to engage by the pattern chains substantially as and for the purpose described; (2) a shedding apparatus or mechanism for looms having a reciprocating sliding cam or tappet to actuate the "jacks" or heald levers, two hooks attached to the cam or tappet one at each side, two continuously reciprocating sliding knife bars G to engage with the hooks and give a motion to the sliding cam in both directions as required by the patterns, and two pattern barrels O and chains R substantially as and for the purposes described; (3) a shedding mechanism or motion for looms for weaving fancy cloths constructed and arranged substantially as herein described and shown.—No. 4757. March 19th, 1889. 11*d*.

PIPE FLANGES.—*E. Edwards, London.* (*R. Weyher, Arnstadt.*)—The improved flange is so constructed that it may at any time be removed from the pipe, and replaced by another without injury and without taking the pipe from its place and position. The flange is composed of two halves exactly similar to each other. If the flange is of a round shape, each half would be in the form of a disc having holes pierced in it for the bolts and pipe. The central hole for the pipe would be cut away upon one side to permit the flange being passed over the pipe. The part cut away would be of a wedge shape, and a thickened portion of the opposite half of the flange is made to fit the space so formed. Thus the flange would appear to have the parts cut out of one half attached to the corresponding face of the other half. The halves of the flanges are secured to each other and to the pipes by bolts. Claim: A pipe flange, consisting of two halves of the same shape, each having a recess and a raised wedge-shaped part fitting into the recess of the other half, the said halves being so put together as to leave between them the aperture for the pipe and to be secured to each other and to an adjoining pipe flange by means of bolts.—No. 6693. April 18th, 1889. 8*d*.

OBTAINING SOUNDINGS AT SEA.—*W. H. Schwartz, London.*—An appliance is here described by which soundings may be taken at sea whilst the vessel from which the operations are conducted is in motion. It consists of a floating device containing the sounding line and controlled by electricity from the vessel. In the illustrations Fig. 1 is a side view partly in section, Figs. 2 and 3 end views, and Figs. 4 to 8 modifications. To the water-tight casing B is attached the frame F for partly supporting the drum C carrying the sounding line. A magnet and coils A are fixed in the casing B. E is an armature in proximity to the poles of the magnet, the spindle of the said armature passing through the stuffing box or bearing D and engaging with the spindle of the drum C. The sounding line (which may be a thin wire or string) is coiled on the drum C and carries the weight or sinker H. The descent of this weight causes the drum and therefore the armature E to revolve before the poles of the magnet A, thereby generating alternate electric currents, which are conveyed by insulated wires from the coils of the magnet A to and through the cable G and thence to a suitable recording instrument on the vessel, by which the number of revolutions can be ascertained by reference to a scale, and consequently the depth of the water in which the sinker has fallen.



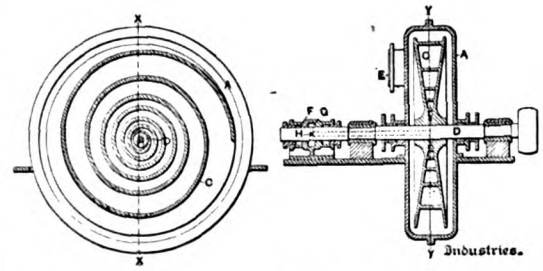
Or electricity generated upon the vessel may be used and a circuit completed and broken at each revolution of the drum C by a device such as shown in Figs. 4 and 5. In this case the spindle D carries a disc I with an insulating piece J by which the current between the terminals K is broken at each revolution. A further modification of this system is shown in Figs. 6 and 7. To more readily rewind the wire upon the drum C after a sounding has been taken, the weight H may be disconnected on reaching the bottom by a device such as shown in Fig. 8. The pusher L is forced up by contact with the bottom, and the arms M thus permitted to drop and release the part N from the weight H. Claims: (1) In apparatus for obtaining soundings of depths from ships or vessels in motion a buoy or float supporting the sounding line and connected to the ship or vessel, and means for indicating the length of sounding line payed out, so that a vertical or approximately vertical descent of the sounding line is obtained with the ship or vessel in motion; (2) in apparatus for obtaining soundings of depths from ships or vessels in motion the combination of a float and drum for the sounding line with means for indicating the length of line payed out.—No. 3197. February 22nd, 1889. 8*d*.

PUMPS.—*T. Eddleston, Pleasington, Lancashire.*—This pump is designed for agricultural purposes, being of simple construction and not liable to become blocked by solid matter suspended in the fluid. The pump is immersed in the liquid to be raised. Its barrel is placed horizontally, and its two discharge pipes, passing upwards, join the main at the same point, so that the discharge pipes and the barrel form a triangle. At the end of the pump barrel are flap-valves, which open directly to the body of fluid to be raised. The discharge pipes are also fitted with flap-valves. In the barrel is a piston for drawing in the liquid and forcing it up the discharge pipes. The piston is oscillated by a hand-lever which is pivoted to the piston rod and to a bracket attached to the pump barrel and one of the discharge pipes. One claim is made.—No. 6976. April 26th, 1889. 8*d*.

AIR PROPELLERS.—*B. & J. B. Verity, London.*—The apparatus is composed of an axle having radial blades secured to it, and the blades encased in a cylindrical casing, which is attached to and revolves with them. The blades are substantially of a screw form similar to that of a ship's propeller, so that when revolved the air is screwed forward and not forced by sudden concussion. Three claims are made for the form of blade described and the surrounding casing in air propellers.—No. 7017. April 27th, 1889.

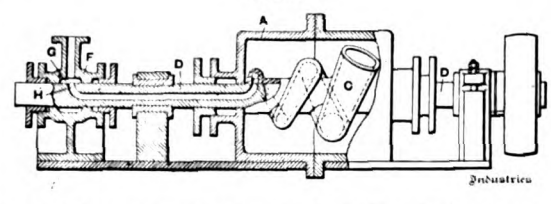
ROTARY ENGINE.—*A. A. Garside, London.*—In the revolving part of this engine there is formed a spiral passage which tapers from the centre outwards. Steam is admitted to the centre of this passage, and in its motion outwards causes the part to revolve. In Figs. 1 and 2 is shown one form of the apparatus, the figures being sections upon the lines X X and Y Y, and in Fig. 3 is shown a modified form. The revolving part C is fixed to hollow shaft D, through which steam is admitted to the centre of C as shown in Fig. 1. A suitable block supplies the means of admitting steam to the shaft as the shaft revolves. The part C is encased in a chamber A provided with the steam outlet E. This improved motor works in the following manner: Steam is supplied from a steam generator to the chamber G of the block F and passes through the orifice H along the centre of the shaft D to the centre of the spiral

FIG. 1. FIG. 2.



passage C. From the centre of C it travels to the outer part, expanding and causing C to revolve with its shaft D. The steam finally enters the chamber A, and is then drawn off to the condenser through E. Claims: (1) In a motive-power engine worked by means of an expansible fluid the use of a hollow spiral C fixed to a shaft, spindle, or drum D, and enclosed in a chamber E; (2) in a motive-power engine driven by means of an expansible fluid

FIG. 3.



the use of one or more hollow spirals C of gradually increasing area and fixed upon a shaft, spindle, or drum D; (3) the combination of a hollow spiral C secured to a partly hollow shaft D with a chamber A, bearings, and box F as described; (4) an engine, whose motive power is an expansible fluid, arranged and constructed substantially as set forth in Figs. 1 and 2; (5) in a motive power engine driven by an expansible fluid the use of one or more hollow helices C of gradually increasing area and secured upon a shaft, spindle, or drum D; (6) an engine whose motive power is an expansible fluid arranged and constructed substantially as set forth in Fig. 4.—No. 5619. April 2nd, 1889. 8*d*.

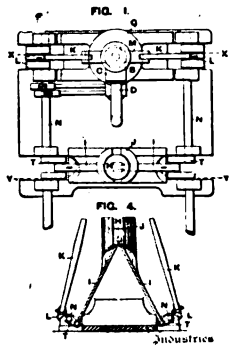
SIGNALLING ON RAILWAYS.—*W. Holland, Worcester.* (*S. P. Wood, Newport, Victoria*).—This invention refers to visible signalling apparatus for railway and other purposes of the kind in which a lamp is used in conjunction with discs or targets. According to this invention, the lamp is made stationary, and the targets, fitted with pieces of coloured glass, are secured to a carriage capable of being revolved about the lamp. The lamp, which is of ordinary construction, is secured to a stud at the top of a standard. The target carriage is supported by this stud. In a slot in the target carriage passes one end of a lever, which is pivoted to the side of the standard; to the other end is jointed an actuating rod, the arrangement being that by actuating the lever the target carriage can be revolved and the glass portion of the targets made to cover the apertures of the lamps as required. The actuating rod may be worked from any suitable apparatus such as the points of the line. Claims: (1) The construction of an indicating disc signal for railway and other purposes with a stationary lamp, a carrier, and a target or targets, in such a manner that when the carrier is actuated the lamp will not turn with the target or targets, but will remain stationary; (2) refers to the signalling apparatus as illustrated in the specification.—No. 6607. April 17th, 1889. 8*d*.

STOPPERS FOR BOILER TUBES.—*G. M. Key, London.*—One feature of this invention is that the insertion of the stopper cuts off the steam and water from the end introduced and so protects the operator. The stopper comprises a central bolt, upon which is threaded two pairs of collars at the ends and a distance tube between the pairs of collars. Between each pair of collars are placed elastic washers made of vulcanised india-rubber or such like material. These washers are so moulded as to have concave and convex surfaces. The concave surfaces face each other, and the convex are in contact with the collars. Between the elastic washers are thin metal discs. The collars are shaped so as to be easily entered into the tube, and the one nearest the operating end has a flange which covers the end of the tube and prevents the outrush of steam and water. When the stopper is inserted the bolt is screwed up and compresses the elastic washers between the collars, causing them to expand radially and stop the tube. Claims: (1) Effecting the closing and sealing of burst boiler tubes and the like; (2) the use of woodite, whaleite, asbestos, and vulcanised rubber with other material or materials; (3) that is formed in such a shape as convex and concave surfaces with bevelled edges or its equivalent arranged in manner such as herein set forth and operating for the purposes specified; (4) the construction and arrangement as herein set forth.—No. 3809. March 5th, 1889. 8*d*.

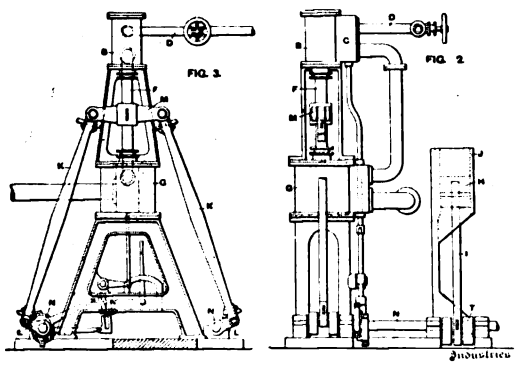
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PIG IRON CARRIER AND BREAKER.—*R. B. Sparrow, Askam-in-Furness.*—The carrier consists of one or more endless bands and rollers, the latter being fixed along the pig bed and driven at any desired speed. At the end of the carrier is an elevator, having an endless band provided with metal brackets or hooks. The bands of the carrier and elevator are composed of iron or steel wire, chains, sheets, or any other suitable material. The pigs are placed upon the carrier and are conveyed by it to the elevator, whose metal brackets or hooks pick them up and raise them to the top of the elevator. As the endless band passes over the top pulley of the elevator, the "pigs" fall from brackets upon a breaker of the usual diamond shaped or any other suitable design to break the "pigs." The breaker is preferably constructed of steel. The broken pieces of iron may be conveyed away from the breaker by suitable shoots to a distance, from whence they can be safely removed. Claim: The combination of a horizontal conveyer with a vertically inclined elevator for the purpose of conveying, elevating, releasing, breaking, and distributing the fractured portions of pig iron as described.—No. 5049. March 23rd, 1889. 6*d.*

COMPOUND ENGINES.—*J. A. Clarke, Canada.*—This invention relates to compound tandem engines, specially designed for driving twin propellers. In the illustrations Fig. 1 is a plan of the engines, Fig. 2 a side elevation, Fig. 3 a sectional end elevation upon the line X X, and Fig. 4 a sectional end elevation on the line Y Y. The operation of the engine is as follows: Live steam passes into the steam chest C, through inlet pipe D, and operates the piston in the high-pressure cylinder B, while the exhaust from the latter acts on the piston in the low-pressure



cylinder G. The piston rod F thus receives an up and down motion by the action of the steam in the cylinders B and G, and as it is connected by its cross-head M, rods K, and the cranks L with the shafts N, the latter are rotated in opposite directions. The rotation of the crank shafts N works the slide H up and down in the guide ways J by the cranks T and connecting rods I. By this method of coupling the shafts N together, the power exerted upon each is proportional to the work performed by each. The improved engine, as above mentioned, is especially designed for marine purposes to drive twin screws, secured directly on the crank shafts N in front of the cranks T. In case



one of the screw propellers should become disabled, the power imparted to its shaft will be directly transmitted to the other shaft by means of the cranks T, the connecting rods I, and the slide H. In a heavy rolling sea one of the propellers frequently gets partially out of the water while the other is deeply submerged, and when this happens the slide H will prevent the flying around of the one propeller and will assist the other. It will be understood that as the cross-head M is secured directly on the piston F, and the rods K are directly connected to the said cross-head, no guide ways are used, thus economising power which would otherwise be lost in friction, and affording other attendant advantages. Three claims are made.—No. 20,988. December 31st, 1889. 8*d.*

GAS ENGINES.—*A. E. Tarernier & E. Casper, London.*—By a method described in this specification the engine cylinders are kept cool by converting water into steam. The cylinder is provided with a double jacket, but, instead of causing water to merely circulate therein, the double envelope becomes a boiler. The steam produced is conducted to a coiled pipe condenser. A suitable valve regulates the pressure at which the steam is allowed to escape from the jacket, and so regulates the temperature of the water surrounding the engine cylinder. The coils of the condenser are kept cool by a current of air, preferably that used for exploding the gas. Claims: (1) Cooling the cylinder of an engine operated by an explosive mixture by means of steam generated in a jacket surrounding the cylinder by the heat due to the explosives; (2) in an engine operated by an explosive mixture the combination of a jacketed cylinder with a pump for introducing water into the jacket in such quantities that it can be vaporised, a condenser for condensing the steam after it leaves the jacket, and a reservoir into which the water of condensation flows and from which it is withdrawn by the pump; (3) in apparatus of the kind described for cooling the cylinders of engines operated by explosive mixtures, cooling the condensers by means of air currents; (4) in apparatus of the kind described for cooling the cylinders of engines operated by explosive mixtures, the arrangement of mechanism as illustrated in the patent specification.—No. 7069. April 27th, 1889. 8*d.*

HYDRAULIC TRANSMISSION OF POWER.—*G. Pinnington, Chester.*—This invention may be understood from the following claims: (1) The duplication of pipes or tubes in the hydraulic transmission of power, whereby fluid is retained in the said pipes or tubes, and not discharged or lost after conveying power through or by means of subsidiary engines or machines, but is returned to the central station or stations and engines to be used again for the transmission of power to subsidiary engines or machines, side pumps being used as forcing pumps to supply the pipes or tubes with extra fluid to compensate for leakages; (2) it is evident that the fluid used in the pipes or tubes under pressure and conveying power may be specially mixed, or compounded, with a view to prevent sediment, or corrosion of metal, or to act as a lubricant, and this is claimed as a distinct feature of this invention.—No. 6400. April 15th, 1889. 6*d.*

STEAMSHIPS.—*A. H. Lucas, St. Louis, U.S.A.*—The improvements consist of an adjustable keel and supplemental hulls, which are simple and effective in their construction. The main hull has supplemental hulls fixed to each side of it. Between the supplemental hulls is the adjustable keel. The keel consists of a beam extending the entire length of the vessel. It is connected to the vessel by several posts, in the form of racks. These posts pass upwards into the main hull of the vessel, through cylinders with open ends, the top ends being of sufficient height to be above the level of the surrounding water. The racks are geared to pinions, by which they and the keel can together be raised and lowered. Three claims are made.—No. 496. January 10th, 1890. 6*d.*

ELECTRICITY.

DRIVING ELECTRICAL VEHICLES.—*A. Dickinson, Darlaston, Staffordshire.*—In this system the whole of the gearing is carried in pitch line and independently of the frame which carries the car body. The gear is mounted in a frame which is supported by the bogie axles. One end of the frame is pivoted to one bogie axle and the other end is mounted upon the other axle by a radial axle box, so that this end is free to rise and fall. The radial axle box is fitted with coiled springs, which tend to hold the frame in a horizontal position midway between its upward and downward freedom. The motor shaft is mounted in the centre of the frame parallel to the bogie axles, and carries a small pinion which gears by intermediate wheels secured to countershafts with spur wheels upon the bogie axles. The magnets, the armatures, the countershafts, and all the gearing except the helical wheels on the bogie axles, are mounted upon the frame, causing the whole to be in a sensitive elastic connection with the bogie wheels. Claims (1) The improvements in the mode of driving electrical vehicles by which greater steadiness is obtained; (2) in vehicles driven by electricity the extra frame for carrying the mechanism as described; (3) in vehicles driven by electricity the use of helical gear mounted substantially as described.—No. 18638. November 21st, 1889. 6*d.*

ELECTRIC RAILWAYS.—*G. E. Vaughan, London.* (*S. Trott, Nova Scotia.*)—This invention refers to the brush contacts of electric railways, the inventor's object being to more effectually insulate the conductors connected with the contact brushes, to protect them from injury, and to provide the conductors and brushes with an efficient carrier. The conductors are encased in insulating material, and at the point where the brushes are attached to their holders the insulating material is spread out into hoods, which protect the brushes from falling moisture, the brushes being arranged vertically to make contact with the upper surface of the conducting rail. The two insulated conductors are enclosed in a carrier which travels in the slot of the conduit enclosing the conducting rails. The carrier is formed of two thin plates between which the conductors are clamped. Between the ends of these plates are screwed thick vertical plates which act as a plough or clearer for the slot. These several plates are secured together by means of two solid horizontal plates upon each side of the upper part of the carrier and firmly connected together by bolts passing through them and the end plates. The carrier is supported from the car by means of swivels attached to the ends of the horizontal solid bars. By these means the carrier is flexibly connected to the car, and it is pressed down on to the conducting bar by coiled springs. Three claims are made.—No. 7127. April 29th, 1889. 8*d.*

CHEMISTRY.

NON-CORROSIVE MATERIAL.—*B. Rhodes, London.*—This is an acid-resisting material of the following composition:—Para rubber in solution 25 per cent., asphaltum in solution 5, albocarbon in solution 5, mica in fine powder 20, flower of sulphur 3, and talc in fine powder 2. These ingredients are thoroughly mixed together, and a solvent, such as rectified spirit, added, until the mixture is about the consistency of cream. To this mixture is added 40 per cent. of the strongest fibrous asbestos, and the whole is then kneaded together. The material thus formed may be rolled into sheets and dried, producing a felt suitable for jointing, &c.; or it may be passed through rollers with sharp spikes, or otherwise teazled out into a substance resembling tow, which when dried may be used for caulking. The proportion of rubber and sulphur may be increased, so as to form a more elastic and flexible material. Claims: (1) The coating or covering of fibrous asbestos with mica and talc, or either of them, by the aid of vegetable gums in solution, to form an acid-resisting packing or jointing material for the purposes set forth; (2) non-corrosive packing or covering materials as described.—No. 5363. March 28th, 1889. 4*d.*

GENERATION OF HEAT IN FURNACES.—*H. H. Lake, London.* (*E. B. Cornell, Philadelphia, U.S.A.*)—This invention relates to the generation of heat through the agency of steam. Heretofore it has been customary to increase the heat in furnaces by increasing the consumption of fuel by increasing the draught or supply of oxygen. The method most closely resembling the invention is that in which steam and air is injected upon the fuel. In this method, the heat necessary to dissociate the steam greatly counteracts the extra heat produced. In the present method of dissociating the steam, the steam is passed over iron or similar material that will absorb the oxygen, setting free the hydrogen to be used as fuel. The principle of the invention is based upon the discovery that steam passed through a cast-iron tube, maintained at or above the temperature of molten silver, is decomposed into its constituent gases without oxidation of the tube. The action cannot be obtained with plain wrought-iron tubes for the reason that the wrought-iron tube is rapidly oxidised. Cast-iron tubes are therefore used, these tubes being rendered non-oxidisable for the supposed reason that they are coated with a stratum of carbide of iron or carbon-silicide of iron. In the practical use of this action, the dissociating tubes are placed in the hottest part of the furnace of the boiler. The steam is passed through these tubes, and the gases so formed conducted by pipes to the closed ashpit of the furnace. If coal is being burnt in the furnace, the water gases in their passage to the ashpit are made to induce a draught of air sufficient for the combustion of the fuel. Twelve claims are made.—No. 20986. December 31st, 1889. 8*d.*

SUBSTITUTE FOR IVORY, &C.—*F. Greening, London.*—The substitute is prepared from any suitable fibre or cellulose matter such as cotton combings, paper, esparto grass, or rags. These are treated with a mixture of nitric acid of about 1,420 sp. g., and sulphuric acid of about 1,840 sp. g., in the proportion of about 30 per cent. nitric acid. The fibre is thoroughly saturated with the mixture, and then the excess is allowed to drain off. After this treatment it is kept in a warm atmosphere for one hour, when the conversion will have taken place. The mass is now well washed in water to free it of any remaining acid, and is then submitted to a bath of sodium chloride and ammonia alum in the proportion of 75 per cent. ammonia alum. The material thus obtained is dried and dissolved in a solvent prepared by distilling acetate of lead and anhydrous lime in the proportion of two parts by weight of acetate of lead to one of anhydrous lime. The distillate produced is mixed with fusel oil, and when thoroughly mixed a purifying agent such as phosphoric chloride is added and the mixture again distilled. In this solvent the treated fibre is dissolved, producing a plastic material which, when dry, may be used as a substitute for ivory, &c. Claims: (1) Treating fibrous substances with a mixture of nitric acid and sulphuric acid, and after washing the product submitting t to a bath of sodium chloride and ammonia alum for the purpose of producing a soluble base as and for the purposes described; (2) the manufacture and use of the described solvent, such solvent being produced by distilling a mixture of acetate of lead and anhydrous lime, fusel oil being added to the distillate and also a suitable purifier; (3) treating the base forming the subject of claim 1 with the solvent forming the subject of claim 2 as and for the purposes described; (4) the manufacture and use of an improved material adapted to be used for a variety of purposes, substantially as hereinbefore described.—No. 5344. March 28th, 1889. 6*d.*

MISCELLANEOUS.

COATING IRON PLATES.—*W. E. Everitt, Birmingham.*—In coating plates and sheets of iron with copper or brass by the method constituting this invention, the plate or sheet is freed from rust and then covered by a thin layer of finely granulated hard solder with an addition of finely powdered borax. The sheet of copper or brass with which the iron is to be coated is then laid upon the hard solder and borax, and the whole exposed to a bright red heat. The solder and borax are thus melted, and pressure being applied the sheet of copper or brass adheres to the surface of the iron. The apparatus employed in this process consists of a furnace with openings upon opposite sides. The sheets of metal prepared with the layer of solder and borax are passed in at one opening of the furnace, and, when sufficiently heated, drawn out at the other and passed between a pair of rolls, which finish the process. Claims: (1) Coating plates and sheets of iron with plates or sheets of copper or brass by interposing between them a layer of mixed granulated hard solder and borax, and exposing the said plates and the mixture between them to a bright heat and applying pressure to the heated plates as described; (2) constructing a furnace having openings at opposite sides and combining therewith a pair of cylindrical rolls to be used in conducting the coating process claimed in the prior claim.—No. 4335. March 12th, 1889. 6*d.*

DRAWING METALLICALLY COATED METALS.—*W. A. Thoms.*—The chief object of this invention is to produce compound wires suitable for use in electric incandescent lamps. For this purpose the core of the wire is composed of steel or iron, and the coating of platinum, gold, or aluminium The iron (say, No. 20 standard wire gauge) is carefully cleaned, and then coated by any of the well-known methods with a metal such as tin or gold which will prevent the oxidation of the core in the succeeding operations, and assist its union with the incorrodible metal. The wire thus prepared is inserted into a tube of platinum and attached at one end. The length of platinum covered wire is then submitted to the well-known method of drawing, by which means the component parts are drawn out to the required length and joined together. Claim: In the manufacture of drawn or rolled metallically coated metal articles, the preparing of the core (whether in a solid or hollow form) by the application of tin, gold, or other non-oxidisable metal as described, for preventing the oxidation of the core metal during the process of working, and to increase the cohesion of the core with the metal employed to form the covering or envelope for the core.—No. 908. January 17th, 1890. 4*d.*

Copies of the British specifications may be obtained on application to H. READER LACK, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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GRIPPER PLATEN PRINTING MACHINE.

THERE was shown at the recent Ironmongers' Exhibition a gripper platen printing machine made by the Godfrey Printing Machine Company, 69, Old Street, E.C. The machine has been for many years in the market, but has been lately improved, and an illustration of the most recent type is given herewith. Speed is its great feature, 2,500 sheets per hour being passed by it. There are four sets of grippers moving round the platen. While one impression is being made, a sheet is taken by one of the rows of grippers, and while this is advancing another is caught, and so on in rapid succession. The platen can be turned over into a convenient position for making ready, and the machine is self-delivering. The whole of the movements are automatic, and to work it no skilled labour is required.

THE MANUFACTURE OF BASIC PIG IRON.*

THE rapid extension of the basic process, both in the Bessemer, Siemens, and other types of furnaces, and the certainty that from various causes the manufacture of steel or ingot iron by this process will be of much greater importance in the future, and that the production will be in much greater quantities than at present, must of necessity render the question of producing suitable pig iron one of paramount importance. When we reflect that the supplies of hematite ores of steel-making qualities are comparatively limited, and moreover that these supplies are only available in very few localities, it will at once be seen that the basic process to us assumes great importance, and affords us a means of converting the unlimited supplies of phosphoric ores in this country into steel. The absence of hematite ores of suitable quality in Germany, and the cost of importing those ores or Bessemer pig iron, has caused an extraordinary development of the basic process there, and we can have no better illustration of its value than that afforded by Germany. I need scarcely point out to this Institute that, to us in this district, where the cost of transit all but precludes the use of hematite pig iron, if steel is to be made at all, the basic process is the process best suited to our requirements. Our supplies of suitable materials are plentiful, and the success of the process in open-hearth furnaces gives us a convenient furnace for this district, and for the arrangements of our works and our particular manufactures. As the results obtained in the basic process depend to a considerable extent upon the quality and regularity of the crude iron used, and as I have had some amount of experience in its manufacture, it has been thought that some few remarks upon it may not be deemed uninteresting.

When first introduced, the basic process (like many other processes) promised very wonderful things; almost any pig iron was suitable, provided it only contained plenty of phosphorus. I find that in 1882, at this Institute, one of the patentees of the basic process said, "As regards the composition of the pig used, great fluctuation is permissible; thus, the silicon may vary from 0·5 to 1·8 per cent.; the phosphorus from 1·8 to 3·0 per cent.; the sulphur from 0·08 to 0·3 per cent.; and the manganese from 0·5 to 2·5 per cent.;" it was therefore proposed to use the common cinder pig of the district. In the experiments made by a syndicate, selected pigs were used of the following composition:—

	Strong Forge.	Strong Forge.
Manganese	1·12	1·77
Silicon	1·17	1·17
Sulphur	0·08	0·05
Phosphorus	2·97	4·40

For some considerable time, common white or mottled cinder pig was used in Staffordshire, very often produced indiscriminately when furnaces were out of order, a typical analysis of which would be—

Manganese	1·35
Silicon	1·50 to 2·00
Sulphur	0·10 to 0·20
Phosphorus	3·50 to 4·00

I am not aware that such a feat as this was ever attempted in any other district. It was very soon found, however, that such metal was unsuitable, the waste and wear and tear being enormous, to say nothing of the quality of the steel produced from it. It is wonderful, however, with what tenacity some steel makers stuck to this material even up to a recent date. It has been, however, of late years, largely substituted by other and more expensive pig iron.

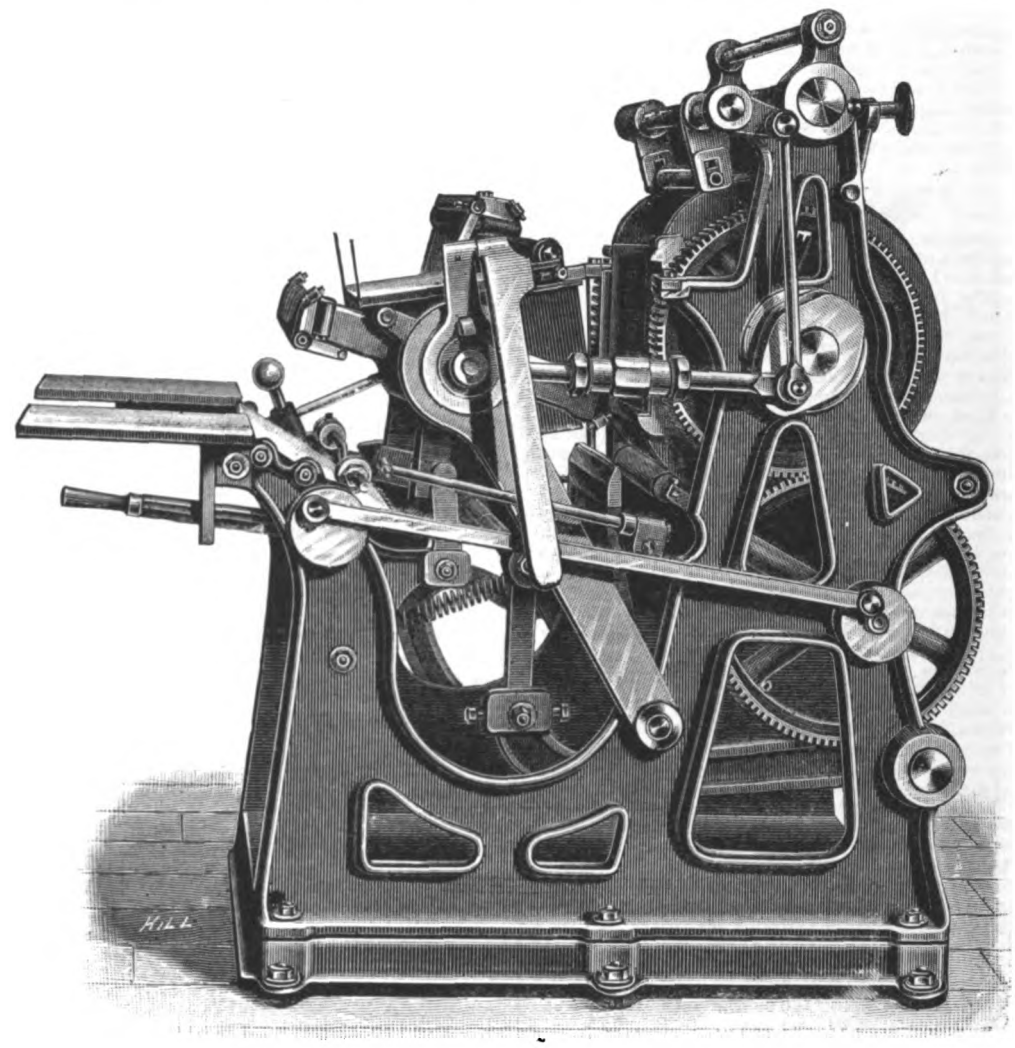
In the Cleveland district, in the early days of the basic process, ordinary grey Cleveland iron was used, which, as you are aware, does not contain more than about 1·5 per cent. of phosphorus; the silicon being over 2 per cent. Afterwards, several brands were mixed together, often with a little spiegel; then, as the necessity for lower silicons became apparent, forged and mottled or white iron were used; the drawback to white iron being its high sulphur. Finally, it became apparent that it would be convenient and expedient to combine all these results in one pig, the required manganese being an aid to the manufacture of such a white pig, low in both silicon and sulphur. Such a pig is a basic pig. One of the first basic pigs made in this district contained—

Manganese	2·00
Silicon	2·50
Sulphur	0·06
Phosphorus	2·95

* Paper read before the South Staffordshire Institute of Iron and Steel Works Managers, by Mr. Herbert Pilkington, F.C.S., M.I.Mech.E., Vice-President, on the 15th ult.

GRIPPER PLATEN PRINTING MACHINE.

CONSTRUCTED BY THE GODFREY PRINTING MACHINE COMPANY, LONDON.



But those made at the present time will vary at different works, as under:—

Manganese	2·0
Silicon	0·4 to 1·2
Sulphur	0·05
Phosphorus	2·5 to 3·25

I also add a table of analysis of basic pigs at works in other districts:—

	N. Staffs.	N. Wales.	Middlesbro.	France.	Germany.
Manganese	2·50	1·75	2·25	1·50	1·50
Silicon	0·25	0·40	0·74	0·75	·60
Sulphur	0·05	0·04	0·04	0·06	·06
Phosphorus	2·84	3·00	2·60	2·00	2·00

It will thus be seen that different steel works have different requirements; but, speaking generally, in this district a basic pig is a pig which must be low in silicon and sulphur. Over 1 per cent. silicon or 0·10 per cent. sulphur would be objected to, and half that quantity would be considered a good pig. It should contain about 1·5 per cent. to 2·0 per cent. of manganese and 2·5 to 3·00 per cent. of phosphorus. Whether it would not be better to work with less phosphorus than 3 per cent. I must leave entirely to steel makers. The value of such a pig for forge purposes should be very great indeed, as it cannot but be economical to use, as a mixture, a pig so low in silicon and sulphur, and containing so much manganese. I believe it has been tried to a limited extent, but I am not aware that it has been used regularly. In order to produce this pig it is necessary to work the furnace with a very basic slag, and also at such a temperature that the iron shall be white in order to keep the silicon low, and, on the other hand, sufficiently hot to keep the furnace in working order, and also to allow the sulphur to escape in the slag. In arranging the charges, therefore, this is the primary consideration; and keeping this in view, it admits of considerable latitude in the nature of the materials employed. I need not tell this Institute that tap cinder forms the principal part of the furnace burden, and the only limit placed upon its use is the quantity of phosphorus required in the pig. It is usual to use Northampton ore or pottery mine to reduce the phosphorus, the use of the latter having some little advantage, owing to the fact that it introduces a little manganese. Having regard to the character of the slag required, I have always found it an advantage to add ores to the charge that are of a basic character, and so reduce the use of added lime, &c., to a minimum; and indeed this principle should be kept in view in selecting any ore for basic work; not only is it economical as regards the fusibility and basicity of the slag, but it is also much less troublesome to work in the furnace. Such ores as these are not difficult to obtain, nor can they be deemed expensive. I give analyses of two such ores, one from the Lincolnshire district, and the other from the Oxfordshire district:—

	Lincolnshire.	Oxfordshire.
Ferric oxide	39·24	40·65
Ferrous oxide	trace	trace
Silica	13·04	7·24
Alumina	5·56	6·94
Lime	18·42	20·22
Magnesia	0·72	—
Magnesia oxide	0·63	0·40
Phosphoric acid	0·61	0·86
Sulphuric acid	trace	trace
Carbonic acid	11·26	22·65
Combined water	10·54	—
	100 03	98·96
Metallic iron	27·46	28·46

In order that sufficient manganese may be imparted to the pig, resource must be had to manganiferous or manganese ore, and I attach a great deal of importance to the selection of a suitable ore. It is infinitely better to use a manganiferous carbonate low in silicon than rich manganese ores, which often contain upwards of 20 to 35 per cent. of silica. Manganese has a most powerful affinity for silica, and where there is an excess of silica there is often a great loss of manganese in the slag, notwithstanding its being of a very basic character. On the other hand there is also a danger of the reduction of too much silicon into the pigs, there being very good ground for supposing that the methods of reduction of silicon and manganese are very similar. It is not always easy for the furnace manager to obtain accurate information about these ores, and the usual analyses are not always sufficient; few of them show the state in which the silicon exists, and I feel sure that a little work in this direction would be highly instructive. If the silica is in combination with the manganese, you have both elements in the most favourable state for passing into the slag unreduced, as the silicate has to descend the furnace until the reduction is effected by the solid fuel, where a portion of the silicate may easily escape reduction. On the other hand, the silica being liberated in the presence of highly-heated metal is very favourably situated for reduction into silicon in the pig, were it not that, generally speaking, the other and more powerful influence generally prevails. It is, of course, well known that many makers of basic iron use the slag made in the manufacture of spiegeleisen, which usually contains from 7 to 10 per cent. of manganese, as silicate. In some circumstances, of course, this slag is often the cheapest source of manganese available; but invariably it is found that the results obtained are not so satisfactory as if a good ore was used; a little variation in the furnace temperature, or the

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composition of the charge or the slag, will send the whole of the manganese into the slag, and there is always a greater loss of manganese by its use. If a spathic carbonate is used, it must of necessity be calcined; and if properly calcined, all the elements in combination of whatever character will be liberated and will be then in a perfectly free state. I give the analysis of such an ore when calcined:—

Molland Ore.			
Ferric iron	54·55		
Alumina	4·05		
Manganese oxide	21·94	Metallic iron	38·19
Lime	2·00	„ manganese	17·00
Magnesia	0·78		
Phosphoric acid	0·38		
Sulphuric acid	0·20		
Silica	12·00		
Loss on ignition	3·00		
	98·92		

As the tap cinder of this district contains some amount of manganese, the addition of 5 per cent. of this ore to the furnace charge is usually sufficient to produce 2 per cent. of manganese in the pig. Incidentally, I may say that flue cinder is not used for basic pig, because of its silica; it being of the utmost importance to put as little silica into the furnace as possible. You will probably be aware that the tap cinder is usually calcined in South Staffordshire. As I have previously stated, the required furnace conditions are: a furnace sufficiently cold to keep the silicon low, and on the other hand, sufficiently hot to enable the slag to carry off the sulphur, that slag being a very basic slag for that purpose, as well as to keep the silicon down. This set of conditions could not be very easily complied with were it not that the use of manganese supplies the key to the whole situation. In the first place, it makes the iron both hot and fluid, and secondly, it greatly increases both the basicity and fluidity of the slag, which, although very basic, is through the presence of manganese fused at a comparatively low temperature, and it is therefore a slag of great fluidity, or, as a furnaceman would say, "a hot slag." The precise action of manganese in the slag, I take to be, in the absence of a better explanation, what I have already described in a previous paper, *i.e.*, that it exists as a silicate of manganese, the manganese replacing lime, and therefore leaving that much more lime free to carry off sulphur. The quantity of lime here liberated may be only small, but the total quantity of lime in the slag is large; moreover, the silicate of manganese increases greatly the basicity of the slag, and the temperature being comparatively low, the silica is dealt with readily as a silicate of lime, magnesia, alumina, and manganese, while the considerable amount of lime present can deal with the sulphur easily at that temperature which is sufficiently hot to allow it to be slagged off. It will thus be seen that the influence of temperature is very great, and that, other conditions being right, the regularity of the pig depends to a very considerable extent upon the care with which the furnace is managed, in keeping it in the happy mean between the two extremes, which I illustrate by the following analyses of pigs made in a basic furnace:—

	Hot Grey Iron.		Cold White Iron.	
Manganese	2·42	2·68	1·76	1·04
Sulphur	0·04	0·08	0·42	0·22
Silicon	2·09	1·93	0·57	0·71
Phosphorus	3·45	3·33	3·54	3·32

It may be said that many of the facts here presented are well known, and that although the manufacture of basic iron may require more care and presents more risk than in the case of ordinary pig iron, yet it presents no difficulties that may not be readily overcome. I am quite ready to grant all this when its manufacture is accomplished by means of good hard oven coke (such as Durham coke), but when this admirable material is replaced by soft gas coke and raw coal, I think that most furnace managers will admit that when these fuels are used in a furnace making white iron, and with a slag containing 40 to 46 per cent. of lime, those difficulties and risks are greatly increased. The following analyses may be taken as those of a typical slag where the fuel is good hard coke, and where the lime is usually kept at the utmost quantity the furnace will carry, and the manganese in the slag is reduced to a minimum:—

Slag.		Iron.	
Ferrous oxide	1·52	Phosphorus	2·79
Alumina	12·12	Sulphur	0·04
Manganese proto	2·10	Silicon	0·35
Lime	51·13	Manganese	1·90
Magnesia	·22		
Alkalies	·50		
Sulphur	0·89		
Phosphoric acid			
Silica	31·21		
	99·69		

In this district it is not possible to keep a furnace working very long with a slag containing 50 per cent. of lime when soft gas coke and coal are used. These fuels produce a large amount of dust, which in the case of a basic furnace accumulate to a large extent, and when the lime is very high causes great trouble at the tuyeres by cold noses, pocketing, chilling up in the hearth, &c. In the case of an ordinary furnace this dust is not so apparent; because with a hotter furnace and a silicious slag a considerable quantity of it is burnt and melted. The object to be aimed at under these circumstances is to work as hot as possible, consistent with low silicons, and to back up the lime by a little manganese in the slag. The following irons and slags were produced regularly under such circumstances:—

Slag.		Iron.		
Lime	46·20	Manganese	2·27	2·02
Magnesia	2·87	Sulphur	0·02	0·01
Alumina	9·97	Silicon	0·40	0·35
Silica	34·76	Phosphorus	3·20	3·19
Manganese proto	4·30			

The following is a slag made under somewhat different conditions, which produced a pig having 0·06 per cent. of sulphur and 0·89 of silicon; and this may be regarded as the most acid type of slag from which good basic iron can be made, as under no circumstances can more than 36 per cent. of silica be tolerated if the quality of the pig is to be maintained. It is somewhat exceptional in its contents of manganese oxide, the furnace being working rather hot at the time, a sample taken a few days previously containing 5·55 per cent:—

Silica	36·05
Alumina	8·72
Iron oxide	3·94
Calcium	2·66
Sulphur	2·13
Lime	39·60
Manganese oxide	1·80
Magnesia	4·48
Alkalies	1·20
	100·58

It will be readily understood that there is not a large margin of heat for the safety of the furnace, and I have known times when from dust accumulations, excess of lime, and coldness of the furnace, a "gob" has appeared imminent, having given very little warning of its appearance. I have usually in these circumstances immediately taken off a considerable amount of lime for a short time, when the furnace will often recover itself readily when the excess of lime has been worked off. The pig iron is not much affected by this treatment if the lime is replaced early enough, owing to the accumulation in the furnace. If a tendency to silting up appears, a little extra manganese will often correct it and prevent further accumulation. The trouble at the tuyeres is often considerable, and tuyere changing is frequent, and it is very convenient to have the furnace well fitted with tuyere valves, &c., in order to be able to shut off pocketed tuyeres with as little loss of time as possible. These troubles may, however, be avoided to a considerable extent by the use of a strong blast, a frequent use of the tuyere pricker, and a good hot slag, and, allow me to add, good management. As I have observed before, having all other things right, the principal point is to keep the furnace temperature constant, and the regular working of the furnace is then ensured. I cannot too strongly emphasise the fact, however, that in order to ensure regularity and good quality in the product, there must be a regular and systematic system of analyses of the fuels, fluxes, minerals, and slags; as not only does this save great trouble and anxiety in working, but also enables a pig to be produced more economically, and of a better and more regular quality, than if only intermittent analyses were taken. The fuel consumption when making basic iron is certainly not high if the furnace works well; it is then tolerably regular at 21 to 22 cwt. of coke per ton of iron, or its equivalent in coal or coke, with a blast at a temperature of 950° F. But if any silting up in the hearth or difficulties at the tuyeres occur, it often rises very much higher and continues high until the furnace returns to a normal state.

These remarks apply to furnaces 56ft. to 60ft. high, such as are prevalent in this district, producing 280 to 350 tons per week. If good hard coke were used most of these troubles and difficulties would be avoided, and the production of our furnaces much increased, and it is therefore to be hoped that the attempts being made in the district to produce such a coke may ultimately be successful, as from its freedom from sulphur, and other reasons, such a fuel would be a most valuable addition to the resources of South Staffordshire.

THE INSTITUTION OF NAVAL ARCHITECTS.

(*Continued from page* 316.)

The discussion on Admiral Colomb's paper, on the "Washington Maritime Conference," was opened by Mr. Baden Powell, who thought that the Conference had left the rule of the road at sea very much as before. The verdict of the mercantile marine was that the rule of the road can be done without, and that everything depends on the officers themselves.

Admiral de Horsey thought that accidents will happen with the best of management. The most fruitful causes were bad look-out, ignorance of the rules, and neglect of the rules. He thought that the risk of collision was from the opposite ship not changing in time. He had always understood that the ship which kept its course was bound to keep its speed also. The rules as they at present stood were certainly in bad English, and wanted some explanation.

Mr. McFarlane Gray, of the Board of Trade, said he once asked a captain after a collision what about his rules, and was told he had thought of them too late. This was adduced as an argument that the rules were of little value.

Admiral Bowden Smith, as a member of the Washington Conference, congratulated Admiral Colomb on his paper. The Admiralty experiments, previous to the Conference, were found very valuable, and the same might be said of what had been done at the recent manœuvres. What he thought was required was not so much alteration of the rules, but more supervision in carrying them out. When a ship held on her course, she did not know what the giving-way ship would do. What was wanted was that the holding-on ship should have her own way completely. Experiments had demonstrated that red lenses absorbed about 60 per cent. of white light and green 90 per cent.

Captain Wharton, the Hydrographer of the Navy, said that out of 45 collisions, 39 were due to want of intelligence on the part of those in charge. The crossing a ship's bows was the cause of almost all collisions.

Mr. Stromeyer considered many collisions were owing to the position of the lights, and in a diagram he explained that all the difference followed from the side light being well forward or not. Many captains asked themselves where the light was, because if considerably aft, there might be a very large angle made by the ship which would not show by the light at all, whereas the nearer the light was to the bow the more impossible it became for this difference to occur.

After remarks by other speakers Admiral Colomb replied. He thought some definite form of instruction should be given to our seamen on this all important matter. When he commanded a ship, it was his inflexible rule to give the order to stand by in the engine-room before he altered his helm. He was thus prepared for an emergency. The most frequent cause of collision was altering the helm too soon.

The next paper was read by Professor P. Jenkins on "The Strength of Ships, with Special Reference to the Distribution of Shearing stress over a Transverse Section.' We intend to publish this important paper in full in an early issue, together with the discussion which followed it.

Mr. Frank C. Goodall then read a paper on "Steatite as a Pigment for Anti-Corrosive Paint." How to efficiently protect the iron and steel work of our ships, bridges, and other iron and steel structures from rust and premature decay is a question which has long occupied the public mind; and up to the present time no complete or satisfactory answer has been forthcoming. For many years the author has had the impression that the mineral steatite, commonly known as "soapstone," if it could be incorporated in an elastic paint, would possess qualities incomparably superior to the metallic oxide pigments generally used; steatite when mixed as an ordinary paint, viz., with raw or boiled linseed oil, driers, turpentine, terebine, &c., neither mixes nor dries hard, and was quite useless as a protective paint. After further experimenting, and finding oil, driers, terebine, &c., would not act with steatite in the formation of a paint, the author wrote a letter to the press calling the attention of shipowners and paint manufacturers to the subject. Immediately afterwards he received numerous letters and calls in reference thereto. Amongst the first to visit him was a member of a well-known firm of paint manufacturers, who stated on their behalf that they had also experimented with steatite in the same direction, and that they had succeeded in embodying it as a pigment for paint with a quick-drying varnish; that their experiments up to date had proved that steatite as a pigment for anti-corrosive composition was a success, and that they had acquired patent rights for the combination. Subsequent experiments and trials by the author have shown their statements to be well founded. Steatite does not protect steel in the same way that a metallic oil paint protects it, but once properly applied to the true surface of the steel, it is indestructible, and there will be absolutely no rust on the parts coated with it. Varnish alone is porous, and admits the atmosphere and moisture to the body coated with it; but when mixed with steatite, owing to the minute atoms of which it is composed, the fine pores are completely closed, and the paint becomes air and water tight. It is thus that steatite answers the double purpose of enabling the composition to adhere to the steel, and to make it completely air and water tight. The varnish also is a non-conductor of electricity, so that no galvanic currents can be set up.

In the discussion which followed the reading of this paper, Captain Fairholme said the damage done by paints was due to the oxygen they contained. His plan was to use naphtha such as the gas factories supplied, as the ordinary oil produced rust. Steatite was suitable as a pigment, if his plan were adopted.

Mr. Martell said it was most important in connection with ships' paints that samples should always be brought forward. He did not agree that the ordinary oxide of iron paint was harmful. Why paints frequently peeled off steel ships was because the mill scale had not been removed in the first place. If this were done, the plates pickled, and the painting applied at regular intervals, steel was as good as iron in this respect.

The next paper was read by Mr. C. E. Stromeyer, on "The Distribution of Evaporation in a Marine Boiler."

This subject has not been dealt with at previous meetings of this Society, but I have been able to avail myself of some very interesting inquiries by Mr. D. K. Clark* and Mr. J. A. Longridge† into the distribution of evaporation of locomotive boilers. Naturally their chief interest centres on the question of the distribution over the length of the tubes, the diameters of these boilers being very much less than their lengths. In a marine boiler it often happens that we have combustion chambers high enough to stand in, while the tubes hardly exceed six feet in length, and it is very probable that there must be more gas (or products of com-

* Institution of Civil Engineers, Vol. XLVI., page 242.
† *Ibid.*, Vol. LII., page 101.

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bustion) passing through the upper than through the lower tubes. This distribution is governed partly by the temperatures in the combustion chamber and smoke box, and partly by the resistance of the gas in the tubes, and this again depends upon the velocity and temperature of the gas, and on the loss of heat experienced by it. It will therefore be necessary to deal first with some of these problems.

The coefficient of transmission of heat through boiler tubes or combustion chamber plates found by Mr. Longridge is 11 cals. of heat per square foot per hour for every degree (Fahr.) of difference between the gas and the water: 0·91 is the reciprocal value of the above, and is the resistance offered to the flow of heat under the above condition. Now this resistance is composed of the resistance which is offered when heat passes from one medium to another—as, for instance, from the gas to the metal, from the metal to the boiler scale, or to the water—and it also includes the resistance offered by the metal and the scale. For iron, and for plaster of Paris, which latter is the same substance as boiler scale, the resistances are 0·00202 and 0·207 per inch thickness, so that a clean half-inch plate would offer 0·001 resistance, or, if covered with scale 1-10in. thick, the resistance would be $0{\cdot}001 + 0{\cdot}021 = 0{\cdot}022$. Comparing these values with 0·091, which is the value adopted by Mr. Longridge, we are driven to the conclusion that the chief resistance, about 80 per cent., is encountered at the surfaces. I doubt whether the change of medium from iron to scale, and to water, influences the above values very much, as it seems more than probable that the chief difficulty in transmitting heat from the gas to the tubes is the want of circulation, and the outer layers of the gas are not replaced sufficiently quickly by the inner ones, which are hotter. It ought to be possible to effect this by draught retarders or by using corrugated boiler tubes; and I also believe that the excellent results which have been obtained by the use of John Brown's ribbed tubes is simply due to the increased inner surface which is exposed to the gases, whereby the resistance is diminished from 0·091 to 0·055. If the above is the true explanation, then I believe that Mr. Longridge is not quite correct in adopting the same coefficient for the combustion chamber as for the tubes, because, in the former case, heat is imparted to the plates, not only by contact, but also by radiation, and, under these circumstances, a recalculation of his results would most likely lead to a higher value for the resistance of the tubes, and a lower one for the combustion chambers. That radiation plays an important part will be seen from the experiments by M. P. Havrez,* referred to by Mr. Clark. In one of his experiments coke was used, while in the other one briquettes were burnt, and it was found that there was relatively more heat absorbed in the firebox with the flaming material than with the flameless coke, and it is well known that a luminous flame radiates more heat than a non-luminous one, for which reason the latter may not be used in the Siemens-Martin furnace. For these various reasons, I believe that the formulæ used by Mr. Longridge for the heating of boiler tubes will be more correct if the coefficient of resistance $\frac{1}{m}$ is increased a little, say from 0·091 to 0·1, so that his formulæ would be—

$$t = t_0 \cdot \epsilon^{-\frac{10 \cdot S}{h}}$$

$$H = h\,t\left(1 - \epsilon^{-\frac{10 \cdot S}{h}}\right)$$

t = Difference between the temperatures of the boiler water and of the gas in the tube after having traversed S square feet of surface.
t_0 = Difference of the above temperatures before the gas has entered the tube.
ϵ = 2·718 . . .
$h = \sigma$. Q = Specific heat × Weight of gas (products of combustion) passing through the tube.
H = Quantity of heat transmitted through the walls of the tubes. This quantity divided by 1,150 gives the quantity of water evaporated from 60° F.

The coefficient 10 is the quantity of heat transmitted per hour, therefore the time units of h and H must also be the hour.

I intend to adopt the following values:—

$\sigma = 0{\cdot}236$.
S = π . D . L . = π . 3in. . 6ft. = 4·72 square feet.

Instead of Q, the weight of the products of combustion, I intend to use C = the weight of coal from which Q has been produced.

$$Q = 30 \cdot C \text{ nearly}$$

Then

$$t = t_0\,\epsilon^{-\frac{20}{3 \cdot C}}$$

$$H = 708 \cdot C t_0\left(1 - \epsilon^{-\frac{30}{3 \cdot C}}\right)$$

These formulæ have been arrived at without taking into account the fact that the gases grow denser and travel slower as they grow colder, and that they therefore remain longer in contact with the tube surfaces. Fortunately the influence of the reduction of speed and increased density balance each other, and no correction need be added to the above.

Before leaving the subject of conductivity, it will be as well to mention the case of tubes which are partly choked with ashes. One would suppose that their efficiency is reduced in the same ratio as the exposed surface, but this is not quite the case, especially if they are coated with scale, and if the differences of temperature are not too great. Then the heat travels down the sides of the tubes, and the exposed inner surfaces, being colder than those of tubes without obstruction, would also absorb more heat per square foot of exposed surface. The numerical values can be obtained by determining the values of the various constants in the following formulæ —

$$t_1 = A + B \sin \alpha \cdot x$$

$$t_2 = a\left(\epsilon^{\beta x} + \epsilon^{-\beta x}\right)$$

Here t_1 is the temperature of the top part of the tube, and t_2 that of the bottom part; x is measured on the circumference of the tube, starting from the top or bottom. All the other values are constants, which can be determined: t_1 and t_2, as well as their first differential quotients, must be equal at the boundary formed by the ashes.

As there exist very large differences of temperature in a boiler, it is desirable, while dealing with the flow of the gases, to take them into account, and it will therefore be necessary to construct the formulæ for the resistance of gas in motion. Starting from the well-known formula

$$v^2 = 2\,g\,h$$

where v is velocity of acceleration due to gravity, and h the height of the fall or the height of the liquid, it can be replaced by $\frac{p_1}{S}$ which is the pressure per square foot divided by the weight of one cubic foot of gas. S the denominator is inversely proportionate to its absolute temperature T_1, and we have

$$v^2 = 2\,g\,\frac{p_1}{S_0}\,\frac{T_1}{T_0}$$

$S_0 = 0{\cdot}0845$lb. per cubic foot at 32° F. or at $T_0 = 493°$ absolute temperature. Let a be the sectional area of one tube, then the weight which passes through it per hour is

$$Q = \tfrac{2}{3}\,v \,.\, a \,.\, S \,.\, 3600 = \tfrac{2}{3}\,a \,.\, 3600\sqrt{2\,g\,p_1\,S_0\,\frac{T_0}{T_1}}$$

Here the coefficient $\frac{2}{3}$ is a coefficient of experience. Seeing that the resistance to entering the tube is inversely proportionate to the absolute temperature, it is more than probable that the surface friction in the tube is also dependent on it.

$$p = p_1 + p_2 = \frac{Q^2\left(\frac{9}{4}T_1 + 0{\cdot}012\,\frac{S}{a}\,T_2\right)}{(3600)^2\,a^2\,2\,.\,g\,S_0\,T_0}$$

Here S is the surface of the tube, T_2 is the average temperature of the gas in the tube, and 0·012 is a coefficient of friction adopted by Rankine. Let T be the absolute temperature of the water in the boiler, then the final temperature is

$$T + t = T + t_0\,\epsilon^{-\frac{10 \cdot S}{h}}$$

and the average temperature is

$$T_2 = T + t_0\,\frac{h}{10\,S}\left(1 - \epsilon^{-\frac{10 \cdot S}{h}}\right)$$

Inserting the previously found notation, and replacing $\frac{Q}{30}$ by C, we have

$$T_2 = T + t_0\,\frac{20}{3\,C}\left(1 - \epsilon^{-\frac{20}{3C}}\right)$$

None of these values are negligeable, for C can easily be made to exceed unity. The pressure p can then be expressed by a formula of the following form:—

$$p = C^2\,(a\,T + b\,t_0) + C\,c\,.\,t_0\left(1 - \epsilon^{-\frac{20}{3\,.\,C}}\right)$$

Here a b c are constants, and it will be seen that the resistance encountered by a gas which passes through a boiler tube depends not only on the absolute temperature in the combustion chamber ($T + t_0$), but also on C^2 and C^2.

As matters would get too complicated if the formulæ were carried further, I shall insert the following numerical values, which would, of course, have to be altered for different cases:—Let the temperature of the boiler water be 379° Fahr. Then $T = 379° + 461° = 840°$. Let the absolute temperature in the combustion chamber be 2840°; then $t_0 = 2000°$, and if the boiler tubes are 3in. diameter and 6ft. long, we have $a = 7{\cdot}07$ square inches = 0·049 square feet. S, the tube surface, = 4·71 square feet.

$$p = C^2\,0{\cdot}173 + C\,.\,0{\cdot}166\left(1 - 2{\cdot}718\ldots^{-\frac{20}{3\,.\,C}}\right)$$

$$\log 2{\cdot}718\ldots^{-\frac{20}{3\,.\,C}} = \frac{1{\cdot}815\ldots}{C}$$

$$\log t = 3{\cdot}301 - \frac{1{\cdot}815\ldots}{C}$$

All that is now necessary is to determine the value of p, which is the difference of pressure at either end of a tube. Let P be the value of p for the lowest row of tubes in a combustion chamber; then for any row of tubes situated n feet higher we have $p = P + n\,\Delta p$. Here Δp is the difference of weight of 1 cubic foot of gas in the combustion chamber and in the smoke-box. The temperature of the first of these is assumed to be 2840° absolute, and the latter can safely be taken as the mean value of all the tubes, it is $840 + t$. Now, as the weight of 1 cubic foot of gas at 32° Fahr. is 0·0845lb., we have—

$$\Delta p = \left(\frac{493}{840 + t} - \frac{493}{2840}\right) 0{\cdot}0845$$

Suppose now that the combustion chamber with which we are dealing consists of 10 rows of 10 tubes pitched 4in. apart: then $n = 2\frac{1}{2}$ft., and $C_1 = 100\,C$ is the total weight of coal burnt per hour for supplying these 100 tubes, then, assuming C_1 to be 100, 200, 400, and 800 lbs. per hour, corresponding to easy firing, ordinary firing, and strong firing, with natural draught, and, lastly, strong forced draught:—

C_1 Consumption per hour. Lb.	$379° + t$ Temperature in smoke-box. Deg. Fahr.	p Average resistance in tubes. Lb per sq. ft.	$\frac{\Delta p}{\Delta C_1}$	Δp Difference of weights of gas. Lb per ft.
100	382	0·33!0	0·0049	0·035
200	626	0·983	0·0079	0·024
400	1,094	3·20	0·0150	0·012
800	1,564	11·60	0·0170	0·006

In order to find the relative quantities of gas which pass through the top and bottom rows of tubes, multiply the values in the fifth column by 1½ft., being half the height of the combustion chamber and divide by the values in the fourth column, and add and subtract from the values of C_1, and divide the one by the other thus:—

$$100 \pm \frac{1{\cdot}25 \times 0{\cdot}035}{0{\cdot}0049} = 100 \pm 9 = 109 \text{ and } 91,$$

Showing that the top rows receive $\frac{109}{91}$, or 20 per cent. more than the bottom rows, when the average consumption is 100lb. per hour. In the other three cases this value is 4 per cent., ½ per cent., and ¼ per cent. The difference of the temperature in the smoke box for each extra pound of coal burnt is 0·2° when the consumption is only 100lb., therefore with 20lb. difference the range of the temperature of the waste gases is only about 4°. In the three other cases the difference for each extra pound of coal is 0·3°, 0·6°, and 1·0°, and the difference of the final temperatures from the lowest and highest tubes are 2·4°, 1·2°, and 1°, showing that generally the heat is pretty evenly distributed amongst the tubes. I have taken no account of the actual efficiency of the boiler surface, but have restricted myself simply to the theoretical question of the distribution, and by applying the above results to those trials of marine boilers which I am glad to see are now often carried out, it will be possible to obtain accurate values as to the various heating surfaces.

*Ann. du Génie Civil, 1874.

Mr. McFarlane Gray said the question opened up was one which was very little understood. The question of the condition of the tubes and the formation of scale was of the greatest importance to the rate of combustion, and deserved full consideration.

Mr. Fothergill said that if the paper was, as he took it to be, a theoretical one, we must put on one side the question of scale and the condition of the tubes. From the title one would have expected that the efficiency of evaporation would have included the various parts of the heating surface of the boiler generally, whereas the tubes had been particularly dealt with. The heat of the tubes must depend upon the completeness of combustion in them. A comparison had been made between a locomotive and a marine boiler, but he failed to observe the similarity. In the locomotive they got the more complete state of combustion for the time being, and they had no deposit in the tubes; therefore the heat would be much greater than in a marine boiler. He did not think more of the gases passed through the upper than through the lower tubes. In the marine boiler it was known that the lower tubes became choked first, and this could not be so if less passed through them. Again all practical engineers were fully aware that tubes might have a considerable deposit on the top, and be bare at the bottom. He quite agreed that it was greatly to the advantage of economy to bottle up the gases in the tubes, and he thought mechanical draught then became useful. The temperatures given in the last table should depend on the conditions of combustion.

Mr. Stromeyer, in reply, considered that the thickness of the plates did not make much difference. He had found the chief resistance of the gases to be when they passed into the tubes. There was no difference in the thickness of the scale in the top and bottom rows of tubes, nor between the top and bottom of each separate tube as had been suggested. He thought it was a mistake to suppose that the gases could be retarded, while at the same time they were being forced through the boiler mechanically. He had proposed draught retarders, not on account of the extra resistance which they offered to the products of combustion, but for the disturbing influence set up.

The next paper read was by Mr. Andrew Betts Brown, F.R.S.E., on "The Application of a System of Combined Steam and Hydraulic Machinery to the Loading, Discharging, and Steering of Steamships."

Since addressing this Institution, in 1884, on the subject of a complete system of direct acting hydraulic machinery for first-class passenger steamers, the author has effected many improvements, which have been suggested by the varied types of over fifty steamships fitted.

The sympathy of the stevedores, who have to work out cargo in the shortest possible time, are only with those who make their particular interest the paramount one in the general compromise which obtains on board ship. When at sea, captains and other officers are equally anxious to perfect their departments, and the apparatus described in this paper are the outcome of the various complaints made by these difficult-to-please gentlemen; by this term no offence is meant, but rather a compliment, as without such fault-finding, duly considered, it would not be possible to make any advances.

The Hydraulic Derrick.—The derrick is shown in vertical elevation in Fig. 1, and in plan in Fig. 2 (page 340). A is the lifting cylinder, with its ram and pulleys placed between the girders of the derrick. On the right-hand side is placed the slueing cylinder B, with its ram pulleys and rope tackle made fast at C, the derrick being pulled in and falling out by gravity. On the left-hand side is the topping cylinder D, which with its ram pulleys and tackle in duplicate, lowers the derrick over the side of the ship, as the hatch is too close to the mast to admit of the cargo being delivered over the side without such appliance. Water is admitted to these cylinders through stuffing boxes at E, which are controlled by the three valves and levers, situated close to the hatch at F. All the motions are independent, and can be worked simultaneously. The derrick is stowed horizontally when at sea, and its lifting cylinder suffices to raise and lower the derrick.

The Steam Derrick.—In cheap cargo ships, and those carrying few passengers, the large percentage of cost which the hydraulic system bears to the total cost of the ship is principally brought about by the expense of the compound surface condensing pumping engines and steam accumulator. The advent of high-pressure steam, however, has enabled the author to preserve the form of the general deck discharging gear, so far as speed of working, noiselessness, and durability are concerned, but to use steam as the motive force in place of water, and so dispense with the pumping engines, as well as the space occupied in the engine

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MACHINERY FOR LOADING AND DISCHARGING CARGOES.

DESIGNED BY MR. ANDREW BETTS BROWN, AND CONSTRUCTED BY MESSRS. BROWN BROTHERS, EDINBURGH.

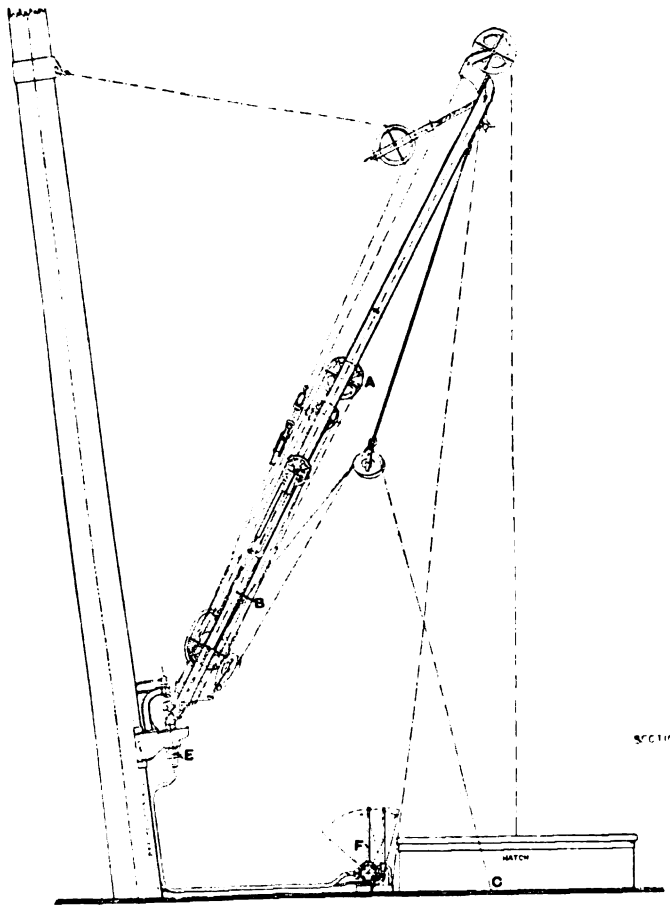
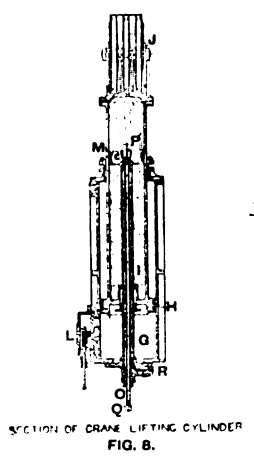


FIG. 1.



SECTION OF CRANE LIFTING CYLINDER
FIG. 8.

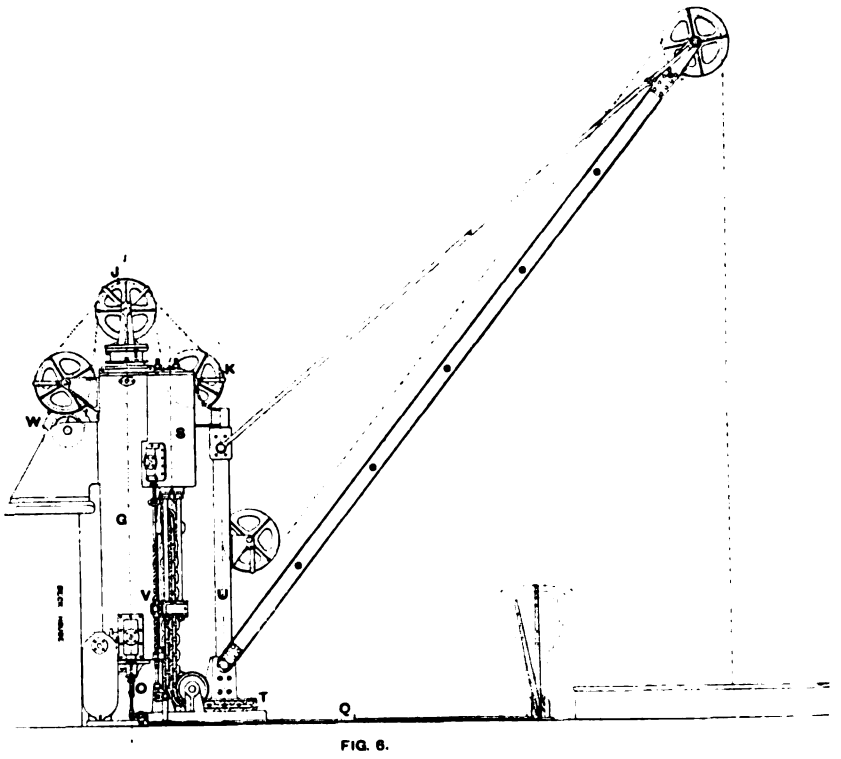


FIG. 6.

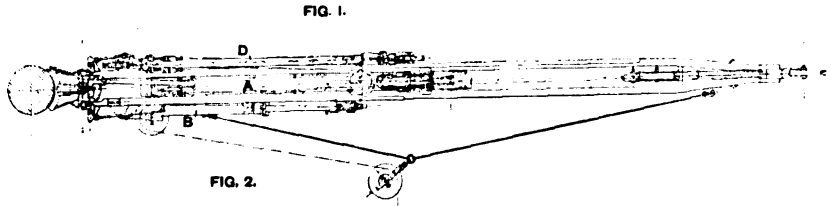


FIG. 2.

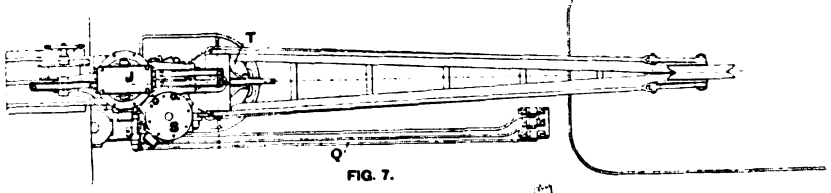


FIG. 7.

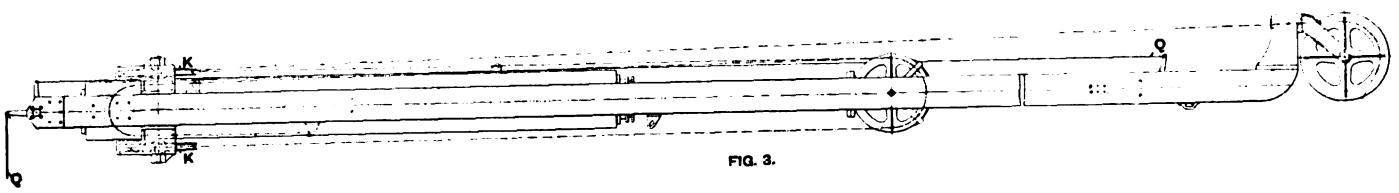


FIG. 3.

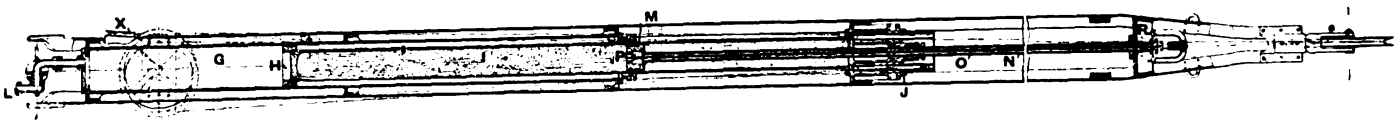


FIG. 4.

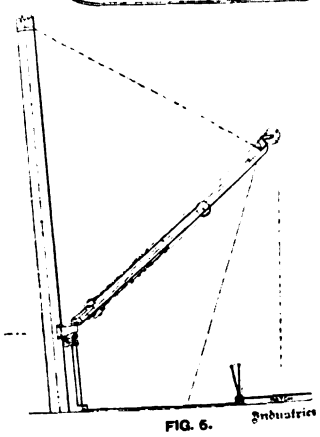


FIG. 5.

rom. Although this derrick cannot compete with hydraulic machinery, yet its action is precisely similar, and the high-pressure steam (150lb. to 180lb.) enables the work of lifting to be done by a steam cylinder of comparatively small diameter. In fact, the derrick is lighter than a hydraulic derrick, having slewing and topping gear, which motions, however, cannot be conveniently fitted to the steam derrick. It is therefore advisable to hang these derricks with the points of support plumb, and they will then swing quite easily by hand with the usual tackles. Fig. 3 shows a side view, and Fig. 4 a section, while Fig. 5 shows the derrick in position, with the valve handles close to the hatch. A steam cylinder G is fitted between two channel beams; in it works a piston H, whose ram T carries at its extremity a crosshead J and two grooved lifting pulleys; a wire rope passes round these pulleys and round the fixed pulleys K. When steam is admitted under the piston H from the pipe L the load is raised. It is necessary, however, to control the movement of this piston, so that an inelastic fluid should be interposed in the operation of heaving and lowering, otherwise the piston and its ram might move like a shot out of a steam gun. To effect this the trunk I is bored out and fitted at its upper end with a stationary piston M, which is carried by a tube N. A rod O passes through a stuffing-box in this tube for the purpose of opening a clack-valve P in the stationary hydraulic piston; this valve is only allowed sufficient lift for the maximum lifting speed of the derrick, which may be 5ft. to 10ft. per second. The whole of the interior of this trunk is filled with water, as shown in dotted lines. In making a lift it will be seen that all the water has to pass to the upper portion of the stationary control piston, and, as the valve falls into its seat and the steam is exhausted, the load will be held until this valve is opened by pulling the rod Q on end, lifting the valve L out of its seat. The rod is actuated by a separate lowering lever shown in Fig 5. The trunk is kept filled with condensed water under boiler pressure by being connected to a reservoir which has a sufficient quantity of condensed water from the branch R, so that it will always remain full, and will compensate for the displacement of the tube N. The annular space is connected with the exhaust steam pipes by trunnions. The lifting rope may be varied in length by being attached to various points on the side of the derrick, either direct or by passing round the segment X, so as to economise steam when lifting through short heights. It is claimed for this derrick that it is simple, rapid and noiseless, and being hung entirely on the mast, it occupies no deck space, and is suitable for the cheaper class of cargo and passenger ships.

Where masts are not available a form of crane shown in Figs. 6, 7, and 8 is convenient. This is supported by being bolted to the deck at the lower part of the lifting cylinder, the upper part being attached to the deck-house. Fig. 8 shows the lifting cylinder with the hydraulic controlling ram in section. The only difference is that the tube N carrying the stationary piston passes down through the cylinder end instead of up, as in the derrick. When the crane is slued a double-acting steam cylinder S operates on an endless chain, which passes round a pitched wheel T. The swinging valve is controlled by an automatic cut-off gear V, so that the jib will stop at any point assigned to it by the travel of the swing handle in its quadrant. Where a deck-house is not available, this crane can be arranged on the usual post which passes to the lower deck; in this case an all-round swing can be obtained. The length of the lifting rope may be varied according to the height of lift required by the winding drum W, which carries the fast end of the rope, so that the steam piston may be kept, as far as possible, working at the lower end of the cylinder, otherwise steam would be unnecessarily wasted.

STEAM TILLER.—The next important subject is the question of steering gear, which, from the various reports of captains, appears to formulate itself into the following requirements of an ideally successful steering gear, whether it be actuated by water or steam: (1) The steering engine or machine should be attached to the rudder head without the intervention of chains or ropes; (2) it should let go the rudder when unduly strained, and when the abnormal strain has gone must return to its former position; (3) an easy method should be provided of connecting from steam to hand gear, which shall not involve the engagement of a clutch, or the more common practice of shipping large bolts into a fixed crosshead from a loose one, all of which appliances take much valuable time to get into their places, particularly when a ship is

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rolling at sea, with the rudder adrift; (4) the communication to the bridge from the machinery aft should be of a kind which dispenses with rods, chains, and shafting, all being equally troublesome to the shipbuilder to arrange, and to the officers attending to them to keep in order, involving oiling bearings, pulleys, and tightening up ropes and chains.

To meet this want the author has designed what is termed a steam tiller and telemotor. Fig. 9 shows an elevation of the steam tiller with the hand steering gear, Fig. 10 being the plan. Fig. 11 shows the telemotor in vertical section. Fig. 12 is the same in plan. Fig. 13 is the corresponding cylinder aft. In Fig. 1 A^1 is a cast-steel tiller keyed on to the rudder head B^1, which has at its after end a double jaw C^1 fitted with bearings. At the other end D^1 there is a toothed segment, into which a pinion works. Aft of the tiller there is bolted to the deck a toothed quadrant E^1, into which the steel pinion F^1 gears. The shaft G^1 is shrunk into this, and, passing through the bearings on the jaws of the tiller, terminates in an expanding clutch wheel H^1. The worm wheel I^1 embraces this clutch wheel, there being a strip of elm wood interposed circumferentially between the two. This wood possesses the property of having a coefficient of friction nearly constant, whether it is wet or dry. The necessary friction to drive the shaft G^1 is obtained by the worm and worm wheel arrangement J^1, which expands the clutch wheel against the laminated spring K^1. The steering engines are carried on the tiller and move round with it, receiving and exhausting their steam through a double stuffing box arrangement L^1 mounted on the axis of the rudder head. The steam cylinders M^1 are of the usual well-known construction, originally introduced by Mr. Macfarlane Gray. The reversal is effected by changing the direction of the steam, which enters the cylinders through the slide valve N^1. The whole of the valve gear—viz., slipper guides, connecting rods, crank shaft, and eccentric rods, are enclosed in a water-tight box or chest O^1, having two hinged lids P^1, for occasional examination. For the purpose of oiling the various parts a tank Q^1 is fitted between the engines, from which proceed pipes leading to every bearing and joint, piston rods, valve rods, worm and wormwheel. Two valueless oil pumps R^1 R^1 are worked from the eccentric rods, and they keep up a continual supply of oil, which returns into the well S^1; the large end of the connecting rods dips into a trough and throws the oil generally about the clutch and wormwheels; a regulated quantity of oil finds its way down the shaft G^1 to the main bearings on the end of the tiller. From this arrangement it will be seen that it is only necessary to pour a few gallons of oil into the machinery casing, and the oiling of the various parts will be effected automatically by the working of the steering gear. The steering lever operating on the valve is shown at S^1; it is actuated by a hand-wheel T with worm and worm sector U^1 with its shaft and corresponding lever. This opens the slide valve N^1 in either direction, and the revolving motion of the tiller and engines shuts it again. The hand-steering wheel is shown at V^1; it is mounted on a worm shaft W^1, which gears into a wormwheel precisely similar to that of the steering engine at I^1. A vertical shaft passes down into a steel pinion, which gears with the toothed segment D^1. This shaft is brought into gear with the wormwheel by an expanding clutch similar to that on the engine shaft, and lettered similarly H^1.

In proportioning the strain of the engine with the torsional strain on the rudder head it is not necessary to consider the question of a safe strain; in fact, the engines may be made overpowerful, so as to allow for reduced boiler pressure. In practice the clutch H^1 is expanded at full speed trials sufficiently tight to put the helm hard over, but no more, and the worm wheel screw then set, so that in changing from hand to steam it cannot be made dangerously tight. It will be seen from this arrangement that any abnormal strain on any part of the gear or rudder head, caused by heavy seas, must be transmitted through the elm wood liner; this is held tight by the spring K^1, which has not sufficient hold to break any part of the machinery, but slips, and the valve gear opening brings the rudder into its original position. This friction clutch arrangement being also on the hand steering gear, admits of connection at any position of the rudder, even when flying about adrift; also the change from steam to hand, or *vice versâ*, is effected without shipping bolts or jaw clutches, so difficult to manipulate in emergency. It is therefore submitted that this gear fulfils the foregoing conditions, 1, 2, and 3.

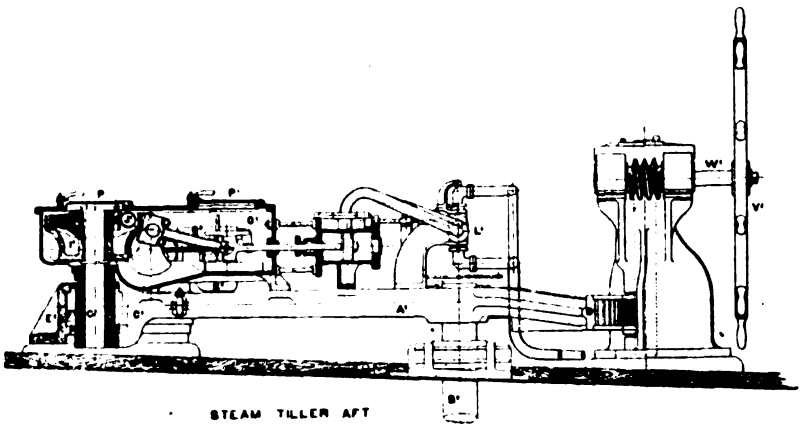
TELEMOTOR.—The object of this device is to communicate the motion of a revolving wheel at the bridge to the rectilinear motion of a piston and its connecting rod attached to the steering lever, acting upon a steering valve, which may be either steam or hydraulic. Fig. 11 shows a vertical section of what is really a hand-pump The steering wheel A^2 drives a shaft and pair of bevel wheels B^2, which actuate a vertical shaft C^2; the pinions D^2, one of which forms a nut, act on the screwed piston rod E^2. This is shown at mid-gear, the piston F^2 being in a cylindrical distance piece forming part of the upper cylinder G^2 and the lower cylinder H^2; this distance piece, however, allows a free passage of water through an annular port from the cylinder G^2 to the cylinder H^2, as it is open at the top and bottom of these cylinders one-sixteenth of an inch. On turning the wheel A^2 the piston F^2 will travel one-sixteenth of an inch each way before the cylinders G^2 or H^2 become effective hand-pumps. The machinery on Fig. 13 consists of an ordinary double-acting hydraulic cylinder I^1 fitted to the piston J^1 and its rod, which is connected to a crosshead K^1, and from there to the lever S^1 in the steering gear. The after steering wheel T^1 being disengaged, two spiral springs L^1 L^1 tend to force the piston J^1 into mid-stroke, and consequently bring the rudder amidships; they have not only sufficient power to overcome the friction of the gear aft, but tend to make the wheel amidships run back to mid-stroke. The cylinder G^2 on the bridge (Fig. 11) is connected by a pipe, ¼in. in diameter, to the corresponding letter G^2 on the cylinder aft, while the cylinder H^2 is connected to the corresponding letter H^2 aft. It will be seen that (the pipes and cylinders being full of water) the piston F passes the distance piece, say, on the upper stroke; the piston J^2 aft will move towards the cylinder end, thus increasing the initial compression of the springs L^1 L^1. Let us assume that we put the helm hard over in that direction and leave it there for an hour, and we find that a slight leakage in the piston has allowed the gear aft, by virtue of the springs, to come amidships, while the bridge wheel indicates hard over; the order is now given to reverse the helm—that is, to cause the piston F^2 to leave the cylinder G and to enter the cylinder H^2. The gear being out of correspondence, it sends the water into that half of the cylinder aft lettered H^2, driving the piston J^2 hard over towards the stuffing-box end of the cylinder; but whenever the piston F^2 enters the distance piece, there is established a free communication between the cylinders on the bridge and both ends of the cylinder I. The springs then exert their force and run the gear amidships, and the whole is again in correspondence. An extreme case has been taken of an hour's time hard over with a leaky piston; but as in practice the helm is put very frequently to port or starboard, and the combination of the piston F^2 passing through the cylindrical distant piece M^2 with the springs aft, tending to put the steering gear amidships, causes a continual rectification of the relative positions of the bridge wheel and the cylinder aft, which may be disturbed by a worn-out leather. Under exceptional circumstances it may happen that when carrying weather helm for a long period of time, the piston F^2 may be working entirely in the cylinder G^2 or the cylinder H^2, and having no opportunity of passing the distance piece M^2, and consequently with a defective piston there would be no automatic regulation. For that purpose a foot lever N^2 is provided, which opens a cock O^2, and thus enables the steersman to run his wheel back and bring the indicator over to zero, when the steering is then effected with the piston working in or about the distance piece, and the automatic regulation will go on. Any external leakage is made up by water stored in a small tank P^2, which enters the end of the cylinders by inlet valves in the boxes Q^2 Q^2, in which are also placed safety valves to allow for the expansion of the water in the pipes through change of temperature. One of these boxes is shown in section to a large scale at Fig. 14. It is scarcely necessary to say that with well fitted and good leathers no regulation takes place, but it is necessary to provide some such device, the tendency of which is to go *into order* rather than, as is usual, *out of order* as wear takes place.

In the discussion which followed,

Dr. Kirk wished to know whether, in the comparative tests between the steam winch and derrick, the winch was an old one.

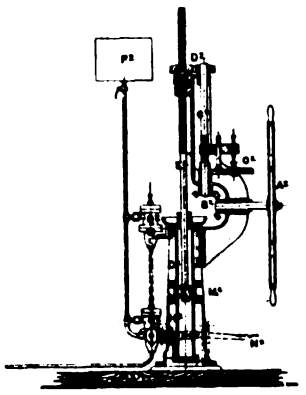
MACHINERY FOR STEERING SHIPS.

Designed by Mr. Andrew Betts Brown, and Constructed by Messrs. Brown Brothers, Edinburgh.



STEAM TILLER AFT

FIG. 9.



TELEMOTOR ON BRIDGE

FIG. 11.

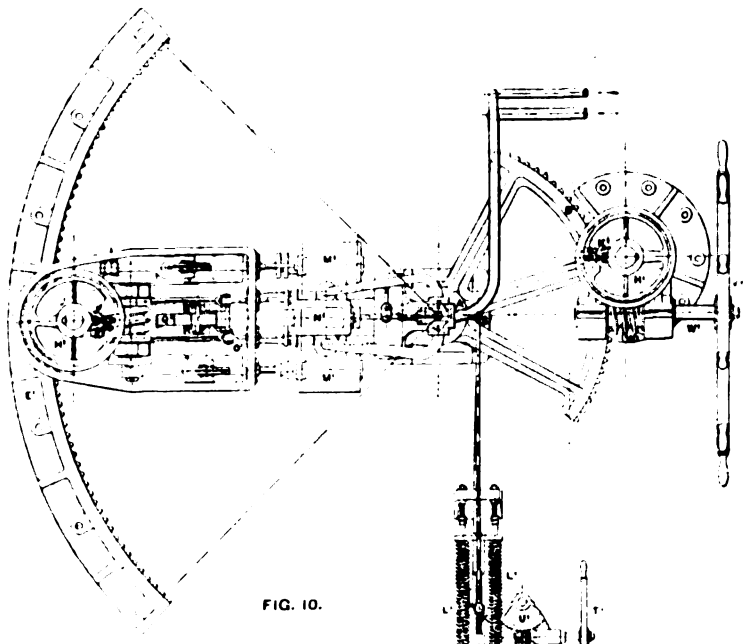


FIG. 10.

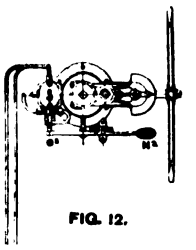


FIG. 12.

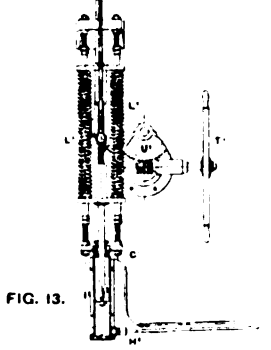


FIG. 13.

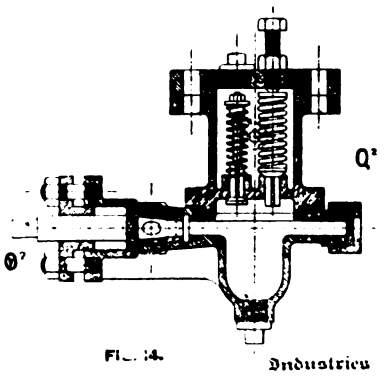


FIG. 14.

Industries

Mr. Seaton thought it a matter of regret that some such arrangement was not fitted on board ships, especially in substitution for cranes. Cranes were really more troublesome than winches. So far as the clutch arrangement was concerned, he knew it would answer very well, because on some machines he had made recently they had some such arrangement which answered well, and was perfectly noiseless and efficient. It was no doubt an advantage to be able to disconnect readily the hand and steam steering gear. Many ships had been lost through the pins having to be taken out when an accident happened.

Mr. McFarlane Gray said Mr. Brown had attributed to him the introduction of steam steering. What he did introduce was not the system, but the controlling valves.

Mr. White wanted to know why the rams were carried on the jib itself. He said that the steering gear was receiving the consideration of the Admiralty.

Mr. Brown, in replying, said the steam winch with which the tests were made was one which had been used and put in perfect order, as a new winch would have had considerable friction, both in engines and gearing. The cylinders are placed in the jib of the derrick because room could not be found for them elsewhere, either on the deck or on the mast. The steering gear has been especially devised for the merchant service, but there are no obstacles to its being adapted also to naval requirements.

(*To be continued.*)

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 8th April, 1890.

Iron.—The influence of the holidays, apart from the general aspect of the iron market, remains unchanged. The tendency of business is to shrink, and the downward course of prices shows that this tendency is something more than a passing influence. Here in Paris business is languid. To tempt buyers the merchants are offering bars at 156s. and even 152s., and joists at 4s. above these prices. It is a significant fact that the lower figures are for future delivery. In the Haute-Marne the market continues animated, the demand for wire and wire nails being very brisk; but in the other centres of the iron trade the demand is falling off, and prices are maintained with difficulty.

Metals.—Copper is firmer, the feature of the market being a rise in "best selected." This is, however, a mere fluctuation, due to speculative operations. There are no solid grounds even for the maintenance of the present rates. Best Chili bars are quoted £52, and best selected £58. Tin is still quoted £100 for Banca, but the market is weak. Lead is quiet at £13, delivered at Havre. Spelter continues its downward course, Silesian being now quoted £23 12s. at Havre.

Labour.—Though French industry is not yet seriously troubled by the labour movement in progress abroad, it cannot be said that it is not seriously threatened. There is considerable ferment among the working men of all classes, and the organisations and preparations which are being made for the "manifestions" on the 1st of May show that this country is not likely to be long exempted from the labour disturbances that are obstructing the course of trade in neighbouring countries. The Socialist leaders are hard at work sowing discord everywhere.

The Northern Canal.—The scheme for the construction of the great northern canal, the waterway that is to connect the capital with the mining and manufacturing district of the North, is again being vigorously promoted. The return of M. Freycinet to power renders it probable that the project will be carried through on this occasion. It is one of immense importance to French industry, and not without interest to the import trade in English produce, particularly coal.

BERLIN, 7th April, 1890.

Iron.—Business in iron was very brisk in the early part of last week in anticipation of the Easter holidays. For the moment there is nothing doing, and there will be a slack market for several days to come. The customs returns for the first two months of the year show a threefold increase in the imports relatively to 1889, the total quantities being 87,776 tons against 29,174 tons. The pig iron and scrap received from abroad amounted to 75,667 tons against 21,714 tons in the corresponding period of 1889. Bars show an increase from 2,643 tons to 4,399 tons, about the half of which come from Great Britain.

German Iron Abroad.—The total exports of German iron in the month of February amounted to 79,294 tons, against 64,334 tons in January and 91,804 tons in the same month of last year. The effect of high prices in restricting the export trade becomes more distinctly visible every month. The following is a classified account of the trade in the first two months of the current year compared with that of the corresponding period of 1889: Pig iron, 18,510 (35,153) tons; old and scrap iron, 4,080 (4,046) tons; half-wrought iron and steel, 2,692 (4,192) tons; finished iron and steel (bars, angles, and plates), 30,846 (44,899) tons; wire, 17,763 (30,086) tons; wire nails, 5,509 (7,813) tons; rails, 20,124 (15,925) tons; other railway iron, 8,075 (7,625 tons; heavy castings, except ordnance, 4,220 (2,224) tons; other manufactured goods, except machinery, 31 809 (30,173) tons. Total, 143,628 (182,036) tons. The falling off, it will be seen, is chiefly in crude iron, finished iron and steel, and in wire. The shrinkage in the latter is very serious. Wire nails, too, have fallen off heavily. The quantity of wire nails shipped to Great Britain in the two months was 1,923 tons. The consignments of wire nails to Japan amounted to 1,237 tons.

Labour.—The labour question continues to develop itself. From all parts of the country we learn that fresh demands are being made by the working men of all the principal industries. The miners of the Chemnitz district are asking for a 20 per cent. advance in wages and the eight hours' shift. The colliers of Upper Silesia are discussing a similar project. There is much commotion in all trades, and everywhere there seems to be a determination to strike for higher wages and shorter hours. The movement is of immense importance to German industry.

Ozokerite Mines.—The scheme of the group of speculators known as the "Rothschild Ring," to buy up, in conjunction with Bleichröder, the ozokerite mines in the district of Boryslau, and to reunite them in one great share company, has proved abortive. But the *Compagnie commerciale française* have bought, in conjunction with a Vienna merchant at Boryslau, a number of these mines, for the purpose of working them in a more rational manner from two properly arranged engine shafts. These changes will lead to a considerable reduction in the cost of production of ozokerite.

Lignite on the Baltic Sea.—A discovery of a bed of lignite has lately been made on the shores of the Baltic Sea, near Palmnecken and Lettausdorf. The Breslau Mining Office have made several borings, and have proved that the seams are thick and likely to prove remunerative.

Chemicals.—The directors of the firm of Meister Lucius & Brüning, of Höchst-am-Main, whose specialty is the manufacture of Dr. Knorr's antipyrine (Lion brand), have decided to propose at the general meeting the distribution of a dividend of 22 per cent. for 1889, as compared with 16 per cent. in 1880.

The Water Communications of Berlin.—The great importance of the several waterways for Berlin traffic may be seen from the fact that no less than two-fifths of the entire imports from Berlin came by water, whilst the ten railways have the other three-fifths between them. The number of boats on the waterways here has declined from 96,151 in 1888 to 92,930 in 1889, but the total weight of the goods arriving has risen. The goods passing through Berlin by water amounted to 283,667 tons, the arrivals to 4,351,550 tons, and the departures to 327,538 tons.

The South-German Telephones.—The Frankfort Chamber of Commerce has addressed a petition to the postal authorities in favour of erecting a telephone network to connect the leading business places of South Germany. The towns proposed to be included in the network are—Frankfort-on-the-Main, Cassel, Giessen, Worms, Schweinfurt, Mannheim, Aschaffenburg, Würzburg, Bamburg, Nuremberg, Augsburg, Munich, Pforzheim, Stuttgart, Coblenz, and Kreuznach.

Underground Telegraphs.—The laying of underground telegraph wires is to be begun in Bavaria. A Bill on the subject will be laid before the present Bavarian Diet. The main lines may be from Munich to Ingolstadt, Nuremberg to Bayreuth, or Munich to Landshut, and Regensburg and Bayreuth to the Saxon frontier near Hof, to be connected with the existing imperial line from Berlin to Dresden. To establish a direct underground connection between Munich, Hof, Dresden, and Berlin, representing a distance of 850 kilometres, the Imperial Post Office will also have to lay down a wire of 216 kilometres in length between Hof and Dresden. Since 1877, 5669 kilometres of underground wires have been laid in Germany, with 38,000 kilometres of wires. All important commercial towns and seaports, and every fortress and naval port, are now connected with Berlin in this secure way.

VIENNA, 7th April, 1890.

The Coal Market.—The coal traffic continues to be very animated, and there has been a brisk demand, especially for the export. Westphalian manufactories have petitioned the Bavarian and Bohemian railways to reduce the tariffs for coal transport, in order that they may be able to procure coals from Bohemia. The Aussig-Teplitz Railway Company is enlarging its capital, in order to buy new rolling stock for the coal transport. The yearly report of this company shows an animated export to South Germany. The colliery "Victoria-Tiefbau of Brux" produced during last business year the total quantity of 369,728 tons of brown coals, and had a clear profit of 137,000 florins. It pays a dividend of 6 per cent. The "Westböhmischer Bergbau-Actienverein," which has large possessions in Western Bohemia, held its general meeting last week. According to the report, the income of this association during last year amounted to 1,328,000 florins. In its works there have been produced 337,000 tons of coal. A dividend of 5½ per cent. was paid. Coke has a good sale, and great quantities are going to Germany.

The Iron Market.—Nothing new can be said of the iron market; the transactions are very animated, and the tendency remains firm. It would be very advantageous if the pig-iron works should soon complete the old orders, because there are a number of new ones of some importance. There is an animated demand for all sorts of building iron; indeed, the building season shows an extraordinary animation. There is a good demand for sheets, both black and tinned, and agricultural machines have a good sale. Rails are in the best request.

The Austrian Coal Trade in 1889.—The principal exports were brown coals, and the principal import ordinary coals. The import of black coal amounted last year to 3,272,627 tons, against 3,085,321 in 1888; 682,385 tons of the same sort have been exported; in 1888 the quantity was 691,196. The total export of brown coals in 1889 was 5,270,707 tons, and the import 9,112 tons. The import of coke amounted to 192,345 tons, and 39,660 tons have been exported.

BRUSSELS, 8th April, 1890.

The Coal Market.—In spite of the efforts which are being made continually by the consumers, the prices of coal and other forms of fuel keep very firm and no concessions can be obtained. In all the coal centres the stocks are being rapidly reduced, and at most of the pits there is hardly any reserve. It is no wonder, therefore, that the coal-owners can demand their own prices. At Liége, nuts for rolling mills cannot be bought at less than 18fr., and 19·50fr. is demanded for the best qualities; while at Charleroi the price of this sort is 18fr. At one of the collieries in the South nuts have been sold largely at 20fr. The prices in the Mons district are similar to the above, if anything, rather higher. Small sorts for coking purposes are unvaried at Charleroi and in the Centre, 19·50fr. being the price for deliveries over the next three months. The producers of coke met at Brussels last week and decided to maintain the price of 35fr. firmly. During the past week the carriage of fuel over the State railways amounted to 24,136 waggon-loads, as compared with 22,176 waggon-loads during the same period of 1889.

The Iron Trade.—The iron market is quiet. New orders come with difficulty, and there is a great deal of reserve shown by the buyers. However, all appearances point to a continuance of the high prices, for there is no sign of yielding in the cost of raw materials. The contract for 2,000 tons of Goliath rails for the State railways has been divided between the Angleur, Ougrée, & Cockerill Companies, at a price of 177·5fr. per 1,000 kilogs. The ironmasters met on Sunday last and decided on the restriction of their production.

The Glass Trade.—The demand is beginning to improve somewhat, especially from England and the United States. Some satisfactory repeat orders have been received from Canada. The production generally has been increased. A new furnace is to be started at the works of Les Verreries Morel at Lodelinsart, making the 296th in use in Belgium. In view of the continued high prices of fuel there is a movement among some of the glass manufacturers in favour of establishing a syndicate for the buying of raw material.

DÜSSELDORF, 8th April, 1890.

The Foreign Coal Trade.—Great activity prevails in the foreign coal trade. The imports are exceptionally heavy, a circumstance due partly to the larger requirements of the manufacturing industries and partly to the interruption of the output of the German mines by strikes. The quantities imported in the first two months of the current year were as follows, the figures in parentheses being those of the corresponding period of 1889:—Lignite, 900,615 (641,673) tons; coal, 501,522 (497,092) tons; coke, 78,200 (42,517) tons; briquettes, 10,315 (4,037) tons. About two-thirds of the coal received came from England. The exports, which show a shrinkage in coke and briquettes, were for the period in question as follows:—Lignite, 1,909 (1,560) tons; coal, 1,518,831 (1,432,175) tons; coke, 135,269 (143,168) tons; briquettes, 16,196 (17,533) tons. The quantity of coal sent into Holland amounted to 459,504 tons, and that of coke to 12,428 tons. A good deal of ground has been lost in Holland of late, the high prices rendering it impossible to hold either market against English competition.

Iron.—The Easter holidays have for the time put a stop to the business of the iron market. But there was no life in the trade in the half week preceding Good Friday. The demand for pig iron was very slack, and merchants' prices dropped a little for some classes. Thus Rhenish-Westphalian forge was offered at 90s., Siegen forge at 89s., and foundry pig at 96s. Manufacturers refuse to make any concessions. The market for finished produce was fairly active for joists; but generally the demand was weak. Some revival is expected after Easter, the present lull being in large part due to the uncertainty of the labour situation. This expectation is founded on the belief that the labour difficulties are likely to be overcome within a short time. Probably a disappointment lies in this direction. The demand for hoops is likely to increase in the course of the next month. Founders have plenty of work in hand.

The Cement Industry.—The cement manufacturing industry is in a flourishing state. At a general meeting of the Westphalian Cement Manufacturing Company, held here the other day, a dividend of 19 per cent. for the year 1889 was declared. Judging from the trade of the first quarter, the current year will compare favourably with the last. The export trade is very brisk. The quantity of cement exported in the first two months of 1890 amounted to 35,216 tons, against 16,815 tons in the corresponding period of 1889.

LILLE, 8th April, 1890.

Iron.—The state of the iron market in this district is, notwithstanding reports to the contrary, unsatisfactory. Consumers not only abstain from buying, but, in some instances, those who have considerable stocks in hand are selling in the belief that they will be able to replace them at lower prices before the end of the second quarter of the year. The commonly held opinion is that the present level of prices cannot be much longer maintained. The tone of affairs is, therefore, weak and hesitating. The only encouraging feature in the prospect is a downward tendency in the prices of coal.

Textile Manufactures.—The business in textile goods has been interrupted by the Easter holidays, but irrespective of this influence it is easy to discern a declining tendency in the trade in linen woven goods. As usual at this season the demand is steadily falling off. The trade of the year hitherto, however, has been very satisfactory considered relatively to that of 1889. The woollen goods trade of Roubaix is featureless; but the market for raw wool, which has been declining for some time past, has suddenly revived. Prices are now firm with an upward tendency. For the present manufacturers are buying but sparingly.

Flax and Yarns.—The market for flax and yarns was, down to the time of its interruption by the Easter holi-

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days, exceedingly active for home-grown produce, and prices were very firm. The demand for Russian goods also showed more life. Tows, of which there was not much on offer, were inquired for, especially those of the best quality. Business in yarns was restricted to dealings for present requirements, but the volume of the transactions was considerable. Prices remain unaltered. Jute yarns are in brisk demand at last week's prices.

COMMERCIAL MUSEUM.—The managing committee of the Lille Commercial Museum has just received the following additions to the samples now on view, and which are worth the notice of English visitors:—(1) An important collection of table linen most in vogue at Buenos Ayres; (2) a varied collection of products from Algeria, Tunisia, Uruguay, Japan, and the Dutch Indies; and (3) a sample of hemp and linen harness-straps much used in Turkey, and for which therefore there is a good demand.

AMSTERDAM, 7TH APRIL, 1890.

RAILWAYS.—The shareholders of the State Railways Company are convened to an extraordinary meeting, to be held at Amsterdam on the 16th inst., to consider and, if thought fit, to sanction a modified agreement with the State for the working of certain railways, to be taken over from the Dutch-Rhenish Railway Company, dissolved. An important conference of delegates from the leading Chambers of Commerce in the kingdom has been held at Utrecht, to consider and report on the various contracts between the Government and the Dutch-Rhenish Railway Company, the State Railways Company, and the Holland Railway Company, by which the whole national railway system will be altered and centralised. A great difference of opinion manifested itself at Utrecht. The delegates from the Hague have reported strongly in favour of the new state of affairs, whilst those sent by the Chambers of Commerce at Amsterdam, Rotterdam, and Leyden have advised the rejection of the projects as framed by the Government. Utrecht reserved her opinion. These reports are to be submitted to the States-General.—The Minister of the Means of Communication, accompanied by the Director-General of the State Railways Company and the Chief Engineer of the latter, has paid a visit to Flushing, in view of the important alterations proposed at that port. The "town" station at Flushing will be merged with the harbour station. The latter will be much enlarged, and there is to be a railway hotel in the building, a thing which has been much wanted for a long time. The Directors of the "Zeeland" Company, performing the service between Flushing and Queenborough, were, of course, present at the conference, which was followed by a luncheon on board the "day" steamer "Duitschland."

EMIGRATION TO THE ARGENTINE REPUBLIC.—Mr. Reed, the Dutch Consul-General at Buenos Ayres, has issued a warning to his countrymen against their indiscriminate emigration to the Argentine Republic. He points out that the thing has been overdone, no less than 289,000 immigrants from various parts of Europe having landed at Buenos Ayres in the course of last year. This, of course, greatly impedes the placing of immigrants, and the chances of employment are further reduced by the serious crisis the country is now undergoing. Except servants, nobody, according to Mr. Reed, has now the remotest chance of finding employment on arrival at port, and vagabonds, or people of that ilk, cannot get on at all. There are already too many of them.

THE YEAST AND SPIRIT FACTORY AT DELFT.—This undertaking, the largest of its kind in Holland, has done exceedingly well in 1889. The net profit amounted to 254,764 guilders, and a dividend of 20 per cent. was declared at the annual meeting, which also authorised the directors to increase the share capital from 400,000 to 800,000 guilders, the new shares to be issued at 5 per cent. premium.

THE OYSTER CULTIVATION AT BERGEN-OP-ZOOM.—These beds are becoming gradually more productive despite low prices. The weekly average of exported bivalves exceeds 600,000. They mostly go to England.

THE DUTCH MAIL SERVICE TO INSULAND.—The Royal Mail Packets Company, whose subsidised steamers will perform the service between the islands of the Archipelago and Holland as soon as the existing contracts with the Netherland India Steam Navigation Company lapse, has held its first meeting. No results are of course forthcoming, but the chairman stated that thirteen steamers are now in course of construction. They have to be built in Holland in accordance with the law subsidising this mail service. The company has been fortunate enough to induce the Netherland India Steam Navigation Company to sell to it the entire fleet in the Archipelago, consisting of sixteen steamers, wherewith the new company will continue the local service, thus securing a monopoly with Holland, and in the mail service among the islands of Insuland as well.

THE PALACE OF INDUSTRY AT AMSTERDAM.—The company owning the Crystal Palace at Amsterdam has fared badly in 1889. Not only is there no dividend, but a loss of nearly £7,000 has to be faced, in consequence, it is said, of mismanagement, and of "bad times," as the directors aver.

TRAMWAYS IN AMSTERDAM.—An important contract has just been entered into between the town authorities and the Amsterdam Omnibus Company, which also owns the main portion of the tram system in the Dutch capital. In virtue of said agreement the company will obtain the exclusive concession for three new tram lines in different parts of the town, for which it is to pay the costs of expropriation and of lowering several bridges over canals, such costs not to exceed 1½ million guilders, say £125,000. The Town Council reserves itself the right to cancel at any time the whole concession at cost price. The shareholders of the Omnibus Company have been convened in extraordinary meeting to approve the draft of the concession and a loan project of 5,000,000 guilders.

COPENHAGEN, 5TH APRIL, 1890.

A RUSSIAN NAVAL PORT.—The projected Russian naval port at the Murman coast is hailed with much satisfaction by the Russian press. According to the present anticipations, there is a lucrative business to be done there, which is now partly neglected and partly in the hands of the more enterprising Swedes and Norwegians. The establishment of a Russian naval station will, however, put a stop to all this. As an instance of the rich yield of the ocean in those parts, it may be stated that the steamer "Vega," in the year 1888, between April 25th and May 5th, killed no less than 5,000 seals, representing a value of some 25,000 roubles.

THE SWEDISH-NORWEGIAN RAILWAY COMPANY.—It now looks as if this ill-fated undertaking might before long pass into the possession of the Swedish State, as far as the Swedish section is concerned. The terms will certainly be very different from those which the company submitted to the Swedish Government some fifteen months ago, but the company's affairs have since then gone from bad to worse. The railway has already been valued by Swedish officials some time ago, and the Lulea-Gellivara section put at something approaching 5,000,000kr. A Swedish syndicate has been formed to bring about the projected transfer, and it has been said that the Swedish Government might be disposed to go as far as 7,000,000kr.

MINING IN NORWAY.—Although English enterprise in Norwegian mining undertakings has on the whole been unsuccessful, there is no lack of fresh attempts. Some good findings of ore are reported from Saude, containing silver, lead, copper, and gold. The means of access is easy, and the position very convenient for shipping, so everything seems as promising as anyone could desire. Another English mining venture is being advertised in Norway—a Norway Mining Exploration Company. The natives seem very sceptical about it, for they think that more gold is put into gold mines than ever comes out.

MADRID, 7TH APRIL, 1890.

CADIZ SHIPBUILDING YARD.—A contract has been given to the new shipbuilding yard at Cadiz for a cruiser of 7,000 tons at the price of £600,000. This is practically the same price given for the three now building at Bilbao. At Cadiz there is very little accommodation for building ships of this size, and the steel will have to be brought from Bilbao, whilst the boiler, engines, and other machinery will have to be made either at Seville or Barcelona. It is to be feared that the contractor will be far from being able to comply with the conditions of the contract as to time. In the locality there are some hopes that the giving of the contract may help to establish regular shipbuilding at that bay for mercantile requirements, but the chances of building there at a sufficiently low cost are very slight, as labour at Cadiz is paid very high, and coals and everything else will be dearer than in the North of Spain.

THE FORREVIEJA SALT PANS.—These salt pans, which belong to the Government, are to be sold by public auction, and a well-grounded alarm has been created at Cadiz as regards the effect which its passing to private hands may have upon the salt market of the country. The fact is that Forrevieja is supposed to be able to produce more than 700,000 tons per year, and if an attempt to sell that large quantity be made the average price of salt will be much lowered in the general market. This affects very particularly the producers of salt at Cadiz, who sell their salt at about four times the prime cost. A deputation has been sent from Cadiz to the Central Government to ask that a very large price may be put on the Forrevieja Mine, so as to incapacitate the purchaser from selling cheaply. Their demand is that £2,300,000 shall be the minimum accepted, which is quite absurd.

LA VIZCAYA CO. WORKS AT BILBAO.—At the general meeting of shareholders of the large company "La Viscaya," the directors' report showed some interesting details of the rapid advance of this company. At present they have two large blast furnaces, which are to be increased to three before next June. They make coke in 108 furnaces, with such good results that the number is to be raised to 216, in which case the daily make of coke will be 440 tons. Their make of pig iron last year was 74,812 tons, 34,400 of which were disposed of in Spain, 31,500 in Italy, and the remainder in various countries. The company has three Siemens-Martin steel smelting furnaces, and the number will be increased to four by August. They have at work three rolling mills, but so far they have no plate mill. Their paid up capital is £250,000. Notwithstanding the favourable times they have not been able to pay a larger dividend than 5 per cent.

NEW YORK, 29TH MARCH, 1890.

THE COAL MARKET.—The anthracite trade has not improved. Prices are low, and are constantly being shaded, and the demand for domestic sizes is light. While the condition of the trade is bad enough, much more is made of it than necessary to influence the stock market The worst is over, and the real danger was past some months ago. Some time will pass before much improvement can be expected; but if the companies stand together, it is very probable that the end of the year will find over 33,000,000 tons sold, and at a fair average profit.

OCEAN FREIGHTS.—There has been a decided drop in ocean freights which have been strong for nearly two years. The *New York Commercial Bulletin* in a long article on the subject says that rates have fallen from New York to Liverpool within a month or two as follows: Grain, from 5½d. to 4d.; flour, 18s. 9d. to 13s. 9d.; oil cake, 17s. 6d. to 12s. 6d.; cheese, 35s. to 30s.; and cotton, ¼d. to ⅛d. Freights to nearly all other ports have made a similar decline, but the rates on provisions to Liverpool are quoted higher than in February. If there is any such weakness in outward freights as there was in the early parts of 1888, it is very likely that we shall ship bituminous coal and coke to England this year.

RAIL OR WATER.—The irrepressible conflict between the lake lines and the railways is almost ready to recommence. The east-bound shipments for the week show a large falling off in the grain traffic, the reason being that it is being stored in the Chicago grain elevators waiting the opening of navigation. In spite of numerous conferences between the rail and lake lines, no satisfactory disposition has been made of the matter, and the season bids fair to open with a renewal of the old policy of the boat lines cutting rates to any figure necessary to secure a load.

THE "NEWARK."—The "Newark" has been launched at the shipyard of the Cramps, in Philadelphia. She was the first of the vessels provided for under the last administration, and was known as Cruiser No. 1. The contract time for the completion of the vessel was two years, and expired on October 27th last. The vessel is 310ft. long, 49ft. 2in. beam, and has a maximum draught of 20½ft. and a mean of 18½ft., giving a displacement of 4,083 tons. She is fitted with twin screws and horizontal triple expansion engines, which will furnish 6,000 h.p. under natural and 8,580 under forced draught. The speed is expected to be 18 knots. Her armament will consist of twelve 6in. high-powered breechloading rifles on centre-pivot mounts, giving them a wide broadside range, and in her secondary battery she will carry a dozen rapid-fire and machine guns. The contract price for building the "Newark" was $1,248,000, subject to the deductions for loss of time.

BUILDING TRADES STRIKE.—A general strike in the building trades in Boston during the season of 1890 seems inevitable. The plasterers and carpenters recently demanded that eight hours shall constitute a day's work after April 1st and May 1st. Both trades expected to secure their demands without trouble, but the Carpenters and Builders' Associations (Masters) have voted not to grant the eight hour demand. The association also determined that no members should sign a contract that did not contain a strike clause. The workmen seem determined, and say they will resort to extreme measures to obtain what they ask.

BOUNTIES FOR AMERICAN VESSELS.—This question is regarded as one of the most important matters that will engage the attention of this Congress. The House Committee on Commerce and Fisheries has decided to recommend a bounty on American vessels, both sail and steam, engaged in trading between America and foreign ports of thirty cents per ton per thousand miles; it will apply to all vessels now or hereafter built.

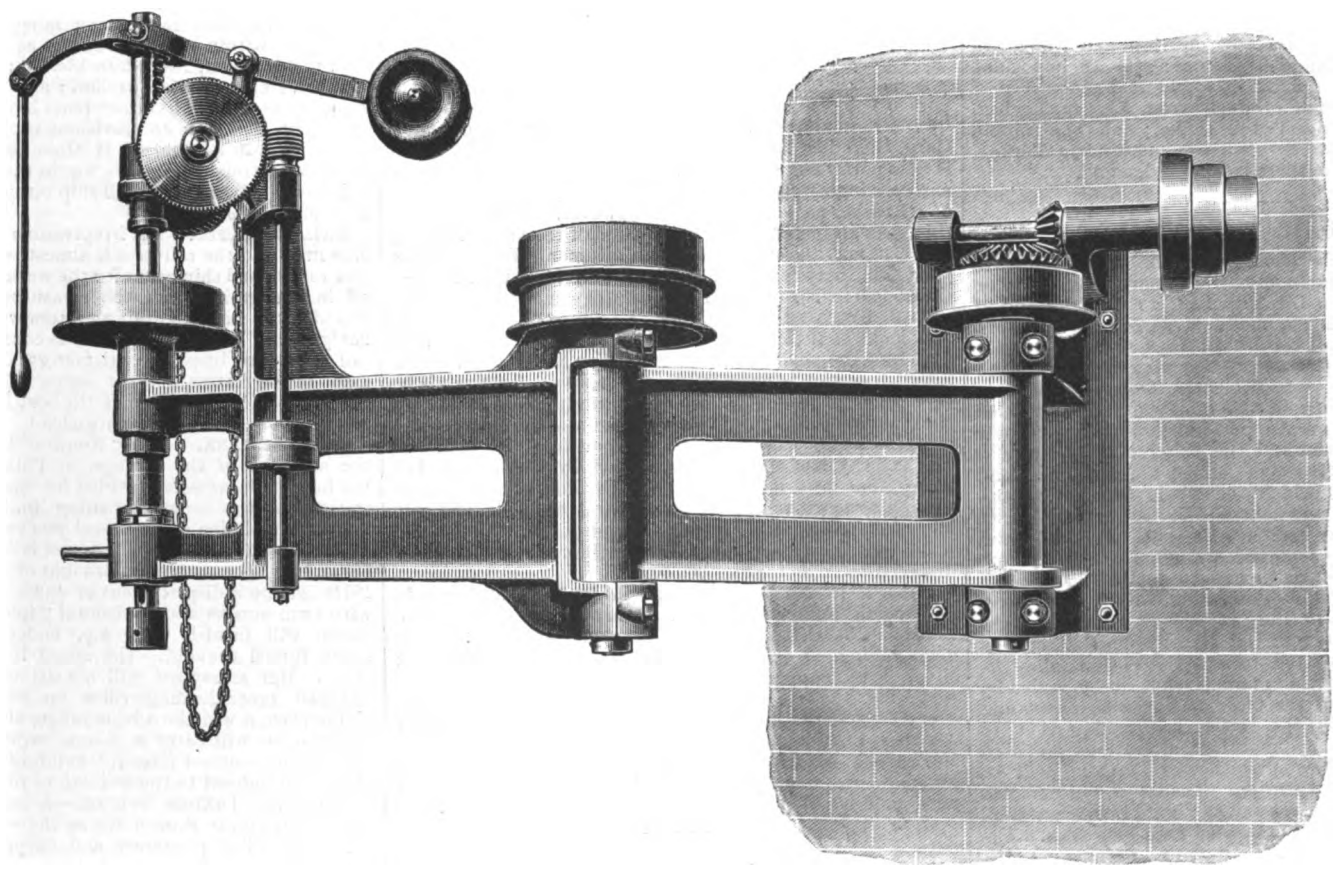
FORTIFICATIONS.—The Appropriation Committee of the House has reported the Fortification Bill, the aggregate of which is $4,521,678. One of the items is $250,000 for breechloading cast-iron hooped 12in. mortars. The report says that one of these mortars has been fired 400 rounds without sensitive detriment with a charge of 80lb. of powder and a shell of 630lb., giving a range of six miles. An item of $25,000 for steel shells indicates a purpose on the part of the War Department to follow up the European experiments with high explosive shells of steel armour-piercing projectiles, for which an appropriation of $100,000 is made.

THE IRON AND STEEL TRADE.—The downward tendency of the market has been very marked during the past couple of weeks, but the indications now are that prices are very near the bottom, and that a reaction is not far distant. At the present, however, the feeling is unsettled, and buyers are inclined to take small lots only until the outlook becomes clearer. In pig iron the weakness in prices has not brought in any larger amount of business so far, although negotiations are in progress which may lead to heavy transactions at any time. The fall in prices is not due to any special falling off in consumption, but to the steady increase in production, which now is at the rate of over nine million tons per year. Sales during the week have been generally at $19, $18, and $17 delivered for the three grades, but in special cases these figures have been shaded considerably. There is still some hesitancy among buyers, but the chances are favourable for an early resumption of activity, if not of better prices. Some increase in the volume of business in manufactured iron is to be noted along the entire line, but prices have continued to drop. A larger business has been done in steel rails than for some time past; lots amounting to upwards of 20,000 tons have been taken at prices about $34·50 per ton at mill. There is still a large amount of business under consideration. The market for billets is unsettled from the continued pressure from holders of speculative lots. Prices are nominally $32·50 to $33 per ton delivered, but orders could probably be placed at something less.

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WALL BRACKET RADIAL DRILLING MACHINE.

CONSTRUCTED BY MESSRS HETHERINGTON & CO., ENGINEERS, MANCHESTER.



RADIAL DRILLING MACHINE.

THE machine of which an illustration is given above is of novel design. It is not uncommon to find radial drill arms hinged to a wall, but the radial adjustment is usually obtained by the employment of a sliding saddle carrying the drill spindle. This, of course, adds materially to the cost of production. In the machine illustrated the arm is in two pieces, which are coupled in the centre by means of a pin. The arm is pivoted on a pin, which passes through ears on a wall bracket of the usual type. The drill spindle is carried at the outer end of the second half of the arm, and is 1¾in. diameter, with a vertical feed traverse of 9in. The feed may be either manual or self-acting, and the spindle is balanced as shown. The driving power is derived from a speed cone, bevel wheels, and a pulley which runs loosely on the pin which forms the inner pivot of the arm; from it a strap passes to the double pulley which is fixed on the centre hinge pin, and from there a second strap drives the spindle. Thus whatever position the arm may be in the distance of the driving centres is preserved and the straps are always tight. The double hinge permits of the drill spindle being easily brought over a hole in any position within 6ft. of the wall bracket, while the construction adopted gives a simple and inexpensive tool which will be very serviceable to many engineers. The makers are Messrs. Hetherington & Co., Ancoats Works, Manchester.

THE INSTITUTION OF CIVIL ENGINEERS.

AT the eighteenth ordinary meeting of the Session, on Tuesday, the 1st inst., Sir John Coode, K.C.M.G., President, in the chair, the paper read was "On the Barry Dock Works, including the Hydraulic Machinery and the Mode of Tipping Coal," by Mr. John Robinson, M. Inst.C.E.

Barry Dock was situated on the north shore of the Bristol Channel, between Barry Island and the mainland of Glamorganshire, seven miles in a direct line south-west of Cardiff. The site chosen for the dock occupied the eastern portion of the channel, which formerly ran between the island and the mainland. An Act of Parliament to authorise the construction of the dock, and the railways connected therewith, obtained the Royal Assent on the 14th of August, 1884. The undertaking comprised a tidal basin of 7 acres, a dock of 73 acres, and a timber pond of 24 acres. The entrance to the dock was at the eastern end of the island, under the shelter of the high land of Nell's Point. This excellent natural shelter was supplemented by two outlying converging breakwaters. The tidal range was 36ft. at ordinary spring-tides, increasing to 40ft. at extraordinary springs; and 19½ft. at ordinary neaps, diminishing to 16ft. at extraordinary neaps. The dock was not fed with water from any river. The width of the entrance between the masonry walls was 80ft., and gave access to the basin. In the entrance was placed a single pair of wrought-iron gates, and the dock not being exposed to heavy seas, there were no gates pointing outwards. The passage between the basin and the dock also had a width of 80ft.

The dock was 3,400ft. in length, the maximum width being 1,100ft., divided at the western end by a mole into two arms, the full width being left at the eastern end for a length of 1,600ft., where vessels of the largest class could swing. The bottom of the dock, which was not puddled, was 20ft. below mean sea-level. The mole was 1,300ft. in length and 200ft. in width, with pitched slopes of 1¾ to 1 on the north side, and of 2 to 1 on the south side. Along the northern side of the dock were 11 high-level tips, and on the northern side of the Mole were 3 low-level fixed tips, and masonry towers for two others had been built. Two more low-level tips were stationed on the south side of the dock, and one at the western end. To prevent the basin and dock being flooded whilst the temporary stone dam was removed a caisson was erected, which could be used for future requirements.

The breakwaters were formed of rubble excavated from the basin and railway cuttings, and the sea slope was protected by blocks of mountain limestone, weighing from 4 to 7 tons each. At the head of the west breakwater there was erected a cast-iron tower, 30ft. in height, the diameter at the base being 7ft. 9in., and at the top 6ft. 6in., with a spiral staircase inside. In the tower was placed a fourth-order dioptric occulting white light, visible in clear weather at a distance of 10 miles.

The hydraulic power was obtained by means of two pairs of compound horizontal condensing pumping engines of the tandem type. The boiler pressure was 80lb. per square inch, and condensing water was obtained from, and returned to, the docks through pipes 15in. in diameter, by the circulating-pumps. Another hydraulic engine-house was in course of construction at the north-west end of the dock.

The entrance from the sea into the basin, and the passage between the basin and the dock, were each provided with a pair of wrought-iron gates having a span of 80ft. and a rise of 20ft. There were six sluices in each leaf, having a combined area of 100 square feet. These were worked from the top by direct-acting hydraulic cylinders and pistons. The gates at the entrance were opened and closed by hydraulic power, chains being dispensed with. The water was admitted to a direct-acting hydraulic cylinder having a piston 2ft. 5¾in. in diameter, and a ram 1ft. 9in. in diameter, with a stroke of 25ft. 9in., attached direct to the gate, the cylinder being in three parts of cast-steel. Trunnions were cast on the cylinders, projecting above and below, and pivoted in saddle bearings, which also had trunnions on their sides, and these pivoted in bearings fixed to the walls of the ram chamber, thus permitting the cylinder to oscillate both horizontally and vertically. The hydraulic rams were of sufficient strength to resist shocks of waves, and to hold the gates rigidly during movement. The passage gates were worked in the same manner as those at the entrance; but in this case the ram was attached to a radius arm near the top, with a slide against the back of the gate, the other end of the arm working on a pin in the holding-down bracket over the top of the heel-post. As the power required was less, the diameter of the piston was only 2ft. 1½in., and that of the ram 1ft. 6in., with a stroke of 16ft. 7in. The cylinder for the passage-gate machine was of iron, cast in one length, and tested to a pressure of 2,400lb. per square inch. The ram was also of cast iron, and the whole machine was arranged in a similar manner to that for the entrance gates. For the protection of the gates stout chain-cables and wrought-iron box booms were placed in front of the masonry. To prevent the gates rising and floating away a cast-steel holding-down bracket was provided at the top of each heel-post. The ordinary time occupied in opening the gates was one minute and a half, and the same in closing; but those at the passage occupied less than a minute in opening, and the same in closing.

The following modes were adopted at Barry for the shipment of coal, where it was shipped both from high and from low levels. On the high-level the trains were backed into curved sidings intended for full waggons, where the engine left them. These sidings were on gradients of 1 in 233. No stop-chocks were employed, neither had they been found necessary. The loaded waggons were sent from the collieries with the doors uphill, to prevent their opening on some of the steep inclines in the valleys, and did not, therefore, require to be turned for tipping when shunted into the sidings, thereby saving both time and labour. The waggons were drawn forward and run one by one on to the weigh-

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bridge, and afterwards drawn on to the coal-tip by means of another hydraulic capstan. The coal-tips consisted of masonry towers, 30ft. square, on which were erected wrought-iron framings, braced together by angle tee, and bar irons. This framing served to support the wrought-iron guides for the cradle. The latter was provided with the necessary tip-up table, hinged in front, and worked by hydraulic power, by means of a cylinder hung on trunnions to girders underneath the cradle which travelled with it, and capable of tipping loads up to 19 tons. The tips were provided with coal-shoots, anti-breakage cranes, boxes, &c. The shoot was tapered towards the point to check the sliding of the coal, and had a single door across near the end for regulating the same. In the bottom plate of each shoot were two iron bar screens for separating the small coal when required. On the underside of the shoots, immediately below the screens, were hinged doors to allow of single-screening, double-screening, or the passage of the coal unscreened. At one of the high-level tips 400 tons had been shipped in one hour in the ordinary course of working.

The tips on the low level differed from those on the high level, insomuch that waggons were received into the hoists at quay level, and the empty waggons were returned from the tip at the same level. The waggon had thus to be lifted the required height for tipping. A movable tip was in course of construction for the high-level, which would run on rails along the quay for a distance of about 50ft. each side of the centre of approach, and could be used in connection with a fixed tip. The tip was moved by a hydraulic engine geared to the travelling wheels. There was also a movable tip in course of construction for the low level. The passage was crossed by a rolling bridge, worked by hydraulic power, carrying a single line of railway and forming part of a roadway. There were eleven movable cranes, capable of lifting from 30 cwt. to 4 tons, for loading and discharging cargoes of vessels lying along the quay wall and against the timber jetties at the east end of the dock. The cranes were of the elevated type, and constructed on a pedestal of wrought-iron plate, with an arch underneath for the waggons to pass while the cranes were at work. The dock and sidings were lighted by electric light. The engineers of the dock works were Mr. John Wolfe Barry, Mr. T. Forster Brown, and Mr. H. M. Brunel. The author was the resident engineer.

SHIPBUILDING NOTES.

ON the 5th inst. the s.s. "Clyde," a vessel of 5,650 tons, was launched by Messrs. Robert Napier & Sons, Govan. This vessel is one of four which the same builders have built for the Royal Mail Steam Packet Company, London, to be employed in the service of this company in the West Indian, Brazil, and River Plate trade. The triple expansion engines are of 7,000 horse power. The dimensions of the vessel are:—Length, 456ft.; breadth, 50ft.; and depth, 33ft. 4in. The ship has been built with a view to meet the requirements of the Admiralty as an armed cruiser. There is accommodation in all for 1,000 passengers. The ship is fitted throughout with electric light, and heated throughout by steam.

ON the 5th inst., the steamship "Federal" was launched from the yard of Messrs. W. Doxford & Sons, of Pallion, Sunderland. She has been built to the order of John McIlwraith, Esq., of Melbourne. The principal dimensions are:—Length between poops, 290ft.; breadth, extreme, 40ft.; depth, moulded, 22ft.; and deadweight, 3,425 tons on 20ft. draught. The engines are of the triple-expansion type, the cylinders being 23in., 37in., 60in. in diameter, and the stroke 42in. She is fitted with steering gear amidships by Messrs. Amos & Smith, of Hull; 5 steam winches, with special coal drums, by Messrs. Welford Bros., of Pallion; special apparatus by Messrs. Brown Bros., of Edinburgh, for the quick discharge of coal cargo, and a steam windlass by Messrs. Clarke, Chapman, & Co., of Gateshead.

ON the 7th inst. Messrs. Scott & Co., Greenock, launched the steel screw steamer "Priam" for the Ocean Steamship Company. The vessel is intended for the China trade. The dimensions are:—Length, 335ft.; breadth, 38½ft.; depth of hold, 27ft.; and tonnage, 2,800 tons.

ON the 7th inst. the s.s. "Brand" was launched by Messrs. Robert Duncan & Co., Port Glasgow. The length of the vessel is 270ft.; width, 37ft.; depth, 23ft.; and the net register tonnage, 2,000 tons. The ship has been built to the order of Mr. Kundsen, Porsgrund, Norway. Messrs. Muir & Houston are making the triple-expansion engines.

ON the 8th inst. Messrs. Fleming & Ferguson, shipbuilders and engineers, Paisley, launched a steel twin-screw steamer with overlapping propellers. The dimensions are:—Length, 220ft.; breadth, 31ft.; depth, 15ft. 6in. She is to be fitted by the builders with two sets of their patent quadruple expansion engines to work with boiler pressure at 200lb. per square inch, and to indicate 1,200 h.p. This vessel has been built to the order of Messrs. J. & A. Brown, New South Wales, for their Colonial trade. As she left the ways she was named the "Duckinfield."

Notices of Meetings.

THIS WEEK.

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Saturday, April 12th, at 5.45 p.m. Discussion on Mr. R. L. Weighton's paper on "The Institution's Rule for the Normal Indicated Horse-power of Marine Engines and Boilers"; Discussion on Mr. Bergström's paper on "The Structural Strength, &c., of Cargo Steamers of Different Types"; Paper on "The Weight of Machinery in the Mercantile Marine," by Mr. William Boyd.

THE JUNIOR ENGINEERING SOCIETY.—Saturday, April 12th. Visit to the Leyton Sewage Disposal Works. Meeting at the Town Hall, Leyton, at 4 p.m.

NEXT WEEK.

SOCIETY OF ENGINEERS.—Monday, April 14th. Paper to be read on "Weighing Machinery and Automatic Apparatus in Connection Therewith," by Mr. William Henry Brothers.

INSTITUTE OF MARINE ENGINEERS. Tuesday, April 15th, at 7.30 p.m. Paper on "Blowing Up the Old Dock Wall at the New Entrance, Royal Albert Dock," by Mr. Jos. Thomas; Paper on "Paddle Engines," by Mr. Buckwell.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, April 15th, at 8 p.m. Ordinary Meeting. Paper to be read: "The Application of Electricity to Welding, Stamping, and other Cognate Purposes," by Sir Frederick Bramwell.

ROYAL METEOROLOGICAL SOCIETY.—Wednesday, April 16th, at 7 p.m. Papers to be read: "The Cold Period at the Beginning of March, 1890," by Charles Harding, F.R.Met.Soc.; "Note on the Whirlwind which occurred at Fulford, near York, March 8th, 1890," by J. E. Clark, B.Sc., F.G.S.; "On the Possibility of Forecasting the Weather by Means of Monthly Averages," by Albert E. Watson, B.A., F.R.Met.Soc.; "Rainfall of the Globe," by W. B. Tripp, M.Inst.C.E., F.R.Met.Soc.

SOCIETY OF ARTS.—Wednesday, April 16th, at 8 p.m. "Old and New Fashions in Typography," by Talbot B. Reed.

ROYAL INSTITUTION OF GREAT BRITAIN.—Friday, April 18th, at 9 p.m. Sir Frederick Bramwell on "Welding by Electricity."

PRICES CURRENT, 9TH APRIL, 1890.

Quotations at per ton, unless otherwise specified.

METALS.

		£	s.	d.		£	s.	d.
Spelter: Ordinary		£22	10	0	to £22	15	0	
Copper: British Cakes and Ingots		54	0	0	„	55	0	0
„ Chili Bars, G.O.B.'s		47	17	6	„	48	5	0
„ Other sorts, G.M.B.'s (equal to Chili Bars)		47	17	6	„	48	5	0
„ Manufactured (strong)		61	0	0	„	.....		
Lead: Common Pig		13	12	6	„	13	15	0
„ English Sheet		14	2	6	„	14	5	0
Tin: Straits		89	15	0	„	90	5	0
„ Australian		90	0	0	„	90	10	0
„ English Ingots		95	0	0	„	.....		

Messrs. Carrick & Brockbank, Manchester, report as follows:—

COPPER: The Easter holidays interfered with business, buyers showing a general inclination to defer operating. In our last report on the 2nd Chili bars were quoted £47 12s. 6d. to £48 cash, but a firmer market on the 3rd caused prices to advance to £48 5s. to £48 12s. 6d. After the holidays these prices were maintained, but values declined to-day to £47 17s. 6d. to £48 5s., a small trade being reported. The demand for manufactured continues slack at £61 sheets, £64 bottoms.

TIN: Although the visible supply of tin for Europe has decreased over 700 tons during March, it has had no appreciable effect on prices. The business transacted is still unimportant, with quotations somewhat easier.

LEAD continues inactive, without alteration in price.

SPELTER keeps very quiet, and prices are rather easier.

PIG IRON.

Middlesbro' Warrants, No. 3	51/4½	Cash
Scotch Warrants, m/n	48/9	„
Hematite Warrants, m/n	57/6	„

Stocks in Stores { Scotch ..... 815,432. Middlesbro' 140,450. Hematite ... 364,231.

Exclusive of stocks in makers' yards.

	No. 1.		No. 3.		
Coltness	72/-	.....	65/6	f.o.t.	Glasgow.
Gartsherrie	69/6	.....	63/6	„	„
Langloan	73/-	.....	65/-	„	„
Summerlee	71/-	.....	65/-	„	„
Glengarnock	72.6	.....	66/-	„	„
G.M.B. ex Store	49/6	.....	49/-	„	„

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £	s.	d.		Best. £	s.	d.	
Middlesbro' Bars	7	0	0	.....	7	10	0	f.o.t. wks.
„ Angles	6	15	0	.....	7	5	0	„
„ Plates	7	0	0	.....	7	10	0	„
Staffordshire Bars (cheaper makes)	8	15	0	.....	9	5	0	London.
„ Angles	8	15	0	.....	9	5	0	„
Crown Sheets	8	10	0	.....	9	0	0	„
„ Hoops	8	2	6	.....	8	12	6	„
"Siemens-Martin" Steel Boiler Plates					9	10	0	„
„ Ship and Girder					8	10	0	„

Market dull.

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	77/-	..... 66/-

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

CHEMICALS.

		£	s.	d.		£	s.	d.
Acid: Carbolic Crystals	lb.	0	0	10½	to	0	1	0
„ „ Liquid	gal.	0	1	2	—	.....		
„ Citric	lb.	0	1	7	—	.....		
„ Oxalic	„	0	0	3½	—	.....		
„ Sulphuric	ton	1	12	0	—	.....		
„ Tartaric	lb.	0	1	4½	—	.....		
Alum: Lump (powder 10/- ex.)	ton	4	17	6	—	.....		
Ammonia: Carbonate	lb.	0	0	3½	—	.....		
„ Muriate (Grey)	ton	22	15	0	—	.....		
„ „ (White)	„	26	10	0	—	.....		
„ Sulphate	„	11	17	6	—	.....		
„ Liquor	lb.	0	0	3½	—	.....		
Antimony	ton	.....			—	.....		
Bleaching Powder	„	5	10	0	—	5	12	6
Bisulphide of Carbon	„	13	10	0	—	.....		
Borax	„	30	0	0	—	.....		
Benzole (90 %)	gal.	0	3	4	—	.....		
„ (50/90 %)	„	0	2	5	—	.....		
Copper Sulphate	ton	26	10	0	—	27	0	0
Copperas	„	2	0	0	—	.....		
Kieserit	„	.....			—	.....		
Lead: Nitrate	„	22	10	0	—	.....		
„ White Sugar	„	24	0	0	—	.....		
„ Brown „	„	19	0	0	—	.....		
Potash: Bichromate	lb.	0	0	4	—	.....		
„ Caustic	ton	22	0	0	—	.....		
„ Carbonate	„	19	10	0	—	.....		
„ Chlorate	lb.	0	0	5	—	.....		
„ Prussiate (Yellow)	„	0	0	9½	—	.....		
„ Sulphate (Basis 90 %)	ton	9	10	0	—	.....		
Precipitate: Red	lb.	0	3	1	—	.....		
„ White	„	0	3	2	—	.....		
Salts: Epsom {Bags	ton	3	0	0	—	.....		
Salts: Epsom {Casks	„	3	15	0	—	.....		
„ Glauber	„	1	10	0	—	.....		
Sulphur: Sublimed Flowers	„	9	0	0	—	.....		
„ Recovered	„	4	10	0	—	.....		
Soda: Ash	deg.	0	0	1¼	—	.....		
„ Caustic (White 70%)	ton	11	0	0	—	11	10	0
„ „ („ 60%)	„	10	0	0	—	10	10	0
„ „ (Cream 60%)	„	9	10	0	—	10	0	0
„ Crystals	„	3	0	0	—	.....		
„ Bicarbonate	„	5	15	0	—	.....		
„ Hyposulphite	„	6	5	0	—	.....		
Solvent Naphtha	gal.	0	4	0	—	.....		
Tartar, Cream of	cwt.	5	12	6	—	.....		
Zinc Sulphate	ton	7	10	0	—	.....		

Messrs. S. W. Royse & Co., Manchester, report as follows:—

CHEMICALS: With the intervention of the Easter holidays since our last there is little of interest to report. Soda ash holds its strong position, and soda crystals are very firm, but caustic soda is somewhat easier. For other chemicals there is only a moderate inquiry, and prices are unchanged.

OILS.

		£	s.	d.
Cocoanut: Cochin	per tun	28	10	0
„ Ceylon	„	25	5	0
Cottonseed	„	22	5	0
Cod	„	21	0	0
Lard	„	37	0	0
Linseed	„	23	0	0
Palm, Lagos	„	24	10	0
Rapeseed: English	„	32	5	0
Seal: Pale	„	28	0	0
„ Brown	„	22	0	0
Sperm	„	46	0	0
Whale	„	24	0	0
Turpentine	per cwt.	1	10	3
Coal	per gal.			
Petroleum (Refined)	„	0	0	5½
„ Spirit	„			

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HOME INDUSTRIES.

LONDON, 10th April, 1890.

The Money Market.—Though at the beginning of the week there was an active demand for money for the repayment of the loans obtained from the Bank of England in the two preceding weeks, money has now become easier. The position is favourable. Gold is coming in plentifully from abroad, and the Consol and other dividends, which have been distributed slightly later than usual through the incidence of Easter, will soon drift back to Lombard Street for employment. Discount rates are easy in view of this. The stock markets have hardly thrown off the holiday influence yet, but, though business is limited, prices are good. Home railways are firm on holiday traffics. Foreign securities are generally good. Egyptians are rising on the renewal of the conversion question, and other international stocks are firm. Argentines have had another severe fall, the gold premium at Buenos Ayres continuing to rise. The American railway market is dull and featureless in spite of New York support. Nitrate securities still fluctuate rather wildly. South African gold shares show a continued disposition to recover. Miscellaneous and industrial shares are inactive.

Companies.—The following companies have been registered since our last report:—The Idaho Syndicate, Ld., with a capital of £500, to investigate the merits of the Idaho Mining and Irrigation Co.; The London Tinplate Co., Ld., with a capital of £50,000; The Greta Collieries, Ld., with a capital of £200,000; The International Exploration Co., Ld., with a capital of £20,100; Penarth Slate and Building Material Supply Co., Ld., with a capital of £5,000; The New England Breweries Co., Ld., with a capital of £410,000; Ottoman Paper Manufacturing Co., Ld., with a capital of £325,000; South of England Coal-Boring Syndicate, Ld., with a capital of £2,000; The Netherseal Colliery Co., Ld., with a capital of £32,000; The Kelsterton Brewery Co., Ld., with a capital of £100,000; Lorillard Brickworks, Ld., with a capital of £400,000; The African Estates Agency, Ld., with a capital of £25,100, to acquire claims, mines, &c.; The International Exhibition of Mining and Metallurgy; Newcastle (Natal) Collieries and Estate Co., Ld., with a capital of £100,000; Brod Brewery Co., Ld., with a capital of £10,000.

Workmen's Exhibition.—There was opened, on Saturday, at the Central Hall, Holborn, a Workmen's Exhibition, which had been promoted by the Club and Institute Union, and which closed yesterday. There had been a flourish of trumpets over the inauguration of this movement, and on the face of it the idea was a good one. The promise was, however, not fulfilled, and though there was a fair number of exhibits, there was little calling for attention beyond some cabinet work and art exhibits, the latter of various qualities.

Exhibition Lighting.—The Military Exhibition at Chelsea will be lighted by Messrs. Davey, Paxman, & Co., and the French Exhibition at Earl's Court by the Gülcher Company.

Slippery Pavements.—At a meeting of the Society of Arts, on the 27th ult., it was mentioned that Mr. J. Compton Merryweather, of Long Acre, has recently taken out a patent for a pavement, according to which he inserts lead plugs or strips in paving to render it less slippery.

The Institution of Mechanical Engineers.—A meeting of this Institution will be held on Thursday and Friday evenings, the 1st and 2nd prox., at the rooms of the Institution of Civil Engineers, Great George Street, Westminster. On Thursday evening, the President, Mr. Joseph Tomlinson, will deliver his inaugural address, and then the following paper will be read:—"Research Committee on Marine Engine Trials' Report upon Trials of three Steamers, 'Fusi Yama,' 'Colchester,' 'Tartar,'" by Professor A. B. W. Kennedy, the discussion upon which will be continued on Friday evening.

The Royal Institution.—According to the present arrangements for afternoon lectures, the Hon. George C. Brodrick will begin a course of three lectures, on "The Place of Oxford University in English History," on Tuesday, the 15th; Professor C. V. Boys will begin a course of three lectures, on "The Heat of the Moon and Stars," on Thursday, the 17th; and Captain Abney will begin a course of three lectures, on "Colour and its Chemical Action," on Saturday, the 19th. The evening meetings will be resumed on Friday, the 18th, when Sir Frederick Bramwell, Bart., will give a discourse on "Welding by Electricity."

Macmahon's Electric Check System.—A new electric check apparatus for use where liquors are sold is being introduced into this country by Macmahon's Patent Electric Check System, Limited, 1, Imperial Buildings, Ludgate Circus. The apparatus is meant for measuring the amount of liquor served at the bar, and for checking and recording the sales and receipts. The amount served depends on the position of a knob, and by means of a series of electric contacts the amount is recorded on a pointer and dial. For each pennyworth of liquor served a distinct contact is made, and the current which then passes is made to excite an electromagnet and thus turn a ratchet wheel through one notch. In this way the total amount of liquor served is checked.

Change of Address.—Messrs. E. L. Berry & Co., late of 8, Wardour Street, electrical engineers and contractors, have removed to temporary premises, 45, Gerrard Street, Wardour Street, until the completion of their new premises.

MANCHESTER, 10th April, 1890.

The Merchandise Marks Bill.—The Bill promoted in Parliament by Mr. Broadhurst, and supported by several other members, is likely to meet with strenuous opposition from the mercantile community here. One of its provisions declares that all pieces of cloth made in England shall be stamped with the name of the manufacturer and the town in which his works are situated. This, it is clear, would seriously damage the trade of the merchants; in many cases, indeed, it would practically close it. The Bill provides that the same mark shall be re-stamped on the cloth after its erasure in the processes of dyeing, bleaching, or printing. This action would be so detrimental to the trade of the district as practically to necessitate it being remodelled. It would not prevent fraud, but would simply throw into the hands of manufacturers a power which would enable them to reap the benefit of the labour and expenditure of the merchants in building up their extensive foreign business. The Manchester Chamber of Commerce is pledged to opposition, except to one clause appointing a Public Prosecutor under the Act, which it supports.

The Iron Trade.—The Easter holidays have somewhat disorganised the market, but there is no sign of any improvement in the demand. In the face of the continual depression in the price of warrants, users do not appear to care to come into the market, and there is in addition a decided lull in the volume of orders coming forward for engineering material. These two causes are making consumers in this market very chary about entering into new obligations, and an opinion is being expressed that an improvement is hardly likely to occur during the summer months. The quarterly meetings to be held this week are expected to result in a drop in the quotations for finished iron, the price of which has been much cut by middle holders, although makers still profess themselves indifferent to new business except at full rates. There is, however, not sufficient weight of work being offered in any department to test prices seriously, and all quotations are practically nominal.

The Manchester Technical School.—A small exhibition of the work of students has been held at the above school during this week. The work in the wood-working department shows promise, some of the articles being well and efficiently made. It cannot be said that anything more than promise is shown generally, but the work of different students is very even in quality. In the art designs shown there are some clever specimens, and a noticeable feature about one or two of them is the skill shown in adapting the design to the class of material and manner in which it is to be worked out. This is a point often lost sight of in decorative designs, and it is the more noteworthy in this case because of the necessary limitations of the school. Without showing any wide departure from the conventional style of design in all cases, there are several specimens of original work which have the merit of being carefully thought out. On the whole, the exhibition is distinctly creditable, and gives great promise of better things when the school possesses greater facilities.

The Linen and Jute Trades.—Attention is now principally centred in fancy goods, and heavy makes generally are dull. Linens are in very poor demand, the only cheerful outlook being for shirting and fronting descriptions, which promise to move off more freely in the course of a week or so. On Tuesday there was a rush both of travellers and orders in some departments, and until we have recovered from the effects of the holidays it will be difficult to gauge with any degree of exactitude the character of the demand. The only cheerful feature at the moment is that American buyers are now looking round the market preparatory to placing their orders, and it is anticipated that, in view of the threatened advances in the United States tariff, houses on the other side will import to a more than average extent. The object of the contemplated legislation is a mystery to every one, as the United States have no linen industry to protect, and higher duties can therefore benefit no special class, while, on the other hand, they impose an additional burden on the nation at large. Certainly this country will not be called upon to bear the extra cost of increased duties, as there is no home competition to contend with. Shipments to the South American republics still continue to be of an unsatisfactory nature, owing to fiscal complications amongst our customers in that region. Sheetings, drills, and other makes are quiet. There is no change in towels, and in fact the whole of the home trade may be described as featureless, while the shipping demand nowhere displays signs of activity.

GLASGOW, 10th April, 1890.

Holidays.—The coincidence of the Easter holidays with the Glasgow spring holiday caused a cessation of business for at least three days. The works were closed only on Monday, but the Bank holidays on Good Friday and on Monday put a stop to business from Thursday till Tuesday. The number of excursionists who left the city on the spring holiday was larger than ever before. All of the railway stations were taxed to their utmost capacity, and old rolling stock was called extensively into requisition. On Tuesday there was little business doing on any of the Exchanges.

Engineering.—The phenomenal success in floating two engineering concerns as limited liability companies quite recently has encouraged several other local firms to adopt the same mode of carrying on their business. Among these are mentioned the Anderston Foundry, and the well-known engineering firm of Messrs. Duncan Stewart & Co.

Shipbuilding.—The elevating ferry steamer being built for the Clyde Trust by Messrs. W. Simons & Co., Renfrew, will shortly be launched. It will, however, be some time ere the necessary preparations for the reception of the steamer are completed at the harbour.

Scottish Railways.—It is reported that the North British Railway Company has acquired all of the shares of the Galloway Steam Packet Company, Leith, saving a single holding, and that henceforward the steamboats plying on the Forth will be run in connection with the North British Railway.—The Forth Bridge is apparently as great an attraction to the tourist as ever. Monday being a holiday in Glasgow and Edinburgh, thousands of people made their way to Queensferry by rail and brake.—The Edinburgh Corporation has finally decided to oppose the Bill of the Caledonian Railway, by which it seeks powers for the construction of an underground railway in Edinburgh.

Coal.—Continental advices confirm the anticipation of a few weeks ago that coal, instead of going up, was tending downwards.

(From our own Correspondents.)

LIVERPOOL, 9th April, 1890.

The Late Dock Strike.—Work along the whole line of docks has assumed its normal condition, and there are no visible signs of the late struggle; a large proportion of the old hands have resumed work, and the imported hands have returned to their homes. The families of the strikers are, however, still suffering from their recent hardships, and much is now being done to relieve their sufferings, subscriptions for large amounts arriving daily from all parts of the country. An unfortunate difference has occurred between the stevedores and the men as to the number of hours to be worked at night in a few of the docks, but this will, no doubt, be amicably settled.

Engineering and Shipbuilding.—Most of the shops and yards on both sides of the river continue to be very busy, and although the Easter holidays are generally taken advantage of to overhaul the machinery and plant, and effect any necessary repairs, many of the shops were this year compelled to work through the holidays on account of pressure of work. The weather being exceptionally fine, the city was thronged with excursionists, and the traffic on all the river boats, and the Mersey and Wirral Railways, was enormous.

LEEDS, 9th April, 1890.

The Iron and Steel Trades.—An extensive amount of business was done in the three months just ended, but the second quarter of the year opens rather quietly, causing a little anxiety as to the future. The depression is greater than was anticipated, and there is no doubt that until a change takes place both the Scotch and English iron markets will be watched with interest by local manufacturers. There is great scarcity of fresh orders, both in the manufactured iron and steel trades; producers in nearly all cases are working out their orders taken last year, and do not get in new work, consumers being evidently waiting for prices to come down. Were it not for old contracts some of the makers would be in a difficulty about giving full employment to their workpeople. Overtime is now the exception, instead of the rule. Orders are not coming forward freely at the engineering works, yet here again the men are well employed, the Amalgamated Society of Engineers in Leeds having very few unemployed men on its books. The agricultural machinery trade remains quiet, there practically being no new business coming to hand. Machine tool makers are still very active. The unsettled state of the pig iron market has caused a considerable falling off in the demand for cut steel and iron nails, though the prices are remarkably firm. It is rumoured that the engineers of the district are going in for an advance of 2s. per week in their wages.

The Coal Trade.—The demand for all kinds of fuel is only moderate, the reason being that many manufacturers and householders obtained extra supplies in anticipation of the recent strike. All the Yorkshire pits are again at work with one exception. The Yorkshire miners, speaking generally, have passed resolutions thanking the National Federation of Miners for securing the advance of 40 per cent. in wages, and approving of the Eight Hours Bill.

SHEFFIELD, 9th April, 1890.

The Coal and Coke Trades.—Manufacturing fuel of all kinds has advanced from 6d. to 1s. per ton during the past week, owing to the extra 5 per cent. given to the colliers. There has been no further advance in house coal, and consumers are using as little as possible, owing to the present high rates; 17s. is a high price to pay for coal almost on the pit banks. Coke of all kinds still holds a good position in the market, and prices are firm at recent quotations; 28s. per ton for coke of best quality is now paid here. There is an opening for a simple and effective coke-washing apparatus capable of being worked by a labourer, and adapted to deal with the ashes from boiler-furnaces.

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THE IRON AND STEEL TRADES.—The rolling mills continue to find plenty of work to keep them employed continuously night and day. In order to reduce the cost of reheating ingots, some of the more energetic mill owners are considering the question of employing more economical types of furnace. A very difficult section of tram rail made in hard steel is being rolled here, to the order of a Continental house. The heavy trades, such as armour plates and shaft forging, are at present fairly off for work. Steel castings are also in good demand. In smaller wares, such as mining tools, agricultural implements, castings, forgings, &c., the workmen are fully employed. Files of all classes are in excellent demand, not alone for the home market, but also for export to the Continent. France, Germany, and Italy are all good customers. Germany continues to be a good customer for file-cutting machines. One firm here have supplied a single house in Germany with more file cutters of their own make than are to be found in all this district, all of the very latest pattern and best construction. Engineers have had their hands full to get their repairs done in time for restarting after the holidays.

SHEFFIELD SOCIETY OF ENGINEERS.—On Saturday evening a paper was read before this Society by Mr. B. H. Thwaite, of Liverpool, on "The Development of the Open-Hearth Steel Furnace." Mr. Thwaite commenced by giving a historic outline of the manufacture of steel, followed by a brief summary of the chemical and thermic principles underlying the open-hearth process. He dealt with the origin and rationale of the recuperative principle, the structural development of the open-hearth steel furnace, the thermic efficiency of the furnace, the production and application of gaseous fuel, the structural and mechanical agents of the furnace, and the latest form of acid and basic furnaces. The lecture was practically illustrated by a model of a basic open-hearth furnace, sent by Mr. James Riley, of the Steel Company of Scotland, showing his neutral course for dividing the lime from the acid part of the furnace. Mr. Riley also sent a number of samples showing the change in the chemical and physical samples of steel and slag taken each hour from the bath. Some exceilent samples of steel were sent by Sir B. Baker, showing the sort of material used in constructing the Forth Bridge. Mr. Percy Gilchrist forwarded samples of open-hearth steel, showing the entire process of open-hearth steel production. Mr. Gilchrist sent some of the best samples of refractory bricks to be found in this country. Mr. Le Neve Foster, of Bolckow, Vaughan, & Co., Middlesbrough, sent a working model of his reversible gas valve.

NORTH STAFFORDSHIRE, 9TH APRIL, 1890.

THE EASTER HOLIDAYS.—Manufacturers are taking advantage of the Easter holidays for general repairs, and the whole of the ironworks in the district are standing idle. Blast furnaces have to be kept going, and colliery managers have some difficulty in keeping up the needful supplies. The collieries do not start till to-day, and a number of men are absent the whole of the week. The potters, in many cases, close their works till Monday next.

THE IRON TRADE.—Considerable anxiety is experienced as to the course of trade at the local quarterly meeting which has been called for to-day and at the meeting at Birmingham on Thursday. It is feared that prices will show further signs of weakness. It is understood that a prominent local firm of ironmasters is in difficulties, and about to call a meeting of its creditors, speculations in pig iron having turned out adversely owing to the heavy fall in values.

THE COAL TRADE.—It is difficult to see how the second instalment of 5 per cent. advance in wages is to be forthcoming on the 1st of August, as prices of all classes of manufacturing fuel are declining rapidly, and colliery proprietors will soon find that selling prices are actually below the cost of production, which has already been enhanced to the extent of 35 per cent. for labour, and to nearly an equal extent for stores, &c.

CARDIFF 9TH APRIL, 1890.

GENERAL TRADE.—Business during the holiday season has been entirely suspended, and there is nothing of importance to record. Inquiries for steam coal have been numerous, but until colliery owners can exactly estimate the loss of output, they are not disposed to make binding offers. Quotations remain firm at last week's figures. Arrivals of pitwood and iron ore have been heavy, and considerable detention has resulted from the small amount of work done by the discharging workmen. Rubio ore is quoted at 16s. 3d. to 16s. 9d. c.i.f. Cardiff and Newport.

BARROW-IN-FURNESS, 9TH APRIL, 1890.

HEMATITE IRON.—There is a rather better tone in the hematite market, although the business doing has not increased. Prices are a shade firmer, hematite warrants being at 59s. 6d. per ton. Makers are asking 70s. for mixed Bessemer numbers, and 69s. for No. 3 forge and foundry iron, and they cannot produce iron at lower prices. A further reduction in warrant stocks has been made to the extent of over 2,000 tons. The output of pig iron is not only being reduced by the blowing out of furnaces, but by transferring two of the furnaces from hematite to spiegeleisen blast. It is probable that makers will further reduce the output of their works, as there is a mutual understanding among them of the necessity of combined efforts.

STEEL.—There is a better inquiry in the steel trade, but the business which has lately been done is not on a large scale, although prices are lower. Heavy sections of rails have gone down to £5 10s. per ton; light rails are at £5 15s., and colliery rails are firm at £8 per ton. There has also been a decline in the value of steel ship plates, which are quoted now at £7 10s., and angles at £7 per ton. Steel boiler plates are in brisk inquiry at £8 10s. There is a better demand for tinplate bars at £6 10s. per ton. It will be necessary for makers to book some orders soon, even at low prices, if they are to keep their works fully employed.

SHIPBUILDING AND ENGINEERING.—No new orders are reported in the shipbuilding and engineering trades, which are, however, very briskly employed. It is believed that with cheaper material shipowners would be disposed to place some large orders which were withheld some time ago in consequence of the heavy cost of tonnage.

IRON ORE.—There is a weaker tone in the hematite iron ore trade, and prices are easier, at from 12s. 6d. to 16s. 6d. per ton net at mines.

COAL AND COKE.—There is an easier tone in coal and coke, and as these are the conditions necessary for making cheaper iron, there is some hope of relieving the present crisis, in which makers find themselves undersold to the extent of fully 10s. per ton.

MIDDLESBROUGH, 9TH APRIL, 1890.

PIG IRON.—The quarterly meeting of the North of England iron trade was held yesterday on 'Change, but there was a very small attendance. The holidays have been taken advantage of, seeing that business was so very quiet. The price of pig iron, however, did not suffer, for it had advanced 2s. 6d. since the previous weekly market day, and eventually reached 53s. This was on account of the heavy drain upon public stores and the increasing shipments. In hematite, on the contrary, there was a heavy fall. Hematite pigs, though quoted at 70s., can now be had at 59s. This has caused the firm which owns the Linthorpe Iron Works to announce their intention of damping down two furnaces, as the iron cannot be made for the selling price.

IRONMASTERS' RETURNS.—The returns announce that the make of pig iron for the month of March amounted to 244,889 tons, as against 221,517 tons in February, being an increase of 23,372 tons. In Cleveland iron only—that is, not including hematite, basic, and spiegel—the make for March amounted to 116,726 tons. The disposal of the iron made was as follows:—57,060 tons were shipped from Middlesbrough; 64,673 tons were consumed locally or sent off by rail; making a total of 121,733 tons. On the 28th of February the total stocks stood at 279,029 tons, and on the 31st of March at 274,022 tons, showing a decrease of 5,007 tons over the month.

MANUFACTURED IRON AND STEEL.—Most of the public works are closed for the holidays, and are not likely to be reopened this week. There is a dulness in both the iron and steel trades, and it is being felt more and more as the season goes on. Few new orders are coming in, and there are fewer inquiries than is usual at this season of the year. Prices remain much the same as usual. Iron ship plates are at £6 12s. 6d.; angles, £6 12s. 6d.; bars, £6 15s. per ton. Steel ship plates, £7 12s. 6d.; angles, £7 12s. 6d.; rails, £5 17s. 6d. per ton, all less the usual discount.

SHIPMENTS OF PIG IRON.—The shipments since the beginning of April have been very good, averaging upwards of 4,000 tons daily. As shippers prefer warrants, they are drawing from the public stores heavily. Connal's stores have probably never before been so much run upon. The shipments, however, are not yet up those of this time last year.

SUNDERLAND, 9TH APRIL, 1890.

SHIPBUILDING AND ENGINEERING.—Work is now being resumed after the Easter holidays. While there is still a time of general activity in store for these industries, there is a growing feeling that there will soon be comparative quietude. Possibly the output for the year 1890 may exceed that of 1889 at this port; at all events, the results of the first quarter point in that direction, twenty vessels of 45,881 tons having been launched up to March 31st, 1890, as against the same number of vessels of 41,511 tons in the corresponding period of last year. But new contracts are not booked in anything like the same proportion that vessels are completed; in fact, it is doubtful if two orders have been booked on the river during the quarter. Amongst the noteworthy orders in course of execution is one for a mail and passenger steamer for a French company at Marseilles, to carry 1,400 to 1,500 emigrants, besides first and second class passengers. This vessel is being built by the Sunderland Shipbuilding Company, Limited, and is to attain a speed of 14½ knots.

SHIPPING.—The prospects of the freight market are far from bright. Vessels are being sent out to the United States in ballast owing to the unremunerative character of outward rates. Homewards the market is firm, but in all other quarters, as compared with the corresponding period of last year, there is a falling off; this, combined with heavier working expenses owing to dearer bunker coals, is seriously affecting shipping. Possibly a good harvest in South Russia will yet cause a boom in the freight market, but as yet rates from the Black Sea are far from satisfactory. The demand for coals does not now appear to be so great, owing to the mild winter. During the past week 72,421 tons of coal were shipped as against 70,355 tons, 68,540 tons, 84,257 tons, 65,231 tons, and 78,647 tons in the immediately preceding weeks; 48,126 tons were shipped coastwise, and 24,235 tons to foreign ports. Other coastwise shipments included 250 tons of patent fuel, 170 tons of cement, 135 tons of bricks, 130 tons of steel plates, 76 tons of lime, 53 tons of crystals, and 15,000 dozen glass bottles. The imports for the week comprised nine cargoes of timber and 42,417 sacks of wheat.

NEWCASTLE, 9TH APRIL, 1890.

THE EASTER HOLIDAYS.—In most of the industrial establishments work was suspended on Thursday, April 3rd, for the Easter holidays, and a resumption does not take place till to-day or to-morrow. According to an arrangement entered into in connection with the settlement of the "12 o'clock Saturday" question, the holiday periods in future are to be restricted in length, but this arrangement does not come into effect till Whitsuntide, and it is doubtful that even then it will be carried out with strict exactitude. The inconvenience and loss resulting from prolonged holiday periods have frequently been pointed out in *Industries*, and it is to be hoped, now that the employers have come to a definite understanding with the workmen for an abatement of the evil, that they will insist upon the latter fulfilling their part of the compact.

ENGINEERING.—The constructive department of the North Eastern Railway Company at Gateshead is at present unusually busy, and a number of additional hands have been taken on. The principal work in hand consists of a set of ten locomotive engines of a larger and more powerful type than any which have hitherto been constructed for the company's service, and they are designed for the attainment of a higher rate of speed than has yet been attempted. It is estimated that each of these engines, with its tender and accessories complete, will weigh about 80 tons. It may be stated here that the constructive establishments of the North Eastern Railway Company at other centres are also exceedingly busy just now.

GLASSWORKS AND POTTERIES.—In these classes of manufacturing establishments business has been somewhat dull for some weeks past, and in several instances the operatives have been put on short time. It is not likely that any considerable change for the better will take place before Midsummer, when orders in connection with the fruit-preserving trade may be looked for.

THE COAL TRADE.—The mild weather which has lately been experienced has caused a lessened demand for household coals, and the falling off has not been compensated for by any improvement in the demand for other qualities. The pits throughout the district are laid in during the holiday period, and the stoppage will, of course, cause a diminution of stocks. The shipments of coal and coke at Tyne Dock during the week ending the 5th inst. amounted to 88,155 tons, being a decrease as compared with the shipments for the corresponding week last year of 4,644 tons.

THE CARRIAGE TAX.—It is gratifying to hear that the Coachmakers' Company have recognised the efforts which were successfully made by Mr. John Philipson, the well-known coachbuilder, of Newcastle, to obtain a modification of the carriage tax. The other day they sent him an official address thanking him for his labours. It appears that Mr. Philipson spent nearly £500 in prosecuting the agitation for an all-round 15s. tax for public carriages, great and small, and a testimonial is being raised to defray these expenses. Mr. E. Rogers, carriage manufacturer, Bristol, is treasurer of the fund.

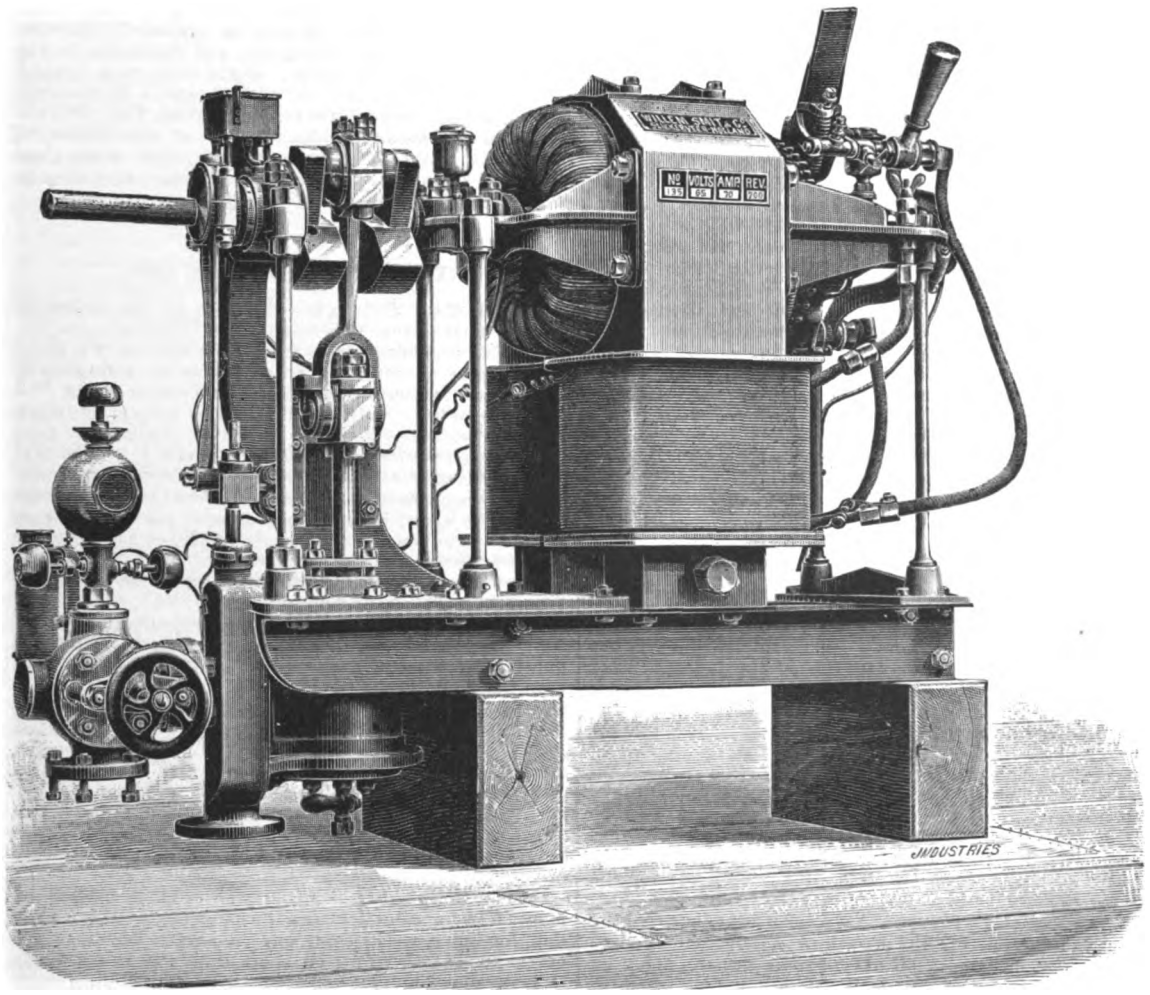
DUNDEE, 9TH APRIL, 1890.

JUTE AND FLAX TRADES.—Business has been interrupted owing to the holidays. There has been little change in the position of the staple industries of the district during the past fortnight. Jute of good quality in dock lots is selling at high prices, but there is hardly anything doing on contract. Jute yarns are inactive, but prices of fine spins are decidedly firm. There is a fair demand for jute goods, and manufacturers being well employed quotations are maintained. Very little business is passing in flax, either on spot or for shipment. There is more inquiry for flax yarns. The home demand for linens is good, inquiries coming in pretty freely. On shipping account there is as yet little movement. The proposed changes in the United States tariff are attracting attention here, and it is feared that if the new rates are adopted the local trade will be injuriously affected. The most important change is the proposed removal of the 20 per cent. *ad valorem* duty on raw jute. It is believed that the result of this change would be to stimulate the jute manufacturers of the States. Should the proposed change be made we shall probably have a demand from our manufacturers for the imposition of an export duty on jute. The removal of the duty on the raw material will, if the jute interest on the other side has its way, be accompanied by an increase in the duty on manufactured articles, both linens and hessians.

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COMBINED ENGINE AND DYNAMO.

CONSTRUCTED BY MESSRS. WILLEM SMIT & CO., SLIKKERVEER, HOLLAND.



BREAKDOWN OF THE "CITY OF PARIS."

THE accident which has befallen the "City of Paris" is a matter which requires the careful attention of all interested in shipbuilding and naval architecture, for, however important it may be to the owners or the builders of the ship, it is of much greater importance to the travelling and trading public, and it should be used to extract lessons for guidance in the future. No doubt a complete investigation will be made into the whole circumstances of the case, but, in the meantime, it may be well to note some of the points in connection with it. As to the facts, so far as they are known, we have, in the first place, the official report of the captain, which we gave in our last week's issue. His short report has been amplified by letters from passengers, but these contain little information which will be of use in arriving at a conclusion as to the cause of the accident, but they all testify to the excellent behaviour of the crew and all on board. Fortunately the weather was fine, and by hard work the crew and passengers were able to keep the water under.

The cause of the accident must in the meantime be a matter of speculation. What occurred to marine engineers was that it was due to water having collected in the cylinders, and to the piston having come down as upon a solid block upon the confined liquid, and smashed out the bottom of the cylinder, and caused damage to the side of the ship by breaking injection and water pipe connection, and, at the same time, injuring the bulkhead. The examination which was made of the ship after its arrival at Queenstown proved that the inflow of water was altogether due to the destruction of the injection pipes. The divers found that it was quite feasible to plug these, and a large quantity of the water was pumped out, and the ship was soon at her usual draught. The port engine was found to be in good working order.

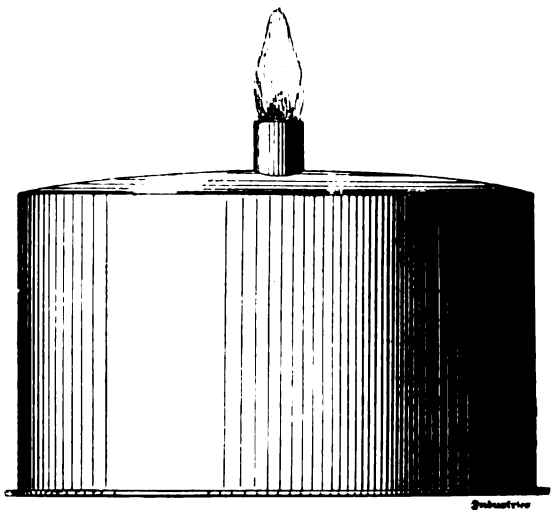
Whatever doubt there may be as to the cause of the accident, there can be none as to what saved the ship from sinking almost instantly. It had fourteen bulkheads, which thus divided it into fifteen portions, any one of which might be filled with water, while the other compartments would be perfectly safe so long as the bulkheads remained intact. When the engines gave way the longitudinal bulkhead between the engine rooms was damaged, so that both sets of engines were disabled, but notwithstanding this the ship drifted about for three days with more than 2,000 tons of water in these two compartments before help came to her. The first lesson, then, which the disaster teaches is the necessity of having a sufficient number of sufficiently strong bulkheads, both longitudinal and transverse, in every ocean-going passenger steamer, as to practically make her unsinkable. Lloyd's Register Committee have done good service in directing more attention to bulkheads, both as regards number and strength, and especially to those bounding the engine spaces. The fact that the longitudinal bulkhead between the engine rooms gave way practically nullified, as regards safety, the advantages of having duplicate sets of engines. If one set could have been worked, the ship might have been safely brought into harbour without assistance of any kind. It is quite evident, now that the accident has directed attention to the subject of bulkheads, that regulations will be made more stringent regarding them. Mr. Plimsoll has taken up the matter, and he points out that watertight compartments in iron ships were once made compulsory by various Acts passed between 1846 and 1854, and that in 1862 all this legislation was swept away secretly and silently, not a word of explanation being given to the House of Commons to show what was being done. But he remarks that, fortunately for the nation, Lloyd's Register Committee refused classification to any ship the owner of which availed himself of this "dreadful liberty" to dispense with bulkheads, and the consequence is that the greater proportion of our iron ships have now four, five, or six bulkheads, according to their length.

The fact that the divers found that the holes could be plugged up seems to prove the advisability of such large ships as the "City of Paris" carrying a diver with proper diving dress, who could ascertain the actual state of the case, and might often save, not only anxiety, but expense.

Admiral Elliot writes to the *Times* to point out that the accident to the "City of Paris" brings into prominence the decision lately arrived at by the Board of Admiralty—to abandon entirely sail motive power, even for war vessels intended for long voyages in distant seas. He says it is almost a certainty that if the accident to the "City of Paris" had occurred in the Southern Atlantic or Pacific or Indian Ocean, and the ship had been drifted by currents out of the beaten track of steamers and in unfavourable weather, and possibly distant 1,000 or 2,000 miles, instead of only 200, from the land, she would never have been heard of; whereas a very moderate supply of sail power would have enabled her, especially in the locality of prevalent winds, to keep in the track of vessels, and probably reach the land. Admiral Elliot thinks that sail motive power, as an auxiliary to steam, might advantageously be abandoned in battle-ships and cruisers intended for European waters; but for distant voyages on the wide ocean the decision arrived at is wanting in precaution, and it is to be hoped that the recent disaster may cause more prudent counsels to prevail at Whitehall. The same remarks also apply to merchant ships. The Board of Trade is now directing special attention to life-saving appliances, such as life boats and belts; and while this is quite proper, it ought also to insist, as far as it can, on arrangements being made which would make these almost entirely unnecessary.

THE "DEVONSHIRE" EVERLASTING CANDLE.

THE accompanying illustration represents one form of a new, ingenious, and inexpensive lamp which is being introduced by Mr. Devonshire, of 243, Pentonville Road, London, N. These lamps are suitable for night lights, fire lighters, portable stoves for cooking purposes for picnic parties, &c. They can be made in any form with any number of burners, whilst for simplicity of construction, entire absence of movable parts, and freedom from danger, they would certainly appear to supply a long-felt want. Each lamp consists of an outer casing



of metal, glass, or other material, with a perforated bottom, and almost completely filled with a porous earthy material, which the inventor terms "Egyptian clay," which absorbs the oil, and above this is placed an indestructible wick composed of a mixture of slag wool and asbestos fibre. To charge the lamp it is merely necessary to place it on a saucer or plate containing oil, which will be absorbed by the porous material inside. This charge will be sufficient, we are informed, to last a lamp of the same size as our illustration for sixteen hours. It is claimed that these lamps are much cheaper than composite candles, while giving an equal light.

THE SMIT COMBINED ENGINE AND DYNAMO.

MESSRS. SMIT, of Slikkerveer, Holland, have brought out a neat combination engine and dynamo lighting an arc light projector at sea. It is designed with a view of having as little weight as possible. The output is 65 volts and 70 amperes, as required for the Dutch Navy's torpedo boat "Cerberus." In order to reduce the weight to the lowest possible limit, as demanded by the naval authorities, Messrs. Smit have used an open engine instead of the closed-in type, and thus have sacrificed efficiency, durability, and freedom from breakdown. The armature is Gramme wound with 3·5mm. wire. The speed is 450 revolutions per minute, and is controlled by an electromagnetic governor interposed in the shunt circuit.

The engine has 4in. cylinder, by 5in. stroke, and works with 100lb. to 150lb. pressure of steam. The engine and dynamo together weigh 840lb., and the 20in. projector to match weighs 520lb., or 1,360lb. total weight. The outside dimensions are 3ft. 9in. long, 2ft. 6in. high, and 1ft. 5½in. broad.

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As we go to press early with certain of our advertisement pages, all Alterations to Standing Advertisements should reach the Publisher not later than 2 o'clock on Wednesday afternoon in each week.

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

Contents.

	PAGE
Gripper Platen Printing Machine (*Illus.*)	337
The Manufacture of Basic Pig Iron	337
The Institution of Naval Architects (*Illus.*)	338
Foreign Industries (Corres.)	342-343
Radial Drilling Machine (*Illus.*)	344
The Institution of Civil Engineers	344
Shipbuilding Notes	345
Notices of Meetings	345
Prices Current	345
Home Industries (Corres.)	346-347
Breakdown of the "City of Paris"	348
The "Devonshire" Everlasting Candle (*Illus.*)	348
The Smit Combined Engine and Dynamo (*Illus.*)	348
The Berlin Labour Conference	349
The Admiralty Dynamo Specifications	350
Architects' Registration Bill	351
Board of Trade Rules on Life Saving Appliances	351
Letters to the Editor:— Compressed Air Tramcars	351
The Institution of Marine Engineers	351
The Girard Hydraulic Railway (*Illus.*)	352
The Friction and Lubrication of Cylindrical Journals (*Illus.*)	353
The Central Electric Supply Stations of Paris	355
Notes on Alloys—III.	355
The Society of Chemical Industry	355
Notes	356
"Industries" Patent Record:— Applications and Acceptances	357-358
Illustrated Abridgments	358-360

To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

We cannot undertake to return manuscripts or drawings, and must request correspondents to keep copies.

BOUND VOLUMES OF Industries,

In half calf, gilt lettered, may be obtained at our London, Manchester, and Glasgow Offices, Price 20s. each.

Industries:

FRIDAY, 11TH APRIL, 1890.

THE BERLIN LABOUR CONFERENCE.

THE Congress, unique in its kind, convened by the German Emperor to deliberate concerning industrial reforms, has completed its work and delivered its report. We have described this Conference as unique, for never before have representatives of the peoples of Europe been called together in council by Imperial authority to discuss other than political questions. This new departure is, therefore, a remarkable event in the history of the present age. That it will be a memorable event—a landmark in the development of industry in the nineteenth century—none can doubt; for though its direct consequences may be of small importance, indirectly it will influence in a large degree the future of industrial life. Its chief claim to consideration at the present time lies in its being the beginning of a system of international control of labour which seems to have become a necessity of the times in which we live. We do not believe it practicable that any large amount of such control can ever be exercised. But the conditions of trade have become of such a nature that, to keep competition within reasonable limits, the labour question must be considered and provided for in wider relations than those of merely local convenience. Baron von Berlepsch speaks of the achievements of the Congress with wise moderation. He claims only to have found "a basis on which the thought of affording the working classes better protection, greater security for their material, physical, moral, and intellectual powers, may live on and be further developed." This basis is practically the state of things now prevailing in this country, and the development is, in reality, nothing more than the approximation of Continental to English practice. For what are the Resolutions but recommendations to adopt as a uniform system the laws and regulations by which English industrial life is now governed? This result would have been arrived at in a few years without the Conference. It was brought about in this country without any such official aids, and events abroad have for some time past been visibly tending in the same direction. But the Conference has hastened the current of events, and made that possible within the present century which otherwise might have required a much longer time for its accomplishment. Public attention has been directed thereby to the question, and public opinion has been influenced in its favour. The working classes have been greatly encouraged to press their claims for immediate satisfaction, and a wider scope has been given to their aspirations. And the Socialists, though in some respects checkmated thereby, have acquired fresh strength from the acknowledgment of the justice of some of their pretensions. These effects must all tend to promote the movement of reform now in progress.

Among the recommendations of the Conference a prominent place is given to the Council of Arbitration. This remedy for strikes—the only efficient remedy, it seems to us—has already been discussed in these columns. Our view is considerably at variance with that propounded in the official report of the proceedings at Berlin, for in the latter the Council is to be composed solely of employers and employed. We believe the presence of a third and disinterested party essential to the success of such an undertaking. This third party might be one of the law officers of the Crown or his representative. Moreover, the Conference would make the Council optional, a provision which, in our opinion, would leave matters pretty much as they now are. What is wanted is a standing Council, a properly constituted Court of Appeal, always ready to deal with every question as it arises, and invested with authority to enforce its decisions. We should have liked to see such a Council recommended by the Berlin Congress. What it proposes is but a half measure, inadequate to the requirements of the case. Another recommendation, that of periodical International Labour Conferences, is open to the charge of being impracticable. There may be certain conjunctures of circumstances when, as now, it may be desirable to convene the representatives of several nations for the purpose of conferring together on some question of which the solution cannot otherwise be arrived at. But such opportunities must necessarily be of rare occurrence. On what basis could such Conferences meet? What is trade but incessant industrial war? Competition is but another name for combat. When competition has become so keen that both parties are being ruined by the struggle, the time will have arrived for some mutual agreement to mitigate the sufferings of the combatants. Till then it is vain to hope for international treaties to regulate labour. Will, for example, the men of a district, in which the conditions of a manufacture are specially favourable to cheap production or cheap distribution of the produce, consent to nullify their advantages for the good of another district less fortunately situate? Yet it is something of this nature which is asked for, when the working men of one country are called upon to regulate their affairs in conformity with those prevailing in another. And unless something of this kind be demanded, of what use will the periodical International Conference be? We fear that, except in the particular case we have mentioned, the international regulation of labour, whether by Trades Unions or by Governments, is but a dream.

What will be the practical consequences of the Berlin Conference? That its recommendations will for the most part be carried into effect without unnecessary delay may be safely assumed. First, because they are nothing more than the objects for which the toiling classes, who are rapidly acquiring political power, have been striving. Next, because the maintenance of the existing order of things gives strength to the Socialist party in the State. And lastly, because each and all of the Governments who were represented at Berlin will feel bound to make some manifestation of good-will by giving effect to the resolutions to which they have openly subscribed. For ourselves we can afford to stand quietly by, since the Resolutions do not apply in our case. When all the recommendations have been adopted by our foreign rivals in trade, we shall not have been left behind in any particular. But the reform undertaken by our neighbours will greatly affect our position in the industrial world. We have suffered from foreign competition because we have hitherto been alone in the work of improving the material condition of the working classes. The price paid for the industrial legislation of recent years has been an increased cost of production, which increase has heavily handicapped us in the race of com-

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petition. The general adoption of the measures recommended by the Conference will change all that by putting all parties on an equality in those matters. By adding thus largely to the cost of production abroad, British commerce will be relieved and British industry stimulated. The project of the German Emperor inaugurates, therefore, a period of returning prosperity to this country. So much at least we may hope for. There is but one thing which could prevent its attainment, namely, fresh and commensurate demands on the part of the British workman. Here is an opportunity for the trades unions to give proof of practical wisdom. By manifesting and recommending a spirit of moderation at times when circumstances are favourable to fresh acquisitions they will earn the gratitude of all classes of the community. Only by such self-denial in moments of prosperity can the working men of this country profit to the full by the altered state of industry abroad brought about or hastened by the Berlin Conference.

THE ADMIRALTY DYNAMO SPECIFICATIONS.

THERE has been considerable discontent among dynamo makers on the subject of the Admiralty specifications, the temperature clause being generally the centre round which differences arise.

The method of testing the temperature seems to be very unsatisfactory. It is specified that, after running for six hours at full load, "no accessible part of the armature or magnets should have a temperature of more than 20° Fahr. above the temperature of the dynamo room." This temperature is taken at the end of one minute after stopping. In many, especially of the more recent specifications, 30° Fahr. is substituted for 20° Fahr. The question that has always puzzled the contractors is: How is the temperature taken? It seems that it is taken by laying a thermometer on the armature or field magnets and seeing what reading it gives. But it is clear that the apparent temperature, as given by a thermometer under these circumstances, has no very definite relation to the real temperature of the outside of the armature. The dynamo is allowed to rise in temperature to 70° Fahr. after stopping—that is to say, there may be a sort of store of heat in the armature. Before a machine is stopped after six hours' run at full load the armature and all parts of it have come to their final temperature—that is to say, the heat dissipated is exactly equal to the heat developed. For the sake of simplicity we will assume that the armature is a drum with no internal ventilation. As a matter of fact, this is the type generally used. In that case all the heat is dissipated from the outside of the armature by radiation, conduction, and convection. The last two are intimately connected and may be taken together, and account for the greater part of the heat. As the heat is all developed in the armature, and must find its way to the outside there must be a difference of temperature between the inside and outside. If the parts where the heat is generated are covered in with insulation, which is a bad conductor of heat, the conductors will be at a much higher temperature than the surface of the armature. Only a small amount of heat is generated in the core itself, so there will be little flow of heat from the core through the insulation into the conductors and thence to the surface; the core will thus be only slightly hotter than the conductors themselves. On first starting, the core is colder and is heated partly by the armature conductors and partly by its own loss by hysteresis, but, though its capacity for heat is large, because of its large mass, it will eventually become somewhat hotter than the conductors.

As the amount of heat which will penetrate the outside insulation in a second depends on the heat conductivity of the insulation and the difference of temperature, it follows that if the insulation is a very bad conductor of heat the difference of temperature between the conductors and the surface of the insulation of the armature will be great. The less the outside of the armature is lagged, therefore, the lower will be the temperature of the conductors for a given total loss of heat per second in the armature. As far as heating is concerned, therefore, the less lagging the better.

Let us now consider what happens on stopping after the six hours' run. The facilities for the escape of heat from the surface of the armature are enormously reduced, because there are now no draughts caused by the rotation of the armature. The generation of heat in the armature is also stopped, but the core acts as a store. If all escape of heat from the surface were prevented, the conductors would rise to the same temperature as the core—that is to say, a little higher than they were before stopping. The surface of the armature would also rise to the same temperature. If there is some dissipation of heat, however, the surface never gets so hot, and the difference in temperature between the surface and the conductor may be considerable.

If a thermometer is now applied for a minute. and covered in, say, by a bit of waste, the capacity for heat of the thermometer is, as pointed out by Mr. Willans, very considerable in comparison with the rate at which the heat can flow into it; the result is that the thermometer does not measure the temperature at all, even of the insulation on the immediate surface, much less of the conductor under it.

Suppose now the thermometer with the bit of waste is left for, say, half an hour, its temperature will rise nearly to the temperature of the conductors at that time. It will not rise quite so high, because the loss that still takes place through the waste is not insignificant in comparison with the supply of heat through the insulation of the conductors. Suppose the thermometer at this time shows its maximum reading of a rise of 70° Fahr. above the atmosphere, the temperature of the conductors underneath it must be still greater, by how much cannot be definitely stated. The conductors at the maximum reading are then more than 70° Fahr. above the atmosphere; but they have been cooling slowly for some fifteen or thirty minutes, so that at the instant of stopping they must have been considerably more than 70° Fahr. above the atmosphere. It might be urged that at the instant of stopping they were cool, but the core was hot. This reasoning will not hold, however, for there is so little heat generated in the core itself that it cannot be much above the temperature of the conductors. It must also be remembered that during the fifteen or thirty minutes the conductors have been getting rid of heat through the insulation to the surface, and there is a layer of insulation between the core and the conductors. So with the very slight difference of temperature between the core and the conductors at the instant of stopping, the conductors would get rid of heat much quicker through the outside insulation, which has a large difference of temperature on its sides, than the core could supply heat through the core insulation with a small difference of temperature.

Suppose now that the external insulation or lagging were taken off and the dynamo run again for six hours at full load. The same amount of heat would be generated per second, so, as the radiation, convection, and conduction from the surface remain as before, the same external or surface temperature would be reached, and this would now be the temperature of the copper itself. The core would be at a slightly higher temperature. On stopping and placing the thermometer on the copper with a piece of waste over it as before, the thermometer bulb would absorb more heat than before in a minute, so that at the end of the first minute the temperature, as taken by the Admiralty, would be higher than before; simply because the copper could now supply heat quickly to the thermometer bulb, as there is little or no insulation to stop the flow.

If the thermometer is left on, it might rise a little more, though the temperature of the copper will be falling gradually, as in the first case; but the thermometer can never rise to the temperature shown in the first case because the copper and core are so much cooler to begin with. The Admiralty test thus shows a higher temperature for the cooler machine, as far as the 20° or 30° test is concerned; and if, as we understand, most importance is attached to this test, the Admiralty are doing their best to select bad dynamos. The one minute test is, as Mr. Willans pointed out at the Institution of Electrical Engineers, simply an absurd method of putting a premium on lagging dynamos in so as to supply little heat to a thermometer bulb while the temperature of the conductors is high.

The temperature of the core does not matter, what is really important is the temperature of the insulation, on which the life of the machine depends. The insulation which is important is in contact with the copper conductors, so all that is required is to see that the temperature of the conductors is not too high. This cannot be found by leaving thermometers about on the armature, but can be determined with the greatest accuracy by measuring the rise of resistance of the conductors. There are so many simple ways of taking the resistance, even of a short thick bar, that it is not necessary to discuss them. Another curious regulation in the specification is that the rise of resistance of 20° or 30° Fahr. only concerns the accessible parts of the dynamo. Apparently the inaccessible parts do not matter. This is strange, because the accessible parts are the parts which are easy to repair; and there is no reason why the parts which cannot be got at should be allowed to come to any temperatures they like. Many makers of drum armatures close the ends in such way that the rise of temperature there is very great, an this is a frequent cause of breakdowns.

As to the highest temperature admissible, we think the Admiralty place the limit not too low, but far too high. As already explained, if the maximum rise of temperature measured in their way is 70° Fahr., it is really probably much, very much, more; but even if the conductors themselves only rise 80° Fahr., this means, in a stoke hole at 120° Fahr., that the conductors are at 200° Fahr., or nearly the temperature of boiling water! Ordinary dynamos in this country are made to have a maximum temperature of about 150° Fahr.; in the United States they often allow 200° Fahr. There is no difficulty at all in making machines for Admiralty work which will have a maximum rise not exceeding, say, 40° or 50° Fahr., and still smaller rises can be obtained by making the dynamos very large, and using low current densities.

The point at which insulation will char seems to be a matter of doubt. Most forms of insulation will stand 300° Fahr. for some hours without charring, but a much lower temperature will char them if applied long enough. The question is not at what temperature insulation will become carbonised enough to conduct, as to make it conduct a red heat is necessary, but at what temperature it will become brittle and mechanically weak. The cleading on a locomotive lasts for years without being thoroughly charred, but it is converted into a sort of tinder without any mechanical strength in a very short time.

Though armatures with bare copper conductors keep cooler, there is more chance of small particles of metal bridging across and starting short circuits. Apart from this, however, bare copper feels hotter to the hand, and most people try to judge temperatures by the feel. A piece of bare copper at a temperature of 120° Fahr. will burn the hand rather unpleasantly, but if it is thickly insulated it will feel comparatively cool. It is a trick perfectly well-known in the trade, when an armature gets rather warm, to lag it in so that it gets hotter than ever, for the average customer will merely feel it with his hand.

Apart from the question of the way temperatures are measured, or supposed to be measured, there is a common idea that a dynamo that gets hot must be less efficient than one that keeps cool. If the machines are the same size, and give the same output, and have the same amount of lagging on the armatures, this is, of course, perfectly true; but if the hot machine gives a larger output, or if it gives the same output and is smaller, it may be more efficient than the cool one. The temperature depends, not only on the power wasted in the armature, but also on the facilities for dissipating the heat. Other things being equal, the small armature has less facilities; so a small machine may easily be hotter than a large one and give the same output at a higher efficiency.

Before leaving the subject of heating, let it be clearly understood that we do not mean to say that the machines made for the Admiralty necessarily run hot; all we say is that the 20° or 30° clause is well calculated to make them do so.

There are very few other points in the specification which have given rise to much trouble. Nothing is said as to whether the machine is to compound accurately at the temperature of the room in which the trial takes place at Portsmouth Dockyard, or in a 120° stoke hole. If they are to be run in a hot stoke hole, resistance should be inserted in the shunt circuit during the Portsmouth test.

There are some curious regulations. A whole paragraph is devoted to details about the commutator dimensions, and another to the brushes. Surely it would be better to leave these matters to the contractors, who, if they know how to make dynamos at all, know how to make commutators and brushes. Stringent rules might, with equal propriety, be given as to the design of the terminals or the shape of the eye-bolt. These regulations only prevent makers using their ordinary patterns for commutators and brushes, and thus give annoyance. The regulation that only 96 per cent. copper should be used might be removed with advantage. No maker would use impure copper, because it costs nearly as much per pound, and a lower current density, and therefore more copper would have to be used. A rule might as well have been inserted to say that a maker must not buy his raw material dear if he can get better stuff cheap. Such a regulation can only make the Admiralty appear in an absurd position in the eyes of the contractors.

Apart from these points there is nothing to be said against the Admiralty dynamo specifications. As many dynamo makers have said, they have done a great deal of good. The direct, coupled engines and dynamos now coming into such extensive use for central station work were worked out to suit Admiralty requirements, and their strictness in passing nothing but the best work has been highly beneficial to the electric lighting industry.

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ARCHITECTS' REGISTRATION BILL.

Two years ago the engineering profession was somewhat fluttered, and to a certain extent amused, by the good intentions of some unknown friends, who seemed to think that a special Act of Parliament was required for their protection and that of the public. A Bill was introduced with the innocent title of the "Architects' Registration Bill," but on looking into its provisions it was found to contain a great deal that was of interest to others besides architects. Its preamble stated that, "whereas it was expedient that persons requiring professional aid in architecture, civil engineering, or surveying, should be enabled to distinguish qualified from unqualified practitioners, it was expedient . . . . &c. &c." In short an unknown body of architects took under its protection the whole engineering profession, and drew out most elaborate regulations for its guidance. The odd thing was that the representative institutions named in the Bill disclaimed its paternity, and did all they could to oppose it. The whole thing seemed so utterly ridiculous and pretentious that it collapsed after a very short debate in the House of Commons. This year the Bill has been reintroduced with the same name, but with much more limited provisions, it being entirely confined to architects, and engineers are left in the same position as they were, for which they ought to be profoundly thankful. Engineering is much too big a profession, or rather group of professions, to be taken under the protection of the architects, even if it were desirable to do so. We, of course, are of opinion that every profession or trade should guard the admission to its ranks in such a way as to ensure to the public that those enrolled in them are fairly well qualified for the duties they undertake, and this is now being done to a very considerable extent, and the practice is certain to spread. We would have thought, however, that the architects were less in need of an Act of Parliament than any other profession, because for a good many years past the Royal Institute of British Architects has had an examination for its Associateship which has done much to raise the standard of architectural education throughout the country, and the various local institutions of architects are more careful in the matter of admitting members than the majority of other professions. The question for the architects to consider is: whether by extending and improving their present organisation they could not meet all the wants of the profession and of the public? We are strongly of opinion that they could, and that any Act of Parliament is altogether unnecessary. Let the Royal Institute of British Architects place itself at the head of the movement, and co-operate with the various local institutions throughout the country, and an organisation could be arranged which would be more useful to the profession than anything which is done under the guidance of an Act of Parliament. We are rather curious to observe what steps the architects will take in this matter, and our chief interest in it is the effect which such a precedent would have on other professions and trades more directly connected with the industries with which we are concerned. We think that if they are wise they will organise their own affairs, and develop that spirit of freedom and independence which will do them and their members more good than any amount of Government support or interference.

BOARD OF TRADE RULES ON LIFE SAVING APPLIANCES.

(*Concluded from page* 330.)

VIII. Sailing Ships.

CLASS 1.—*Rules for Sailing Ships carrying Emigrant Passengers subject to all the Provisions of the Passengers Acts.*

Sailing ships of this class shall carry boats in accordance with the following Table, and such boats shall be, as far as practicable, placed under davits with proper appliances for getting them into the water, to the satisfaction of the Board of Trade officer, such of these boats as are not placed under davits being so carried that they can also be readily got into the water, to the satisfaction of the Board of Trade officer, but no sailing ship of this class shall be required to carry more boats than will furnish accommodation for all persons on board.

If the boats so carried do not furnish sufficient accommodation for all persons on board, then additional wood, metal, collapsible or other boats of approved description (whether placed under davits or otherwise), or approved lite rafts shall be carried.

Such additional boats or rafts shall be of at least such carrying capacity that they and the boats required to be placed under davits provide together, in the aggregate, double the minimum cubic contents required by column 3 of the following table.

All such additional boats or rafts shall be placed as conveniently for being available as the ship's arrangements admit of, having regard to the avoidance of undue encumbrance of the deck, and to the safety of the ship for her voyage.

When sailing ships are divided into efficient water-tight compartments so that with any two of them in free communication with the sea the vessel will remain afloat in moderate weather, they shall only be required to carry additional boats or life rafts of one-half of the capacity required by preceding paragraph.

Sailing ships of this class shall carry approved life belts or other similar approved articles of equal buoyancy, suitable for being worn on the person, so that there may be at least one for each person on board; and there shall also be one approved life buoy for each boat of wood or metal.

CLASS 2.—*Rules for Foreign-going Sailing Ships carrying Passengers, but not subject to all the Provisions of the Passengers Acts.*

Sailing ships of this class shall be subject to the same requirements as those in Class 1.

CLASS 3.—*Rules for Foreign-going Sailing Ships not carrying Passengers.*

Sailing ships of this class shall carry boats in accordance with the table provided for Class 1, and in addition thereto one good serviceable boat properly constructed of wood or metal. Such boat shall be, as far as practicable, placed under davits, with proper appliances for getting them into the water to the satisfaction of the Board of Trade officer; such boats as are not placed under davits being so carried that they also can readily be got into the water to the satisfaction of the Board of Trade officer.

Sailing ships of this class shall carry approved life belts as required for sailing ships of Class 1., and also one approved life buoy for each boat of wood or metal.

CLASS 4.—*Rules for Sailing Ships engaged within the Home Trade Limits—that is to say, between Places in the United Kingdom and Ports in Europe between the River Elbe and Brest, but not carrying Passengers.*

Sailing ships of this class shall carry a boat or boats of wood or metal at least sufficient for all persons on board, and in such a position as to be readily got into the water to the satisfaction of the Board of Trade officer. Each boat shall be provided with one gallon of vegetable or animal oil, in a vessel of an approved pattern, for distribution on the water during rough weather.

They shall carry an approved life belt for each person on board.

They shall carry at least two approved life buoys.

TABLE FOR SAILING SHIPS OF CLASS 1.

Gross Tonnage. 1.	Minimum Number of Boats to be placed under Davits. 2.	Total Minimum Cubic Contents of Boats to be placed under Davits. L. × B. × D × ·6. 3.
9,000 and upwards	14	5,250
8,500 and under 9,000.....	14	5,100
8,000 ,, 8,500.....	14	5,000
7,750 ,, 8,000.....	12	4,700
7,500 ,, 7,750.....	12	4,600
7,250 ,, 7,500.....	12	4,500
7,000 ,, 7,250.....	12	4,400
6,750 ,, 7,000.....	12	4,300
6,500 ,, 6,750.....	12	4,200
6,250 ,, 6,500.....	12	4,100
6,000 ,, 6,250.....	12	4,000
5,750 ,, 6,000.....	10	3,700
5,500 ,, 5,750.....	10	3,600
5,250 ,, 5,500.....	10	3,500
5,000 ,, 5,250.....	10	3,400
4,750 ,, 5,000.....	10	3,300
4,500 ,, 4,750.....	8	2,900
4,250 ,, 4,500.....	8	2,900
4,000 ,, 4,250.....	8	2,800
3,750 ,, 4,000.....	8	2,700
3,500 ,, 3,750.....	8	2,600
3,250 ,, 3,500.....	8	2,500
3,000 ,, 3,250.....	8	2,400
2,750 ,, 3,000.....	6	2,100
2,500 ,, 2,750.....	6	2,050
2,250 ,, 2,500...	6	2,000
2,000 ,, 2,250.....	6	1,900
1,750 ,, 2,000.....	6	1,800
1,500 ,, 1,750.....	6	1,700
1,250 ,, 1,500.....	6	1,500
1,000 ,, 1,250.....	4	1,200
750 ,, 1,000.....	4	1,000
500 ,, 750.....	4	800
250 ,, 500.....	2	400
150 ,, 250.....	2	300

NOTE.—Where in vessels already fitted the required *cubic contents* of boats placed under davits is provided, although by a smaller *number* of boats than the *minimum* required by this table, such boats shall be regarded as complying with these rules.

COMPRESSED AIR TRAMCARS.

No. of Tramway.	Length in Miles.	Frequency of Service in Minutes.	No. of Cars, including sufficient Reserve.	Gauge.	Steepest Gradient.	Cost per Mile of Tramway, including all Cars, Plant, Piping, &c., but excluding the Ordinary Permanent Way and Buildings.	Working Expenses per Car Mile including Royalty, but excluding Directors' Fees and General Management Charges.	Remarks.
				Ft. in.		£	d.	
1	1	10	3	3 6	1 in 16	4,600	5¾	Steep gradients rather frequent.
2	4¼	6	16	4 8½	1 „ 15	6,235	2½	Gradients average 1 in 60 each way.
3	5¾	30	6	3 6	1 „ 15	2,957	4⅛	Steep gradients frequent.
4	4	10	8	4 8½	1 „ 30	4,656	5¾	Chiefly level. Colonial line.

Letters to the Editor.

COMPRESSED AIR TRAMCARS.

To the Editor of "Industries."

SIR,—Your correspondent "Car" is mistaken in supposing that a special new roadway is required to work our patent low-pressure compressed air tramcar system. Our system can be applied to any existing roadway, of any gauge, without any alteration whatever. All that is necessary as regards the road is to lay the air main under the footway, with branches across to the valve boxes, which are fixed beside the rails at intervals of from a quarter of a mile to a mile apart, according to the nature of the gradients.

The car was, as your correspondent states, "only an experimental one." Nevertheless, the results obtained from it, even in its imperfect state, show a decided advantage over any other system of traction. The above table gives particulars of cost and working expenses for four lines for which we have sent in tenders, and is based on the actual results obtained from this experimental car. We have thought it safer to base our calculations upon what we actually know and can rely upon, as confirmed by the experiments of Professor Unwin and Mr. D. K. Clark, than to make any allowance for anticipated improvements. The figures are quite good enough as they are, and we prefer to leave the improvement that may be counted upon in the actual results with the specially constructed car to speak for itself.

From this table your correspondent will see how very much the first cost and working expenses vary with the conditions of each case, and how impossible it is to lay down any general rule. We have not included buildings in the capital cost, as the existing buildings in each case were to be utilised, and we have also omitted from the working expenses the directors' fees and general management charges, as these follow no fixed rule. These items, however, are easily estimated according to the conditions of each case. In No. 3 case, the cost of running is given as 4¼d., which covers all expenses included in the ascertained cost of 6⅛d. per car mile by the steam locomotives, at present used on this line.

We cannot give a comparison with electric traction, as we find it impossible to get at any reliable data, especially as to performance on steep gradients. We can only point out that the Brussels Tramway Company have abandoned electric traction after four years of patient effort, and a loss of £1,144 as compared with horse traction, seeing no prospect of making it pay, even after making every allowance for all possible improvements. We believe this is the only case in which the system is worked by the tramway company, and not the electric company, and where, consequently, the actual results are obtainable.

The letter of "A. W." refers to the Mekarski tramcar system, in which the air is compressed to about four times the pressure required for our cars. All the advantages referred to by "A. W." apply to our system, with the additional advantages that our cars are much lighter, having no elaborate heating apparatus, require much less power owing to the much lower pressure used, —the power required to compress the air being, for a level line, 4,900,000 ft. lbs. per car mile on Mekarski's system, against 3,800,000 ft. lbs. on our system. As regards liability to explosion, Mekarski has a body of water in his "hot-pots" heated to a temperature of 320° Fahr., which, in case of a rupture of the receiver, would produce an explosion as destructive as any boiler explosion.

We have nothing of that kind in our cars, and only one-fourth of the air pressure, with corresponding increased safety.

Yours, &c.,

HUGHES & LANCASTER.

City Road, Chester, April 9th, 1890.

THE INSTITUTE OF MARINE ENGINEERS.

THE annual general meeting of the Institute was held in the Langthorne Rooms, Broadway, Stratford, on the 29th ult., when the secretary read his report and balance sheets. He reviewed the history of the Institute during the first year of its existence, and briefly referred to the initial work of the organising committee. The balance sheet showed an eminently satisfactory condition of the finances, the receipts being £499 10s., and the expenditure £302 18s. 8d. The voting for officers for the ensuing year resulted as follows:—President, Mr. G. W. Manuel; secretary, Mr. Jas. Adamson; treasurer, Mr. R. Leslie.

After a number of congratulatory speeches, Mr. G. W.

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Manuel, the new President, gave his opening address, in which he said that he looked back with no small surprise on the amount of work which had been accomplished during the past year. The amount of vitality which was evidently in the members was very great, and therefore he augured well for the second year upon which the Institute had entered. He pressed home upon all the necessity of thinking out the various questions connected with marine engines and boilers, and the various machines now fitted in the new steamers for electric lighting, refrigeration, &c. The Institute would become a power in the land for bringing forward the necessity of marine engineers having a higher training before they entered upon duties in the engine rooms of steamers. He pointed out that the duties of engineers would now consist more and more of watching closely the possibilities of increasing the efficiency of the machinery placed in their care.

Mr. Manuel closed by giving the following data showing the progress made during fifty years in the steamers of the Peninsular and Oriental Steam Navigation Company:—

Year.	Ship's Name.	Gross Tonnage.	I.H.P.	Speed in Knots.	Steam Pressure per sq. in.	Description of Engines.
1837	Iberia	516	180	8	7	Paddle.
1852	Indus	1,950	1,367	10 to 11	12	Paddle oscil.
1867	Hindostan	3,113	3,194	12	30	Screw horiz.
1882	Ballaarat	4,752	4,500	13	90	Comp. inver.
1887	Oceana	6,000	7,000	15·7	150	Triple expn.

Mr. H. E. Lester and Mr. R. Leslie then addressed the meeting on the subject of erecting a building for the Institute, to enable the plans which had been laid down by the Council being carried into effect—class and recreation rooms, lecture hall, and rooms in which young engineers, strangers in port, could find accommodation at reasonable rates. It was stated that a sum of not less than £10,000 would be required. Mr. Lester offered to start the building fund by a donation of £10, and £10 more for the purpose of convening a meeting at which the claims of the Institute could be laid before an influential audience.

Several other gentlemen immediately promised other handsome sums, and it is quite probable that the objects of the promoters will be gained.

A meeting of the Institute was held on the 1st inst., when the adjourned discussion on the "Friction of Screw-Propelling Engines" was resumed. Mr. Brett also read a short paper in extension of his original paper with special reference to experiments on friction and the best system of lubrication. An interesting discussion ensued.

THE GIRARD HYDRAULIC RAILWAY.

In *Industries*, of the 23rd August last, we gave a general account of this invention, which has excited so much interest in this country and in America. As it would appear from the paper recently read on this railway before the Society of Arts that a certain interest is still taken in it, we now proceed to complete our description and to illustrate such further details as are necessary to understand the working. Those of our readers who are interested in the historical development of the details we may refer to Girard's voluminous and profusely illustrated English specification No. 2506, 1889. Here will be found a number of ingenious mechanical contrivances, most of which have been very much simplified by M. Charles Armand Athanase Barre, in the railway lately at work on the Esplanade des Invalides.

The shoes which carry the carriages are shown in *Industries*, Vol. VII., p. 176, and are supported by a thin film of water about half a millimetre in thickness. M. Girard's first shoes were flat plates, and he proposed to support them by means of a film of compressed air, but this was at once found to be impracticable. Even with the latest form of shoe the waste of water is very great. The pressure is obtained by carrying on the tender vessels charged with compressed air. These will only carry sufficient air to compress water enough to carry the train about 1,800 yards, and require to be recharged after travelling this distance. For longer journeys, an engine and boiler, with pumps and apparatus for compressing the air, must be carried on the tender, the water being taken up from between the rails, as is now done by express trains in this country. This seems to be a very serious objection, since the weight of the engine and the accessories will be so great as to require an enormous pressure to raise them from the rails, and so neutralise the chief advantage of the system, which is that the carriages and apparatus may be very light, and no practical traction resistance felt.

The construction of the rail requires careful consideration so as to obtain anything approaching the required efficiency. In the trials with his slide at La Jonchère Girard did not pay particular attention to the difference in level of the rails, since he attributed to his slide the entire friction which he found at the several points, such as at the joints of the rails; he, therefore, never attempted any special system of joining the rails with the object of avoiding such differences of level, although methods of joining the rails otherwise ingenious are given in his English specification just referred to. For anything approaching efficiency the rails must have perfectly true surfaces, without differences of level at the points of junction, and they must be free to expand and contract. Many forms have been tried, but the latest and most satisfactory form is shown in Figs. 1, 2, and 3. With this system of rail it is found that the differences of level which may occur are not capable of reaching the normal thickness of the layer of water compressed between the shoes and the tops of the rails, the result being that the highest efficiency resulting from the form of slide is realised. The rails rest on wooden sleepers, and may be of cast iron or steel. They are about 10ft. long. They are planed on the top and sides, and are bolted down to the sleepers by means of the lugs A. The level is preserved as follows: Lugs B are cast on to the ends of each rail and are truly bored. Pins C are inserted and held in position by a small cotter. In the end of each rail is cut a curved groove E F, in which is placed a strip of indiarubber, which is compressed between the two rails, but retains sufficient elasticity to allow of the expansion of the rails.

The high-pressure water main, which runs along the whole length of the line, carries at short intervals injectors, which throw the water against the turbines under the carriages, and thus propel the train. These we shall now describe, as the construction is very ingenious, and is one of the main features of the invention. Fig. 8 shows a vertical section of one of these injectors, Fig. 9 is a plan, and Fig. 7 shows an end elevation partly in section. The high-pressure water from the main is conducted into the chamber G, whence it flows on the opening of the valve H along the pipe J, through the nozzle K, against the blades of the turbines under the carriage. The opening and closing of the valve H is the only difficulty in the arrangement, as it is under great pressure and is liable to severe shocks. The valve rod L, which carries at one end the valve H, carries at the other end a piston M, which works in a cylinder N. This piston has a larger area than the valve H. Water at high pressure can be admitted to the right hand side of this piston by means of the pipe O, the cock P, and the pipe Q. The left hand side of the piston is open to the air, and is acted on by a spring R, which helps to close the valve. When the guide on the carriage opens the cock P by moving the tappet, water flows along the pipes O and Q, and moves the piston outwards, opening the valve H. When the cock is closed the pressure is removed from the back of the piston, and the spring R, aided by the pressure, closes the valve H. It will be understood that when the pressure is taken off the water will escape along the pipe Q, and through the cock P to the waste pipe, the escaping water acting as a hydraulic brake and tending to prevent shocks. But this in itself was found to be insufficient, and a disc was provided on the inside of the piston, which comes into contact with a ring S as the valve approaches its seat, and thus by the friction reducing the shock. It is claimed for the improved injector that it is not affected by frost, but the only reason for this claim appears to be the fact that an arrangement is provided for emptying the pipe when not in use. In M. Girard's injector a hole was made near the valve H from which the water escaped when the injector was not in use, but by this arrangement much water was lost in the working, as a large quantity of high-pressure water escaped during the time the valve H was open. M. Barre designed the arrangement shown in Figs. 7 and 8, by which the high-pressure water is not allowed to escape, and by which he claims that he obtains greater economy. On a horizontal track there will be rarely more than a single injector in communication with the turbine of the train, and the economy is not very great, but on an incline where there are always several and even a considerable number of injectors open at the same time the saving of water will amount to as much as 6 per cent. The action is as follows:—When the valve H is closed water is admitted from the chamber G by a pipe T through the cock U and pipe V to the cylinder W, and this opens a valve X in the pipe J, which allows the water to escape. When the valve H is opened the levers Y Z move the plug of the cock U, and, the pressure being removed from the piston in the cylinder W, the spring closes the valve X, and thus no water is wasted. In the most recent injectors a still simpler appliance is used. It consists of a valve A^1 placed underneath J. When the valve H is closed a spring keeps open the valve A^1, and the water is allowed to escape from the pipe J. When the valve H opens the pressure of the water closes the valve A^1 and prevents the escape of high-pressure water. When the propelling water passes out of the turbine of the train it still has a considerable velocity, which would take it out of the track if the momentum due to this velocity were not destroyed. This is done by means of a deadening apparatus, one being placed opposite to each injector. This is shown in Figs. 4 and 5, Fig. 4 being an elevation looking from the injector, and Fig. 5 a section. The framing is made of sheet iron, and the water from the injector, after passing the turbines, is received in the chambers shown and broken up. It is guided downwards, and its velocity is still further reduced by means of the chains suspended from the plates as shown. The water is finally collected in the trough between the rails and conducted to the reservoir to be used over again.

It remains to describe the apparatus for starting or stopping the train by opening or closing the injectors so as to start in one direction or the other. The cocks shown in Fig. 6 start the apparatus from the tender as desired by the driver or guard of the train. When the train stops on the track for any reason the injector which happens to be engaged with the turbine of the train is at an undetermined spot in relation to the length of the train, and the driver must be able to open or shut this injector quickly without leaving the tender, which is his post of control, or the train might be stopped suddenly by a signal leaving a jet from an injector still working. This the driver must be able at once to shut, and also to open when he wishes to start. The apparatus by which this is accomplished is shown in Fig. 10. A hollow rod B^1 is suspended under each vehicle, and runs along its whole length. It runs in bearings fixed under the cross-beams of the carriage, and is fixed in the vertical plane passing through the middle of the extreme positions C^1 C^2 of the arm or tappet which opens the injector. This rod B^1 carries by means of arms D^1 the rods E^1, which also run along the whole length of the carriage, and are so arranged as just to clear the tappets C^1 C^2 when in the middle position. A pinion F^1 is keyed on to B^1, and this works into a rack G^1, which prolonged passes through the cylinder H^1 and is attached to the piston. Two springs, one on each side of a collar on this piston rod, tend to keep it in its middle position, as also does the weight of the rods E^1 and the arms D^1. Two pipes J^1 K^1, which run the whole length of the train, can convey the liquid to either side of the piston, the pipe J^1 communicating by means of the pipe L^1, and the pipe K^1 by means of the pipe M^1. One end of each of the pipes J^1 K^1 is joined to a small receiver on the tender, and the whole, pipes, cylinder, and receivers, are filled with glycerine. The upper part of each receiver communicates with a small accumulator filled with compressed air. The various connections are governed at will by means of a pair of connected controlling cocks situated on the tender and shown in Fig. 6. Each of the two connected cocks can cause its corresponding pipe to communicate either with the accumulator on the tender, by the pipe N^1, Fig. 6, or with the free air reservoir by the two pipes O^1 O^2. The three pipes J^1 N^1 and O^1 and K^1 N^1 and O^1 open into the casings of the cocks by apertures which divide the circumference of the casings into three equal parts. The position of the pipes O^2 is given by the fact that they must be opposite to the openings of the plugs when they are in the "stop" position—*i.e.*, when the train is stopped they must be open to the free air. The plugs of the two cocks are connected by a pair of spur wheels of equal diameter in such a manner that when the handle R^1 of the one is turned the plug of the other is forced to turn to an equal extent in the opposite direction. Thus, when the handle is at "Forward" on the dial, the pressure liquid enters by the pipes N^1 and K^1 into the cylinder through the pipe M^1, and this drives the piston of the cylinder H^1 to the left, and thus raises the system B^1 D^1 E^1 into the position shown by the dotted lines opening the injector. During this forward motion of the piston the liquid contained in the other side of the piston escapes by the pipes L^1 and J^1, and through the cock by the aperture, and into free air. If the handle is moved through a third of a revolution the contrary movement takes place, and the injector is shut. Again, when the handle points to "Stop" on the dial, each of the two pipes J^1 and K^1 is placed in communication with the free air, and the piston is in the middle of its stroke. M. Barre states that this apparatus can be operated without effort, and that it acts with rapidity and smoothness. This railway possesses the most powerful possible brake, and the trains arrive and stop very quickly in all stations. In order to provide against any shock against the safety buffers in terminal stations, a ramp of wrought iron rises up from the track between the rails at a distance of some metres from the end. This ramp is intended to shut the feed cocks of the slides in case the driver shall from any reason omit to do so. No arrangements are shown for crossings or for junctions, and these will certainly present serious difficulties with this form of rail. From our description and remarks it will be seen that the system is likely to be little more than a mechanical curiosity—an ingenious one, it is true—yet nothing more, and its great expense alone will prevent its coming into general use, even if it were otherwise practicable.

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THE GIRARD HYDRAULIC RAILWAY AT THE LATE PARIS EXHIBITION.

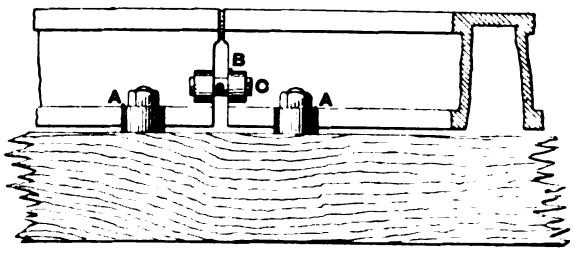


FIG. 1.

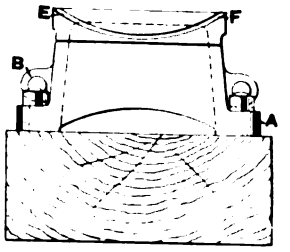


FIG. 2.

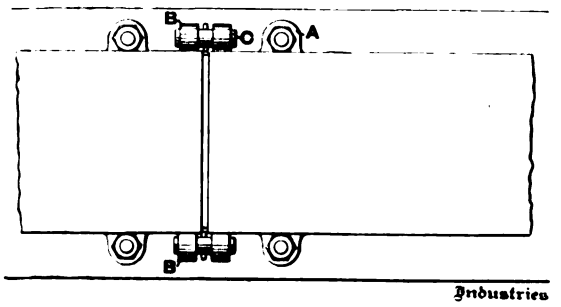


FIG. 3.

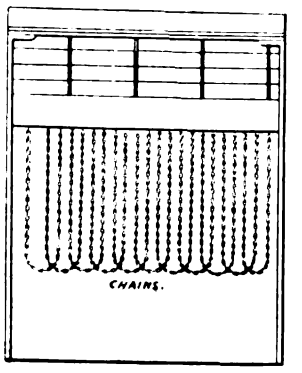


FIG. 4.

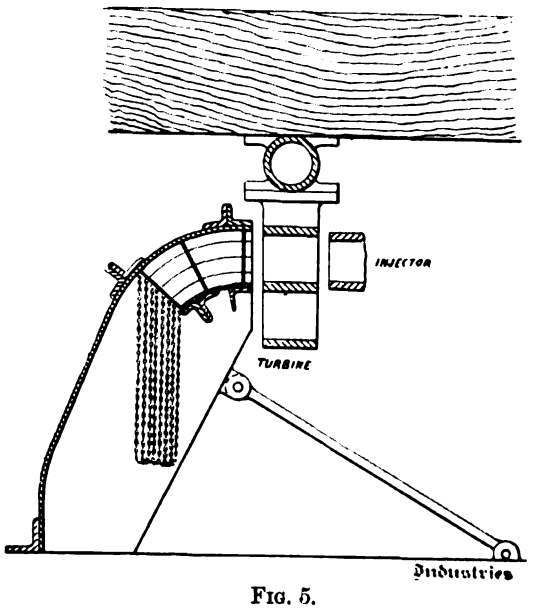


FIG. 5.

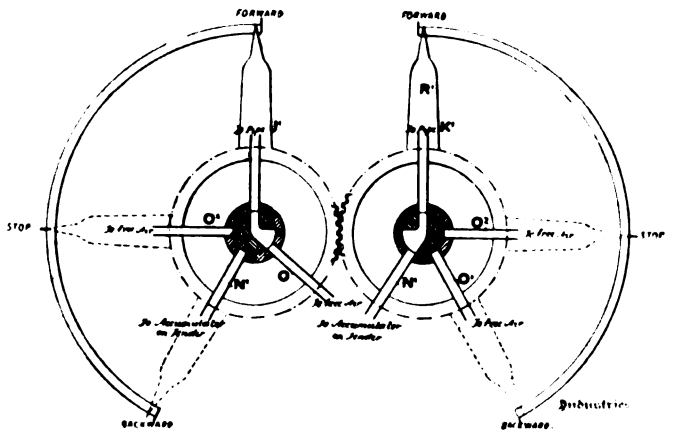


FIG. 6.

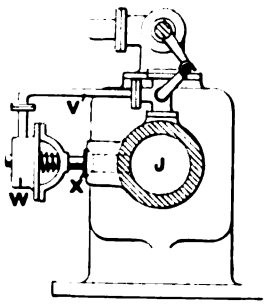


FIG. 7.

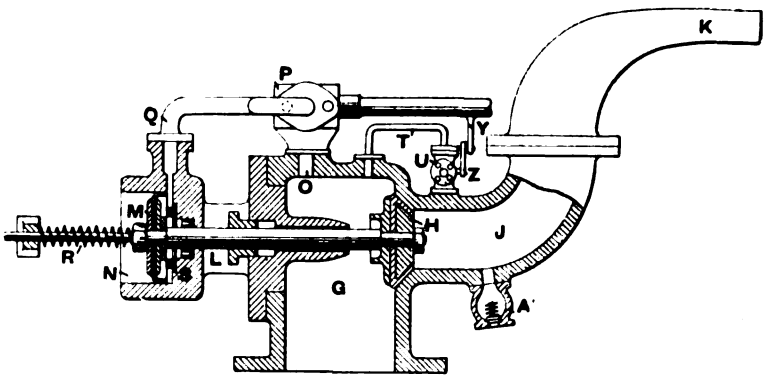


FIG. 8.

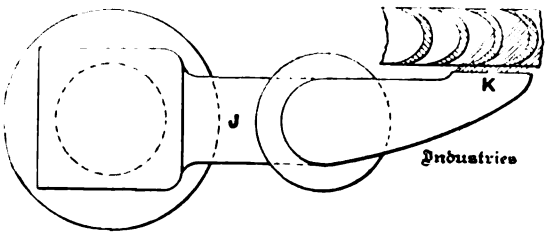


FIG. 9

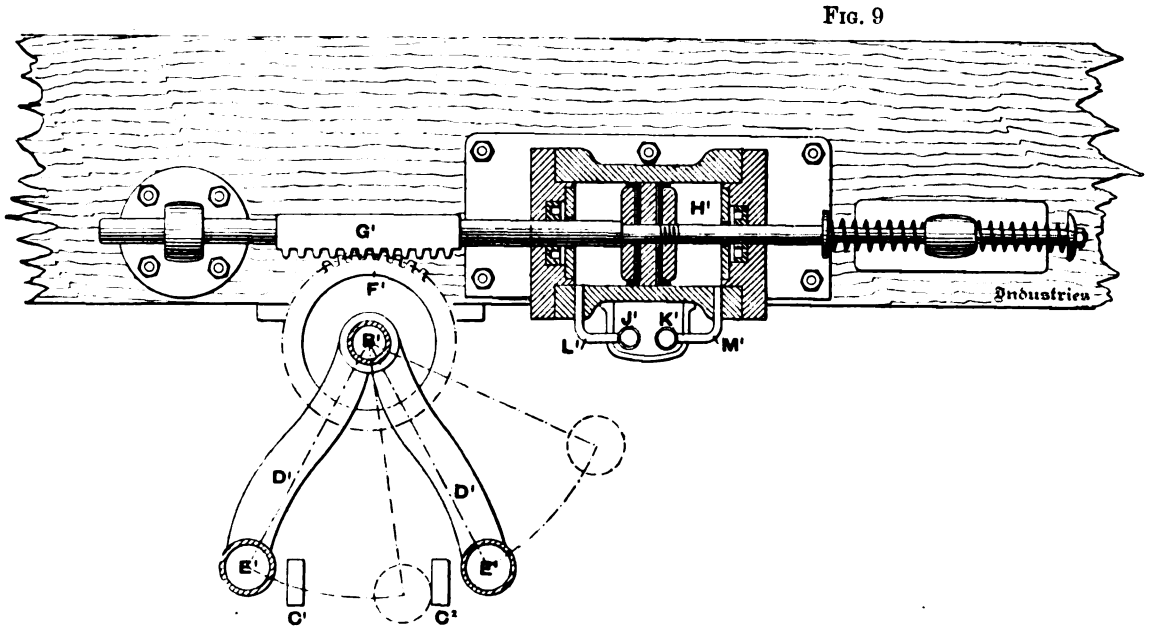


FIG. 10.

THE FRICTION AND LUBRICATION OF CYLINDRICAL JOURNALS.

AT a meeting of the Manchester Association of Engineers, held on the 22nd ult., Mr. John Goodman, A.M.I.C.E., Professor of Civil and Mechanical Engineering, Yorkshire College, Leeds, read a paper on the above subject.

After stating the general laws of friction, the author proceeded to describe Thurston's, Towers', Stroudley's, and his own testing machines. He then summarised the conditions upon which the friction of lubricated surfaces are dependent, as follows:—(1) The intensity of pressure between the sliding surfaces; (2) the velocity of sliding; (3) the temperature of the journal; (4) the shape of the brasses and position of oil grooves; (5) the method of lubrication; (6) the materials of which the sliding surfaces are composed; (7) the time the load acts upon the bearing; (8) the physical properties of the lubricant.

A meagrely lubricated surface is in an intermedate condition between dry and wet, and the way in which the friction varies with the pressure entirely depends upon the efficiency of the lubrication. The relation between the frictional resistance and pressure with bath lubrication is shown by the formula $F = \frac{P + 10000}{K}$, where P = total pressure normal to the surface and K a constant determined by experiment in each case. In the case of pad lubrication the following formulæ are approximately correct:—First (saturated pad), $F = \frac{P + 500}{K}$; second (ordinary pad), $F = \frac{P + 50}{K}$.

Mr. Wellington, Professor Kimball, and others found that the friction of journals revolving at a very low speed is abnormally high and gradually decreases as the speed is raised to about 100ft. per minute. This is illustrated by a series of tables. Beyond the speed named Mr. Towers' experiments show that the friction varies approximately as the square root of the speed when the lubrication is good, the load in every case being over 400lb. per square inch. The author's experiments show that when the nominal load per square inch is below 60lb. the frictional resistance regularly decreases

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with a reduction of speed, but when the intensity of the load is greater the frictional resistance falls below about 50ft. per minute. This appears to be accounted for by the fact that the greater load squeezes the lubricant out at low speeds. If the speed remains constant the load at which the change point occurs varies in an inverse ratio to the temperature, the lubricant when heated becoming more fluid and more easily squeezed out. This action is aided by any jar or vibration of the bearing. Generally speaking, the friction varies inversely as the temperature of the journal, so long as the temperature is not excessive. The varying viscosity of the oils used renders it impossible to formulate anything approaching a definite law.

As the result of over a thousand experiments made by the author in 1886, he found that the frictional resistance of a brass may be enormously reduced by cutting away the sides. For instance, if the width of the brass be made one-half the diameter of the journal, the friction will be less than one-half that of a semi-circular brass. The practice of railway engineers confirms this, as the width of the brasses is usually $\frac{5}{8}$ to $\frac{3}{4}$ the diameter of the journals. The author is of opinion that when a reduction is made the brasses should not be made less than $\frac{7}{10}$ of the diameter. In making a number of experiments with brasses which were bored on the crowns, the author found that the oil escaped through the hole so formed. He fitted the oil-hole with a screw-down valve, and found that when the valve was closed the friction was reduced 25 per cent., returning to the higher value when the valve was opened. From further experiments made the author demonstrated that the practice of putting oil holes or grooves along the resultant line of pressure is radically wrong and should be studiously avoided.

There are three methods of lubrication—bath or perfect, pad, and siphon lubrication. The advantages of bath lubrication were many, but it is sometimes urged that it cannot be carried out in practice. Pad lubrication is effected by a woollen or felt pad kept soaked with oil and lightly pressed against the journal, the necessary supply being obtained by lamp cotton communicating with a reservoir or by an ordinary siphon lubricator. This system is very economical, this being demonstrated by the following experiment:—A new pad weighing 14 drachms was supplied with 2¼oz. of rape oil and placed in contact with a 7in. journal, the total load on the brass being 4,984lb., or 237lb. per square inch. At the end of 319,660 revolutions, equivalent to 1,239 train miles, the pad was weighed, and found to be 2oz. 2drms., only 1oz. of oil having been used. The velocity was 166 revolutions per minute, the mean temperature of the journal was 130° Fahr., rising to 145° Fahr. at the end of the experiment; the mean coefficient of friction was 0·010, rising to 0·012. Siphon lubrication not only wastes oil, but very inefficiently reduces the friction. In some experiments made by the author to determine the rate of deterioration of oil, it was found that every time the oil was used in a siphon lubricator it lost about 5 per cent. of its lubricating property, the temperature and friction both being higher. The relative values of the three systems are shown in the following table, the friction produced being thus clearly shown:—

	Oil Bath.	Saturated Pad.	Ordinary Pad.	Siphon.
Towers.....	1·00	—	6·48	7·06
Goodman	1·00	1·32	2·21	4·20

With reference to the nature of the bearing surfaces the author's experiments show that there is little variation with different kinds of gun-metals, that white metal patches are distinctly an improvement, and that cast iron when well lubricated gives good results.

The effect of time upon lubrication was dwelt upon, and Professor Goodman said that, to avoid the squeezing out of the oil when a journal runs under a constant load, that load must be much smaller than if the load were only applied for a short space of time. For instance, the dead load on axles rarely exceeds 450lb. to 500lb. per square inch, while in connecting rods, where the load is applied for the fraction of a second, it often amounts to 2,000lb. per square inch on the big and 5,000lb. on the small end.

The function of a lubricant being to separate the metallic surfaces of a journal, the resistance to sliding becomes simply that of shearing this thin film of oil. By a special apparatus the author has succeeded in measuring this film, and finds it to be from ·0001 to ·0004 of an inch, which almost exactly agrees with Professor Reynolds' calculation. The shearing resistance of an oil is simply another term for its viscosity or "body." The greater the viscosity the greater the resistance to shearing, and the frictional resistance of a well-lubricated bearing depends upon the viscosity of the lubricant. It does not follow that an oil with a low viscosity should be chosen, as it squeezes out more readily. There is, further, the influence of temperature, which rapidly reduces the viscosity of an oil. For this reason solid lubricants are sometimes advantageously used, although the natural coefficient of friction and the temperature are much higher than is the case with oil. The natural coefficient and temperature are those to which a bearing attains when running with an ample supply of lubricant under a given load and speed. After standing, however, oil often gets squeezed out, and a good deal of frictional resistance and heating occurs which do not happen with solid lubricants. This is shown by the following table, the load being 58lb. per square inch: u = coefficient:—

Lubricant used.	Natural u	Temperature C.	u of rest after standing 16 hours.	Ratio of u of rest to natural u.	Ratio of Natural u.	Ratio of Rest u.
Bells' asbestos oil.....	·0084	34°	·192	22·9	1·0	2·1
Price's valve oil { B thick..	·0252	50°	·147	5·8	3·0	1·6
Price's valve oil { A viscous	·0329	37·5°	·1715	5·2	3·9	1·9
Bells' Asbestoline ..... } Hard solid grease ..... }	·0350	40°	·09	2·6	4·2	1·0

The author then proceeded to give the result of a number of experiments in which the chord of the brass was reduced. The arrangement must be such that the resultant line of pressures bisects the chord at right angles, in order that the wear may be symmetrical about that line. He contended that with a well-fitting semi-circular brass the wear takes place on the "off side" of the brass, and continues to do so until it subtends an angle of about 100°, when the wear becomes central. If the chord be still further reduced, the wear takes place on the "on side," as it does with a loosely fitting brass. The wear was greater on the off side, even with narrowed chords, when a groove and oil-hole was placed at the top of the brass. The author is of opinion that the film of oil carried round by the shaft exercises a wedging action, and forces the shaft over to the off side. If, therefore, the brass be reduced in width the area of the wedge would cover a greater proportional surface of the journal and make the wear more central. The presence of a groove and oil-hole at the top of the brass in the line of pressure was strongly condemned, as in every case experiment showed that it resulted in imperfect lubrication of one part of the bearing. It was recommended that the bearings should be made to subtend an angle of 90°, the wear being then nearly central.

Dealing with the general design of bearings, Mr. Goodman thought that, instead of taking the load per square inch as a basis of design, the number of thermal units a given area is capable of conducting away was better. The result of several thousand experiments showed that a gun-metal bearing working on a steel axle will keep cool when one square inch of surface is allowed for every thermal unit conducted away per minute. Let P = total pressure in pounds on the journal, w = the assumed coefficient of friction, s = the speed of journal surfaces in feet per minute, A = nominal area of brass in square inches, *i.e.*, length × width of chord, and r = revs. per minute, the values of u being given as follow:—

	Above 100ft. per Min.		Below 100ft. per Min.
Bath lubrication ...	·010	.....	$\frac{0{\cdot}12}{s}$
Pad do.	·012	.....	$\frac{0{\cdot}12}{s}$
Siphon	·015 to ·02	.....	$\frac{0{\cdot}15}{s}$ to $\frac{0{\cdot}2}{s}$

Then the frictional resistance = P u : foot lbs. of work done per minute = P u s : thermal units generated per minute = $\frac{Pus}{772}$: A = $\frac{Pus}{772}$. Wherever practicable, bearings should have about 1 per cent. of their length of end play. The brasses should never subtend more than an angle of 90°, the sides being cut away and pads inserted. An engine fitted with bearings of this type gave a mechanical efficiency of 90 per cent., and the report of its test stated that "the amount of lubricant used during the experiment was very small indeed." The right lubricant should be found by experiment, and once found should always be used.

The author then dealt with the question of ball bearings, and referred to certain experiments he had made with an ordinary "Rudge" bicycle bearing. The following laws appear to hold for the special bearing used:—(1) The coefficient of friction of ball bearings is constant for varying loads, hence the frictional resistance varies directly as the load; (2) the friction is unaffected by a change of temperature. The coefficient of friction with ball bearings is rather higher than that of plain bearings when bath lubrication is used, but it is lower than when they are lubricated by the ordinary methods.

The discussion on this paper was opened by Mr. Buckley, who said that, while he did not question the accuracy of the experiments made, he did not agree with some of the author's conclusions. He thought a bearing wore on the on side, for as a shaft was a roller the tendency was always to the front. If the side of the bearing was removed he contended the shaft would roll out, and for that reason the proposed construction of pedestal would be quite inapplicable to the case of a mill engine or shafts. The question of lubrication was a most important one, in view of the increase in the size of mills, and generally he questioned whether there was much improvement during the last thirty years. The application of a bearing determined its shape, and this was a cardinal feature. In one case of a bearing 10in. or 12in. diameter by 2ft. 6in. long, with a heavy weight upon the shaft, the difficulty of heating had been overcome by cutting in the journal three recesses or grooves, so that these became filled with oil, and thus fed the rest of the bearing.

Mr. Hans Renold gave some particulars of American bearings which he had running, and said this question appeared to be more closely studied in America than in England.

Mr. John Taylor said the proposed bearing was very old. Continuous feed pedestals had been made by one firm in Manchester for many years with great success. In many cases the brasses were made too thin, and bent up so as to clip the shaft, scraping off the lubricant and causing heating. The item of cost too often interfered with a good job, as manufacturers did not pay a price permitting of a perfect piece of work.

Mr. Nasmith said that it appeared to him the paper was of value as formulating a number of facts which were useful. It was hardly possible to put a 10in. or 12in. shaft into a testing machine, but the results obtained with smaller sizes gave an indication of the behaviour of all shafts. He thought the plan named by Mr. Buckley was practically bath lubrication, and saw no reason why the construction advocated by Professor Goodman should not be successful. The Mohler pedestal and the American type of universal bearings were successful instances of continuous lubrication, but the most striking instance of the continued use of oil was probably found in the quick running spindles in ring frames. These revolved 9,000 times a minute and ran for six to nine months with one small charge of oil, the abrasion being very slight in that period. In the care of shafting within a mill or workshop there was a good deal of room for improvement, as it was certain that an enormous loss of power arose from the imperfections of the bearings of line shafts.

Mr. Daniels said that his experience showed the accuracy of the author's conclusions with regard to railway practice. It was found that if too large a brass was used it was not long before a knock of the journal developed.

Mr. Buckley explained that he did not advocate a tight-fitting bearing, and it was a common practice to counterbore steps, side bearing being an evil, except in cases of side pressure. He knew of a pair of necks, 14in. in diameter by 2ft. 3in. long, on a shaft making 54 revolutions and developing 1,100 h.p., the oil consumption of which was one pint each per week.

Mr. Constantine said his experience with marine engines bore out Mr. Goodman's remarks. He had known cases in which brasses were grooved at the bottom, without being bored, with good results. When he was engineer of a large Atlantic liner, at that time the largest afloat, in one of the trips westward heating of one of the journals was incessant. On examining the journal in New York flaws were found, and grooves were cut in with round-nosed chisels to find their extent. The result was that on the return trip the journal worked satisfactorily without heating.

Mr. Rea said the importance of the subject was very great. He had known cases where, out of total power of 1,000 or 1,200 h.p., the friction diagram represented 170 to 200 h.p. He thought it would pay millowners to employ engineers to periodically test bearings. He objected to the pad, because he thought it got dirty and gritty. In dealing with the bearings of large shafts, he made the brasses square on the outside and cut out grooves in the corners, thus providing oil storage. The weight on the journal should be reduced to its lowest point. He had under his charge an engine, which had been running continuously every week from Monday morning to Saturday evening since 1884, the slide block of which had never touched the slide bar during the whole of that time. It was therefore possible to perfectly lubricate sliding surfaces.

Mr. Marshall said his experience showed him that to cut away the brasses as suggested was quite feasible and tended to preserve the shaft. He had an upright shaft working, the footstep of which had not seen the light of day since 1867, and had not in that time worn down ⅛in.

Mr. Goodman, in reply, said that locomotive bearings always wear forward. Pads may be old, but the question was, how many are used? He had cured a number of chronic hot bearings by the adoption of bearings on the principle he had indicated. The brasses must, of

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course, be arranged to suit the resultant lines of pressure. If asbestos pads were used no danger of firing occurred, nor did pads clog if mineral oils were used. If the sides of the brasses were cut away they could not pinch in. End play in shafts was important, and the cutting of spiral grooves was also beneficial. Grooves without oil holes were valuable, but were worse than useless if oil holes were provided. He was engaged in the construction of a testing machine by which loads up to 20 tons could be applied, and he hoped to get a number of valuable results from it. He entirely disagreed with Mr. Buckley's contention as to the rolling action of a shaft, and maintained that in a well-fitting bearing the off side would always be worn.

THE CENTRAL ELECTRIC SUPPLY STATIONS OF PARIS.

Central station lighting has developed very rapidly in Paris since last year; an account of some of the most important may, therefore, be of interest to English readers. We will discuss the following central stations in turn:—

1. Cie. Française, on the compressed air system.
2. The Cie. Française, on the rarefied air system.
3. Cie. Edison.
4. Société anonyme pour la transmission de force motrice.
5. Société anonyme du Secteur de Clichy.
6. Municipale.
7. Various.

The Central Station of the Compagnie Francaise pour l'Air Comprimé.—In 1883 M. Popp installed a system of distribution of power by means of compressed air. The works are situated at the Lac St. Farjeau. This mode of distributing power has already been described in this journal, so a further explanation is unnecessary. The reader may be reminded, however, that on the 1st July, 1889, the power of the works of St. Farjeau was 3,000 h.p., and the length of the main arteries of distribution of compressed air was 55 kilometres. Since that time M. Popp has utilised compressed air in setting up a large number of small electric light installations, the dynamos being driven by compressed air motors. Among the most important installations are those of the Rue de Bondy, of 50 h.p.; the Passage des Panorames, 100 h.p.; la Rue Caumartin, le Boulevard des Capucins, 50 h.p.; la Rue Ste. Anne, 20 h.p.; la Rue de la Franche Comté, 20 h.p.; and the Théâtre des Variétés, 50 h.p. This system of distribution of power by compressed air permitted a great extension of house-lighting at a time when large electric light stations did not exist, and the installations in private houses have been very numerous.

In 1888 the Conseil Municipal de Paris went into the question of granting concessions for electric lighting to several companies. M. Popp applied for a concession for one section of Paris, and it was granted to him. He was thus obliged to change his mode of distribution. He devoted himself to the development of three sub-stations which could distribute electrical power direct to private houses. These stations are as follow:—

1. L'Eden Théâtre.
2. Buen-Retiro.
3. La Bourse de Commerce.

The first two have been completed, and are in actual use; the third station is still in the hands of the contractors. Before the company reduced its system down to three stations it had several small installations, which have since disappeared, but which are well worthy of description. In Rue Meyerbeer there was a sub-station with accumulators charged from the Eden Theatre station, but it has since been shut down. During the Exhibition there was also a station on the Boulevard des Capucins driven by compressed air motors, and it supplied 40 Thomson-Houston arc lamps installed on the boulevards by the Popp Co. These lamps are now supplied from the station of the Buen-Retiro or from the Eden Theatre.

The three main stations may now be described.

The Eden Theatre Station.—This station is established in the basement of the theatre. It consists of two compressed air engines of 50 h.p. each, by Messrs. Davey, Paxman, & Co. A six-horse vertical engine works an Anthonay ventilator. Each of the air motors drives an inverted Gramme machine giving 500 volts and 70 amperes. These machines charge accumulators fixed in different places. Special batteries of accumulators are devoted to the supply of the Eden Theatre. Three batteries supply a neighbouring café, and three others Les Montagnes Russes, an establishment close to the station. At first, Les Montagnes Russes had a compressed air motor of their own, which is now replaced by this battery. The station also has a Thomson-Houston dynamo, giving 2,000 volts and 6·4 amperes, feeding 48 Thomson-Houston arc lamps. The Eden Theatre station is connected with that of the Buen-Retiro, so that in case of accident to either the other can supply power for both.

The Buen-Retiro Station.—This station is not supplied with power by compressed air, but has its own steam engines. The generating plant consists of six locomotive boilers of 50 h.p. each by Messrs. Davey, Paxman, and Co., and six double-cylinder 50 h.p. horizontal engines by the same makers. There are four 2,400 volt Thomson-Houston arc lighters, and two inverted Gramme dynamos giving 250 amperes and 110 volts. These last charge eleven batteries of 50 Philippart cells each.

Bourse de Commerce.—As will be explained immediately, this station should be a very important station in the near future. As it was very requisite to distribute electric power in this district, a provisional service has been established. This consists of two 50 h.p. tubular locomotive boilers by Messrs. Ransomes, Sims, & Jefferies. They drive two inverted Gramme machines, giving 110 volts and 250 amperes each, and these charge two batteries of fifty Gadot accumulators, having a mean capacity of 300 ampere hours. These accumulators in their turn, charge others at distant points of supply. There are installations run in this way at the Bazar de l'Hôtel-de-Ville, and at a furrier's (MM. Révillon). In the latter there are five batteries of 39 Philippart accumulators each. There are 1,300 or 1,400 16-candle lamps running at 10 volts.

There are already two compressed air Davey Paxman motors of 50 h.p. each, and there will be eight or ten. Each of these motors works a high-pressure continuous current, and in each circuit an apparatus invented by M. Solignac will be placed. This apparatus consists essentially of a rotating drum which introduces variable resistances. This causes the main current to vary, and the variable current so produced is to be used to work transformers.

The reader will see from this account that the installations of M. Popp can hardly be taken seriously. Distribution of power by compressed air can never be economical, as an elementary knowledge of thermodynamics would seem to show. Moreover, the distribution of power by means of artificially varied direct currents and transformers will not strike electrical engineers as very promising.

(To be continued.)

NOTES ON ALLOYS.

III.

Mr. James Riley has recently given the public his views and experience on the new steel alloys. He stated in his lecture to the Greenock Philosophical Society that the use of aluminium in the manufacture of steel is not so advantageous as is usually maintained. Although when added to molten steel it greatly increases the fluidity of the mass and lowers the melting point, and thus enables sound castings to be made, equally good results can be obtained without its use. The strength and ductility of the steel is also not improved by additions of aluminium. In speaking of the chromium steels, which are being used for protective plates, he pointed out that the expense of this metal was a considerable drawback to its general use, not only on account of its original cost, but owing to the great loss incurred by oxidation of the metal in the manufacture of the alloy. Considerable care and skill are required in the production of chrome steel to get the necessary amount of chromium alloyed to the steel in presence of the requisite quantity of carbon. As a general result of adding chromium to steel, he points out that increased hardness and strength is accompanied by a slight loss of ductility and greater difficulties in machining. It can be very readily hardened and tempered in water or oil, but in working at the hammer or rolls care must be taken that the masses of steel are heated very gradually and not to a high temperature. He praises in very warm terms nickel steel, and believes it to be "the most important of the alloys, and the one which is likely to prove of greatest interest, because of its great utility." With the addition of 7 per cent. of nickel to the steel, the hardness and tensile strength are considerably augmented, and at the same time the elastic limit is raised, and the finished product is far more durable and less liable to corrosion than the best unalloyed steel. With a larger percentage (from 7 to 20) the alloy becomes brittle and practically valueless for machining, but with a still greater proportion of nickel the alloy again possesses great ductility, high tensile strength, and non-corroding properties. Nickel steel, if used for boilers, can be safely employed for nearly double the ordinary pressure without increasing the weight or dimensions. We have already alluded to the recent discoveries of large quantities of nickel ores both in America and Europe, so that there seems no reason for doubting that nickel steel can be manufactured at prices which will not be considered at all unreasonable.

Some of these new steels have recently been examined by Herr A. Ziegler with a view to ascertaining the most convenient and ready method for estimating the percentage composition of the alloy. As these alloys are introduced into the manufacturing world, it will be very necessary that their chemical composition be checked, as slight variations in the amounts of the added metals give very marked changes in the physical properties of the alloys.

Herr Ziegler at present has only worked out processes for the tungsten and chromium alloys, of which the following is a short abstract. Those of our readers who may desire further details of these processes may refer to the original paper in *Dingler's Polytechnic Journal*, 274, 513–528. Ferro-tungsten is best analysed by warming a known weight of the finely powdered alloy for some time with dilute aqua regia, and finally evaporating the solution with excess of strong nitric acid to as near dryness as possible. The residue is then treated with ammonium nitrate and nitric acid, and filtered. The insoluble portion consists of tungstic acid, silica, and any unattacked alloy, while the filtrate contains iron and manganese and traces of silica and tungstic acid. The tungstic acid and silica in the residue can be dissolved from the unaltered alloy by hot ammonia, filtered, evaporated, dried, ignited, and weighed. Mercurous nitrate can be used to precipitate the traces of tungstic and silicic acids in one portion of the solution, while the iron and manganese is estimated in another. The silicon is best obtained by difference—that is, after having found the total weight of tungstic acid and silica, the mixture is heated with hydrofluoric acid and re-weighed, the loss being equal to the amount of silica present.

Tungsten steel is analysed by first warming it with 80cc. of nitric acid, sp.g. 1·2, and then adding 100cc. of sulphuric acid (1:3) and evaporating until acid fumes begin to be evolved. Water is then added, and the residue, consisting of tungstic acid and silica, is weighed, treated with hydrofluoric acid, and re-weighed as in the case of ferro-tungsten. The filtrate is used for estimating the iron and manganese, and carbon is determined by Eggertz's method.

Ferro-chromium is best obtained in solution by fusing it with sodium nitrate or a mixture of sodium carbonate and potassium nitrate. The melt is extracted with water, the solution containing the chromium, and the residue iron and manganese. This residue is then dissolved in hydrochloric acid, and any insoluble residue re-fused. The solutions are then mixed and acidified, evaporated to dryness, and the residue weighed as silica and confirmed by treatment with hydrofluoric acid. The solution containing iron, manganese, and chromium is then examined as follows:—

Sodium hypophosphite is added to the boiling solution until the colour is pure green and zinc oxide stirred in while still hot; the precipitate is quickly filtered, washed, re-dissolved, the reduction and precipitation repeated, the precipitate dissolved in hydrochloric acid, precipitated with ammonia in excess, dried, ignited, and weighed as chromium oxide. Chromium steel is soluble in hydrochloric acid, and is examined in a similar way to the ferro-chrome. The author does not advocate the use of copper ammonium chloride. Carbon is best estimated by burning the finely divided alloy in oxygen, as Eggertz's method cannot be relied on unless chromium steel be taken as a standard.

THE SOCIETY OF CHEMICAL INDUSTRY.

MANCHESTER SECTION.

At the annual meeting, held on the 1st inst., Dr. Bailey gave an outline of a paper which he hoped to give in detail at a future meeting. The subject was a novel one, being a ready method of analysis by finding the specific gravity of a compound without weighing it.

Mr. Grimshaw then communicated two laboratory notes. The first referred to some experiments he had been making to determine the dissociation point of some of the metallic chlorides. The method of experiment employed was to titrate a known weight of the solution of the chloride with decinormal silver solution, expose the same weight of the solution to various temperatures, and titrate again. An indication was thus obtained of the loss of chlorine. Mr. Grimshaw stated that the dissociation of chlorides was an important point in the textile industries, especially where the goods had to be heated.

The second note was on an improved form of air-bath. There is a double casing, and there are arrangements for a constant temperature being obtained. The apparatus is made of sheet iron and brass instead of copper.

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GLASGOW AND SCOTTISH SECTION.

At a meeting, held on the 1st inst., Mr. R. R. Tatlock, Glasgow, contributed a short paper on "The Fatty Acids of Olive and Other Oils." He said that in estimating the fatty acids in olive oil soap he had noticed that after the acids were completely dried they continued to lose weight by exposure to the heat of the water oven, which was usually at a temperature of 190° Fahr. That this loss resulted from the volatilisation of some acid body which had been in combination with soda there could be little doubt, and subsequent experiments confirmed that view. He was of opinion that this volatile substance was in reality a portion of the true fatty acid.

A paper on "The Estimation of Cobalt and Nickel" was then read by Mr. James Hope. He said that the separation of cobalt from nickel had always been a matter of difficulty to the chemist, and he thought he was justified in putting on record a complete process which, although not quite new, was not generally known. That process consisted of two operations—separation and determination of the cobalt by the "phosphate method," and the determination of the nickel by electrolysis.

LIVERPOOL SECTION.

At the annual general meeting, held on the 2nd inst., a paper was read by Mr. E. J. Ballard on a new method of using luminous calcium sulphide (Balmain's luminous paint) for actinometrical purposes, with description of a new actinometer for photographic purposes. The author described a new actinometer he had constructed, in which advantage is taken of the rate of fading of calcium sulphide illuminated to its maximum intensity by a preliminary exposure to daylight. The law regulating this rate of fading had been worked out, and a table constructed from the curve obtained.

Mr. A. F. Fryer communicated a note on a beautifully crystalline boiler deposit, taken from the boiler of a steam tug. It consisted essentially of anhydrous calcium sulphate, together with a little meno-hydrated magnesium sulphate (kieserite) and alumina. In appearance it resembled satin-spar, and was crystalline throughout almost the whole of its mass.

Dr. F. Hurter described a most ingenious instrument he had contrived for the measurement of the intensity of diffused daylight, and also exhibited the "Actinograph."

Notes.

A NEW STEEL WORKS IN WEST CUMBERLAND.

THE new steel works, erected by the Hampton and Facer "Special" Steel Ingot Company, at Maryport, Cumberland, were started on Thursday in last week, in the presence of a large number of gentlemen interested in the iron and steel trades. When completed the works will include rolling mills and a foundry, and will give employment to about 400 hands. The company was formed for the purpose of working out a new system of ingot casting devised by Messrs. Hampton and Facer. The advantages claimed for the new system are numerous, and include greater soundness and homogeneity, the absence of the expense of "cogging down," the securing of good sound tops, and the regulation of the weight of each ingot. The Bessemer plant includes two 5-ton converters, two pig iron and two spiegel cupolas, four new hydraulic cranes, two centre-casting hydraulic cranes, and a pair of blowing engines. The blowing engines are by Messrs. Walker, Eaton, & Co., Sheffield, and will work up to a pressure of 25lb. per square inch. The output of the works will be about 1,000 tons per week, the principal portion of which will be supplied to the Sheffield trade for the manufacture of cutlery, springs, chisels, &c.

ARDROSSAN HARBOUR WORKS.

LAST week a special train was run from Glasgow to Ardrossan, with the board of directors of the Caledonian Company, in order that they might make an inspection of the new harbour works which have been under construction for some years past. When completed, which will be early next year, the harbour will be in every way suited for the carrying on of a large trade, which it is expected to develop, as it is in direct connection with the Lanarkshire and Ayrshire Railway, and thus offers a convenient point for both exporting and importing raw materials and manufactured goods. The present harbour resources include a wet dock of considerable size, and tidal quays, where cargo boats which do not go into the dock can be accommodated; while in connection with it there is a shipbuilding yard, with an excellent graving dock and slip, where shipbuilding and repairing may be carried on. The new works add a wet dock capable of taking in steamers of the largest dimensions, and a new tidal basin and piers which will give accommodation for a greatly increased traffic. The whole of the works are to be protected by a substantial breakwater, which will shelter the harbour from the force of the north-west storms. The area of the new dock will be nearly ten acres, and that of the new outer basin about seven acres, and they will have a depth of 18ft. and 27ft. at low and high water respectively. A contract has been made with the Hydraulic Engineering Company, of Chester, for a supply of all the most recent hydraulic appliances and for the machinery for working the dock gates. Station accommodation will be provided at the terminus of the Lanarkshire and Ayrshire Railway at the new pier, and the contracts for a large station shed have been given to Messrs. J. & G. Findlay, Glasgow. The firm at present carrying on the principal parts of the dock and harbour works is that of Messrs. Lucas & Aird, contractors, London, and the engineers are Messrs. Strain & Robertson, Glasgow. The cost of the whole works, when completed, is expected to be close upon £200,000.

STATE OF JOHANNESBURG.

THE present state of the town and district of Johannesburg is another example of the dangers arising from over-speculation, and too great a rush to any particular spot. Fortunes were being made—at least, on paper—so rapidly, that people of all kinds went to the district in crowds. Now, however, the reaction has come, and hundreds are leaving for Cape Colony, when they have the means to take them there. Those who have not the means have been reduced to dreadful straits. The cause of the depression is the state of the share market. Gambling in stocks became the chief occupation, and the people seemed to be governed by nothing else, and never thought of developing the mines and keeping up the return of gold to the anticipated yield; the town, in short, became a speculating and not a mining centre, and now when the banks, to secure themselves against loss, have called on all those who have overdrawn, the result has been the forced sale of property at ruinous prices. Still, however, building is going on, and the town is being very much improved, but drainage is bad, and fever is reported to be raging. Altogether it does not seem to be a very desirable place of residence.

REPORTED NEW LINES OF ATLANTIC STEAMERS.

IT is stated that the charter constituting a company for a fast line of steamers between Canada and Milford Haven has passed the Dominion Parliament, and is now before the Senate. The object of the company is to reduce the Atlantic voyage to something like 1,700 miles, as against 3,052 miles between New York and Liverpool. It is proposed to construct a railway along the north shore of the River and Gulf of St. Lawrence, from Quebec to St. Charles Bay, on the Labrador coast, a distance of 844 miles, and with steamers making 20 knots an hour it is expected that the voyage between St. Charles Bay and Milford Haven will be made in 3 days 13 hours. It is expected that this route will take the bulk of the Western passenger business, and of the shipment of perishable freight, as the distance from Chicago to London will be covered in six days. The names of those who are promoting the scheme seem to show that it is a genuine commercial undertaking, and that it will be prosecuted with energy. It is further reported that a syndicate has been formed for providing a fast line of steamers to be run between New York and Milford Haven, at a minimum speed of 20 knots an hour. The members of the syndicate are mostly Americans, and consist, among others, of the presidents of the three leading United States railways, and they intend to have all the ships built in the United States.

SUBSIDIES FOR AMERICAN SHIPPING.

TO carry out the idea of binding the various countries of North and South America into one large self-contained community, the Pan-American Conference has recommended that one or more lines of steam navigation should be subsidised between the ports of the United States and certain important South American ports. It is proposed that the countries receiving Government aid will establish a fast bi-monthly service between the ports of the United States and Rio Janeiro, Monte Video, and Buenos Ayres, and that the vessels shall have the accommodation and capacity necessary for the transportation of freight and passengers and shall carry the mails. The speed of the fast steamships is to be at least 16 knots an hour. In addition, an auxiliary line of freight steamships, to sail twice a month, making not less than 12 knots an hour, is recommended. The contracting States are to have the right to impose their flags and register on the vessels to a number proportionate to the percentage of the aid they pay. Only vessels constructed in the United States are to be accepted, in consideration of a higher percentage of aid paid by them. This last provision we consider a very acute one in the interests of the ironmasters and shipbuilders of the United States, for it not only secures to them a monopoly for their own country, but also for all the countries which agree to the terms proposed by the Conference. A very strong feeling is, however, being developed against measures of this kind in the United States, and possibly the proposals we have mentioned may not be ratified.

ARGENTINE SECURITIES.

FOR some years past the Argentine Republic, both as a Government, and by local loans of various kinds, has been one of the heaviest borrowers on the European money market, and, although the great resources of the country have been fully recognised, still it has been felt by those who took a statesmanlike view of the matter that too much was being attempted at one time. The too great hurry in every department has led to a financial crisis, and gold has in consequence gone up to a very high premium, and all Argentine securities have fallen very much in value. We think that the country has a great future before it, if it only be governed wisely, and we are pleased to know that the Government has resolved to meet the economic crisis by immediately adopting energetic measures. Considerable reductions have been made in the Budget expenditure for the present year, and next year's Budget will also show a great reduction in expenditure. The Government has ordered the suspension of all concessions with Government guarantees to new railroad companies and other undertakings creating fresh obligations. The Provincial Government is going to be ordered to suspend the issue of Mortgage Cedulas, and all the provinces will also be ordered to make no further issues of credit paper, and to abstain from working any exterior loans. The Government has resolved that all guarantees given to railway lines be paid on the 1st of January and 1st of July of each year, even if the accounts have not been examined and approved. The issue banks will not be allowed to increase their note circulation, and the Government proposes to diminish the issues made.

EXPLOSION AT THE BELL ROCK.

ON Saturday evening an explosion occurred at the Bell Rock, which had the effect of placing the lighthouse in darkness. About the middle of last month there was fitted up at the lighthouse a cotton powder explosive signal, which during thick weather or snow showers was fired once in ten minutes. The charges of cotton powder are connected by the wires of an electric fuse and detonator to a cable, attached to a lever or jib fitted to the roof of the lighthouse, and the electricity is supplied by a small magneto-electric machine placed inside the light room. The charges for producing the explosion consist of small cylindrical discs of dry cotton powder coated with paraffin, and having a small hole up the centre to receive the detonator, which is a copper tube containing a fulminating composition. Since the apparatus was erected the signals have been used during foggy weather, and the report is so loud that it is distinctly heard in Arbroath, at a distance of twelve miles. On Saturday night, when the weather was thick, and arrangements were made for the signals being fired, about ten o'clock one of them exploded prematurely, or, at all events, the explosion had the effect of injuring the dome of the lighthouse, which is also the light room. The windows were blown out, all the internal fittings smashed, and the framework of the room damaged. It is not yet reported how much damage is done to the machinery, but it is supposed that it is not very great. As, however, it is paraffin oil which is used for the light, it was impossible to light the lamps on account of the glass in the windows being smashed, and fog signals were fired every ten minutes as a warning to vessels. Workmen have gone from Edinburgh to repair the damage, and it is expected that the lighthouse will soon be in its normal condition. The man who was in charge at the time of the explosion was knocked down and rendered insensible, although he does not seem to have been injured otherwise than by the nervous shock.

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Patent Record.

(Compiled from "The Illustrated Official Journal (Patents).")

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

24th March, 1890.

4556. Rainforth, Sen., Rainforth, Jun., & Rainforth ..... Screens for dressing corn.
4563. Hart, W. F..... Sole edge burnishing machines (*Gordon & Lewis*).
4564. Thomson, J..... Calico printing machines.
4565. Mud & Powers ..... Metallic tubes and cylinders.
4567. Cooper, W. ..... Loose pulleys.
4570. Leng & Leng ..... Bottle finishing machines.
4573. Shepherd & Midgley ... Grinding flats.
4574. Kasblowsky, E..... Gas motors.
4575-6. Tangyes, Ld., Floyd, & Morton ..... Steam pumps.
4578. Imray, O..... Sewing machine (*Welch*).
4587. Mariotte, A. ..... Grinding grain.
4589. Hornsby & Edwards ... Steam boiler.
4592. Parfitt, H. T. ..... Kilns for firing glass, &c.
4594. Jones, E. ..... Apparatus for separating liquids or solids from vapours or gases.
4597. Horne & Whinfield ... Turret guns.

25th March, 1890.

4611. Ainsworth, J. T. ..... Mules.
4613. Dean & Powell..... Consumption of smoke in furnaces.
4614. Guthrie, M..... Drying apparatus.
4617. Sturgeon, T. ..... Engineering constructions.
4618. Armstrong, R. ..... Hydraulic transmission.
4621. Gatling, R. J..... Torpedo boats.
4623. Wahlin, Lundstrom, & Collins ..... Separators.
4624. Hudson, H. ..... Boats, railway carriages, &c.
4630. Rickards, J. E ..... Machines for rolling cigars.
4631. Radford, R. H. ..... Casting composite ingots.
4632. Busby, A. E. ..... Splayed cotter machinery.
4638. George, O. ..... Printing machines.
4639-40. Fox, S. ..... Boiler flues, &c.
4642. Robinson, E. ..... Circular knitting machines.
4643. Masterman, C. E..... Condensers.
4648. Degn, P. F..... Dynamo-electric machines.
4653. Davies, E. ..... Hydraulic motors.
4654. Justice, P. M..... Machines for making springs (*Swift & Davenport*).
4655. Meydenbauer, A. ..... Gas engines.
4656. Lake, H. H..... Screw propellers (*Gibert*).
4671. Boult, A. J..... Steam engines (*Stanwood*).
4672. Baer, A. ..... Check valves for hydraulic apparatus.
4674. Thompson, W. P. ..... Heading bolts, rivets, &c. (*Seaton & Seaton*).
4675. Tiefford, R. J..... Welding of metals.
4676. Weston, P. ..... Anchors.
4677. Boult, A. J. ..... Propelling rotative tools (*Veds*).
4680. Gooding & Ladd ..... Mechanism for lasting boots.
4682. Longmore & Watson ... Combing machines.
4684. Foord, W. S. ..... Printing machines.
4686. Schneider, H..... Minimising recoil in ordnance.
4688-9. Potts, I. B. ..... Pipe couplings.
4691. Haddan, H. J..... Bolting reels (*Dobson*).
4693. Fox, S. ..... Metallic articles of box-like form.
4698. Mayhew, C. J. ..... Fluid motor.

26th March, 1890.

4702. Mayoh, J. ..... Joist for floors.
4706. Wear, S. ..... Sieving apparatus.
4707. White, J. W. ..... Measuring apparatus for liquids.
4708. Whitaker, R. M. ..... Boiler furnaces.
4709. Hart, G. W. ..... Steam generators.
4714. Wilde, O..... Steam engines.
4716. Punch, R..... Making rivets.
4717. Sauvée, A. ..... Gun mounting (*Canet*).
4719. Scott, L. A..... Oil-tight and water-tight joints.
4721. Watson, H..... Malt-drying kilns.
4722. Edwards, J. ..... Reversible rail, fish-plate, and chair.
4725. Gillespie, J., Jun. ..... Rolling mills.
4727. Fulton, R. J. ..... Rolling mills.
4731. O'Neill, S. ..... Machinery for making paper tubes.
4732. Birch, W. ..... Apparatus for filtering sewage.
4735. Averill, F. W. ..... Flush bolts.
4741. Gibbs, W. A. ..... Kilns for cement.
4742. Tangyes, Ld., Meacock, & Deakin ..... Hydraulic lifting jackets.
4750. Crossley, F. W. ..... Centrifugal governors.
4764. Gasteiger, J. ..... Boiler furnaces.
4768. Lundgren, F..... Machines for filling match boxes.
4769. Lake, H. H..... Machines for manufacture of cigars (*Wertheimer*).

27th March, 1890.

4772. Nield, W. ..... Spinning apparatus.
4774. Coutts, C. ..... Air and vacuum brakes.
4776. Donkin & Hargreaves Gas valves.
4778. Sykes, T..... "Fuel economisers."
4781. Schmitz, J. ..... Utilising waste gases from flues.
4784. Faulds & Hool ..... Lubricator.
4787. Thomis, Priestley, & Priestley ..... Jacquard machines.
4793. Moorhouse & Ogden ... Reeling machines.
4805. Duncombe, I. ..... Self-sustaining motive power.
4806. Barns, D..... Boiler flues.
4808. Haddan, H. J. ..... Vacuum drying apparatus (*Passburg*).
4810. Brunton & Brewster... Manufacture of projectiles.
4811. Davidson, J. A..... Lubricators.
4813. Jenner, T. ..... Weighing machines.
4817. Grafton, H. ..... Steam engines.
4819. Pryce, H. J. ..... Operating railway points.
4820. Judson, W. L..... Street railways.
4823. Otto, N. A. ..... Gas engines.
4825. English, T..... Transporting and working guns on railways.
4826. Lewes, V. B. ..... Preventing ignition of coal cargoes.
4828. Wright, R. ..... Cranes.
4829. Noble & Murray ..... Apparatus for working guns.
4832. Oakman, R. N., Jun..... Furnaces for melting metals.
4833. Wells, C..... Hot air motors.
4837. Templeton, E. A. S..... Machine for finishing pedestals.
4838. Templeton, E. A. S ..... Boring machine for pedestals.
4844. Wilson, J. H..... Textile machinery.

28th March, 1890.

4850. Collier & Binns ..... Heating metal plates.
4854. Heys, W. E..... Machines for dyeing (*Châtel*).
4856. Brooke, R. G..... Back pressure valves.
4858. Kapp, G. ..... Dynamo-electric machines.
4861. Marsden, H. M..... Manufacture of saws.
4866. Harbinger & Bell ..... Compound gland.
4867. Watts, J. W. ..... Knitting machines.
4868-9. Merryweather, J. C. Fire engines.
4870. Weir, J. ..... Looms.
4871. Watson, T. ..... Spinning flax.
4884. Maffuniades, A. J. ..... Paper cutting machines.
4886. Thompson, W. P. ..... Roller mills (*Willford*).
4887. Purves, D. ..... Fire bars.
4892. Allen, Wright, & Allen Steam engines.
4894. Van Ollefen, W. F. D. Lifting and lowering doors of bulkheads.
4895. Cucco, G. ..... Plate steam presses.
4896. English, T..... Mountings and carriages for disappearing guns.
4898. The Harrison Self-Tightening Steel Rail-Key Co., Ld., & John Harrison..... Securing nuts upon bolts.
4899. Tavernier & Casper ... Explosive engines.
4902. Mann, M. F. J. ..... Brakes.
4911. Topliss, J. R..... Machinery for distributing type.

29th March, 1890.

4912. Martin, R. ..... Engine governor.
4923. Dixon, W. E. ..... Mules.
4924. Dewrance & Wall ..... Water gauges.
4926. Mefford, D. M. ..... Projectiles.
4927. Siddall, C. ..... Signalling apparatus for railways.
4931. Cumming, W. B..... Controlling rudders.
4932. Bateman & Sellers..... Bench vices.
4937. Blachon & Mimard ..... Sporting guns.
4945. Mumford, C. E. ..... Grain elevators.
4947. Weiss, O. ..... Petroleum engines.
4961. Redfern, G. F. ..... Spinning machines (*Defraiteur & Maron*).
4963. Reixach & Bracewell... Pile fabric machinery.

31st March, 1890.

4964. Pope & Pope ..... Apparatus for separating ground substances.
4966. Wilson & Wilson..... Boats for life saving purposes.
4967. Claringburn, J. A. ..... Knitting machines.
4968. Radcliffe, J. H. ..... Oil vessels.
4969. Scotson, W..... Regenerative furnaces.
4980. Piatkowski & Came..... Transmission of power.
4990. Booth, A. T. ..... Sawing machines.
5001. Lake, H. H..... Puddling furnaces (*York*).
5002. Lake, H. H..... Machines for sharpening knives (*Peer & Ely*).
5005. Baxter, S. ..... Gas engines (*Holst*).
5007. Nunan, E. ..... Pipe coupling.
5009. Unger, R. ..... Machine for winding yarn.
5010. Hartmann & Thomson... Leather paring machines.
5012. Tinline, Jun., & Holt... Machines for planing wood.
5013. Foley, J. S..... Locking nuts.
5017. Kirchhoff, O. ..... Collapsible boats.
5019. Richardson & Dimant... Coupling railway carriages.
5021. Rittenhouse & Dresher Punching and shearing curved plates.
5022. Deans & Foster ..... Apparatus for twisting strands.

ELECTRICITY.

24th March, 1890.

4547. Wilkinson, J. ..... Electric wires.
4557. Andersen & Girdlestone Dynamo-electric machines.

25th March, 1890.

4605. Swinton, A. A. C..... Electric switches.
4650. Palmer, H. B..... Producing intermittent motion by electricity.
4657. Lake, H. H..... Soldering metals by electricity (*Thomson*).
4670. Imray, O..... Electrical heating devices for forging machines (*Gilbert*).
4699. Kellogg, M. G. ..... Telephony.
4700. Isenthal, A. W..... Arc lamps.

26th March, 1890.

4745. Essinger & Crampton... Dynamo machines.
4761. Mensing, L. C. H. ..... Producing force by explosions of water electrically.
4767. Sherrin, J. V. ..... Electromotors.

27th March, 1890.

4791. Douglas, W. H. ..... Measuring electrical currents.
4815. Smith & Heath ..... Ships' compasses.
4821. Obach, E. F. A. ..... Insulated electric conductors.
4824. Nebel, J. ..... Dynamo electric machines.

28th March, 1890.

4846. Andrews, W. ..... Electric lights.

29th March, 1890.

4921. Perry, J. ..... Galvanometers.
4943. Balch & Bromhead ..... Batteries.
4949. Weigert, L. ..... Galvanic batteries.
4952. Contarini, A. N. ..... Electric arc lamps.

31st March, 1890.

4972. Kennedy, R. ..... Arc lamps.
4973. Kennedy, R. ..... Dynamo-electric machinery.
4974. Kennedy, R. ..... Electric meters.
4984. Robinson, J. ..... Electric telegraph.
4991. Gay & Hammond ..... Electric arc lamps.
4992. Gay & Hammond ..... Electric recording apparatus.
4993. Gay & Hammond ..... Electric heating apparatus.
4994. Sinnock, W. ..... Obtaining currents of electricity.
4998. Nichols, H. G. ..... Electric lamps.
5008. Furtado, E. F. ..... Electro telephonic apparatus.
5016. Bary, C. P. ..... Alternating electric currents.
5023. Redfern, G. F. ..... Electricity meters (*Ferges*).

CHEMISTRY.

24th March, 1890.

4560. Teague, T. ..... Refining raw tin.
4577. Imray, O..... Colouring matters (*Farbwerke vormals Meister, Lucius & Brüning*).
4588. Precht, H. ..... Carbonate of magnesium.
4596. Pitt, S..... Sulphonated thiouines (*Cassella & Co.*).
4598. Gray, W. ..... Manufacture of gas.

25th March, 1890.

4690. Haddan, H. J..... Concentrating magnetic iron ore (*Conkling*).
4694. Lawrence, E. G. ..... Salts from brine (*Pick*).
4695. Lawrance, E. G. ..... Drying salt (*Pick*).

26th March, 1890.

4751. Cowper, E. A..... Producing fine salt from brine.
4752. Cameron, D. ..... Extracting silver (*Pearce*).
4759. Precht, H. ..... Hydrate of magnesia.

27th March, 1890.

4780. Thwaite, B. H. ... . Dechlorination of salt.
4798. Burghardt, C. A..... Nitrate of ammonium.
4809. Johnson, J. Y. ..... Soap (*Duclos*).
4836. Price, J. ..... Treatment of sewage.

28th March, 1890.

4904. Pitt, S..... Dyestuffs (*Cassella & Co.*).

29th March, 1890.

4930. Hay, Alexander, & Bentz ..... Indigo.
4946. Imray, O..... Ethylether of cinnamic acid (*Farbwerke vormals Meister, Lucius & Brüning*).
4950. Ellis, A. W. ..... Distillation of ammoniacal liquors.
4959. Kellner, C. ..... Sulphide cellulose.
4960. Kellner, C. ..... Purifying paper pulp.

31st March, 1890.

5003. Eaton & Vanderbilt ... Chromium.

MISCELLANEOUS.

24th March, 1890.

4542. Fawcett & Swallow ... Block fuel.
4545. Campbell & Cameron ... Fire hose couplings.
4546. Blake, J. W. ..... Ship's lamp.
4586. Macaulay, H..... Range finding instrument.

25th March, 1890.

4607. Crane, W. E. ..... Filtering oil.
4608. Longley, C. J. ..... Wood block flooring.
4615. Bower, H. ..... Joining driving belts.
4652. Mewburn, J. C..... Purifying brine (*Peck*).
4664. Clark, A. M. ..... Flexible tube (*Almond & Fretigh*).
4669. Tyer, E. ..... Fog signalling.
4681. Thompson, W. P. ..... Graphophones (*White*).
4683. Boult, A. J. ..... Dyeing yarns (*Koblenzer & Koblenzer*).

26th March, 1890.

4739. Buckman, T. F. ..... Hose pipes.
4743. Raikem, E. ..... Fire alarm.
4760. Gray, A. ..... Signalling apparatus.

27th March, 1890.

4792. Rylands & Husselbee... Glass lined piping.
4803. Honeysett & Stanley... Slide rules.
4822. Dombrain, H. A. A..... Extracting fatty matters.

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28th March, 1890.

4847. Heys, W. E..... Tubes for spinning machines (*Châtel*).
4858. Berry & Shuttleworth Loom shuttles.
4855. Heys, W. E..... Tubes for spinning machines (*Châtel*).
4865. Barraclough, A. ..... Fire extinguishing apparatus.
4903. Samuels, W. O. ..... Extinguishing fires.

29th March, 1890.

4936. Girling, S. ..... Incandescent gas lamps.

31st March, 1890.

4976. Hawksley, G. W..... Boiling esparto grass.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form, of such opposition.

Year 1889.

5010. Andersen.
5098. Lea & Wynne.
5151. Gibb.
5170. Garrow & McKenzie.
5578. Pollok.
5643. Boult (*Carl Heinrich, Jung, & Johannes Paul Lindig*).
5878. Small & Parrish.
5945. Atkinson.
6339. Fletcher.
6365. Vom Steim.
6453. Boult (*Giussani*).
6751. Williams.
6900. Pool.
6958. Martindale.
6994. Harvey.
7074. Fell, Friedenwald, & Friedenwald.
7213. Gay.
7337. Jacomin.
7660. Sales.
7780. Morris.
7794. Gouraud (*Edison*).
7897. Bruce.
8090. Dawson.
8127. Thompson & Barker.
8198. Garfitt.
8251. Engelbach.
8324. Robson.
8329. Bradford.
8368. Bowling.
8383. Lake (*Alden*).
8409. Anderton.
8426. Baumgartner.
8473. Brown.
8531. Davidson.
8560. James-Ashburner & Okell.
8568. Pilkington.
8575. Wayte, Sayer, & Sayer.
8638. Ward.
8688. Brooke & Beaumont.
8723. Grocott.
8743. Thompson (*Kapff*).
8764. Oberwinter.
8780. De Facieu.
8783. Edwards (*Wennemede*).
8813. Abel.
8822. Matheson.
8835. Holmes & Williams.
8844. Smyth.
8860. Truffault.
8867. Sloan (*Hardtmuth*).
8871. Heartfield & Walker.
8914. Tonks & Baker.
8936. Hammond.
8940. Channon.
8965. Wood.
9030. McKenzie & McKenzie.
9037. Crossley.
9070. Flowers & Eldridge.
9090. Naylor & Kinlay.
9181. Luck.
9242. Moore.
9375. King.
9727. Richard Leach Holt & Roger Wallwork.
10196. Burchett.
10347. Beare.
11788. Dennes (*Rose partly*).
12877. Hamilton (*Doorey, Minelan, Lodge, Boniface, & Allen*).
13711. Schnarrendorf.
14137. Malcolm & Pennington.
14439. Lewis.
14788. Shillito (*Wildemann*).
15772. Bruce.
16427. Staples, Staples, & Staples.
17522. Damoizeau.
18003. Bailey.
19201. Stone.
19923. Smedley & Smedley.
20362. Paul.
5033. Frederick Waldec Moore. (25th August, 1888.)
5418. Wise (*Badon*).
5560. Von Seydlitz.
5592. Wise (*Escher, Wyss, & Co.*).
5719. Rowan.
5861. McFerran. (5th January, 1889.)
5978. Thomas & Thomas' Patent Bottle & Stopper Co., Ld.
6689. Denton.
6859. Simpson.
6928. Wilbs.
6984. Vasarhelyi & Jambor.
7058. Weatherdon (*Compere*).
7165. Munro.
7296. Smith.
7507. Timmis.
7733. The Alkaline Reduction Syndicate, Ld., & Cunningham.
8032. Fletcher.
8106. Schevelin & Mindovsky.
8210. Lucas & Allsop.
8295. Meal.
8328. Jagger.
8352. Lee & Goddard.
8382. Liebmann.
8389. Penn & Penn.
8417. Merrey & Hindes.
8455. Grundy.
8508. Baume, Baume, & Chatelain.
8565. Eddington & Stevenson.
8572. Taylor.
8587. Da Fonseca.
8603. Fischer.
8656. Hooper & Moore.
8700. Le'collier.
8742. Cass.
8763. Darerkow.
8775. Couthier.
8782. Booty.
8790. Wise (*Wehrli & Bally*).
8815. Thompson (*The Westinghouse Electric Company*).
8852. Brown.
8863. Esdaile & Co. (Ld.) & Tavener.
8909. Crompton.
8930. Hetherington.
8937. McDowell & Melsom.
8962. Baildon & Kershaw.
8990. Lennard.
9035. Stead.
9047. Redfern.
9077. Tomkins.
9112. Sheldon.
9235. Stiehle.
9337. Russell.
9586. Rope.
10115. Bechhoefer.
10121. Bywaters & Tabor.
10197. Burchett.
10476. Wharton.
12549. Shillito (*Feer*).
13454. Schreiner.
13477. Flad.
13496. Baylis.
13818. Ernst. (12th February, 1889.)
14401. Lucas.
14591. Fuchslocher.
15355. Hill & Hodges.
16372. Mander.
16781. Gabriel.
17459. Berry.
17948. Korn & Hoffmann.
18323. Nicoll.
19896. Boult (*Eastman*).
20308. Boult (*Julius Wilhelm von Pittler*).

1890.

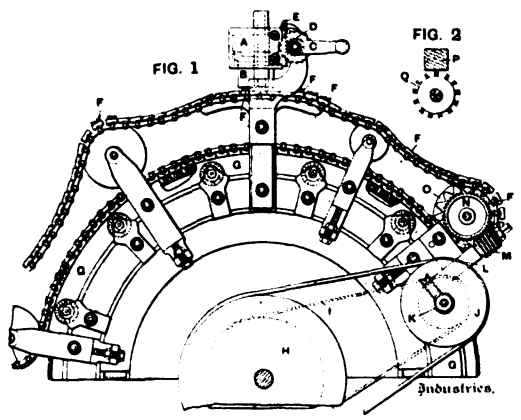
138. Clarke.
298. Baltzley.
540. Wade.
798. Nicoll.
1003. Boult (*Carl Andersson & Taye Blom*).
1265. Nicol.
1370. Wolseley.
1412. Theodor Bergmann.
1518. Griffith.
1645. Sinsel.
1814. Preston, Marshall, & Cotton.
1884. Jensen (*Underwood*).
1946. Wright.
1960. Boffa (*Müller*).
2236. Rouveyre.
2271. Justice (*Underwood*).
2369. Kössner.
2561. Lake (*Von Lovenskjold-Lovenborg*).
2625. Stevens & Birch.
2714. Hothersall.
2833. Lake (*Von Lovenskjold-Lovenborg*).
2942. Dane.
2981. Coomes & Hyde.
3014. Eldredge.
3017. Sergeant.
3022. Lake (*Sisum*).
3100. Wright.
3149. Thomson & Hampshire.
3182. Middleton & Jones.
3237. Thomson.
263. Johann (*Feketehazy*).
446. Fisher.
641. Watson & Hooper-Rastrick.
1098. Lake (*Kipper & Perry*).
1206. Chumard.
1281. Ernst. (28th September, 1889.)
1481. Blake, Blake, & Bartholomew.
1711. Hardingham (*McCormick*).
1865. Tuchmann.
1910. Gronwald & Oehlmann.
2156. Lake (*Whitcomb & Hammond*).
2351. Kinnell.
2528. Toovey (*Kildoyle*).
2567. McErlain.
2603. Graetz, Graetz, & Graetz.
2776. Bishop (*The Firm of Voigtländer & Son*).
2879. Line.
2968. Loughridge.
3007. Beck.
3016. Wadsworth.
3021. O'Brien & Carew.
3024. Lake (*Parkhurst*).
3147. Fiek.
3172. Wardle.
3191. Muir.
3247. Cordes.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

Split Pulleys.—*W. Thomlinson-Walker, York.*—The invention consists of an improved jointing plate for connecting at the rim the halves of split pulleys. The rim is made of wrought iron, and to each half of the rim at its joints are riveted cast steel plates. These plates are made of such a shape, that when the two halves of the pulley are bolted together at the hub or boss, the plates dovetail into each other, thus taking up all the side strains at the rim joints. Through the dovetailed portions of the jointing plates a tapered hole is formed lengthwise with the rim. A tapered pin is driven into this hole and is screwed up tightly by a nut, thus closing the joint and at the same time causing the inner dovetailed part to expand and fit the outer dovetailed recess. Claims: (1) A joint in two halves, the boss or bearing of the one being split and the other being recessed, the said recess being slightly dovetailed; (2) the forcing into the dovetailed portion of the split half, and the opening of same by means of a tapered bolt or stud.—No. 9437. June 7th, 1889. 6*d*.

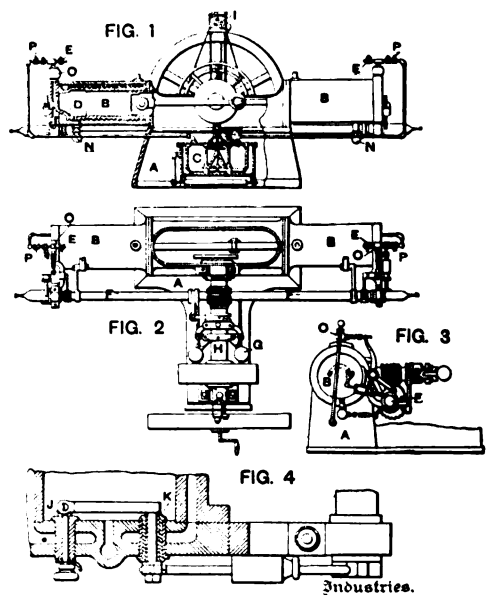
Carding Engines.—*J. Bullough, Accrington, Lancashire.*—By the use of this invention the distance of the flats from the cylinder may be accurately judged and greater accuracy obtained in grinding the flats and doffers and in adjusting them. The illustrations show parts of a carding engine with the improvements applied. At the top of the machine is a trough A with an open bottom. In



this trough, and protruding through the bottom, is a block of pipeclay B. The pipeclay is retained in the trough by suitable means, so that when the latter is raised and lowered by the handle C, pinion D, and rack E the bottom surface of the pipeclay will touch the ends of the wire or cards F as they pass to the cylinder G. If the wire upon the cards is in contact with the wire upon the cylinder the pipeclay will be removed, and will indicate the depth and extent of contact, so that the flats can be readily adjusted. In order to expedite the traverse of the flats during the time they are being tested, the pulleys and bands H I and J are employed in combination with worm K, shaft L, worm M, and wheel N to drive the carrying rolls O. When the grinding is effected through contact between wire of flats and cylinder, tendency to heat is prevented by the use of a flannel-covered roller. The roller is partially immersed in a trough of water and moistens the flats as they come into contact with it and cause it to revolve. Fig. 2 shows an alternative arrangement for colouring the wires of the cards by holding a block of chalk P upon the ordinary stripping brush Q. A spray of chalk dust is thus directed into the flats as they pass along. Claims: (1) The means herein fully described for ascertaining the space or distance between the wire of the flats and the wire of the cylinder; (2) the means and appliances herein set forth for effecting a nearer approach to accuracy in the grinding and in the adjustment of the flats to the cylinder; (3) the use and employment of colouring matter combined with appliances such as described for applying same to the wire of the flats for purpose of indicating degree of contact between wire of flats and wire on the cylinder; (4) the combination of appliances and flats whereby the traverse of the latter during its testing is expedited as described and illustrated.—No. 3236. February 23rd, 1889. 11*d*.

Steam Turbines.—*C. G. Patrik de Laval, Stockholm, Sweden.*—The invention relates to an improvement in turbines which are set in motion by means of a current of steam, the object being to increase by complete expansion the velocity of the steam current, thus producing relatively the largest quantity of *vis viva* of the steam. The steam supply way is constructed in such a manner that its cross sections are slowly increased in size as they near the turbine wheel, and that in the steam passage between these two sections a permanent current of steam is produced under isoëntropical expansion. Claim: In steam turbines the combination of the turbine wheel with a steam supply, the cross section of which increase regularly near to the turbine wheel and in the direction of the cam as and for the purpose specified.—No. 7143. April 29th, 1889. 6*d*.

Gas Engines.—*M. Rogers & J. A. Wharry, Terre Haute, Indiana, U.S.A.*—This a two-cylinder gas engine, whose connecting rod operates one crank pin, and whose controlling valves are operated by a single way shaft. The explosive mixture is preferably carburetted air, which is made in a carburetter attached to the engine. The ignition of the explosive charge is effected by an electric spark. In the accompanying illustration, Fig. 1 is a side elevation of the engine, Fig. 2 a plan, Fig 3 an end elevation, and Fig. 4 a section upon the end of a cylinder. The cylinders



B are water-jacketed, and their outer surface ribbed, so as to more readily give up their heat to the water. In the base A of the engine is situated the carburetter C, which is in communication with the combustion chambers D of the cylinders by pipes and the valves P and O. Air is admitted to the combustion chambers by the valves E and O. The products of combustion of the gases are extracted from the cylinder by the valves N. All the valves are operated by cams fixed to the way shaft F, which is driven through gearing by the crank shaft H. By the motion of the shaft F to the right or to the left (due to the motion of the governor G), the quantity of explosive charge may be regulated or entirely cut off. A small dynamo I generates the electricity for producing the electric spark. The spark is made at the required instant by a cam upon the way shaft F disconnecting two electrodes J K (Fig. 4), situated in the combustion chambers. The current passes through these electrodes when they touch, but when they are disconnected a spark is formed. The operation of the engine is as follows: The engine being turned by hand on the outstroke of each piston in succession, a charge of carburetted air of regulated strength and temperature and a charge of atmospheric air are drawn by suction through valves P, E, and O into the cylinders; on the return stroke of each piston the charges are compressed into the combustion chambers, and then fired by the electric spark produced by the igniting apparatus. When one engine is drawing in its charge the other is compressing its charge, and then fires it whilst the first engine compresses. The second engine then exhausts whilst the first is making its power stroke, then to exhaust in its turn. The exhaust products serve to heat the carburetter before reaching the atmosphere. The regulation of the speed is effected by the governor—that is, each cam is moved to the left as the speed increases, and the inlet valve lever drops from one cam step to another, thus decreasing the lift of the inlet valve; or if only one cam surface is used instead of the steps the gas inlet valve will at once fail to open. The two cams occupy such a relative position with respect to the inlet valves that the right-hand engine drops off the cam sooner than the left-hand engine, thus throwing it idle when excessive speed takes place, and at a still higher speed both engines run idle. Nine claims are made.—No. 10286. June 24th, 1889. 8*d*.

Locomotives.—*J. F. A. Mallet, Paris.*—According to this invention the cylinders of compound locomotives are arranged tandem fashion along the longitudinal centre line of the engine, instead of being placed side by side. The piston rods of the cylinders are independent of each other, and drive two centrally cranked axles whose wheels are coupled together in the ordinary manner with their cranks at right angles to each other. Or one of the pistons may drive a central crank, and the

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other piston may, by means of a cross-head and two outside connecting rods, drive outside cranks on the same axle but at right angles to the centre crank. By the above-described arrangements the inventor claims the two following advantages: (1) The efforts of the pistons are exerted only in the longitudinal axis of the engine, thus avoiding the oscillation due to the alternate action of the pistons situated at the opposite sides as in ordinary engines, and ensuring greater stability when running at high speeds; (2) by placing the low-pressure cylinder in the longitudinal axis of the engine the whole width between the side frame is available, and the cylinder can be 3ft. or more in diameter. Claim: A compound locomotive engine having the high and low pressure cylinders placed tandem-wise one in front of the other in the centre line of the engine, their pistons being coupled to cranks at 90° to each other by means such as described.—No. 8472. May 21st, 1889. 8d.

GAS ENGINES.—*H. Sumner, Kilmarnock.*—The novelty claimed by the inventor is the use and application of a travelling incandescent coiled or porous piece of platinum or other metal for the purpose of igniting the charge of gas engines, &c. The platinum is arranged and secured in a hollow cylindrical rod or tube, which is provided with holes at the point where the platinum is situated to expose it to the heat of the flame of a Bunsen burner. The tube is given a reciprocal sliding motion in the direction of its axis by means of a cam, eccentric, or other suitable device worked by the motor. The tube is caused to dwell between its movements, so that the platinum remains over the flame of the Bunsen burner a sufficient length of time to keep it at an incandescent heat. The tube in its motion passes through a chamber having communication with the exploding chamber of the motor engine, so that the charge is ignited by the incandescent metal. Claims: The use and application of a hollow cylindrical rod, carrying a piece of incandescent platinum, passing through a chamber in communication with a motor cylinder for igniting the charge therein; (2) the use of the above apparatus as a starter for motors.—No. 7533. May 6th, 1889. 6d.

BLOCK FUEL MACHINERY.—*J. Pring, Newport.*—To a pug mill of ordinary construction is fitted a pusher plate having cast in it the moulds for forming the blocks of fuel. The material is fed into the moulds, compressed, and discharged in finished blocks as the pusher plate is reciprocated. In the illustrations, A is a pug mill of any description fitted with a pusher-plate B. The pusher-plate receives a reciprocal motion from the gear shown. Under the pusher-plate is a lever E pivoted at one end F to the framing and at the other end to the piston rod of a cylinder D The cycle of operations is as follows: The mould C is charged whilst under the opening J, and it is then moved farther back until it is under the centre block of metal. Steam or other motive fluid is now admitted to the cylinder D and raises the lever E. A pin G in the lever catches the stamper L and so compresses the charge. The lever E then falls down to a horizontal position, and the pusher-plate is drawn back until the mould is in the position shown in illustrations. Steam is again admitted to the cylinder, and the pin H, catching the stamper L, forces the block of fuel out of the mould. Claims: (1) The combination of a a reciprocating pusher-plate, contained wherein

FIG. 1.

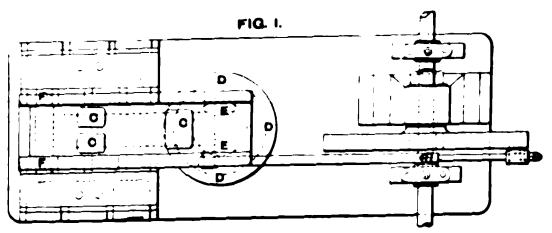
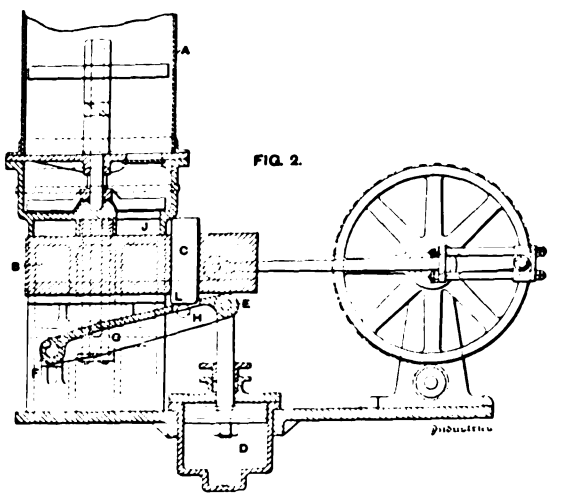


FIG. 2.



or attached thereto is a mould or recess, and a lever worked by any applicable mechanism, which lever is attached to or connected with, directly or indirectly, a die working into the said mould for the purpose of compressing the material delivered into such mould into blocks or briquettes of patent fuel; (2) the combination of a reciprocating die or plate together with a lever for compressing the material into the said die or mould, as before described, and the utilisation of the same lever for the subsequent discharge from the mould of the pressed block or briquette of patent fuel after such block or briquette has been formed and compressed.—No. 2561. February 13th, 1889. 6d.

CALENDERING APPARATUS.—*T. Pickles & J. H. Pickles, Burnley.*—By these improvements the number of paper rollers in calendering apparatus are reduced. Calendering apparatus as at present constructed have four horizontal rollers or bowls mounted one over the other, two rollers being paper and two metal, so that a metal roller is in contact with a paper roller. As the paper rollers are much more expensive than the metal rollers, the inventor uses one paper and three metal by the following arrangement: Two metal rollers are mounted at the bottom of the machine in the same horizontal plane, but not touching each other. Above these two metal rollers and touching them is mounted a paper roller, and vertically over that a third metal roller. The cloth is passed in at the front of the machine and passes between the paper roller and the two lower metal ones, thence round the paper roller, between it and the top metal roller and over the latter to the back of the machine. Claim: In calendering machines the combination of three metal bowls with one paper or fibrous bowl arranged so that all three metal bowls come in contact with the one paper or fibrous bowl.—No. 6718. April 20th, 1889. 6d.

PROPULSION OF SHIPS.—*T. Parensen, Germany.*—The ships are propelled by wind motors. The system is illustrated in the accompanying drawings, Fig. 1 being an elevation, Fig. 2 a plan. The wind motor comprises a pair of paddle wheels A I secured

FIG. 1

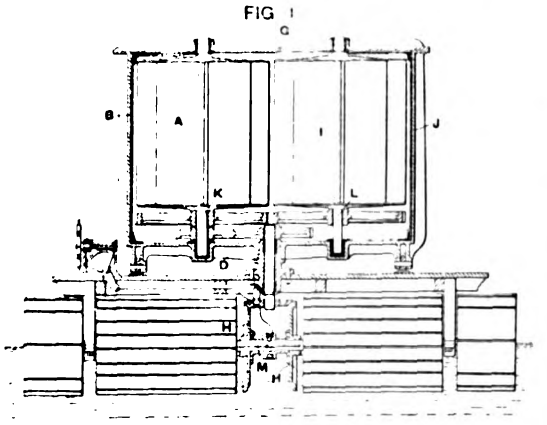
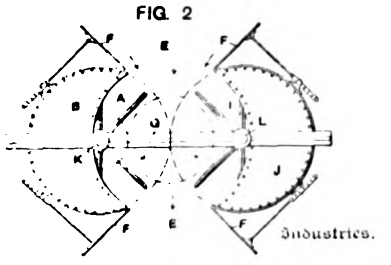


FIG. 2



to vertical shafts and partially enclosed in casings B J. The casings B J are provided with deflecting plates F, which guide the wind into the exposed vanes of the wheels A I. The shafts of the wheels A I are geared together by toothed wheels, and that of the wheel A is also geared to the shaft M of the water wheels. The frame of the wind motor is pivoted at its centre, so that the motor can be moved to directly face the wind. For reversing the motion of the vessel the bevelled wheels H are arranged so that one or the other may be put into gear with the driving wheel of the wind motor as required. A number of these motors may be arranged along the deck of the vessel, and their axes, instead of being vertical, may be horizontal. Four claims are made.—No. 6080. April 9th, 1889. 11d.

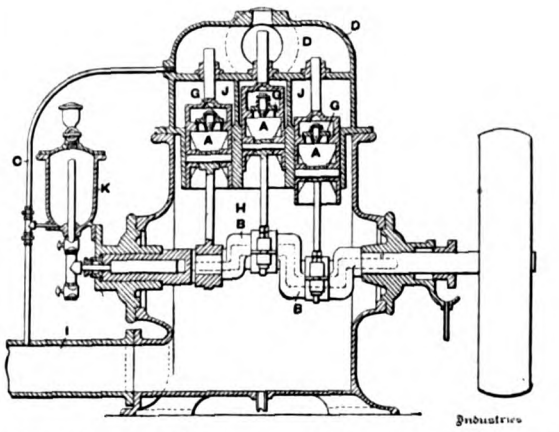
TRANSMISSION OF ROTARY MOTION.—*A. L. Shepard, London.*—A clutch is here described for transmitting motion from one shaft to a similar shaft in direct line with it. Upon the ends of the two shafts are keyed toothed gear wheels, and beyond these wheels are mounted loosely two discs. Between the gear wheels, and supported by the ends of the shafts, is a pulley, to whose flanges are screwed the two discs. In the pulley and discs is supported a short length of shafting, carrying two other toothed wheels, which gear with those upon the end of the shaftings. The wheels upon the counter-shafting are rigidly secured to it, and are of different diameters to suit the wheels of different diameters upon the ends of the shaftings. Over the pulley is a friction band, by means of which the pulley, and with it the discs, can be held stationary or permitted to revolve at any desired speed. The action of the clutch is as follows:—When the driving shaft revolves, the toothed wheel secured to it, being in gear with one upon the counter-shaft, causes the latter to revolve with the third toothed wheel, which gears with the wheel upon the end of the other shafting. Thus, if the pulley and discs are held stationary, the wheels upon the counter-shaft will cause the shaft to be driven to revolve, but if the pulley is freed the motion of the counter-shaft will cause the pulley to revolve only. By means of the friction band the pulley may be held stationary or permitted to revolve at any speed, thus controlling the rate at which the shafting is driven. Claim: The improved clutch, comprising the drum or casing, and means for arresting or retarding its motion as described.—No. 7350. May 2nd, 1889. 8d.

VENTILATOR.—*W. P. Thompson, Liverpool.* (*H. Krämer, Germany.*)—This ventilator separates from the air the particles of dust contained in it. The apparatus works after the manner of a centrifugal separator. It consists of a fixed and preferably cylindrical channel, through which the air enters, the channel ending in a funnel-shaped opening. In the funnel-shaped prolongation of the channel is placed a fan, firmly fixed upon a revolving shaft whose axis is coincident with the axis of the channel and opening. A drum made of wire gauze surrounds the channel and fan, and is firmly fixed to the revolving shaft, so that the fan and the drum are revolved together. The gauze wire drum is surrounded by a second cylindrical case. The action of the ventilator is as follows:—The air is drawn in through the supply channel and given a rotary motion by the revolution of the fan and the gauze drum, at the same time it is driven back through the annular space between the supply and gauze drum. Since the dust is heavier than the air, the centrifugal action causes the dust to separate and fly to the sides of the gauze drum, passing through its interstices to the case surrounding the drum. The dust, after passing into the surrounding case, falls into a number of collecting boxes which have at their bottoms a corrugated roller for conveying the dust away. Five claims are made.—No. 3846. March 5th, 1889. 8d.

FLEXIBLE BENDS.—*S. Z. de Farranti, London.*—For applying steam to steam engines it is usual to employ tubular mains of copper having bends in them. When the mains are of large size the bends have to be made of parts brazed together, and the strength of the metal is thus often impaired. To remedy this, the inventor makes bends from solid drawn copper tubes, by forming in the tubes a succession of indentations passing nearly round their circumferences, giving the inner part of the bend a corrugated form. These indentations or corrugations are formed in the following manner:—The tube is passed over a vertical mandrel, held rigidly at its lower end, and having a groove partly around its upper end. A roller which fits the groove is caused to roll round the mandrel and squeeze the pipe into the groove. The roller moves round the mandrel in a circle eccentric to the axis of the mandrel, so that the indentation made in the pipe gradually tapers away from its centre. Indentations are made like this all the way up one side of the pipe, causing it to curve upon the indented or corrugated side. Another method is to make the bends of a number of small pipes bent to the required curve and connected to the ends of the straight pipes by caps of suitable construction. The bends may also be made of a number of small pipes stranded together in the manner of rope, the ends being suitably connected to the straight pipes. Seven claims are made for the method described of making pipe bends, and for the apparatus employed in indenting them.—No. 7276. May 1st, 1889. 8d.

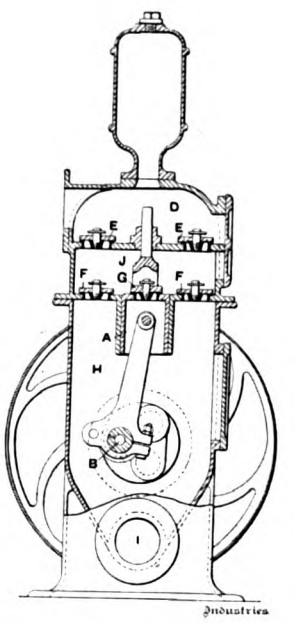
MULTIPLEX PLUNGER PUMPS.—*G. E. Dow, San Francisco, California, U.S.A.*—The accompanying illustrations show a longitudinal and transverse sectional elevation of a pump of new construction and combination of parts. The plungers A are three in number to maintain an even balance and pressure. They are

FIG. 1.



hollow and connected to a three-throw crank shaft B at equal angles. The crank shaft is made hollow for the purpose of lubrication, the oil being forced from the lubricator K by fluid under pressure supplied from the discharging chamber D of the pump through the pipe C. A novel arrangement of the valves E, F, and G will be readily understood from the drawings. In the pump

FG. 2.



shown the suction takes place through a chamber H enclosing the crank shaft and its connections. The liquid enters at the opening I, and after passing through the chambers H, J, and D is discharged by the opening M. For pumping dirty or gritty water, the top of H is divided from the lower by a diaphram, and the entrance for the water made in the top part, the lower part being partially filled with oil and water for lubricating the crank shaft, &c. Eight claims are made.—No. 650. January 14th, 1890. 8d.

DUPLEX RUDDERS.—*V. F. Lässoe, Brooklyn, U.S.A.*—This improvement is more especially designed for screw steamers, and particularly for such as have a single screw. Its object is to produce, by changing the relative angular position of two rudders, such divergence of the column of water thrown back by the propeller, that it will flow at such an angle to the line of the keel, as, by its reaction, to turn the vessel sharply, to the extent if desired of turning on its centre of displacement with a force proportionate to the propelling power of the engine. The rudder is constructed

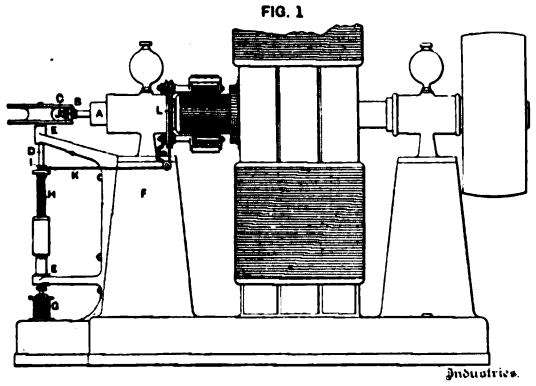
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with a vertical shaft substantially similar to the rudder stock of an ordinary rudder. This shaft has forged to it two pairs of arms which project from the shaft horizoutally, one pair near the top of the shaft and the other from the bottom. These arms proceed from the shaft at an angle of about 60° to each other and the top pair are situated vertically over the bottom pair. Between these arms are pivoted, near one of their vertical edges, the rudder blades. The rudder blades are also connected at the top near their other vertical edges by rods to a sliding block which has a movement in a direct line with the keel. To the upper part of the vertical shaft is secured a toothed sector which gears with a small toothed pinion whose revolution causes the sliding block to move in one or the other direction along its guide. The vertical shaft is revolved by any of the steering mechanism generally employed. When the rudder blades are normal they are parallel to each other, but by turning the vertical shaft to its extreme position, one blade will be in a place at right angles to the length of the vessel whilst the other will be moved to the right or left as the case may be, and remain parallel to the ship's length. Between the extreme position and the normal the blades gradually tend to assume one or other of these positions. Four claims are made.—No. 1103. January 21st, 1890. 8*d*.

ELECTRICITY.

Controlling Electric Currents.—*C. R. Heap, London.*—A regulating device is fitted to the electric generator and controls the current in the working circuit. In Fig. 1 this device is shown fitted to a dynamo. Upon an extension of the shaft A is mounted a small pulley B. The pulley B revolves between the flanges of a larger pulley C mounted upon a vertical shaft D. The shaft D has a vertical movement and has attached to its lower end the core of a solenoid G which is in the working circuit. A V-grooved pulley I is secured to the shaft D, and carries an endless band K, which passes round the pulley L upon the commutator brush

FIG. 1

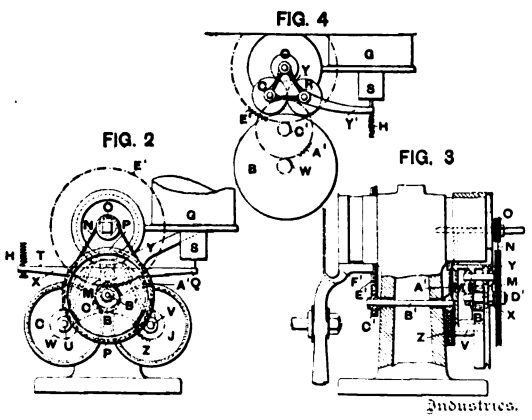


shifter. When the current in the working circuit varies from the normal, the core of the solenoid is raised or lowered, and accordingly one of the flanges of the pulley C comes into contact with the small pulley B. The pulley C and shaft D are thus revolved, and by means of the endless band K shifts the commutator brushes so as to increase or decrease the current. In Figs. 2 and 3 a modification is shown. In this case the small pulley B is carried by a three-armed lever X. The pulley B is driven off the dynamo shaft by the band N. The core of the solenoid G is connected to an arm of the lever X, and so causes the pulley B to frictionally gear with one of the wheels C J when the current in the working circuit varies from the normal. The wheels C J

FIG. 4

FIG. 2

FIG. 3



are geared to the wheel E¹ attached to the brush shifter. A second modification is shown in Fig. 4. The wheel O, which is secured to the shaft of the dynamo, and the wheels Q R are in gear with each other, and consequently always in motion when the dynamo is at work. The wheels Q R are supported by a frame Y, which is itself supported upon the dynamo shaft. By the up and down movement of the solenoid core S the wheels Q and R are put into frictional gear with the wheel B, through which motion is transmitted to the brush shifter. Five claims are made.—No. 6171. April 10th, 1889. 8*d*.

Incandescent Lamps.—*I. A. Timmis, London.*—By this improvement the lamp may be used for two or more purposes; for instance, in lighting railway vehicles the lamp may be used for high candle-power in main lighting and at another time for low power for auxiliary lighting. To do this the inventor constructs the lamp with two filaments of different sizes which will give different candle-power. The higher candle-power filament is used for the main lighting, and the lower one for the auxiliary lighting, thus saving the use of two globes and the use of two sets of lamp fittings. Claim: The use of an incandescent electric lamp which has two or more filaments in it of different candle-power as and for the purpose described.—No. 9537. June 8th, 1889. 6*d*.

Electric Meters.—*G. Hookham, Birmingham.*—The meter is composed essentially of two parts, the first part is a pendulum oscillating isochronously and the second part is a moving part whose position is alternately and at regular intervals first displaced by the current passing and afterwards restored to zero by the action of the pendulum. This last part has its movements recorded by a counting apparatus. In Fig. 1, A is a pulley freely movable about its centre; B is a flexible band from which hangs the core C of a solenoid D; E and G are weights attached rigidly to the pulley A, the one G for the purpose of balancing the core F of a solenoid H. A camel's-hair brush is attached to the arm of E, and a similar brush K is attached to the instrument frame; both are cut obliquely to rest upon the periphery of the wheel I, which is the first wheel of the counting train. The action of the machine is as follows: The current to be measured passes through the wire of the solenoid D, the core C is thus drawn downwards and the weight E lifted. As the weight E rises the brush J grips the surface of the wheel I, and causes it to partially revolve. The distance the weight E is lifted depends upon the force exerted by the solenoid D and consequently the strength of current. At stated intervals a contact actuated by ordinary clockwork completes a shunt current through the fine coil solenoid H. This solenoid is sufficiently powerful to overcome the force exerted by the solenoid D, and so restores the weight E to its former position. The clock afterwards breaks the shunt circuit, and the action described is repeated. Fig. 2 shows a modification in which the counting train is actuated directly by the motion of the pendulum. The weight of the rod G is supported by the rod F and weight E. The rod G is held normally, so that a pin L upon the pendulum just strikes the rod as the pendulum oscillates. If now a current

FIG. 1.

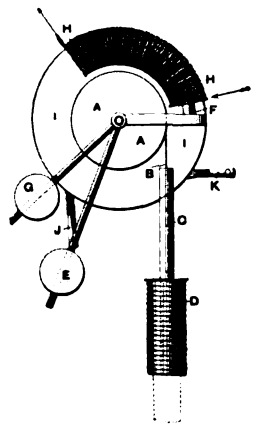
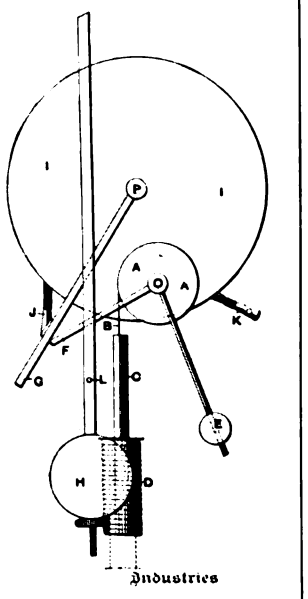


FIG. 2.



passes through the solenoid D the support F lets the lever G drop, and the pin L, in moving it back to zero, rotates the first wheel I of driving train. The stronger the current the more the support F drops and the farther the wheel I is rotated. Claims: (1) The arrangement and combination of parts consisting essentially of an isochronous pendulum or its equivalent and a moving part first displaced from its normal position by the action of the passing current to be measured and afterwards restored directly or indirectly to its normal position by the said pendulum or its equivalent, the said arrangement and combination being used in conjunction with registering or recording mechanism; (2) producing the advance motion and preventing the return motion of the registering or recording mechanism of electricity meters by the employment of camel-hair brushes or other brushes made of natural or artificial fibres arranged so as to act in the manner described; (3) correcting the irregularities of electricity meters caused by excess or defect of the motions communicated to the recording apparatus by the use of a pendulum having a magnetic bob operated upon by a solenoid.—No. 4371. March 13th, 1889. 8*d*.

Electric Firing Fuses.—*H. C. L. Holden, Woolwich.*—The fuse is contained in a double cylindrical case, one part being of larger diameter than the other. An iron core passes through the centre of the two compartments, and it is surrounded in the smaller compartment by a coil of insulated wire, whose ends are connected by a fine wire bridge, which is imbedded in an easily ignitable material. The part of the iron core in the larger cylindrical compartment is surrounded by a second and larger coil of wire. To fire this tube an alternating current of electricity is sent through the larger coil of wire, and by means of the iron core induces an electric current in the smaller coil; this induced current heats the thin wire bridge and ignites the surrounding material. Claim: A tube or fuse containing a closed circuit as described, which is so disposed as regards its electric and magnetic circuit, that an electric current or currents can be induced therein for the purpose of heating the bridge contained therein and thereby firing the tube or fuse.—No. 3761. March 4th, 1889. 6*d*.

Electrodes for Galvanic Batteries.—*F. Marx, Berlin.*—The method of manufacturing metallic electrodes in use up to now consists in working into the required form the metal obtained by a smelting process. The inventor finds that by depositing the metal by electrolysis or precipitation, and using it for the working electrodes, the effect of the electrodes may be considerably increased. The metal deposited as above produces a more powerful current than that produced by smelting. The process of making these electrodes may be understood from the claims: (1) The process of manufacturing metallic electrodes for galvanic batteries by purifying from the presence of salts the metallic deposit obtained by the electrolytic process or by precipitation with other metals, and then working mechanically the mass so purified into the required form; (2) the process of manufacturing metallic electrodes for galvanic batteries by purifying from the presence of salts the metallic deposits obtained by the electrolytic process or by precipitation with other metals, and then rolling into the mass so purified a woven wire fabric or metal plate; (3) the process of manufacturing metallic electrodes for galvanic batteries by electrolytically precipitating, or with metals precipitating, the metal on a conducting plate, then washing the same and fixing it on the plate by rolling.—No. 20217. December 16th, 1889. 4*d*.

CHEMISTRY.

Extraction of Gold and Silver.—*J. A. H. F. Ranft, Sydney, New South Wales.*—According to this invention chlorine is liberated by electrolysis from a common salt solution in contact with the substances containing the gold or silver. This liberated chlorine associates with the metals to form soluble chlorides, which are split up electrolytically as soon as formed, and the chlorine is regenerated for further use whilst the metal is deposited. In

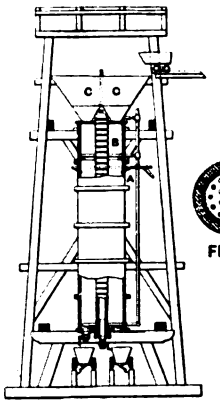


FIG. 1

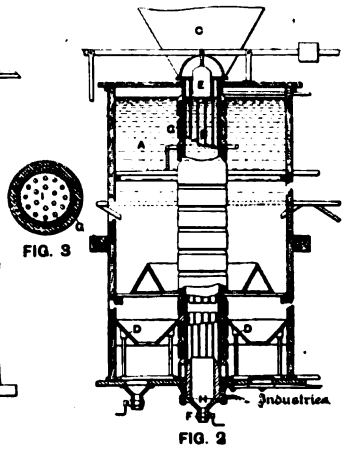


FIG. 3

FIG. 2

the accompanying illustrations of this apparatus Fig. 1 is a side elevation partly in section; Fig. 2, an enlarged side elevation; and Fig. 3, horizontal section. The apparatus principally consists of two cylindrical chambers A and B, between which the material to be treated is fed. Carbon anode plates (not shown) are arranged in the upper part of the outer chamber and metallic cathode plates in the inner chamber. The outer chamber A is constructed of wood, and is provided with charging hoppers C and discharging gates D. The inner vessel is composed of glass segments G fitting one over the other and perforated as shown. These glass segments are supported by a perforated iron tube jacketed by asbestos cloth for the purpose of filtration. The inner chamber is provided with a valve E for the escape of hydrogen gas given off when at work, and a filter H with cock F for drawing off liquor from the chamber. The metal cathodes I (Fig. 3) within this chamber are made preferably of screwed iron rods plated by an incorrodible metal such as platinum. In operation the ore is mixed with the requisite quantity of sodium chloride and fed into the space between the chambers A and B. The chambers are then filled up with water, and the current of electricity passed. The current splits up the sodium chloride and the water into their constituent elements, and the chlorine evolved immediately combines with the gold to form chlorides. Immediately upon formation, these chlorides are split up by the same agency as formed them, and the metallic elements fly to the cathode plates, the gaseous element to the anode. The chlorine formed at the anode quickly combines with fresh metal. The metals deposited at the cathode plates within the inner vessel collect in the form of a sludge, which, whilst being drawn off through the cock F, is partially filtered. When the material has been sufficiently treated, the discharge gates D are opened and fresh material fed in. Ten claims are made.—No. 19944. December 11th, 1889. 8*d*.

MISCELLANEOUS.

Dyeing Yarn in Skeins.—*G. A. Greeven, Crefeld, Germany.*—The process consists in so moving the dyeing liquid as to make the skeins come into contact alternately with the dyeing liquid and air. To obtain this result the skeins are stretched within a reservoir, to which the liquid is admitted by an aperture provided at the lower end. As the liquid is admitted, and its level rises, the skeins are gradually moistened, and when the skeins have become wholly immersed in the liquid the influx is cut off, and after being permitted to act upon the skeins for a sufficient length of time the liquid is gradually let off. The liquid is thus alternately let in and out as many times as is required, and so dyes the yarn uniformly. The apparatus used in this method consists of a trough for the reception of the skeins, and a reservoir situated at a height above the trough for the reception of the dye. The dye reservoir and the trough are in communication by a pipe, which enters the latter near its bottom. The dye liquid is admitted to the trough under pressure of its head, and is drawn back into the reservoir again by means of a pneumatic pump, which removes the air from the reservoir. Two claims are made for the method and apparatus described.—No. 9432. June 7, 1889. 8*d*.

Copies of the British specifications may be obtained on application to H. Reader Lack, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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THE INSTITUTION OF NAVAL ARCHITECTS.

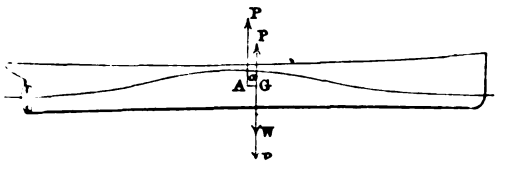
(*Continued from page* 341.)

THE paper read by Professor P. Jenkins, on "The Strength of Ships, with Special Reference to the Distribution of Shearing Stress over a Transverse Section," we give in full as follows:—

Eight years ago, when my friend Mr. Read and I read a joint paper on the strength of ships before the Institution, we commented on the fact that this branch of the science of naval architecture had practically remained untouched. The same fact had been previously adverted to by Mr. William John, who in a paper on the same subject spoke of the field for investigation as being "of almost unlimited extent." Since 1882 but little advance has been chronicled. In 1886 Mr. Read read a paper on the strength of bulkheads, in which that most difficult subject was treated with much originality; and in the same year Dr. Elgar opened up a practically unknown branch by discussing before the Royal Society the twisting strains on ships produced by rolling. With the exception of the work of those two papers, no attempt has been made, so far as I am aware, to advance our knowledge of the stresses upon ships during the above period. Probably the neglect which so important a branch of our professional work has suffered is due to the fact that an investigator cannot proceed far without finding that he needs experimental data for the proper prosecution of his inquiry which do not exist, and which cannot be obtained without the expenditure of much time and money. It is probably true, also, as was said by Mr. Rumage at a recent meeting, that the fact that the Register Societies prescribe the scantlings which all classed ships are required to have, and thus practically relieve the shipbuilder of responsibility for their sufficiency, takes away from him the incentive he would otherwise have to find out what the stresses to which sea-going vessels are subject at different parts really are under the worst conditions of loading thought probable, and to arrange the scantlings accordingly. But be this as it may, I think I may fairly say that up to the present time practical experience of the working of ships has been relied upon mainly in the fixing of scantlings. Scantlings have been increased here and there according as the actual straining of ships seemed to warrant. This may appear at first sight to be an excellent plan; it certainly has the merit of being on the safe side. But inspection does not always accurately reveal the true causes of straining. Hidden indifferent workmanship and exceptionally bad stowage have been in some cases the true causes of the straining that has been set down to lightness of scantling. Even if the straining of ships of sea were in all cases accurately diagnosed by surveyors and attributed to its true cause, reliance upon practical experience alone would never enable us to discover in what parts of a ship scantlings may be safely reduced. It is on this point that we chiefly want information. I remember hearing the late William Denny, on more than one occasion at the meetings of this Institution, appeal to our scientific naval architects not to rest content with telling shipbuilders where they should increase the scantlings of their ships, but to go further, and tell them also where the scantlings could with safety be reduced. I do not claim that a thorough investigation of the stresses experienced by ships at sea from all causes under given conditions should be deemed a sufficient substitute for experience of their working in regulating the scantlings, but I do think that such investigations would be of service in enabling the material in the different parts of the hull to be arranged with due regard to the character and amount of the maximum stress it has to bear. It would, moreover, be of advantage in enabling some discrimination to be made between vessels of full and fine form; in fixing the difference in the scantlings which vessels of the same breadth and depth, but differing in length, should have; and in gauging the effect of changes in the breadth of vessels of the same length and depth, as well as in many other ways. While saying that practical experience has been the main guide in the past, I must make an exception as regards the larger classes of vessels, because I know quite well that at Lloyd's Register at least the question of the sufficiency of their longitudinal strength was studied with the greatest care. But even in this, the simplest of all the problems connected with the strength of ships, the assumptions one has to make at the outset in order to render the calculation possible in the present state of our experimental knowledge, is one which makes the deduced stress of doubtful quantitative value, although it is unquestionably of importance for purposes of comparison.

For many years all published calculations of longitudinal bending moment have proceeded on the assumption that the vessel is most strained when crossing waves of her own length, and at the instant when the crest is amidships, the weight and buoyancy being equal. The former assumption is, perhaps, true; I do not, however, admit the latter assumption to be accurate, although I am quite unable at present to say what the extent of the error in the deduced stress really is. The fact that the calculation of longitudinal bending moments has proceeded for so long a time, on the assumption that the maximum is attained when the vessel is placed on the crest of a wave of her own length, the weight and buoyancy being equal, is due, I think, to the circumstance that, for the largest classes of vessels, the results obtained have appeared to give about the maximum stresses the material could repeatedly withstand without becoming distressed, and as in some of the larger vessels signs of straining at the topsides have not been wanting, this has been taken as a practical confirmation of the truth of the assumptions on which the calculations were based. But Mr. Smith's paper of 1883 showed very clearly that if the variation of the law of pressure within the wave structure from that holding in still water be taken account of, as to a certain extent it undoubtedly should, the maximum stresses obtained from the calculation become reduced to a limit below that which may be expected to cause distress in the material of the hull. Another fact which has led me for some time to regard with suspicion the usual theory adopted in the calculation of longitudinal stresses is the smallness of the deduced maximum stresses for little vessels. These, as calculated, do not, in some instances, amount to more than two tons per square inch for sea-going vessels, and I think it absurd to suppose that intelligent practical men would go on, year after year, building these vessels with such an enormous excess of longitudinal strength as they must have if the results of this calculation are to be relied on. On the ground, then, of the disparity existing between practice and the results of this method of calculation, I think we are entitled to regard it with some doubt. But I think I may show in a few words that the assumption on which the calculation is based is in error, in some cases at least, to a considerable extent. If a vessel be supposed to cross a series of regular waves of her own length at right angles to the line of crests, while considerable changes of trim will occur, she will be lifted bodily as she is embraced by an advancing crest, and will fall bodily as the trough of the wave approaches amidships. She will, in fact, perform a series of dipping oscillations somewhat similar in character to what takes place if a body floating in still water be forced down into it beyond the normal draught, and be made to continue the dipping oscillations by a succession of impulses. Now the rise or fall of the vessel's centre of gravity during the passage of the waves is necessarily conformable to the common law, viz.—Acceleration = (Moving force) Mass moved, the upward pressure of the water being at the same time employed in causing this acceleration and in changing the trim. Thus if, in Fig. 1, P be the resultant upward pressure of the surrounding fluid at any instant, and A its point of application, while G is the centre of gravity through which the weight W acts, we may suppose two equal and opposite forces P applied at G as shown. The difference P — W at G will be the moving force of the above equation, leaving the two other forces P to form a couple P*a* which has effect in changing the vessel's trim. So long, therefore, as the total upward pressure of the water surrounding the vessel is greater than the weight, the upward velocity is being accelerated, and when P is less than W there is an acceleration downward.

FIG. 1



Let us now glance at what must be a very common case. Assume that the vessel's centre of gravity is moving downward as the trough passes amidships. With the advance of the next crest the downward velocity is gradually destroyed, and the centre of gravity begins to move upward. This change in the velocity will not take place until the crest has advanced from the bow some distance along the side, and the velocity downward can only be destroyed by an excess of buoyancy over weight causing an upward acceleration. The vessel then begins to rise under the influence of an excess of fluid pressure. Commonly the total upward pressure of the water will be still greater than the weight of the vessel when the crest of the wave reaches amidships, and as this must have been the case from the instant the velocity downward began to decrease, the upward velocity with the crest amidships must be greater than at any previous instant during the lifting of the vessel. Moreover, the velocity upward will continue to grow as the crest passes abaft amidships until the instant at which the weight and the upward pressure become equal. After that instant the velocity upward is retarded, because the mass moved is greater than the lifting force, and the acceleration is downward. Hence we see that in the case I have taken, instead of the vessel being at rest on the wave when the crest is amidships with the weight and buoyancy equal, she does not come to a state of rest until some little time after the crest has passed the middle of the length, and that at the instant at which she does come to rest the supporting force is a great deal less than the weight. Obviously the motion I have here traced out is not representative of the behaviour of the

BISCUIT MAKING MACHINERY.

EXHIBITED BY MESSRS. JOSEPH BAKER & SONS, AT THE LATE PARIS EXHIBITION.

(*For description see page* 368.)

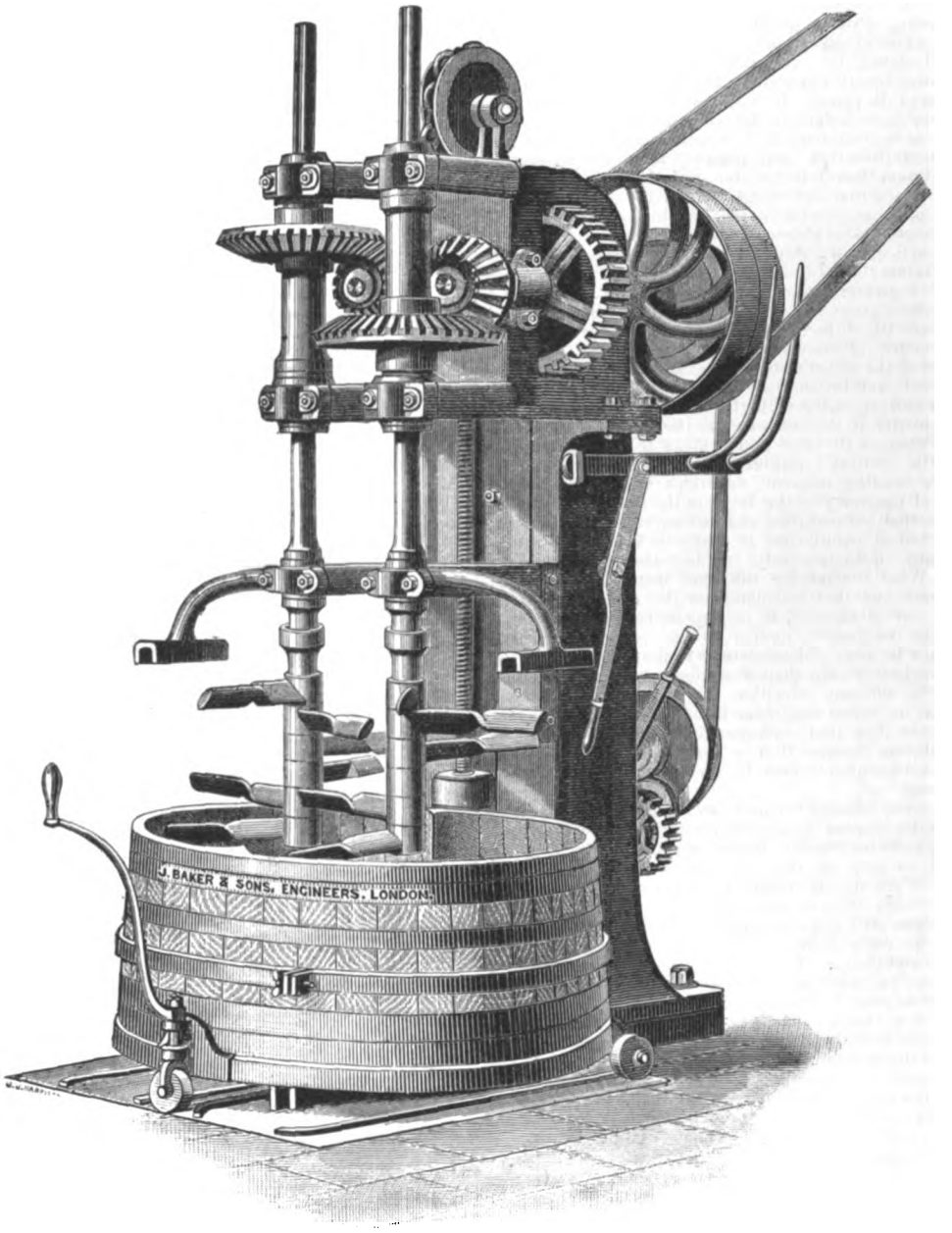


FIG. 1.—VERTICAL MACHINE FOR MIXING DOUGH.

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vessel on every wave of a series. Her behaviour on each wave will be different usually from that on the preceding wave, and will depend on the period of the wave, and on her dipping period. It might at first sight be thought that with the vessel raised on the wave at a greater height than that corresponding with the position of statical equilibrium, the bending moment amidships will be greatly increased, but this is not necessarily the case—it might be greater or it might even be less. By way of illustration, imagine a prism of rectangular section to be in statical equilibrium on the crest of a wave of its own length. Assume it to be homogeneous, and assume that the calculation of the longitudinal bending moment amidships is made in the usual way. If now the prism be supposed on the wave at a lighter draught than that corresponding with the position of statical equilibrium, or at a deeper draught, no change takes place in the value of the bending moment as calculated, if the variation of the pressure in the wave from that holding in still water be neglected; it is the same for all three positions of the prism. If, however, the prism be not homogeneous, having more weight in the ends than in the middle, the bending moment is greater when it is immersed in the wave to a greater extent than that corresponding with the position of statical equilibrium than it is for the statical position, and less when it is immersed to a less extent. If, on the other hand, the weight in the prism be greater in the middle than towards the ends, the converse takes place: the bending moment is greater when the prism is elevated above the position corresponding with statical equilibrium than it is for that position, and less when it is immersed to a greater extent. In the case of an actual vessel elevated on a wave above the position of statical equilibrium, if the centre of gravity of the hull and cargo in, say, the fore body, be before the centre of buoyancy of the layer in the fore body enclosed between the actual water surface and that corresponding with the statical equilibrium, the bending moment amidships is less than that corresponding with the position of statical equilibrium, and greater if the converse be the case. If the vessel be immersed when on the crest to an extent beyond that corresponding with statical equilibrium, as may sometimes be the case, the bending moment amidships will be increased, if the centre of buoyancy of the layer in the fore body enclosed between the actual water surface and that corresponding with the position of statical equilibrium is abaft the centre of gravity of hull and cargo in the fore body, and decreased if the converse be the case. What the precise difference between the greatest bending moment and that calculated on the usual assumption would be in any given case, it is impossible to say without actually tracing the vessel's motion as she crosses the waves, and that cannot be done without data as to the resistance to the motion of a variety of ship-shaped sections downward through the water with different velocities. It is important, however, to observe that the actual maximum bending moment amidships must be greater than that corresponding with the position of statical equilibrium, because if it be less when the vessel is elevated above that position it must be greater when she is below it, and *vice versâ*.

In the foregoing remarks no note has been taken of the effect upon the bending moment of the changes in the trim which occur as the wave passes the vessel. Referring again to Fig. 1, it will be seen that so long as the point A is on the fore side of the centre of gravity, the moment to change trim will have the effect of raising the bow and depressing the stern, and that this will continue with growing angular velocity until A and G are in the same vertical—that is to say, when the crest of the wave is about amidships. The angular velocity of the bow upward has then its maximum value, and when A passes abaft amidships the moment to change trim first destroys the angular velocity and then changes its sign. The effect of this angular motion upon the bending moment amidships depends upon the distribution of the weight in the fore and after bodies. If the moments of inertia of the fore and after bodies about a transverse axis through the centre of gravity be equal, then, if the vessel be out of trim when on the crest of a wave, the bending moment amidships is unaffected thereby. If, however, they be unequal, and they may in practice differ appreciably, the bending moment amidships is decreased when the moment of inertia of the fore body is greater than that of the after body, if the trimming moment tends to depress the bow and raise the stern, and increased if the moment of inertia of the after body be greater than that of the fore body. I have already shown that the bending moment amidships is necessarily greater on some waves of a series than that calculated for the position of statical equilibrium, and we now see that it may be further augmented by the pitching and 'scending of the vessel.

I have been led to make this imperfect sketch of the behaviour of a ship on a wave because the shearing force over a transverse section which I propose now to discuss is similarly affected with the bending moment. Like as regards the maximum longitudinal bending moment, the practice has been to calculate the maximum shearing force for the case in which the vessel is in statical equilibrium on the crest of a wave of her own length. But I have shown that at some time, in crossing a series of regular waves of her own length, the bending moment amidships must be greater than that corresponding with the position of statical equilibrium, and that with a common distribution of cargo it may be further augmented by pitching and 'scending; and since the bending moment at any point of the length is the area of the curve of shearing force between either end of the vessel and that point, it will be seen that augmentation of the bending moment necessarily involves an increase in the shearing force. As with the bending moment, I am not able to place a quantitative value upon this excess. Bearing in mind the fact, however, that the maximum shearing force will be frequently greater than that calculated in the usual way, I will now turn to the problem which has given the title to this paper—viz., that of the distribution of shearing stress over the transverse section of a vessel.

I have long been impressed with the fact that most vessels that exhibit symptoms of straining under water do so at the upper turn of the bilge. Now, so far as the stresses due to longitudinal bending moment are concerned, we know that the distressed parts, being near the neutral axis, can be subject to but very little stress from that cause, and the question arises as to the origin of the sometimes severe straining at that part. No doubt the stress due to the transverse bending moment must be considerable near the place where the floor plate ends, especially when a heavily laden and badly stowed vessel is rolling heavily; and this may in some circumstances be a factor in causing the distress referred to, but I believe it is helped appreciably by the shearing stress the material has also to bear at that part. To make clear what I have to say regarding this particular form of stress, it will be necessary to show how the distribution of shearing stress over a section in the case of a body subject to bending moment differs from that in the case of a section subject of shearing force alone. If two equal and opposite forces F be applied at the section of any bar, as in Fig. 2, the whole shearing force over the section is F, and probably the intensity of the shearing stress per square inch of the material will be nearly uniform throughout, except in the immediate neighbourhood of the places of application of the forces. But if a beam be weighted with a load W, as in Fig. 3, while the total shearing force over any section is W, the shearing stress is not uniformly distributed over the section as in the previous case, but is greatest at the neutral axis, and nil at the top and bottom. The excess of the maximum shearing stress over the mean depends greatly upon the arrangement of the material in the section. The fact that the shearing stress is not uniform over the section in the case illustrated by Fig. 3 has long been known to authorities on the strength of materials. I find that Rankine mentions it in his great work on shipbuilding, and gives a

FIG. 2

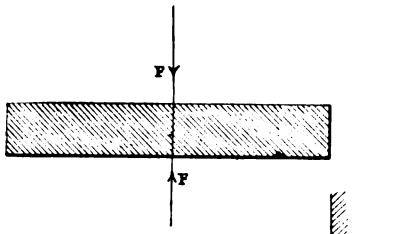


FIG. 3.

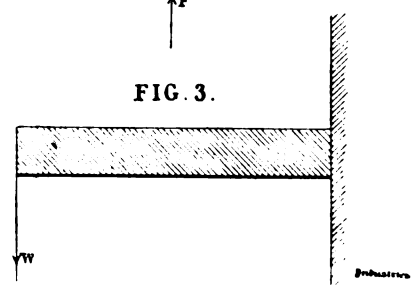


FIG. 4.

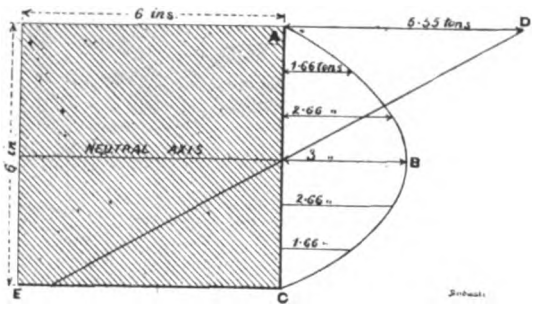
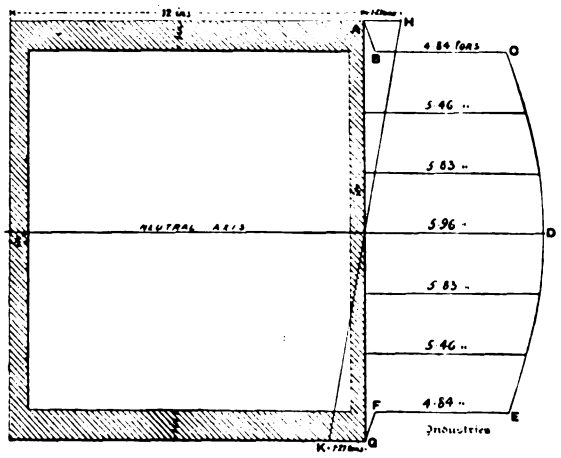


FIG. 5.



rule for determining it at each point of a section in any given case, but I do not think he, at that time, attached to it so much importance as it deserves, and I am not aware that an actual diagram of shearing stress has been at any time made for a ship. I have had the opportunity recently of making a calculation of the varying shearing stress borne by a transverse section of an actual vessel; but before I refer more fully to it, I should like to call attention to some diagrams of shearing stress for one or two sections of simpler form, subject to shearing force in the same way as the bar of Fig. 3. Fig. 4 is a reduced section of a bar 6in. square, subject to a shearing force of 72 tons. This, if uniformly distributed, would give a mean of 2 tons per square inch. The actual distribution of the shearing stress is given by the ordinate from A C to the curved line A B C at the side of the diagram, being 3 tons at the neutral axis, and nothing at the top and bottom. If the bending moment borne at the section be, say, 200 foot tons, the distribution of the stress due to it is represented by the ordinate, from A C to the straight line D E, being 5·55 tons per square inch at the top and bottom of the section, and nil at the neutral axis. Hence we see that the shearing stress is a maximum where the stress due to longitudinal bending moment is nil, and nil where the stress due to the longitudinal bending moment is a maximum.

Consider next the hollow girder shown in Fig. 5, having heavy flanges at the top and bottom. The sectional area is the same as that of the square bar of Fig. 4, and if the total shearing force over the section be assumed to be the same, viz., 72 tons, the mean shearing stress will be two tons per square inch as before, but the maximum will be increased to 5·96 tons per square inch. The actual distribution of the shearing stress is shown at the side by the curve A B C D E F G, the maximum of 5·96 tons being, as before, at the neutral axis. The ratio of the maximum to the mean is here 2·98, whereas in the case of the section of Fig. 4 it is only 1·5. If this girder of Fig. 5 be subject to the same bending moment as that of Fig. 4—viz., 200 foot tons, the distribution of stress due to it is represented at any place by the ordinate from A G to the straight line H K, being but 1·21 tons per square inch at the top and bottom of the section, and nil as before at the neutral axis. While the effect, therefore, of massing the material at the top and bottom of the girder is to reduce the maximum stress due to longitudinal bending moment in the examples given from 5·55 tons per square inch to 1·21 tons per square inch, it augments the maximum stress due to the shearing force from 3 tons per square inch to 5·96 tons per square inch, and if this were carried sufficiently far the girder would break down through the yielding of the sides under the influence of the shearing stress alone.

Although the causes of the variation in the shearing stress over the section of a girder are discussed in some advanced works, it will make this paper more complete if I allude briefly to them here in connection with the case of an actual vessel. Let A B and C D, Fig. 7, be two transverse sections of a vessel near to each other, N N being the neutral axis, and let M_1 be the bending moment borne by the section A B when the vessel is on a wave, and M_2 that similarly borne by C D. Assume the two sections to be so near each other that differences arising out of change of form and sheer may be neglected. The longitudinal stress per square inch at the gunwale A will be found by the well-known equation $p_1/y = M_1/I$, and that at C by the equation $p_2/y = M_2/I$, and if M_2 be greater than M_1, p_2 will be greater than p_1. We shall thus have, if we consider a small strip of sectional area a between A and C, a force $p_2\ a$ acting at the one end, and a smaller force $p_1\ a$ at the other. Under the influence of the unbalanced force $(p_2 - p_1)\ a$ the strip tends to move in the direction from A to C, and the resistance to this tendency is provided by a shearing force along the lower edge of the strip A C. If now we examine the case of a similar strip of section a nearer the neutral axis than A C, p_3 and p_4 being the longitudinal stresses per square inch calculated as above, we shall have similarly a resultant force $(p_4 - p_3)\ a$ on the strip which causes shearing stress along its lower edge, as already explained. It will be seen that the shearing effect of all these differences of stress is cumulative as we pass from the gunwale towards the neutral axis, so that the magnitude of the longitudinal shearing force is greater there than at any point nearer the gunwale. If now we regard the part of the vessel below the neutral axis, we shall have on a strip at D B of section a a compressive stress $q_1\ a$ at the one end, and $q_2\ a$ at the other. Their difference $(q_2 - q_1)\ a$ must be resisted as before by the shearing stress along the upper edge of the strip. The same holds true of any other strip we may select below the neutral axis, and the sum of all such small quantities similar to $(q_2 - q_1)\ a$ below the neutral axis must be the same as the sum of all such small quantities as $(p_2 - p_1)\ a$ above the neutral axis, either of which is the longitudinal shearing force on the plating at N N. In the same way the longitudinal shearing force at any place between N N and the gunwale, or between N N and the keel, may be found by taking the algebraic sum of all these small differences of longitudinal stress between that place and either the gunwale or the keel. The actual longitudinal stress per square inch of the material at any place may now be found by dividing the ascertained shearing force by the sectional area at that place between the sections A B and C D. Having found the longitudinal shearing stress at any place, we may at once obtain the shearing stress at the same place across the transverse section from the fact that shearing stress along any plane must be accompanied by shearing stress of equal intensity along a plane at right angles to it. Hence we see that the longitudinal shearing stress which has been shown to exist in the plating at any place generates equal shearing stress over the transverse section at that place. Briefly stated, the shearing stress per square inch at any point of a transverse section of a vessel may be found by dividing the product of the actual shearing force borne at the section and the moment of the area of the section above the given point about the neutral axis by the product of the moment of inertia of the whole section and twice the thickness of the plating at the given point. It will be obvious, from the above rule, that the maximum shearing stress in a vessel will usually occur in the transverse section at which the shearing force is a maximum.

I have constructed a diagram of shearing stress for a vessel, for which Mr. John Inglis has very kindly supplied me with the necessary data. The vessel in question is 330ft. long, and Mr. Inglis has had curves of shearing force and bending moment drawn for her, as actually laden, on the assumption that she was in statical equilibrium on a wave of her own length, and 20ft. high. The maximum shearing force in this case is 1,233 tons, and occurs at a section 93ft. abaft the stem. Fig. 6 is the transverse section of the vessel at that place, modified somewhat to conform with the usual style of construction, and by the side of it is shown the actual diagram of shearing stress. It will be seen to be a very irregular curve. Starting from zero, at the top of the section, the shearing stress per square inch grows regularly in intensity until the upper deck is reached. Here it becomes reduced again to a very small amount, since the thickness of the deck, measured horizontally, as it has to be for the estimate for shearing stress, is large. Starting again, below the upper deck the shearing stress becomes at once of appreciable magnitude, because, owing to the large amount of plating upon the deck, the difference of longitudinal shearing force over the small vertical interval occupied by the deck becomes large, and the shearing stress thus induced has to be borne by the sheerstrake just below it. The same feature will be noticed in the diagram of shearing stress in Fig. 5 at the inside of the top and bottom flanges. The curve again begins to grow regularly until the lower edge of the sheerstrake is reached. The sheerstrake, which is fourteen-twentieths of an inch thick, is here attached to an eight-twentieth of an inch between-deck strake, and as the actual intensity of the shearing stress is inversely as the thickness of the plate its value in passing from the one plate to the other

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is increased to fourteen-eighths its former amount. On reaching the main shearstrake, which is fifteen-twentieths of an inch thick, the shearing stress, for the reason already given, becomes reduced, and is again very small in way of the middle deck, but increases suddenly as soon as that deck is passed. If below the middle deck the plating were of uniform thickness, the curve would be of practically fair form down to the neutral axis, but as it is gradually reduced in thickness in this instance until the neutral axis is reached, the curve continues irregular, there being a point of discontinuity at each lap. At the height of the neutral axis itself the shearing stress is 3·9 tons per square inch. This figure, which is the maximum, has been deduced from the shearing force of 1,233 tons, obtained on the assumption that the vessel is momentarily in statical equilibrium on the crest of the given wave. Below the neutral axis, the diagram takes the form shown, and there will be no difficulty experienced in tracing out the causes of the irregularities in the curve. I may add, that in the calculation the keelsons have been assumed of equal value with the other parts of the hull as regards this particular kind of stress. This can hardly be the case, but it is very difficult to discover the precise kind of action that really takes place at those parts. In referring earlier in this paper to the straining sometimes observed at the turn of the bilge, I ventured the opinion that this may be caused mainly by the shearing stress borne by the material. It will be seen from Fig. 5 that the value of the shearing stress is not appreciably diminished at that place; and, indeed, if the vessel be inclined when on the wave, the angular movement of the neutral axis which takes place, as I explained in my paper of two years ago, will cause it to pass very nearly through one of the bilges, and thus render the latter subject to the maximum stress. It will be obvious, if we look at the form of the section of the plate at the turn of the bilge, that the shearing force upon it between the frames at a butt will tend to change the curvature, and thus lead to the working, the effect of which is so often visible. If I am correct in my view, a very efficient cure for this form of distress would be the fitting of a tee bar on the inside of the butt-strap along the line of the butt. We may draw one or two important lessons from this diagram of shearing stress. In the first place, while the estimate of longitudinal stress shows that stress to be greatest at the top and bottom of the section, and nil at the neutral axis, and that, therefore, so far as that particular kind of straining is concerned, the girder may be strengthened by removing material from the neighbourhood of the neutral axis and massing it at the top and bottom, the effect upon the intensity of the shearing stress at the neutral axis will be of the contrary character. By way of illustration, suppose the strake of plating in way of the neutral axis, which is in this case eleven-twentieths of an inch, were to be reduced in thickness to seven-twentieths of an inch, the difference being applied at the top and bottom of the section. The increase in the moment of inertia of the section would cause the longitudinal stresses to be correspondingly reduced under the given bending moment, but the shearing stress at the neutral axis would be increased from 3·9 tons to nearly $\frac{11 \times 3{\cdot}9}{7} = 6{\cdot}1$ tons per square inch.

Another important difference in regard to the two kinds of stress is to be found in the effect of variations in the thickness of the plating upon their intensities. I have shown above that the intensity of the shearing stress at any place is inversely as the thickness of the plating at that place; on the other hand, as is well known, the stress due to longitudinal bending moment at any place is independent of the thickness at that place, being the same per square inch upon a fourteen-twentieth of an inch plate as upon an eight-twentieth of an inch plate at their place of junction. It is this fact which makes it possible to fit light erections on the upper decks of ships, where the stress due to longitudinal bending moment is a maximum, whereas the employment of such thin material in the neighbourhood of the neutral axis, where the stress due to longitudinal bending moment is nil, would be attended with great danger, owing to the rapid growth of the intensity of the shearing stress.

One other point of some importance in considering the relative values of shearing and tensile or compressive stresses is the fact that the shearing strength of steel is much less than the tensile strength. According to some very careful experiments conducted by Professor Kennedy a few years ago, steel having a tensile strength of 28·45 tons, which is about the tenacity of that used for shipbuilding, was found to shear under the much lower stress of 23·09 tons. It is of interest to note, further, that the greatest shearing stress is probably never experienced amidships; certainly the maximum shearing stress and the maximum tensile stress never occur on the same section. The former must always occur at the place where the curve of bending moment is growing most rapidly, while the latter is at the section at which the bending moment has its maximum value. I have explained how the varying shearing stress actually experienced over a transverse section of a vessel is induced in the material by the tendency which it has to shear longitudinally, and it will be of interest to measure the effect of this longitudinal shearing stress upon the rivets in the landing edges. In the old wooden ships with no edge connection the effect of the longitudinal shearing stress would be to give the adjacent strakes of planking a tendency to slide past each other. Rankine remarked this tendency, and attributed the "spewing" of the oakum from the seams to it. Members present who have experience of wooden ships may perhaps be able to tell us whether the tendency to spew the oakum has been observed to be greatest at the upper turn of the bilge, and at about one-fourth of the length from each end. In an iron or steel vessel the actual longitudinal shearing stress experienced along the lower edge of one strake of plating has to be communicated from it to the strake below through the rivets in the landing edge. The latter are thus placed under shearing stress. We may give a numerical value to this stress in the case of the vessel before us. The total longitudinal shearing force on the plating for a length of one frame space in the neighbourhood of the neutral axis is 24 × eleven-twentieths × 3·9 = 51·5 tons, and the rivets in the landing edge are arranged as in Fig. 8. They are seven-eighths of an inch in diameter, and assuming the stress in each rivet to be the same, this would give 4 tons per rivet, or 6·7 tons per square inch of rivet area. Of course, if any appreciable yielding were to take place under this stress, the framing would be called into play to help resist it.

The above investigation throws some light upon the problem of the riveting of the laps of the plating. So far as tensile or compressive stresses due to longitudinal bending moment are concerned, double-riveted landing edges are not necessary anywhere; the additional material required for the second row could be more beneficially applied in thickening the plates themselves. As regards transverse bending moments, I think that the nature of the girder formed of the frame, reverse bar, and plating is such that the tensile or compressive stress due to this cause can never be so great in the plating as to require double-riveted landing edges. I have shown, however, that the rivets in even double-riveted laps for the case I have taken are under considerable stress in the neighbourhood of the neutral axis at certain parts of the vessel's length. In that part, therefore, double-riveted landing edges in vessels of any size are very desirable. But away from the neutral axis, towards the upper and lower parts of the section, the necessity for double-riveted landing edges is not so apparent; and so far as the work the rivets have to do is concerned, the edges may well be single-riveted. On the other hand, there are objections to the carrying out of this deduction in practice with large vessels. It must be recognised that double-riveted landing edges help to give rigidity to the structure, and assist in keeping the plating to its work. It would, moreover, be found difficult in practice, probably, to properly close the landing edges of thick plates if they were only single-riveted.

THE STRENGTH OF SHIPS.

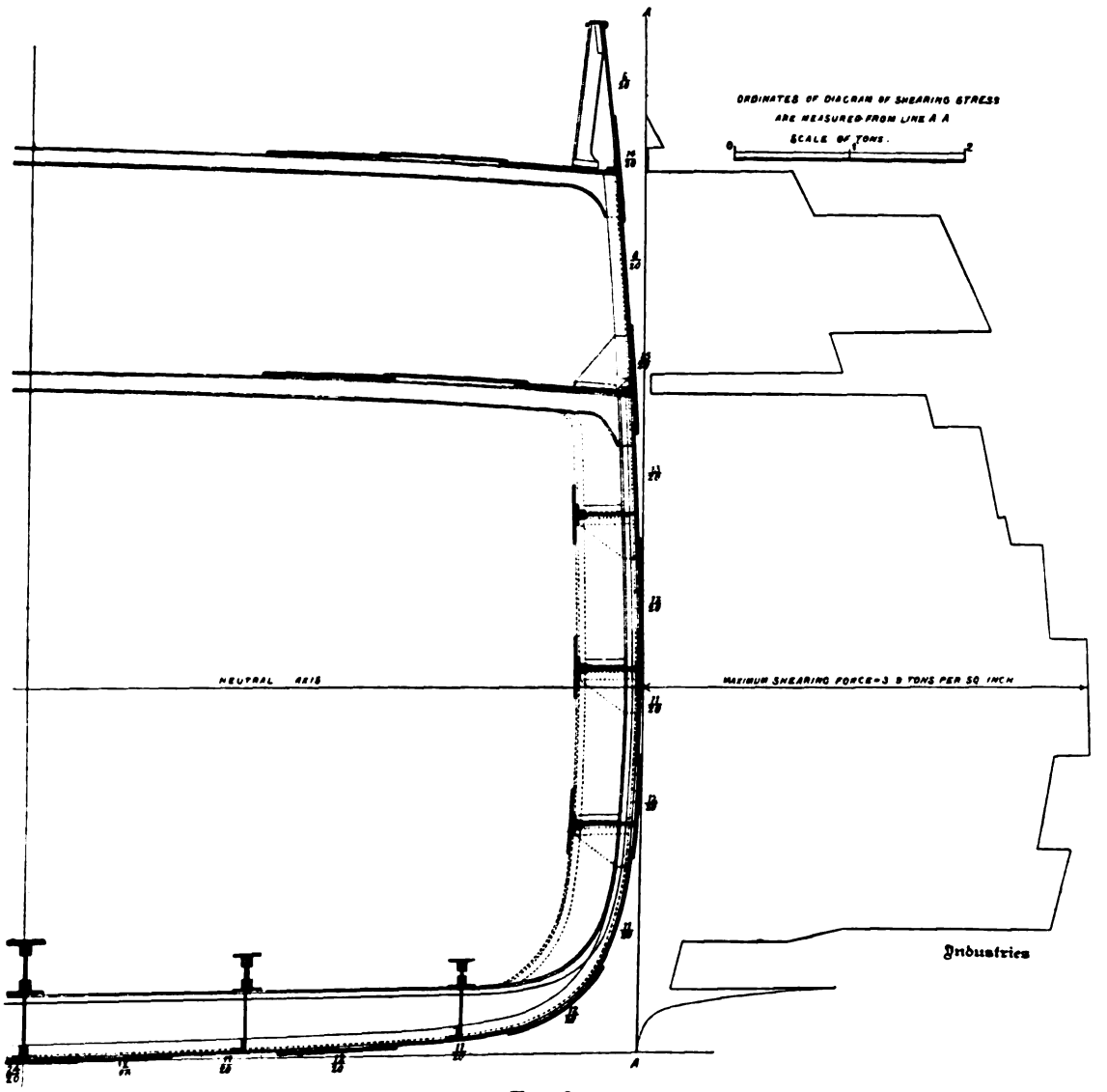


FIG. 6.

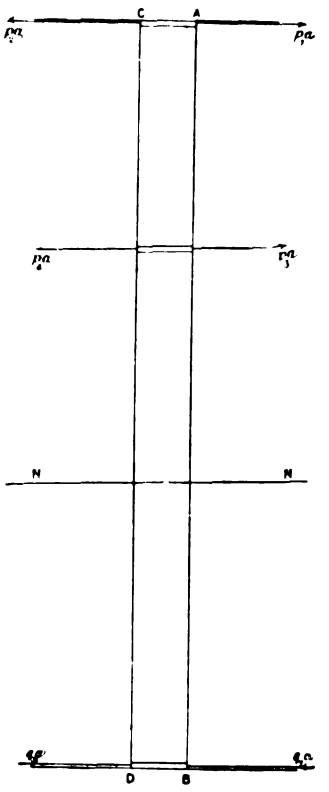


FIG. 7.

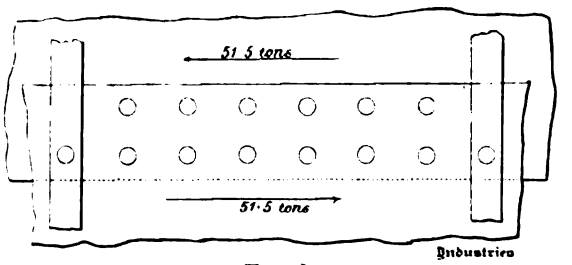


FIG. 8.

The discussion was opened by Mr. Ellis, who said they appeared to be gradually approaching a proper appreciation of the strains to which our ships were liable, and Professor Jenkins had now given them the strain, not on a ship in dock, but when on the crest of a wave. These results had long been known qualitatively, but up to the present time no quantitative results had been given. The deductions had astonished him. The great merit of the paper was in the adaptation of theory to practice. He had previously thought the shearing stress would amount to 3 tons per square inch only, and did not expect the decks would offer any resistance.

Mr. C. E. Stromeyer in answer to Professor Jenkins' requests for further experiments, said that no engineers had followed himself in the results which he laid before the Institution some years ago, but that bridge builders had availed themselves of his idea. He did not agree that

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BISCUIT MAKING MACHINERY.

EXHIBITED BY MESSRS. JOSEPH BAKER & SONS, AT THE LATE PARIS EXHIBITION.

(*For description see page* 368.)

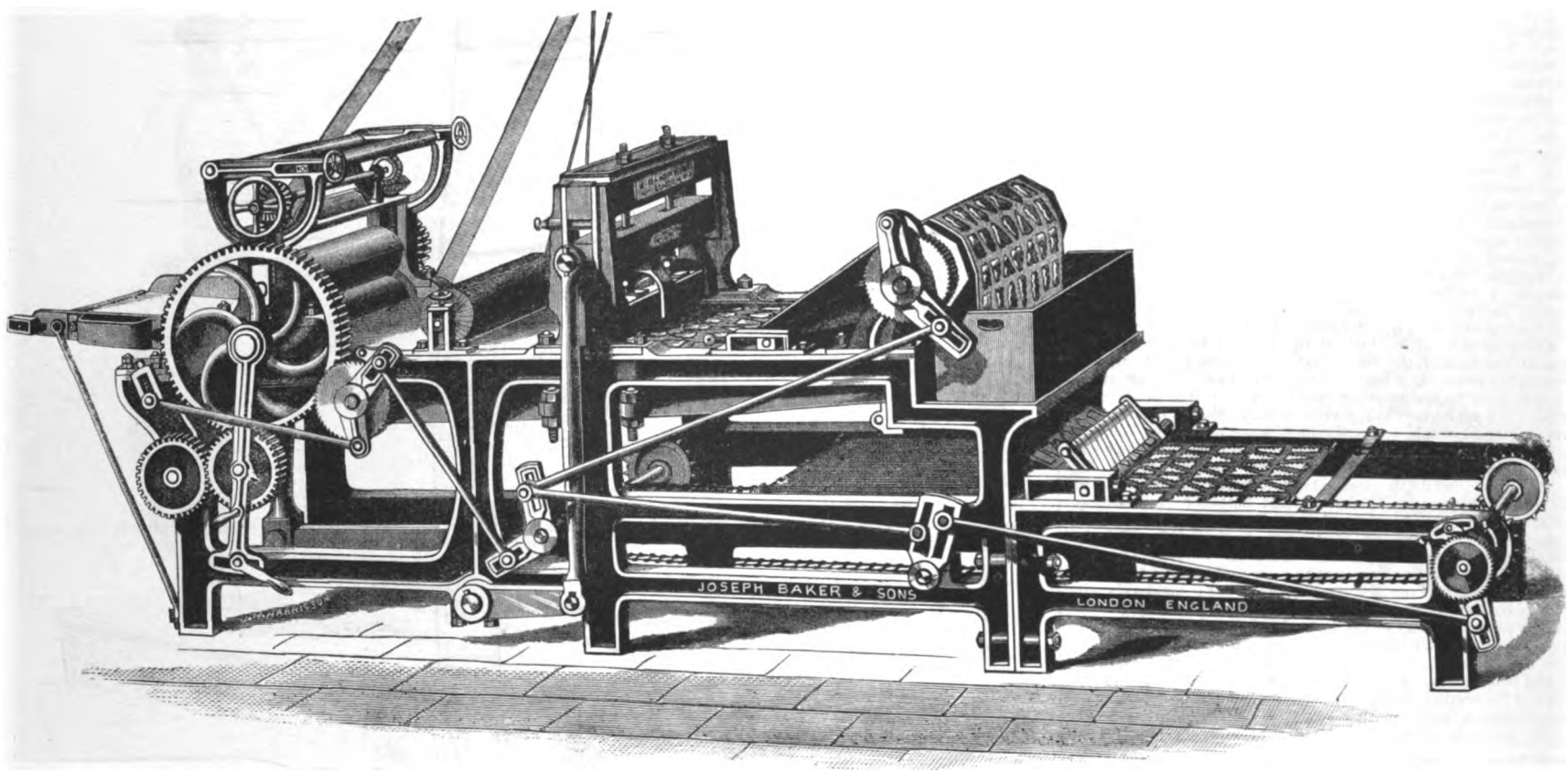


FIG. 2.—BISCUIT GAUGING, CUTTING, AND FRAMING MACHINE.

the decks were subjected to shearing stresses at all, or any other of the horizontal members, and in his opinion the vertical members only bore it.

Mr. McFarlane Gray was of the opinion that many points were left obscure. It was difficult to arrive at the nature of the stresses mentioned.

Dr. Elgar said the paper gave an explanation of many points which had often puzzled him in dealing practically with the strains on ships. The important point of the paper appeared to be the fact that the tensile stresses were not always the chief stresses.

Mr. Biles said the question of the calculation of the strains in a ship was a difficult one, because it was not an exact science. He thought that with small ships the scantlings should be calculated as for large ships. No signs of weakness had been discovered where this had been done in the Navy. He had seen many large steamers in dock which showed signs of straining at the neutral axis, and not elsewhere. This bore out the conclusions arrived at in the paper.

Mr. Martell thought a great service had been rendered to the Institution. Light was thrown upon a subject that had previously been very much in the dark. To those who had to frame rules by which ships should be built it was very advantageous to have the results of such investigations as these. He thought that in the neighbourhood of the neutral axis, the large strains observed were not longitudinal but transverse. Practical men had always remedied this state of things with a double strake, without knowing why they did so. As regards small ships it should be remembered that they had a different duty demanded of them. They were usually employed in going in and out of rivers where they had frequently to take the ground. The matter of wear and tear occasioned thereby had to be taken into consideration, and the scantlings increased accordingly.

Mr. W. H. White agreed with what had been said respecting the paper, but thought the deductions were not altogether new. Twenty years ago Mr. W. John and he had got out diagrams showing the stresses in wooden ships, and the results of their inquiries were mentioned by Sir E. Reed, though not actually published. It was not thought then that iron ships suffered in the same way. Their plan was to thicken the planking at the wales, and use dowelling largely. In bringing forward such quantitative results Professor Jenkins had done the Institution and the shipbuilding industry of the country very great service.

Mr. John confirmed what Mr. White had said as to their joint investigations in connection with wooden ships. If anyone had asked him the value of the maximum shearing stress on a ship of this kind, he would certainly have put it at a lower figure than that quoted in the paper.

Professor Jenkins then replied. He thought Mr. Stromeyer had failed to grasp his meaning as regards including the decks when calculating the shearing stress. He thought, after a long consideration of the question, that the decks did contribute a resistance, as his diagram indicated. He knew that heavier bottoms were required for small vessels to enable them to take the ground, but this ought not to apply also to other parts of such vessels. As to the investigations of the shearing stress upon wooden vessels, he did not consider the two cases the same, as the planks were without any edge connection between them. The longitudinal shearing stresses set up would therefore be very different.

The last paper read on Thursday, the 27th ult., was by Mr. A. Rigg, on his "Revolving Engine as applied on Shipboard." This engine has been before the engineering public for some years now, and, therefore, it is unnecessary to describe it further at present. Mr. Rigg is now engaged in fitting some large engines of this type in river boats on the Thames. An illustration of the application of Mr. Rigg's engines to the launch "Deva" is given in our issue of the 31st of August, 1888.

In the discussion which followed, Mr. A. B. Brown said he had been trying experiments with an engine built on similar lines. In his engine the cylinders revolved. He could never get it adopted on board ship, because of the difficulty of lubrication, and because of the tendency of the oil to get into the boilers. He had some success, however, with water lubrication and roller bearings. He thought the relative reciprocation in Mr. Rigg's engines disturbed the balance of the engine, and he considered that it would be wasteful when cutting off at $\frac{1}{2}$ stroke. He should like to know how the faces of the valves wore, for he had had difficulty with them; and he had substituted eccentric valves for concentric ones, as the latter became badly worn.

Mr. Bevis said he had attended a trial of one of these engines, and found it worked satisfactorily. He was much struck by its simplicity.

Mr. McFarlane Gray said he had seen one of these engines. It was ingeniously arranged, and worked better than he could have expected. When he was a young man he had been employed to work out the details of a revolving engine of this kind. The engine was put into a steamer, and one or two voyages were made, but its working did not give satisfaction. It had three trunk cylinders with a stationary crank, and the general principle was similar to that of Mr. Rigg's engine.

In replying, Mr. Rigg said he was much obliged for Mr. Brown's criticism, coming as it did from one who had worked in the same field as himself. In the matter of oil his engine was not a wasteful one. If it were necessary to pump oil in, it could be done, but he had another method of supplying lubricant. He had no trouble with his valves whatever, because he had found that pressure tended to keep the faces apart. He had run his engine at a very high speed with 700lb. water pressure, and had no trouble with it.

The first paper read on the 28th ult. was by Captain C. C. Penrose FitzGerald, on "Leak-Stopping in Steel Ships." The question of how shot-holes in thin iron and steel are to be dealt with, when next our ships are called upon to receive as well as to fire shot and shell, is one, he said, that has not attracted the attention which its importance demands. In the naval manœuvres we entirely ignore the effect of an enemy's shot piercing one of our ships. It would, of course, be expensive to fire at our own ships, but it might throw some useful light upon disputed questions in naval architecture.

The author said that the following practical questions suggested themselves to the minds of many officers commanding war-ships with thin steel sides. "What will be the condition of the ship's side after ten minutes' action with an enemy, knowing, as we do, the armament and approximate rate of fire of most foreign ships?" Will, or will not, the ship's side be riddled with numerous small holes; to say nothing of the possibility of a large one or two?" "Will, or will not, the water come into these holes unless it is absolutely a flat calm, and the ship has no motion?" And, finally, "How to deal with these holes temporarily?"

Various devices have been suggested as substitutes for armour, in order to keep the sea from swamping steel ships when their sides are injured. Cellulose, woodite, india-rubber, and other substances have been experimented with; but there are objections to the use of all of them. The simple expedient of ordinary outside wood sheathing, extending from 5ft. below the water-line to 10ft. above it, would appear to offer the only method of attaching plugs to the side of the ship, and thus to

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BISCUIT MAKING MACHINERY.

EXHIBITED BY MESSRS. JOSEPH BAKER & SONS, AT THE LATE PARIS EXHIBITION.

(*For description see page* 368.)

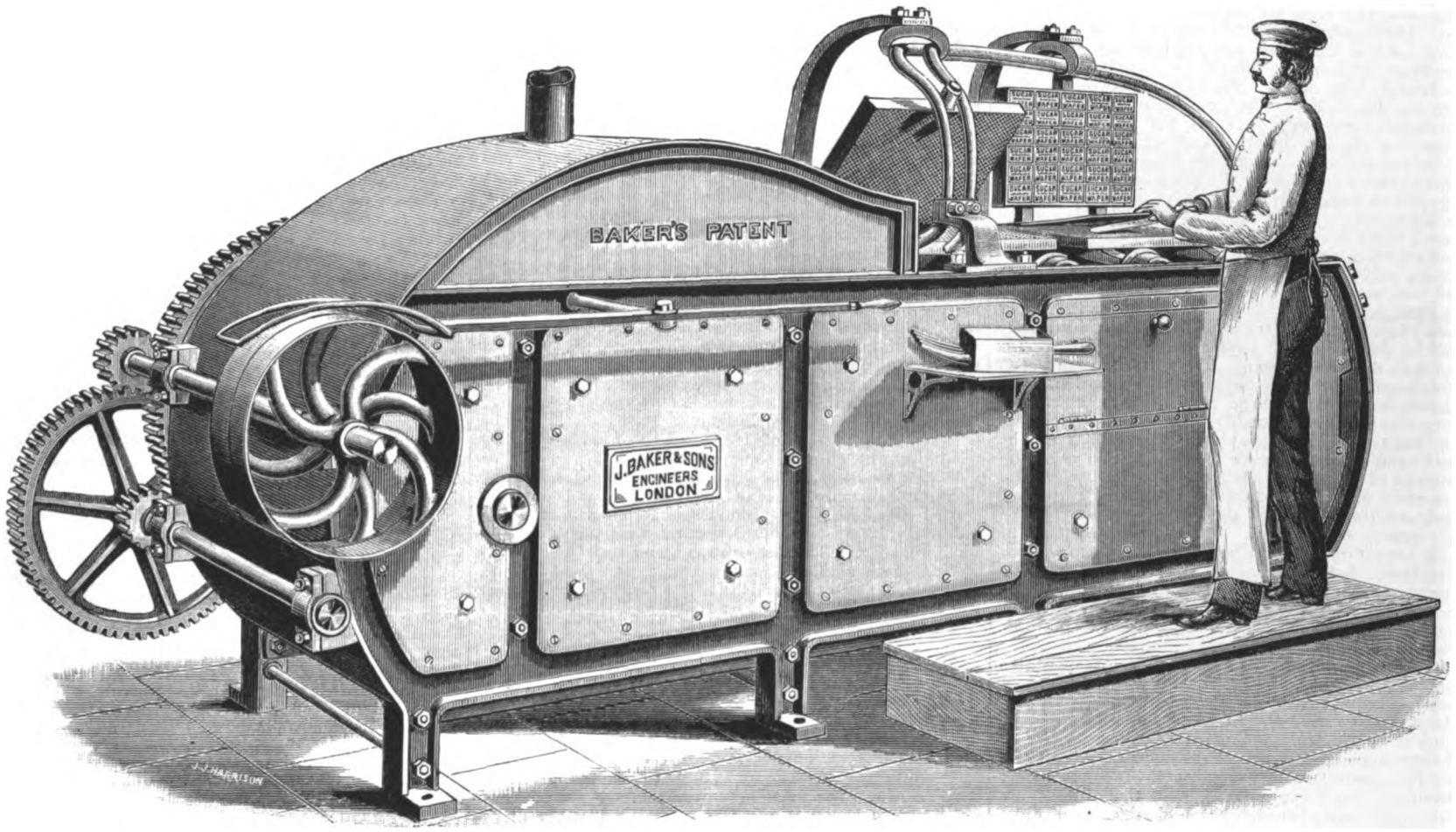


FIG. 3.—SUGAR WAFER MAKING AND BAKING MACHINE.

keep the ship afloat. Some of our ships are wood-sheathed already, but this, the author said, had been done with a totally different object—viz., that they may be coppered, and their bottoms preserved from rapid fouling, so as avoid constant docking.

The author proposed the following experiment: Take out into the Channel, at the back of the Isle of Wight, in moderate weather, two of our modern cruisers, with thin steel sides, and no external armour; let one of them be sheathed with 5in. elm plank, extending from 5ft. below the water-line to 10ft. above it; and let the other be unsheathed. Then fire at them—after removing the crews—that is, a few rounds from the 1in. Nordenfelt, the 3 and 6 pounders, and perhaps one or two rounds from 4in. and 5in guns. If it is thought desirable, the firing could all take place at one or two compartments; and, if necessary, some special arrangements might be made, with cork or otherwise, to avoid all risk of sinking. The author thought that all the holes in the sheathed ship would be dealt with and rendered practically water-tight long before the shipwrights in the unsheathed ship had made up their minds what they were going to do with their holes.

The author suggested a belt of wood sheathing about 15ft. wide—say 10 above and 5 below water—but it would, of course, be a matter for consideration whether, when so much as this has been done, it would not be better to sheath the bottom all over, and copper it.

There seems one objection which might be raised against the author's proposition, and that is that the splinters from the wood would be carried through the hole in the steel, and increase the havoc inside. However, if a tough, short-grained wood, like English elm, were used, very few splinters would find their way through the side.

Captain Long opened the discussion by saying that it was not necessary to fire at a ship in order to find out all that Captain FitzGerald had set forth. A great difficulty naval architects had to contend with was the progress of artillery, for the risks to a ship from under-water projectiles was very great. The number of torpedoes afloat had increased very much, and in a war they must expect to find great damage done by them, and no amount of sheathing would protect the boat against them. Some method of stopping up a hole from the outside while repairs were going on inside would claim attention.

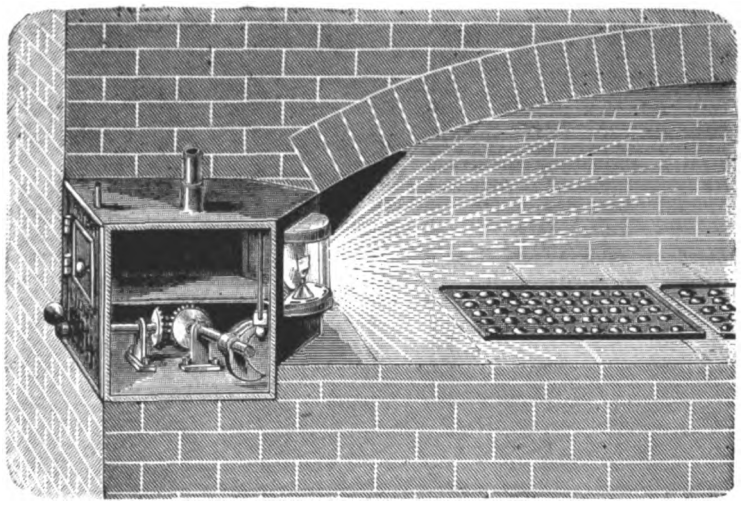


FIG. 4.—LAMP FOR SHOWING INTERIOR OF OVENS.

Mr. White said the utility or otherwise of wood sheathing could be demonstrated without firing at a ship. The progress of artillery and explosives had, however, rendered such experiments unnecessary. In a battle the high explosives and quick-firing guns would not make clean holes in the sides of a vessel, but great pieces of plate would be driven off. That being the case, to clothe the water-line region was useless. It was well known that the interposition of any increased resistance determined the explosion of the projectile at that very place. In our ships of the cruiser class the outer skin was made comparatively thin, and within the ship there were to be found appliances by which any great inflow of water could be prevented. The men would not often work with any water pressure against them, but on a floor which was above water, and with the help of appliances always ready for service. There was no hope of maintaining the water-tightness of a thin side, but large quantities of water might be kept out of the ship by the use of wood on the slopes of the protected deck in association with the cofferdams furnished to all our cruisers. Mr. White also said that the entry of water into the ship above the protected deck did not involve sinking; moreover, in all ships with protected decks the subdivision of space was very minute, and it was part of the design of the ships that a very moderate weight of coal should always remain in the angular space to limit the inflow of water.

Sir John Hay said it might be very desirable to prevent water coming into contact with the internal arrangements by taking the ship out of range to stop the shot-holes. Mr. White had reminded him there were collision mats to be employed to prevent the water coming in, but he doubted if officers had all the information which Mr. White possessed as to the most rapid means of stopping an external hole. The Navy ought to know what was the best way of doing this under fire, in order that the ship might be kept afloat.

(*To be continued.*)

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 15th April, 1890.

Iron.—The market is languid, the recent further decline in English pig having had a depressing effect on business here. As a consequence prices have given way. Merchants are offering bars at 152s. a ton, but for orders of some importance even this does not represent the bottom of the market. Concessions of 2s., 3s., and 4s. a ton are easily obtained. Joists, which are not much inquired for, may be bought at 156s., and on this price concessions are made for moderately large orders. The demand has fallen off a little in the Haute-Marne; but, on the other hand, some improvement is announced from the Nord. The tendency of prices for pig iron in the Meurthe-et-Moselle is distinctly downward. Some time ago forge pig was offered to Belgian consumers at 56s. at the furnaces. This price not having proved sufficiently attractive, offers are now made at 52s. a ton, which is equivalent to 61s. 6d. delivered at the works in Charleroi. This fact is evidence of a feeble demand for home consumption.

Metals.—The efforts of speculators to give another upward turn to copper have proved successful, and we have again Chili bars at £54. But the quotation is rather nominal than real, for the movement has practically stopped for the moment all buying for consumption. Tin continues its downward course. The situation is now such that this metal may be expected to engage the attention of speculators before long. Lead remains firm. Spelter is dropping slowly but continuously.

The Treaties of Commerce.—The replies of the various Chambers of Commerce to the question asked by the Minister of Commerce relative to the renewal of the treaties which expire in 1892 have, for the most part, been received, and the opinion of the country is found to be strongly against such renewal. The Chambers of three of our most important seaports, however—Havre, Marseilles, and Bordeaux—have pronounced in favour of renewal. They point out that the incomparable prosperity of England is due to its ports being free to all the world, and that France can never hope to become a market for raw materials if her frontiers are closed to the importer.

The Chicory Industry.—The Agricultural Committee of Cambrai at an extraordinary sitting, at which upwards of two hundred agriculturists and several deputies were present, have passed a resolution strongly recommending the attention of the Government to a petition of the syndicate of chicory planters and dryers of the district of the Nord, praying for a protective duty on chicory. It appears from this document that the manufacturers of that district use annually 40,000 tons of chicory roots, of which quantity at least 25,000 tons are imported from Belgium. The petitioners say that if this import trade were checked by protective duties, 5,000 hectares of land in the North of France would be immediately planted. The duty asked for is 16s a ton on green roots, and 64s. a ton on dried roots.

The International Labour Demonstration.—Those who are organising the demonstration of the 1st prox. have prepared a petition, which the delegation of working men are to transmit to the Government. It is as follows:—"International demonstration of the 1st of May, in favour of a day of eight hours and a legislation protecting labour, leading, with the eight hours day as an essential basis, to a guarantee of a minimum of pay, to the limitation of the labour of children and women, and to rest for one day in the week. Petition.—The undersigned citizens claim, as the most urgent of all reforms, the limitation by law of the day's work to a maximum of eight hours, because the day of eight hours is work and bread for numbers of labourers who crowd with empty stomachs at the doors of workshops; because the eight hours day will put an end to the periodical strikes which multiply with machinery; because the eight hours day will cause an inevitable rise in wages by suppressing the homicidal competition between the unemployed and those who have work; because the eight hours day is, with eight hours' sleep and eight hours' leisure, life, liberty, and action for the working classes; because the eight hours day will benefit petty trade itself by increasing the power of consumption and purchase by its working-class customers." It is said that 200,000 working men will leave their places of business on the 1st of May and take part in the demonstration in the streets of Paris.

BERLIN, 14th April, 1890.

Iron.—The breaking up of the Upper Silesian pig iron syndicate is another important sign of the times. As English iron is offered for delivery at the price of German produce, the latter is now being offered at a reduction of 5s. and 6s. a ton. The tendency of prices all round is towards a lower level. The downward movement will, however, be slow, because manufacturers have sufficient orders in hand to keep them going for several months to come. The market continues active for finished iron and steel; but the state of the pig iron trade is likely to make buyers of finished produce hesitate. Joists and boiler plates are in very brisk demand. Here in Berlin business is a little slacker, and prices are somewhat weak. Founders continue to receive orders in abundance. Great activity prevails in the machine shops. The foreign trade in manufactured goods is full of life and vigour. The exports of machinery, other than locomotives, boilers, and sewing machines, in the first two months of the year amounted to 10,724 tons, against 9,962 tons in the corresponding period of 1889.

Metals.—There is but little life in the metal markets. Copper maintains its price, though the demand is slack. The zinc market is flat. Manufacturers' prices for spelter remain on the whole unchanged, but merchants are offering their stocks at lower rates. At Breslau some transactions have taken place below £22. The restriction of the consumption caused by high prices is now making itself felt on the markets, which are likely to give way seriously before long. Lead, which is in fairly strong demand, maintains its price firmly.

Flax and Yarns.—All reports agree in describing the situation of the market for linen yarns as good, and the prospect as encouraging. There is a strong and steady current of business that seems likely to continue. For the moment the supply of linens is scarcely equal to the demand. Tows are offered in large quantity; but buyers are numerous and deal freely. Prices are very firm. The imports of yarns in the first two months of the year amounted to 39,886 cwt., against 37,360 cwt. in the corresponding period of 1889.

The Ultramarine Industry. An attempt is being made to combine in one association or syndicate the ultramarine manufacturers of Germany. The association will be of the nature of a share company rather than a convention of manufacturers. Judging from the progress already made, the attempt will be successful. The export trade in ultramarine is steadily growing. The quantity exported in the first two months of the current year amounted to 15,252 cwt., against 12,868 cwt. in the corresponding portion of 1889. Of the former quantity 6,562 cwt. were shipped to Great Britain.

Bavarian Beer.—The financial situation of the great breweries and malt-houses of Bavaria is said to be critical. During the last three years these formerly flourishing industries have been losing ground, particularly in the foreign markets. The last straw, which seems to be breaking the back of this Bavarian camel, was the influenza epidemic, the effect of which on the consumption of beer was very marked.

VIENNA, 14th April, 1890.

The Coal Market.—The brisk demand for coal continues. Prices are very firm, and people are sure that a further increase is certain. The labour question in Westphalia causes an animated export, and Bohemian and Silesian works are very busy, notwithstanding the warm weather which has existed for a fortnight. The demand for waggons which is continually felt in the Bohemian territories has persuaded the Ministry of Commerce to apportion 300 coal-cars of the State Railways to the Dux-Bodenbach line and 615 to the Prague-Dux Railway. A hundred waggons of the 600 ordered by the Dux-Bodenbach Railway have already been delivered, and the Aussig-Teplitz line has enlarged its rolling stock by 14 per cent., so it is to be hoped that the traffic will in future be better arranged. During the first quarter of the present year the Dux-Bodenbach Railway forwarded 495,675 tons, and the Prague-Dux line 311,582 tons of brown coals. The Bohemian collieries are now taking stock, and the reports are all expected to be good. The Duxer Kohlenverein produced 550,587 tons last year. The great increase of wages has caused the profit to become lower; it amounted to 68,000 florins, and the dividend was 4 per cent. The Bruxer Kohlenbergbau-Gesellschaft is increasing its capital from 2½ to 3½ million florins.

The Iron Market.—The character of the Austrian iron market does not change. In all branches there is the same animation, and the transactions are very important. In pig iron the production cannot cope with the demand. Agricultural machine manufactories have received important orders, and have a good prospect. Locomotive constructors have a great deal to do. The Wiener-Neustadter Locomotiv Fabrik is recovering its old position, for it is sharing in an order for 200 locomotives for a German railway, and is to build 40 locomotives for a home railroad company. In Hungary the tendency of the market is essentially different from that in Austria. Foreign influences are not visible, and the market has to be self-dependent.

Electrical Engineering.—A new central electric station is to be erected at Karlsbad by Messrs. Ganz & Co., of Budapest. When completed it will be the largest station in Austria-Hungary out of Vienna.

Beer.—It is proposed to establish two new large breweries at Pilsen. The capital for one will be found by the Vienna Bank, and the other will be under the wing of a London firm.

Trials with the Maxim Gun.—The experiments with the Maxim mitrailleuse were successfully concluded at the Vienna Arsenal last week, after 34,000 rounds had been fired from one gun within four days. The good quality of the steel and of the manufacture was thus amply demonstrated.

BRUSSELS, 15th April, 1890.

The Iron Market.—The syndicate of ironmasters again met last week to consider the state of the market. The continued scarcity of orders is very serious, but the dearness of the raw materials makes it utterly impossible for them to reduce their prices for manufactured goods. There was, therefore, only one course open to the syndicate, and that was to determine to decrease the production. An understanding has been come to among the manufacturers of sheets and bars in the various districts that they are only to work five days a week until the situation is changed. Bars are still quoted at 18fr., and No. 2 sheets at 22fr. The adjudication of the contract for steel rails referred to last week has settled the price of that commodity at 177·50fr.

The Coal Market.—The position of the coal market does not change, and the prices are firm all round. The stocks have everywhere been reduced to almost nothing. *Demi-grasses* for household use are sold in large quantities at 20–21fr.; nuts of best quality are quoted at 27–28fr., and of second quality at 25–27fr.; nuts for rolling mills at 18–19fr.; *fines demi-grasses* at 16–18fr.; close burning coal at 15fr.; and small coking coal at 22fr. In some of the coal districts the owners have been able to sell nuts for rolling mills at 20fr.

The Glass Trade.—The condition of the window-glass market remains unchanged. The efforts of buyers to obtain a reduction of the prices have so far been unsuccessful, and it is likely that their efforts will be resisted to the death, on account of the high prices of fuel and raw materials.

Telephone-Telegrams.—During the month of March 64,062 telegrams were sent from the central telegraph stations of Belgium by order of the various subscribers to the telephone systems. The greatest number of these telephonic messages were received in Antwerp—viz., 20,922, and the next town was Brussels with 10,788. This recent improvement is evidently much appreciated.

DÜSSELDORF, 15th April, 1890.

Iron.—There is but little doing in pig iron, buyers manifesting unwillingness to operate at present prices. This reluctance has been increased by the announcement of a heavy output of the blast furnaces in the month of March. The total production of the furnaces included in the Rhenish-Westphalian pig iron syndicate amounted in that month to 127,231 tons, against 111,656 tons and 117,778 tons in February and January respectively. From Luxembourg it is announced that three new furnaces are to be put in blast in the course of the current month. Further, Belgian trade is very slack, and French prices are giving way, so that foreign competition is likely to become more keen. Lower prices are therefore probable as the year advances. The following are the current quotations, but merchants readily make slight concessions on orders of some importance:—Ordinary spiegel, 103s.; best Rhenish-Westphalian forge pig, 90s.; Siegen forge, 89s.; foundry No. 1, 96s.; Thomas pig, 79s. to 80s. a ton. The market is moderately active for all classes of finished iron and steel, except wire, for which the demand is very slack. Prices remain unchanged.

Coal.—For the coal trade the situation continues to improve. Day by day, as the split in the Socialist camp widens, the chances of another conflict between the colliery owners and their men grow less. The contented are now in a majority, and they seem resolved to make their counsels prevail. This circumstance sufficiently accounts for the more cheerful tone of the markets. That the situation is a strong one is shown by the fact, reported this week, that most of the coal producers are sold forward to the end of next winter. In some cases the contracts extend to July, 1891. As these contracts have been made at prices recently current, the situation and prospects of the coal-mining industry are exceptionally good. The railways, having largely added to their rolling stock of late, are now able to cope with the traffic, and the Belgian coal trucks hired a year ago are now being returned. Coke has given way a little in price, but the market is steady for coal of all classes. The following are the quotations on the Düsseldorf Exchange:—Gas coal, 16s. to 18s.; free burning coal, large, 15s. 6d. to 16s. 6d.; washed nuts, 14s. to 16s.; coking coal, 14s. to 16s.; dry-burning coal, large, 16s. to 19s.; nuts, 17s. to 20s.; small, 7s. to 8s.; blast-furnace coke, 25s. to 27s.; foundry coke, 27s. 6d. to 29s.; and briquettes, 16s. to 18s. a ton. Anthracite nuts have risen 3s. a ton within the last week.

Westphalian Coal at Hamburg.—The high prices of coal in Germany are beginning to tell upon the Westphalian trade with Hamburg and its neighbourhood, in spite of the advantages afforded by the new and commodious wharfs. The consignments of Westphalian produce to that locality in March amounted to 69,730 tons, against 76,190 tons in the same month of last year. During the last week both Westphalian and English coal has been offered at slightly lower prices.

Electric Lighting.—The Commission appointed by the Düsseldorf Municipal Authorities to examine and report on certain schemes for lighting by electricity say, in a report just presented, that during the time in which they have been occupied in this inquiry—less than twelve months—new inventions and improved forms of construction have come upon them with such rapidity that the aspect of the case has been constantly changing, and they find themselves unable to advise immediate action. While progress continues at the present rate there is nothing to lose by waiting.

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LILLE, 15th April, 1890.

Iron.—During the last week the iron market has manifested greater activity, a circumstance which has raised hopes of better times. To the unbiassed observer, however, the larger volume of business will appear merely as the effect of the interruption in the previous week by the Easter holidays. But we are entering upon a season when, in the ordinary course of things, trade becomes more brisk, so that we may reasonably expect some improvement in the next few weeks. Prices are firmer, but it is hard to see how, with falling markets abroad, the present rates are to be long maintained. The weakness of the situation in Paris has an enfeebling influence on the market here. The price of coal seems likely to give way a little.

Textile Manufactures.—There is some revival of trade in linen goods. Orders are coming to hand much more freely, and in sufficient abundance to absorb the whole of the production. There is, therefore, a better tone in the market, the prospect being now regarded as distinctly encouraging. Similarly an improvement is taking place in the woollen goods trade of Roubaix. There is, indeed, no revival of business to chronicle; such is not to be expected at this season. But signs of activity at a later period are multiplying, and the manufacturers are beginning to view the approaching busy season hopefully. Some labour disturbances have occurred to complicate the situation; but no serious troubles are expected. There is nothing new to report of the Calais tulle trade, which is very dull, with but little prospect of speedy improvement.

Flax and Yarns.—The flax market continues active. Home-grown is in brisk demand, all lots offered being promptly bought up. Prices are very firm. There is a little more doing in Russian produce, chiefly for future delivery. Tows are but little inquired for, and prices are weak. Quite a brisk market exists for yarns. Jute yarns continue in strong demand, especially the fine and middle numbers, the tendency of prices being in favour of buyers. There are practically no stocks in hand.

State of Industry.—The Lille Chamber of Commerce, in reply to a set of questions addressed to it by the Superior Council of Commerce and Industry, describes the general state of industry in this locality as "not prosperous." A few exceptions are mentioned, of which the jute industry is one. But the staple industries leave much to be desired. The principal cause is said to be insufficient production, and a revision of the duty tariffs for imported goods is asked for.

AMSTERDAM, 14th April, 1890.

Artisans' Congress in Amsterdam.—The National Dutch Artisans' League has been assembled for two days at Amsterdam. Various topics of interest to the labouring classes were discussed at some length. One of the most important debates was on the question of forming a fund for old age, and for the widows and orphans of artisans. It was resolved to petition the Government to introduce special legislation as to the removal of unsanitary dwellings, and the substitution of hygienic workmen's houses out of the public purse. The establishment of strike funds in various localities was gone into, but this question was postponed. The League has now 3,000 members.

Textile Industries.—The Chamber of Commerce of Tilburg, in Brabant, the centre of our textile industries, has issued a favourable report of last year's work in that district. There was a more ready sale for Dutch textile products abroad, and at more remunerative prices. The consequence was that most manufacturers could work full time. The Chamber states that hand labour is gradually being superseded by mechanical labour. On the other hand, the Chamber of Commerce at Schiedam has issued a rather gloomy account of the "Hollands" industry in that centre.

The "Zone" Railway System in Holland.—The managers of the leading railways in Holland are now discussing the feasibility of introducing the "zone" system on their lines. They have despatched delegates to study the question in Hungary, where the system was first introduced. It is believed that the Austrian Government will be authorised by the Reichstag to follow suit, in which case the "zone" system is almost certain to spread to Germany. The Dutch railway managers want to be prepared for such an eventuality, since the experiment has been highly successful. In the "zone" system the country is divided into "zones" or districts: hence the name. Its feature is uniformity of fares within one district, any distance, and also uniformity of fares from places in one district to places in another district. The method is confined to passenger tariffs, but it is now proposed to apply it to goods rates as well.

Dutch Steamboat Companies. The Netherland-American Steamboat Company, with lines from Rotterdam to New York and South America, has been very successful in 1889, and is enabled to distribute amongst its shareholders a dividend of 17 per cent. The Royal West Indian Steamboat Company has declared a dividend of 6¼ per cent. over the past year. The new shares, amounting to 400,000 guilders, were over-subscribed upon their issue. A Dutch syndicate has offered to the Roumanian Government to start a line of steamers on the Danube under the Roumanian flag.

Shipbuilding.—Messrs. Fop Smit, at Kinderdyk, have just launched a new saloon steamer for passenger traffic on the Rhine between Cologne and Mayence.—Messrs. Bonn & Mees, shipbuilders, of Katendrecht, are engaged upon the new steamship "Leerdam," the property of the Netherland-American Steamboat Company. It will measure 360ft. in length.—The shipbuilding yard and machine factory of the Maas Company, Rotterdam, has made a profit of 40,923 guilders in 1889. The directors propose to write off 25,000 guilders for depreciation, &c., and devote 15,000 guilders to paying a dividend of 5 per cent. on the shares, such dividend not to be distributed, however, until the claim of the company against the fire insurance companies shall have been settled, for the company has had the misfortune of losing its factory by fire quite recently. These proposals have been approved by the shareholders, who have also authorised the directors to re-erect the buildings destroyed as soon as practicable.

The Amsterdam Ship Canal.—The Royal Institute of Civil Engineers has appointed a special committee to study the question of a ship canal of even larger dimensions between Amsterdam and the ocean, than the one at present existing, such canal to be available for vessels of every draught and at all times and tides.

New Company.—The Dutch Oyster Fisheries Company, with a large capital, will shortly issue its prospectus. Its object is to buy up and amalgamate various private oyster cultures, with a view of developing them in a more systematic manner.

COPENHAGEN, 12th April, 1890.

A New Swedish Ironclad.—Although the Swedish Parliament is by no means liberal in its grants to the army and navy, there seems every likelihood of the necessary money being voted for a third ironclad. She would be of the same type as the "Svea" and the "Gota," with some minor alterations so as to ensure a greater speed.

The Fishing Industries in Denmark.—These industries do not seem to be particularly flourishing, judging from the official statistics for the financial year 1888-1889. The number of men engaged in fishing was 7,369, which shows a decline as compared with the previous year. The value of the fishing during the year, inside the Scaw, amounted to 2,964,970kr., which is about 500,000kr. less than the previous year. This decrease in value is owing to a smaller yield, and not to lower prices.

Proposed Zone or Section Railway Fares in Sweden.—The Swedish Parliament has recently been considering a privately introduced Bill proposing a system for railway rates such as has been adopted in Hungary. There may be difficulties attached to the introduction of this method, but the extra expenses entailed would hardly grow any faster than the income.

Naphtha Transport in Russia.—The almost unprecedented development, during the last few years, of the naphtha production in Russia, and the increased tendency to export, have taxed the existing means of transport very severely. Under these circumstances the Transcaucasian Railway from Baku to Batoum and Poti, *viâ* Tiflis, is unable to satisfy the requirements of the exporters. The exports last year of naphtha from Baku alone amounted to an aggregate of 660,000 tons, which quantity would have been still further increased had the above railway been more efficient. Other means of transport have been under consideration, the most ingenious plan being the laying of a gigantic tube or pipe from the Caspian to the Black Sea. About three years ago a concession was given for this unique undertaking, but the holder of the concession was unable to carry out its financial conditions. In the meantime one or two enterprising English capitalists have been negotiating with the Russian Government about the realisation of the scheme, but, although the prospects were favourable at one time, nothing came of it in the end. It is understood that the Russian Government itself contemplates the carrying out of the plan.

MADRID, 14th April, 1890.

Railway from Calatayud to Feruel.—The surveys of this line seem to have deen done so carelessly that new ones have had to be carried out before the commencement of the works. This is not only very costly, but it also causes great delay to the concessionnaires, who have not a very ample time to open the lines of their concessions.

Lighting by Primary Batteries.—A public exhibition has been made of a system of electric lighting with a primary battery, the invention of Major Cabanyes, of the Artillery Corps. The patents not being completed, little information of a technical character was given about the nature of the battery. Of course, some very extensive details were given as to the commercial value of the system, and it is quite possible that it could compete with the dynamo central stations which are now being erected in Madrid, on account of the absurdly high prices demanded by the latter.

The Protection of Property.—The Congress of the International Union for the Protection of Industrial Property has just commenced at Madrid. One of the points that is being discussed is of great interest for England and Spain—viz., the right of seizing imported goods which are marked as the production of a certain place when it is not actually the case. Sheffield articles made in Germany and marked Sheffield, and imitations of Spanish wines imported marked Serez, Malaga, &c., will run a geat risk of being seized, and it is to be expected that the Union will put an end to that practice. Another important question to be dealt with is, whether articles can be imported into a country where there is a patent for its manufacture. Most nations are willing to adhere to this resolution, but England is most decidedly against it, and there is not the least chance that her representatives will yield.

Iron Mines in Biscay.—So far most of the iron mines in Biscay have been of comparatively small extent. Lately, however, some concessions have been demanded at the district of Ceanuri, amongst which there is one of 470 hectares and another of 289 hectares.

NEW YORK, 5th April, 1890.

The Coal Trade.—There has been no change for the better in the anthracite trade. Low prices are being quoted for store and chestnut sizes; coal, which sold at $4 to $4·15 per ton under the old circular rates, can now be bought at $3·25. Larger sizes, which are in greater demand, are bringing rates more nearly equal to the old ones. It is probable that the forthcoming re-opening of canal navigation will increase the demand. Stocks of coal in New England are getting low, and a better demand is expected from that quarter soon. At a meeting of the sales agents of the six great coal companies it was decided to continue the policy of restriction, and the production for the month of April was fixed at $2,000,000 tons. No action was taken with regard to prices.

A Combination of Papermakers.—An attempt is being made to unite several of the larger New York paper companies under one control. It is probable that the Remington Co., the Hudson River Pulp and Paper Co. of Palmer Falls, the Glennsfalls Paper Manufacturing Co., and the Rochester Paper Co. will unite their interests, and the new company will have a capital of $5,000,000.

Iron and Steel.—There is considerably more inquiry, and there are evidences of an inclination among consumers to replenish their stock as soon as they are satisfied that prices are as low as they are ever likely to be. Stocks have not accumulated to any great extent, and a few more heavy orders would change the state of the market entirely. Prices for pig iron are about the same. Any quantity of common brands can be obtained at current rates or lower, but there is not a great quantity of choice iron to be had. In manufactured iron the demand has been more active, but most of the business has been in small lots. Many of the mills are getting near the end of their old orders, and prices are not likely to become much better until some new work comes to hand. There has been little doing in steel rails. Prices are held steadily at $34 to $34·50 per ton at mill. There is every probability of an increase in the demand in the near future.

Electrical Accumulator Company.—The trustees for the holders of the first mortgage bonds of the Electrical Company have begun suit in the Supreme Court to foreclose a mortgage for $1,000,000 on the company's property in New York and New Jersey. The company issued stock for $957,400, and executed a mortgage of $1,000,000. A default was made in the payment of interest in June and December last. The trustees also want a receiver appointed, and an injunction to restrain the company from disposing of its property.

PHILADELPHIA, 4th April, 1890.

New United States Battle Ships.—The Naval Appropriation Bill has been completed in committee. The total appropriation is for $22,151,523, which is about 3½ million dollars less than the Navy Department estimates. Provision is made for four new vessels far beyond anything yet undertaken in America. Three of the vessels are to be sea-going coast defence line-of-battle ships of about 8,500 tons, designed to carry the heaviest armour and correspondingly heavy ordnance. They are to carry enough coal to allow them to steam 5,000 miles, and to have as high a speed as is compatible with the other qualities required. They are to cost not over $4,000,000 each exclusive of armament. The other vessel is to be an armoured cruiser of about 7,300 tons displacement, and it is to cost not over $2,750,000. It is to have a minimum speed of 20 knots. One is to be built on the Pacific Coast and one on the Gulf of Mexico. The Secretary of the Navy can build the vessels in the yards if the work cannot be done at reasonable cost by private contract.

The Largest Wooden Vessel Afloat.—It is rather interesting to observe the survivors of any race, especially when there is something exceptional in their form and appearance. There recently arrived in the port of Philadelphia the wooden vessel "Kappahannock," which is said to be the largest wooden vessel afloat. She was built at Bath, Maine, and cost $125,000. Her dimensions are 287ft. long, 48¾ft. beam, and her tonnage 3,053 net. In the construction of the ship 700 tons of Virginia oak and 1,200,000ft. of Virginia pine timber were used. The frame is of oak, well seasoned when put up, and the first quality of Georgia pine was used in the ceiling, deck frames, and planking. The main keelson is 3ft. 2in. in depth; bilge keelsons, 14in. flush; lower deck beams, 15in. by 15in.; 'tween deck beams, 12in. by 14in.; and the spar deck beams at the main hatchway are 18in. by 18in. The "Kappahannock" is the heaviest sparred ship that ever carried the stars and stripes. Her mainmast is 89ft. long and 38½in. in diameter; the maintopmast, 58ft.; maintop-gallant mast, 71ft.; mainyard, 95ft.; foreyard, 95ft.; and, altogether, she has a spread of canvas of 15,000 yards. The lower masts are of Georgia pine, and the other spars of Oregon pine, but, curiously enough, the bowsprit is of steel.

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BISCUIT MAKING MACHINERY.

Exhibited by Messrs Joseph Baker & Sons, at the late Paris Exhibition.

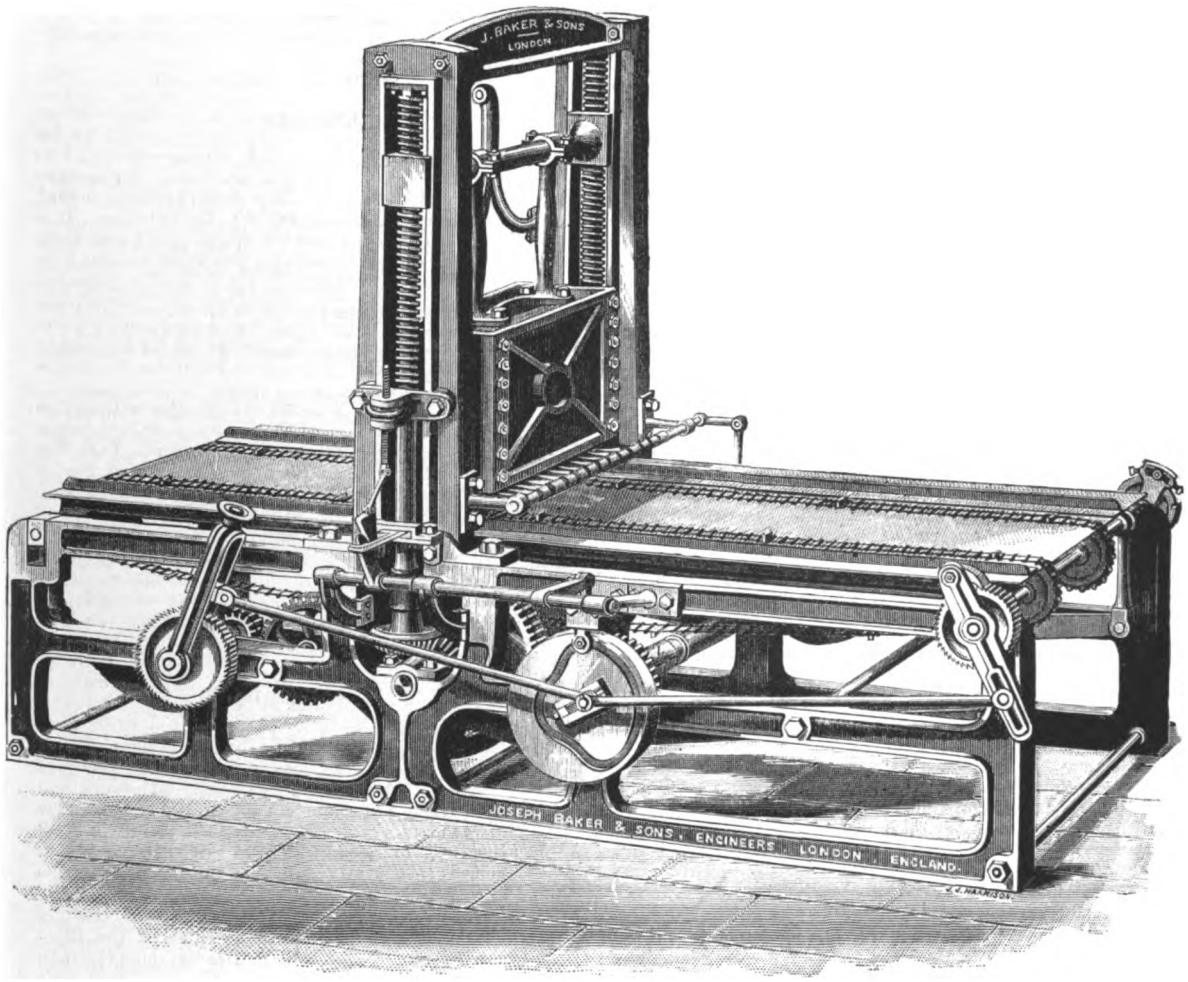


Fig. 5.—Machine for Making Drop Biscuits.

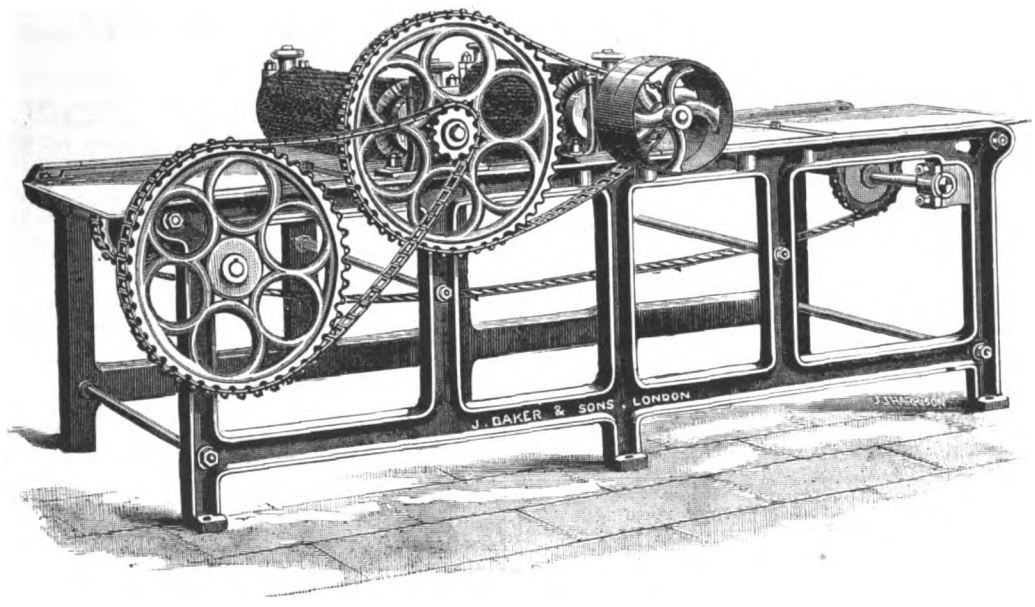


Fig. 6.—Machine for Cleaning and Greasing Pans.

MESSRS. JOSEPH BAKER & SONS' BISCUIT MAKING MACHINERY.

Messrs. Joseph Baker & Sons, 58, City Road, London, had the largest and most complete collection of bread and biscuit making machinery at the late Paris Exhibition. The exhibit contained many entirely new machines, and their machines of older types had some conspicuous improvements embodied in their design. As it will be of interest to our readers to see the modern applications of machinery to so old an industry as biscuit making, we purpose to give as full as possible an account of several machines.

Fig. 1, page 361, shows their improved vertical mixing machine for rich, soft, and semi-soft biscuit doughs. This machine will knead a sack of flour in eight to ten minutes. The tub containing the flour is firmly fixed on the bed-plate of the machine, and the mixers are lowered into it. They are balanced by means of a weight which passes over a pulley at the top, and they can be raised or lowered by means of friction gear at the back. This arrangement avoids the necessity of raising the tubs to the mixers, and is a great improvement on the old form of machines, as it avoids the risk and danger of raising and lowering heavily loaded tubs. The tubs are fitted with wheels, so that one can be substituted for another as soon as the mixing is done. The mixers are driven by strong bevel gearing, and they can be raised or lowered by friction gear, which moves them automatically through the distance required without throwing the rest of the machine out of gear. Messrs. Baker also have a horizontal cylindrical mixing machine for hard biscuit doughs, in which the kneading is done by horizontal mixers mounted on the same shaft but driven at different speeds. The flour is supplied by three hoppers, which distribute it over the cylinder. The mass when kneaded is emptied on the receiving table by tilting the cylinder forward with the help of a worm and worm wheel. The machine is kept closed during the kneading, so as to exclude all dirt, instead of being left open as formerly.

Fig. 2, page 364, shows the combined hard and soft dough biscuit gauging, cutting, and framing machine. This machine is fitted with a scrap-separating and self-framing apparatus, an improved chain gear for carrying pans and wires, a new "skip motion," and a revolving brush or fan. The gauge rollers give the required thickness to the dough, which enters at the left-hand side of the machine. After passing through these rollers it is carried forward by means of an endless band, to and under a revolving brush, or, if required, under a revolving fan. The crimp roller takes the place of the revolving brush in the making of certain kinds of biscuits, and this crimps the biscuits on the top before they pass onwards to the cutters. After the biscuits are cut from the dough the "scrap" is divided from the biscuits by a separating web and roller, while the biscuits are carried forward and automatically deposited upon the pans or wires. During this operation the new "skip motion" ensures that every biscuit is deposited regularly upon the pans, and when one pan or wire is filled it is hitched forward so that the succeeding biscuits are placed on the next pan or wire without any of the biscuits being deposited on the edges of the two pans or between them, as was the case before the "skip motion" was invented. The gauge rolls have a continuous motion given to them by means of one of a number of change wheels. A new spring adjustment fitted under the bearing of the top roller takes up the wear. These improvements prevent all creasing of the dough, and ensure perfect and regular working, thus giving a great advantage over the irregular motion of the ratchet wheels formerly used. The driving pulley has three speeds for the various sizes of biscuits.

Fig. 3, page 365, shows Messrs. Baker's sugar wafer making machine for automatically making and baking sugar wafer biscuits. The plates, when freshly charged with the required quantity of batter, are closed automatically and passed into the baking compartment. The time occupied in their passage is sufficient to bake them, and on passing out the plates open automatically for the removal of the baked sheet of wafer, and are ready to be again charged. The plates are all linked together by connecting shafts, and are carried by wheels, which run on endless tracks. The time required for the complete circuit of the plates is four or five minutes. The machine is made either with a slowly continuous motion, or with a stop motion, that brings the plates to a stop in front of the operator, in order that he may remove the sheet of baked wafer and recharge the plate with batter. The slowly continuous motion, however, is preferred. The oven is heated by gas, and the two sides of the plates are heated equally. The heating may be regulated to the greatest nicety by simply turning the taps and regulating the current of air which is forced through the pipes by the firm's pressure blower. The entire machine is enclosed with sheet iron plates and packed with asbestos, so as to prevent any loss of heat. The wafer plates are all faced with gun-metal and are electro-plated. Very little power is required to drive the machine, ⅓ h.p. being more than sufficient.

Fig. 4, page 365, shows a sectional view of Baker's patent oven gas light, which is so constructed as to give, when required, a brilliant light all over the oven at once. By touching a small ball handle, the fire door inside is instantaneously opened, and in its place the light appears, showing the baker every part of the oven, through a small window in the oven door. No door has to be opened, either for operating the light, or for seeing how the baking is going on. The losses of heat and steam caused by the opening of the oven door and damper are thus entirely avoided, and the heat and steam are kept in the ovens. The light is ventilated so as to be unaffected by the heat or steam.

Fig. 5 illustrates their new drop biscuit machine for making all kinds of drop biscuits, such as macaroons, ratafias, &c., which are usually made by hand. The dough is placed in a rectangular iron box, which is placed between uprights. The piston which presses down the dough is first tilted upwards so as to allow the dough to be placed in the box. It is then placed in position, and gradually descends to the bottom of the box, forcing out the dough through dies of various shapes which are screwed to the bottom of the box. A sliding knife runs across the face of these dies, and checks the flow of the dough, and allows it to fall at regular intervals upon the pans beneath. These pans,

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by an automatic arrangement, rise to receive the dough, and then, on falling, move forward so as to leave room for the biscuits at the next rise. This pan-shifting gear can be so arranged as to receive biscuits at an instantaneous drop or to draw them out into such shapes as the finger biscuit. When the dough has been discharged the press returns rapidly and automatically to its original position, so that the box can be refilled. The baking pans are placed on endless chains, and are carried regularly forward to the drop pipes, which are placed below the dough box. When in position for receiving the drops, a lifting motion is given to the table below the pan, which brings it up in position to receive the drops from the ends of the pipes. Perfect evenness and uniformity of shape and size are ensured by means of the automatic cut-off slide which works transversely above the tops of the pipes, and which allows an exactly equal quantity to enter each pipe and to be measured and cut off at the same instant. The plunger is worked by two powerful screws fixed in the side frames of the machine, and the gearing is so arranged that when the plunger reaches the bottom of the box it runs up automatically by a quick return motion, and is moved to one side out of the way, so as to admit of the dough box being refilled. Hence the work can go on continuously, as rapidly as the pans can be placed on and removed from the machine. No further attention is needed when the machine has been started than to put on the empty baking pans and remove the full ones, and to refill the empty dough box. The new "skip motion" hitches the filled pan quickly forward and replaces it with an empty pan, so that no biscuits fall between or on the edges of the two pans. The machine can turn out at a maximum 2 tons of biscuits a day.

Fig. 6 shows Messrs. Baker's pan cleaning and greasing machine, which diminishes the labour and expense of cleaning biscuit plates or pans by hand. The machine consists of an iron framework having an endless chain running along the top and returning underneath. This chain has projecting links arranged at distances apart equal to the length of the pans. The pans to be cleaned are placed on the top of the chain between guides arranged for the purpose, and are carried forward by means of the projections in the chain under two brushes, which revolve in the opposite direction. The first brush is made of stiff bristles and revolves at a high speed, but the second is made of softer bristles and revolves at one-third of the speed of the first brush. The effect of this is that the first brush cleans off all particles adhering to the pan, and deposits the grease, while the second makes the surface of the grease equal and light all over.

Figs. 7 and 8, page 372, represent the new combined rout biscuit press, cutting and panning machine. Fig. 7 shows the machine as arranged and fitted with the special attachments, dies, travelling web, and cutting and panning gear for all kinds of ordinary rout biscuits, as "oaten," "cable," or "twist;" and Fig. 8 shows the machine, with special front, dies, cutting knife, and panning attachments for "rose," "café," and "ring" biscuits. This machine is used for doughs slightly tougher than those used in the drop machine. When the machine, as shown in Fig. 7, is making cable and twist biscuits, the dough is placed in the square iron box receiver at the left. A plunger forces the dough slowly out through the circular dies shown at the right-hand end of the dough box. A worm gives the dies a circular motion, which sends the dough out in long ropes. These ropes are carried forward by the endless web, and they pass under the cutting block at the right-hand end of the machine. This cutting block cuts them either at right angles or diagonally into the lengths required, and they are then deposited upon the pans, which run along upon an endless chain underneath. In Fig. 8, where rose and café biscuits are to be produced, the dough is forced vertically upwards through the dies. It is cleared from the dies by a special sliding knife, and is then deposited directly upon the pans which pass underneath. The knife itself is cleared of the biscuits by an arrangement of automatic elastic brass fingers, which meet the knife at the moment it touches the pan. This machine produces every variety of press goods more economically than has hitherto been possible, and it makes a great number of new forms in this favourite class of biscuit.

There are many other machines which Messrs. Baker have designed for their own use in connection with the manufacture of confectionery and biscuits, and they are all of excellent design and workmanship.

Notices of Meetings.

NEXT WEEK.

SOCIETY OF CHEMICAL INDUSTRY (LONDON SECTION).—Monday, April 21st. Papers will be read by Dr. Moritz, "On the Expulsion of Ammoniacal Compounds from Sulphuric Acid used in Kjeldahl Determinations"; Mr. Boverton Redwood, "The Petroleum Fields of India."

INSTITUTION OF CIVIL ENGINEERS.—Ordinary Meeting, Tuesday, April 22nd, at 8 p.m. Paper to be discussed: "The Application of Electricity to Welding, Stamping, and other Cognate Purposes," by Sir Frederick Bramwell. Students' Meeting, Friday, April 25th, at 7.30 p.m. Paper to be read: "Some Applications of Electricity in Engineering Workshops," by C. Frewen Jenkin.

LIVERPOOL ENGINEERING SOCIETY.—Wednesday, April 23rd, at 8 p.m. Adjourned discussion upon Mr. Thomas L. Miller's paper, entitled, "The Efficiency of Gas Engines."

SOCIETY OF ARTS.—Wednesday, April 23rd, at 8 p.m. "Coal in the South-East of England," by William Whitaker, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS.—Thursday, April 24th, at 8 p.m. Paper to be read: "On a Lightning Guard for Telegraph Purposes, and on the Protection of Cables from Lightning," by Dr. Oliver Lodge, F.R.S.

TEXTILE SOCIETY, YORKSHIRE COLLEGE, LEEDS.—Friday, April 25th. A Lecture on "Steam Generation," by Mr. B. H. Thwaite.

PRICES CURRENT, 16TH APRIL, 1890.

Quotations at per ton, unless otherwise specified.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	6 17 6	.....	7 7 6	f.o.t. wks.
„ Angles	6 12 6	.....	7 2 6	„
„ Plates	6 17 6	.....	7 7 6	„
Staffordshire Bars (cheaper makes)	8 15 0	.....	9 5 0	London.
„ Angles	8 15 0	.....	9 5 0	„
Crown Sheets	8 10 0	.....	9 0 0	„
„ Hoops	8 2 6	.....	8 12 6	„
"Siemens-Martin" Steel Boiler Plates	9 5 0			„
„ Ship and Girder	8 5 0			„

Market quiet.

PIG IRON.

Middlesbro' Warrants, No. 3	46/-	Cash
Scotch Warrants, m/n	46/-	„
Hematite Warrants, m/n	54/-	„

Stocks in Stores	Scotch ..... 807,584.—Dec.	for the week	7,862	Tons.
	Middlesbro' 139,039.—Dec.	„ „	2,298	„
	Hematite ... 357,065.—Dec.	„ „	5,311	„

Exclusive of stocks in makers' yards.

	No. 1.		No. 3.	
Coltness	69/6	.....	63/-	f.o.b. Glasgow.
Gartsherrie	64/6	.....	59/6	„ „
Langloan	70/-	.....	63/-	„ „
Summerlee	67/6	.....	62/6	„ „
Glengarnock	69/-	.....	67/-	„ „
G.M.B. ex Store	46/6	.....	46/3	f.o.t. Works.

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	77/-	66/-

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

METALS.

		£ s. d.		£ s. d.	
Spelter:	Ordinary	£22 10 0	to	£22 15 0	
Copper:	British Cakes and Ingots	54 0 0	„	55 0 0	
„	Chili Bars, G.O.B.'s	48 7 6	„	48 12 6	
„	Other sorts, G.M.B.'s (equal to Chili Bars)	48 7 6	„	48 12 6	
„	Manufactured (strong)	61 0 0	„	.....	
Lead:	Common Pig	13 12 6	„	13 15 0	
„	English Sheet	14 2 6	„	14 5 0	
Tin:	Straits	89 2 6	„	89 10 0	
„	Australian	.....	„	.....	
„	English Ingots	94 0 0	„	.....	

Messrs. Carrick & Brockbank, Manchester, report as follows:—

COPPER: The market for copper continues very quiet, although an improvement has taken place in raw. On the 9th, the date of our last report, Chili bars were £47 17s. 6d. to £48 5s. cash, but they gradually declined till £47 10s. to £47 17s. 6d. was reached at the end of the week. The market opened at the latter rates on Monday, but a firmer tone has since prevailed, quotations to-day being £48 7s. 6d. to £48 12s. 6d. cash. But little business is taking place in manufactured, which is still quoted £61 sheets and £64 bottoms.

TIN has been very unsettled during the week, and prices are lower. Yesterday quotations for foreign were £88 5s. to £88 12s. 6d. cash; but an active trade is reported to-day at advanced rates—viz., £89 2s. 6d. to £89 10s. cash.

LEAD continues very quiet, without change in price.

SPELTER keeps easy, although there has been a little more demand recently.

CHEMICALS.

			£ s. d.		£ s. d.
Acid:	Carbolic Crystals	lb.	0 0 10	to	0 0 11½
„	„ Liquid	gal.	0 1 2	—	.....
„	Citric	lb.	0 1 7	--	.....
„	Oxalic	„	0 0 3½	--	.....
„	Sulphuric	ton	1 12 0	—	.....
„	Tartaric	lb.	0 1 4½	—	.....
Alum:	Lump (powder 10/- ex.)	ton	4 17 6	—	.....
Ammonia:	Carbonate	lb.	0 0 3½	—	.....
„	Muriate (Grey)	ton	22 15 0	—	.....
„	„ (White)	„	26 10 0	—	.....
„	Sulphate	„	11 12 6	—	.....
„	Liquor	lb.	0 0 3½	—	.....
Antimony		ton	.....	—	.....
Bleaching Powder		„	5 2 6	—	5 5 0
Bisulphide of Carbon		„	13 10 0	—	.....
Borax		„	30 0 0	—	.....
Benzole (90 %)		gal.	0 3 5	—	.....
„ (50/90 %)		„	0 2 8	—	.....
Copper Sulphate		ton	25 10 0	—	26 0 0
Copperas		„	2 0 0	—	.....
Kieserit		„	.....	—	.....
Lead:	Nitrate	„	22 10 0	—	.....
„	White Sugar	„	24 0 0	—	.....
„	Brown „	„	19 0 0	—	.....
Potash:	Bichromate	lb.	0 0 4	—	.....
„	Caustic	ton	22 0 0	—	.....
„	Carbonate	„	19 10 0	—	.....
„	Chlorate	lb.	0 0 5	—	.....
„	Prussiate (Yellow)	„	0 0 9½	—	.....
„	Sulphate (Basis 90 %)	ton	9 10 0	—	.....
Precipitate:	Red	lb.	0 3 1	—	.....
„	White	„	0 3 2	—	.....
Salts:	Epsom { Bags	ton	3 0 0	—	.....
	{ Casks	„	3 15 0	—	.....
„	Glauber	„	1 10 0	—	.....
Sulphur:	Sublimed Flowers	„	9 0 0	—	.....
„	Recovered	„	4 10 0	—	.....
Soda:	Ash	deg.	0 0 1½	—	.....
„	Caustic (White 70%)	ton	10 0 0	—	10 2 6
„	„ { „ 60%)	„	9 0 0	—	9 2 6
„	„ { Cream 60%)	„	8 12 6	—	8 15 0
„	Crystals	„	3 0 0	—	3 2 6
„	Bicarbonate	„	6 5 0	—	.....
„	Hyposulphite	„	6 5 0	—	.....
Solvent Naphtha		gal.	0 4 0	—	.....
Tartar, Cream of		cwt.	5 12 6	—	.....
Zinc Sulphate		ton	7 10 0	—	.....

Messrs. S. W. Royse & Co., Manchester, report as follows:—

CHEMICALS.—The state of the chemical markets is not satisfactory, and many complaints are being made about the quietness of business in general. Caustic soda is more plentiful, and though makers are expecting an improved foreign demand shortly, prices are giving way at present. Bleaching powder continues very dull; soda ash, however, holds a very strong position, and soda crystals and bicarbonate of soda are firm. Chlorate of potash is steady. There is less inquiry for yellow prussiate of potash. Carbolic acids continue to droop; creosote and solvent naphtha are fairly brisk. Sulphate of copper is active for April-May, but quoted much lower for later months.

OILS.

			£ s d
Cocoanut:	Cochin	per tun	28 10 0
„	Ceylon	„	25 5 0
Cottonseed		„	22 0 0
Cod		„	21 0 0
Lard		„	37 0 0
Linseed		„	23 2 6
Palm, Lagos		„	24 10 0
Rapeseed:	English	„	32 0 0
Seal:	Pale	„	28 0 0
„	Brown	„	22 0 0
Sperm		„	46 0 0
Whale		„	24 0 0
Turpentine		per cwt.	1 9 6
Coal		per gal.	
Petroleum	(Refined)	„	0 0 5⅞
„	Spirit	„	

RAISING A SUNKEN STEAMER.—About three weeks ago, as one of the mud-hoppers belonging to the Mersey Docks and Harbour Board was proceeding to the depositing ground at the mouth of the Mersey, it ran into the steamer "Goval," of Aberdeen, and caused it to sink over the line of the Mersey Tunnel As the wreck caused an obstruction to the navigation, the Dock Board employés have been preparing to raise, and on Monday the forward half was successfully raised and beached on the Tranmere shore. The after half will be raised as soon as the preparations are completed.

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HOME INDUSTRIES.

LONDON, 17th April, 1890.

THE MONEY MARKET.—Money has now become exceedingly easy, and what little demand there is for loans, or for the discounting of bills, is satisfied at rates considerably below 2 per cent. The only disturbing element is the decline of the Paris rate of exchange to a point at which gold must leave the Bank of England. The sums sent so far to Paris have been unimportant. The stock markets are all firm and buoyant. The cheapness of money and a number of other favourable influences combined to raise prices considerably at the beginning of the week. Consols have been rising, and home railway stocks have gone up, not so much on account of their prospects, but because the public has paid little heed to the dismal prophecies that have been indulged in about an increase of working expenses concurrent with a cessation of the briskness of trade. Railway stocks have been firmly held, and "bears" who sold now find it difficult to buy stock to fulfil their commitments; hence the rise in quotations. The New York market, having awakened from the lethargy which has afflicted it for a long time, has become an active buyer, and American railway shares have been strong this week. Canadian railways are also in favour, the long-expected rise in Canadian Pacifics having taken place on the discomfiture of the "bears," who have succeeded in preventing it till now. Grand Trunks have also been bought since the issue of a favourable report for last half-year. Foreign securities are firm. Argentines, after experiencing several further severe declines, have taken a more hopeful turn. Copper mining shares have risen a little, but gold shares are neglected. Miscellaneous and industrial securities have presented no special feature.

COMPANIES.—The following companies have been registered since our last report:—Patent Lithographic Zinc Plate Co., Ld., with a capital of £10,000; George Price, Ld., with a capital of £5,000, to carry on the business of manufacturers of safes; Fowler Patents, Ld., with a capital of £36,000, to acquire certain patents for bending pipes; Ambrose Walker & Co., Ld., with a capital of £10,000, to carry on business as earthenware manufacturers; Andrews & Preece, Ld., with a capital of £25,000, to carry on the business of electrical engineers; Pomeroy Patents Gold Extracting Co., Ld., with a capital of £100,000, to acquire a certain patent for extraction of gold; The Scandinavian Exploration Co., Ld., with a capital of £50,000; The Silent Step and Flooring Co., Ld., with a capital of £10,000, to acquire certain patents; The Andrew Patent Cask Syndicate, Ld., with a capital of £10,000; William Hollins & Co., Nottingham, Ld., with a capital of £300,000, to carry on the business of woolspinners, &c.; Centrifugal Gold Process and Fine Reduction Syndicate, Ld., with a capital of £30,000; Cardiff Floating Docks and Ship Repairing Co., Ld., with a capital of £35,650; Denby Iron and Coal Co., Ld., with a capital of £30,000; Butt's Mill Co., Ld., with a capital of £10,000, to carry on the business of spinners, &c.; Kingston Phosphate Co., Ld., with a capital of £5,000; The Tilbury Portland Cement Co., Ld., with a capital of £25,000.

SHIPPING.—Freights have shown no improvement during the last fortnight, and the holidays have prevented the expansion of business. The prices of new steamers have not yet been sufficiently reduced to bring fresh buyers into the market.

THE BOARD OF TRADE RETURNS.—There has been a sudden stoppage in the favourable nature of the Board of Trade Returns, the exports for March amounting to £20,067,022, against £21,459,490 in the same month of last year. Machinery and millwork stand at £919,862, as against £920,238, but on the other hand iron and steel have advanced. Hardware and cutlery is £231,232, as compared with £274,930 in March last year. Implements and tools have increased, being £107,278, against £101,267. Cotton yarn and twist are £936,371, against £1,110,290; piece goods, £3,775,255, against £4,732,311; jute manufactures, £200,649, against £268,106; linen yarn, £73,418, against £82 161; linen manufactures, £429,534, against 486,392; woollen and worsted yarn, £288,110, against £335,949; and woollen and worsted manufactures, £1,692,015, against £1,834,386. The total of chemicals and chemical and medicinal preparations is £711,152, against £680,477, but this increase is wholly under the section of drugs. It is therefore seen that the falling off has been all along the line with but trifling exceptions. In imports a similar state of affairs exists. The total value was £36,140,334, against £36,265,387.

RAILWAYS.—The gross receipts of the twenty-three principal railways in the United Kingdom, for the week ending the 6th inst., amounted, on 16,158¼ miles, to £1,375,901, and for the corresponding period of 1889, on 16,030 miles, to £1,222,708, an increase of 128¼ miles, or 0·8 per cent., and an increase of £153,193, or 12·5 per cent. The Good Friday week traffic income was included in the returns this year as against an ordinary week.

IMPROVEMENTS AND WORKS IN THE CITY.—Colonel Haywood, the engineer to the City Commission of Sewers, has just published his report on the works executed by that body during the past year. He states that the total length of sewers constructed during the year was 1,834ft., of which 1,031ft. were on the lines of old sewers. The number of premises drained was 160. The frontages of various premises were set back for widening streets in Aldersgate Street, Distaff Lane, Creechurch Lane, Duke Street, Milk Street, &c. The Metropolitan Board of Works used to contribute about £30,000 annually towards the cost of the improvements carried out by the Commission. The London County Council have since expressed their intention of discontinuing this practice, and they intend to deal with City improvements in the same manner that they do with those in other parts of the metropolis. Tenders were received from the Gas Light and Coke Company for lighting the public lamps, the price charged being 2s. 2d. per 1,000 cubic feet. The Commission have resolved that all the streets in the City should be lighted by electricity, and tenders have been invited. One contract for lighting the central district has been concluded with the Anglo-American Brush Electric Light Company, and others are under consideration.

THE CHANNEL TUNNEL.—An inspection of these works was made, on Saturday last, by Major Marindin. A few gentlemen and the directors of the company also paid a visit to the works. The Board of Trade gave permission for the boring machinery to be used on the occasion, provided that it was not worked until after Major Marindin had made his inspection. The ventilation of the tunnel, which is now about 2,020 yards long, was found to be perfect, and it still continues almost dry.

HER MAJESTY'S SHIP "BARRACOUTA."—The coroner's inquiry into the death of the stokers who were killed by the explosion on board H.M.S. "Barracouta" during her engine trials concluded at Sheerness on Thursday last. The jury found that "the deceased accidentally came by their death from shock from burns received in the stokeholds, caused by flames suddenly issuing from the ashpits of the port boiler, owing to the combustion-chamber tubes and tube-plates becoming overheated from shortness of water or ebullition on the boiler, thereby producing local expansion and contraction, and allowing the steam to escape into the combustion-chamber and cut off the exit of the flames through the tubes." The jury regretted that the Admiralty had not carried out the recommendations of the jury in the "Thistle" explosion in 1869, by providing hospital accommodation for injured men at Sheerness, and thus caused the necessity of sending cases to Chatham.

THE SPORTSMAN'S EXHIBITION.—This Exhibition is now being held at the Agricultural Hall, Islington. In addition to sporting exhibits proper, there are various gas engines and some light tools.

THE RATING OF MACHINERY.—Mr. Winterbotham's Bill for the exemption of machinery from rating was read a second time in the House of Commons last night. The supporters obtained a majority of 152 in a House of 326, and the general interest thus shown in the measure will probably cause the Government to take the Bill in hand.

THE "ÆOLUS" WATERSPRAY, GENERAL VENTILATING, HEATING, AND ELECTRICAL ENGINEERING COMPANY.—The goodwill of the "Æolus" Waterspray, General Ventilating, and Electrical Engineering Company, together with the patent rights, working plant, &c., have been purchased by Messrs. Baird, Thompson & Co., consulting, ventilating, heating, and sanitary engineers, of London and Glasgow, and will be carried on by them conjointly with their present business at 165, Queen Victoria Street, London, and 24, Bath Street, Glasgow. The "Æolus" waterspray system of ventilating and warming has been before the public for many years, and is well known in the United Kingdom and abroad.

MANCHESTER, 17th April, 1890.

THE IRON TRADE.—The great fall in the price of pig iron during the past few days has been followed by a fall in the quotations for bars. At the quarterly meetings last week the prices were fully maintained, and very little business was done in consequence. Quotations now are nominally £7 10s. per ton delivered, and would be lower but for the increased price of coal. There are signs, however, that the excessive rates asked for coal will be reduced, and there is already a considerable reduction in the price of coke. There is little prospect of any free buying for some two or three months. Yesterday steel boiler plates wrre offered at £9 per ton.

THE ENGINEERING TRADES.—Reports as to the condition of the engineering trades in the district are very variable in their character. Most firms are well off for orders at present, and will not actually need new ones for from six to twelve months. The new business offering is not large.

LINEN AND JUTE TRADES.—The changes that have taken place in the linen trade since our last report are principally in connection with the shipping department, which in the American quarter is brisker, owing to the extensive orders placed, and about to be placed, by buyers on the other side, in anticipation of increased tariffs. These tariffs would seriously interfere with the exports of medium and low grade linens from this country. The home trade business displays no new feature of importance. The inquiry that does exist is chiefly for a few fancy articles, or in the case of heavier fabrics for current requirements. Stocks in first hands are, notwithstanding this state of things, light, as production during the holiday period was curtailed considerably. There is a weakness in yarns which keeps prices of most classes of finished goods low, and makes buyers difficult to deal with. Damasks, and the best descriptions generally, have been inquired for, but there is not much doing in coarser makes, such as crashes and other descriptions of towelling, forfars, &c. The sales of hessians are not large, but the manufacturers may expect further orders from the large consumers here, as extensive quantities are being used for packing purposes. Linen threads are in steady request. The production of the leading concerns engaged in the trade is larger than ever and finds a ready market.

CHEMICAL EXHIBITION.—An Exhibition of samples of various chemical articles and apparatus used in the trades of this district was opened on Tuesday by Mr. Ivan Levinstein. The idea of the promoters (Messrs. Davies Bros.) is to provide a place where the various products manufactured or used in the industries of Lancashire can be examined. In this way it is thought that manufacturers will be able to ascertain what there is in the market suitable to their needs and where it is to be found. The collection at present, although small, is comprehensive, and includes a large number of samples of dye-stuffs and other chemicals. There are several samples of chemical plant of various kinds.

THE SALT TRADE.—Like cotton and other articles, the exports of salt from Cheshire for March show a great falling off. The amount exported was 35,531 tons, as against 74,161 tons in the corresponding month last year. This, coming after the prosperous months of January and February, is somewhat surprising. The owners of the salt works at Preesal, near Fleetwood, are contemplating the establishment of chemical works on the spot, so as to utilise the brine instead of shipping the salt.

SALT SPRING IN THE SHIP CANAL.—We understand that a brine spring has been discovered in the cutting of the Manchester Ship Canal near Partington. The water from the spring is being tested in order to ascertain its strength and the probable richness of the assumed salt beds. If the result is satisfactory, boring will no doubt be resorted to. Should it be proved that rich deposits of salt underlie the company's property, the importance of the discovery to the company, not only as regards the development of a salt industry, but also with respect to traffic on the canal, is manifest.

GLASGOW, 17th April, 1890.

PIG IRON.—Prices have again taken a downward turn. "Bearing" has been largely engaged in, so largely in fact that an upward turn may take place before the week closes. The stock in Connal's stores is now down to a little over 800,000 tons.

SHIPBUILDING.—An order for three large dredgers has been received by Messrs. Lobnitz & Co., Renfrew, through a London firm.—The Clyde Shipbuilding Company have granted an increase of wages to their labourers, and ended the strike.

RAILWAY AMALGAMATION.—The leading soft goods and other warehousemen in Glasgow have presented to Parliament a petition against the proposed amalgamation of the Glasgow and South-Western and North British Railways. The grounds of their complaint are that the existing competition between the two companies would be at an end, and that the North British Company would become possessed of a highly important monopoly.

PUBLIC COMPANIES.—The directors of the Tharsis Sulphur and Copper Company have declared a dividend of 20 per cent. The quantity of pyrites shipped in 1890 was only 58 tons short of the shipments in the previous year. The shipments of copper precipitate were, however, less by about 12 per cent.

A NEW BRIDGE.—The foundation-stone of the new bridge carrying the Great Western Road over the Kelvin was laid on the 9th inst. The ceremony was performed by Bailie Cumming. The earliest bridge at this point was built in 1825, a second was built in 1838, and this one having been for a long time insufficient for the traffic, it was decided in 1887 to erect a new bridge on the site of the old one. The engineers appointed were Messrs. Bell & Millar. The contract was given to Messrs. Morrison & Mason. The total cost of the structure will be £40,000. There will be three piers, the spans being, two of 91ft. each, one of 34ft. and one of 20ft. The width of the bridge will be 60ft. The arches will be of iron, and the piers will be faced with granite. The Loch Katrine water-pipes, which now run under a side extension of the old bridge, will run under the new one.

NEW DISTILLING APPARATUS.—There is about to be formed in Glasgow a new company—The Pure Whisky Distilleries (Scotland) Company, Limited—which has for its object the distilling of whisky by means of the apparatus known as the Improved Wallace Multiple Still. The advantage claimed by this process is that it renders "ageing" in casks unnecessary. The Wallace apparatus consists of a series of pot stills placed over each other. Over these is placed the rectifying portion of the still, consisting of a series of shallow evaporating trays, into each of which the alcoholic vapour that rises from the uppermost "wash" boiler is made to condense in rotation. It is claimed that the spirit produced is absolutely free from fusel oil or acetic acid, and that it is equal to that which has been maturing in casks for five years.

(From our own Correspondents.)

LIVERPOOL, 16th April, 1890.

THE NEW LIVERPOOL WATERWORKS.—There are three important works in connection with the new water supply to be completed before the Vyrnwy water can be delivered in Liverpool—the Norton tower, the Weaver crossing, and the tunnel under the Mersey at Fidler's Ferry. The tower is very far advanced, the tank at the top—which is of a

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novel construction, being suspended on a series of knife-edges—is practically completed; and the Weaver crossing, consisting of a steel pipe buried in the bed of the river, and protected by concrete, is in an advanced state. The tunnel under the Mersey is, however, presenting great difficulties; and in addition to the engineering difficulties, the Council will no doubt have to face litigation, for the original contractors for the work, Messrs. Monk & Newell, will most probably have some heavy claim as compensation for not being able to complete the work on account of the alleged incorrect information as to the substrata. The work has been let to Messrs. Cochrane & Co., Westminster, and they are now proceeding rapidly with the erection of the necessary plant.

THE LIVERPOOL AND MANCHESTER MAIL COACH SERVICE.—The parcels mail service between Liverpool and Manchester was inaugurated on Monday night last, when the first coach was despatched from each place punctually at 10 p.m. The time allowed for the journey is a little over five hours, allowing for a change of horses at Prescot and Hollin's Green. In connection with this service a single-horse coach runs between Southport and Liverpool, calling at Formby, Blundellsands, Waterloo, Seaforth, and Bootle; at Warrington the mail is met by a parcel post van from Wigan.

SHEFFIELD, 16th April, 1890.

IRON AND STEEL.—The Rolling Mill Proprietors' Association have issued a circular to their customers, stating that they are reluctantly compelled to reduce the discount by 5 per cent. for all rolling done, in consequence of the increased price of fuel. The effect of this notice will be to raise the price of all rolled steel, both hard and soft. The iron market is again weaker in all branches. Steel is also quieter, and prices are slightly lower than for some time past. Ironfounders find plenty of work to keep them fully employed. Engineers continue busy in all branches.

COAL AND COKE.—The coal deliveries during the past week have been well up to the average, although there is much grumbling about the price of fuel, which is already beginning to tell upon manufacturers. Coke is reported to be easier in price, no doubt owing to a lessened demand in the North and North East districts.

NORTH STAFFORDSHIRE, 16th April, 1890.

THE IRON TRADE.—As foreshadowed in this column last week, a meeting of the creditors of a firm of local iron-masters—Messrs. Joseph Bull & Son, of the Cliffe Vale Ironworks—has been held. The unsecured creditors are involved to over £20,000, and a composition of 12s. 6d. in the pound, payable by instalments at three, six, nine, twelve, and eighteen months, was accepted. The failure was caused by heavy losses on speculative purchases of Scotch warrants. The iron trade is in a disorganised and unsatisfactory position. Specifications and orders are conspicuous by their absence, and prices have completely collapsed. The position of iron-masters will shortly be a very difficult one to support, and it is quite evident that some reduction in the cost of producing the raw materials must shortly be effected. Partly owing to the speculative mania of the closing months of 1889, and partly to the rapid enhancement of the cost of production through the action of the miners, a reaction has set in, the limits of which do not appear to have been yet reached.

THE POTTERY TRADE.—The formation of a china clay union has become an accomplished fact, and is likely to have a baneful influence on the pottery industry of this district. Orders are for the moment rather more plentiful, but, taking the trade as a whole, it is in anything but a satisfactory condition.

SWANSEA, 16th April, 1889.

EXPERIMENTS WITH "CARBONITE."—Experiments have been recently made at the Upper Cymmer Colliery which were superintended by Mr. Larsen, the managing director of the Carbonite Syndicate, in order to show the flameless character of their new explosive powder. The new material was compared with roburite and securite, both of which showed a flame after each explosion which was absent in the case of carbonite.

TINPLATES.—Stocks in the dock warehouses and vans stood on Saturday at 269,658 boxes, showing an increase exceeding 3,000 boxes during the week. Seemingly all efforts are unavailing to effect a permanent reduction, and this difficulty must continue so long as the receipts from works exceed the shipments. It has been suggested that, with the view to bring about a healthier state of this industry, after a certain date no repairs or turning should be done on Sunday, and that no mill should start before two p.m. on Monday. This alone, it is calculated, would be equivalent to a diminution of output exceeding a million boxes per annum, effected in a manner that would not be felt by either masters or men, whereas the "stop-week" system results in a heavy sacrifice for all concerned. The Tinplate Workers' Union have taken up this question in a very practical way, as they have decided to prevent the acquisition of skilled labour by companies who in the future may embark in the tinplate industry so long as the present glut in the market continues. It is not intended to take such action, however against companies having new works in course of construction. At the quarterly meeting in Birmingham last Thursday Welsh makers offered common coke tinplates as low as 14s. 6d. per box, the Midland firms, who have scarcely any stocks, quoting several shillings higher.

CARDIFF, 16th April, 1890.

IRON AND STEEL.—The fall in pig iron from what was generally expected to be the lowest it could reach under existing circumstances has taken everyone by surprise, and it would serve very little purpose to record the conflicting opinions on, and explanations of, the peculiar state of this branch of the trade. On all sides speculators have been heavily affected, and those who have been compelled to sell have been severely punished. Hematite iron is not quoted, makers knowing that the only offers they could make would be declined by buyers. Meantime stocks in stores continue to decrease, and this is one good result. For steel rails there is not much inquiry, and makers' quotations are nominal. Steel bars are £7 15s. fixed price, but it is difficult to find a buyer for a pound less than this figure. Iron ore keeps exceedingly firm; in fact, it seems the only commodity which has escaped the "bears," and from accounts to hand from Spain there is being experienced extraordinary difficulty to cope with the loading of steamers arriving. At Bilbao about seventy to eighty steamers have to wait eight or nine days before getting their turn. Rubio is quoted at 16s. c.i.f. Cardiff and Newport, 16s. 9d. Middlesbrough, and 17s. Glasgow.

COAL AND COKE.—The steam coal trade is quiet, and colliery owners are more inclined to accept the offers of buyers. It is difficult to ascertain the exact cause of the depression which has all at once come over the trade, but there can be no doubt that the position of the iron trade has its influence over coal, buyers preferring to buy from hand to mouth than to pay the high prices for fuel to any large extent. This, combined with a rather sluggish demand from abroad, has no doubt had its effect upon prices, which are about one shilling less than last quotations. The reduced prices are, however, still remarkably high, and with the contracts on hand there is nothing very disappointing in the outlook. Quotations are irregular, dependent to a great extent on the particular position of the colliery from which the coal is required, but for first qualities the price can be fairly set down at 15s. 3d. to 16s.; second, 14s. 6d. to 15s.; and inferior, 14s. to 14s. 3d. Small steam coal is easier, and the abnormally high price is now a thing of the past. It has, however, enabled some prudent colliery owners to book forward orders at very satisfactory figures. The demand for coke is fairly active, and as there are a good many special shipping orders still to be executed prices seem to be sustained.—The Dunraven Colliery, which has been valued by Sir W. T. Lewis at £130,000 to £140,000, was put up for sale on Saturday last by order of the liquidators of a Sheffield building society, but no bid was made. Negotiations for private sale are being carried on.

LEICESTER, 16th April, 1890.

WOOL SPINNING AND YARN TRADE.—Since the close of the holidays a somewhat better feeling has pervaded the wool market, but perfect confidence is a long way off yet. Supplies of the finer qualities are limited, and buyers wishing to operate extensively have had some difficulty in obtaining sufficient for their requirements at current rates. Spinners are moderately employed, but they are not eager for new business at old rates, as they still complain that prices obtainable are very unremunerative. Yarn merchants are making but a moderate turnover, and, though business is far from satisfactory, there is a feeling that quotations are more reliable.

HOSIERY TRADE.—Business is not very brisk, and the slackness of trade has been influenced by the week's holiday to a large extent. Yet, though trade is so quiet at present, there is a feeling of confidence that the coming season's trade will be good.

BOOT AND SHOE TRADE.—All the manufactories are very busy, so much so that the holidays were somewhat curtailed. There are plenty of orders on hand, and they still come in freely. The outlook is extremely cheerful. Leather merchants are doing more new business since the holidays, and are making a satisfactory turnover.

BARROW-IN-FURNESS, 16th April, 1890.

HEMATITE PIG IRON.—There has been a further depression in the hematite pig iron trade. The demand seems to be vanishing altogether, and as there are prospects of a further decline in prices buyers are withholding what few orders they have to give. Makers have done next to no business during the week, and there have not been any heavy transactions in warrant stocks. Stocks are still large, but they are less than they were in the beginning of the year. Warrant prices have gone down to 53s. 6d. per ton, but makers are still unable to produce iron at less than 65s. per ton. Several furnaces are soon to be blown out. There are now fifty-two in blast, and twenty-seven out of blast.

IRON ORE.—There is less life in the hematite ore trade, and some of the mines are running short of orders. Three months ago there was such a full demand for iron ore that the native production could not supply smelters with their requirements, and Spanish ore was largely imported. Now mine owners are looking out for orders, and, in view of a further restricted production of pig iron, ordinary qualities of iron ore can be bought at 11s. 6d. per ton, although the general quotations in the district range from 12s. 6d. to 17s. 6d. per ton net at mines.

MIDDLESBROUGH, 16th April, 1890.

PIG IRON.—The market is once more in the hands of operators, who have deranged the prices, to the surprise and no small chagrin of makers and others interested in a steady, legitimate trade. The price of No. 3 has been lowered 5s. per ton with the week. No. 3 G.M.B. is down to 47s., and has been sold as low as 46s. 6d. At the market held yesterday there was great depression of spirits at the sudden turn. At first 48s. was quoted, but the fall in the Scotch market, as telegraphed, brought down the price at once, though it rallied somewhat towards the close. The stock in Connal's store is still decreasing. On Monday it stood at 139,359 tons. The decrease during this month is already 12,477 tons. East Coast hematites are nominally 70s. per ton f.o.b. for makers' iron mixed numbers, but the low price of West Coast hematite must bring down the figure considerably.

SHIPMENTS OF PIG IRON.—The shipments are fully maintained as far as the foreign demand is concerned, but have fallen off seriously in the home demand. Up till Monday the shipments of pig iron from the port of Middlesbrough for this month amount to 38,802 tons, as against 21,694 tons to a similar date last month, and 48,219 tons to the 14th of April last year. Connal's stores are still being heavily drawn upon for shipments on account of the difference between warrants and makers' prices.

MANUFACTURED IRON AND STEEL.—In finished iron there is a decided lull, and few inquiries come to hand. Prices have fallen fully 2s. 6d. Iron ship plates are at £6 10s.; angles, £6 7s. 6d.; common bars, £6 12s. 6d. per ton; steel ship plates, £7 10s.; angles, £7 10s.; rails, £5 15s. per ton, all less 2½ per cent. on trucks at manufacturers' works.

NEWCASTLE, 16th April, 1890.

SHIPBUILDING.—The falling off of shipbuilding orders which began to be felt towards the close of last year is now affecting work in the Tyne yards. At one large establishment, out of six available building berths only one is occupied. A few of the leading yards, however, are well stocked with work, and workmen discharged from one establishment find no great difficulty in obtaining employment at another. Should the present dearth of orders continue, however, there can hardly fail to be a scarcity of employment before the end of the year, and at present appearances seem to indicate that such will be the case.

ENGINEERING.—Contracts for replacing compound by triple expansion engines in old vessels have been obtained by more than one engineering firm on the Tyne, but in respect of engines for new vessels, inquiries, for some time past, have been exceedingly few. In the locomotive engineering shops of Newcastle and Gateshead business is fairly active, a considerable part of the work on hand being ordered on foreign account. At the North Eastern Railway shops a new compound engine is being got ready for the Edinburgh Exhibition, and will be sent away in time for the opening day. It is most elaborately finished, and will no doubt be found to be one of the most attractive objects of the show.

THE COAL TRADE.—Owing to the stoppage of collieries for the Easter holidays, the shipments of coal and coke at Tyne Dock for the week ending April 12th were considerably below the average, the figures being 80,626 tons.

BELFAST, 16th April, 1890.

SHIPBUILDING.—Work in the shipyards is now progressing favourably, there having been no disagreement between the masters and men for several months. There is still a large amount of work in hand, and there are several other keels to lay. No new orders, however, have been placed here since the new year, and inquiries are still very scarce, and are likely to remain so as long as wages and material remain so high. Much satisfaction is felt here at the splendid maiden voyage of the new White Star liner "Majestic," which last week completed the run from Queenstown to New York in six days ten and a half hours, being an unprecedented record for a maiden trip. Marine engineers and boilermakers continue busy, and have a large amount of work in hand.

LIGHT RAILWAYS.—A deputation has arranged to hold an interview with the Commissioners of Public Works on the subject of the amalgamation of the Finn Valley and West Donegal Railways, and an effort is being made to obtain powers to construct a narrow gauge railway on the eastern side of the Foyle from Strabane to Derry. These, with the other light railways already in hand, will open up a country hitherto almost inaccessible.

LINEN TRADE.—Business continues fair and stocks are keeping low, while prices remain firm. Inquiries for cloth are numerous, but there are no stocks in hands as makers are still working up past orders. The supply of home-grown flax is now almost exhausted. A local paper gives the capital invested in the linen business in Belfast at £18,250,000, a sum which will give an idea of the great importance of this industry to Ulster.

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BISCUIT MAKING MACHINERY.

EXHIBITED BY MESSRS. JOSEPH BAKER & SONS, AT THE LATE PARIS EXHIBITION.

(*For description see page* 368.)

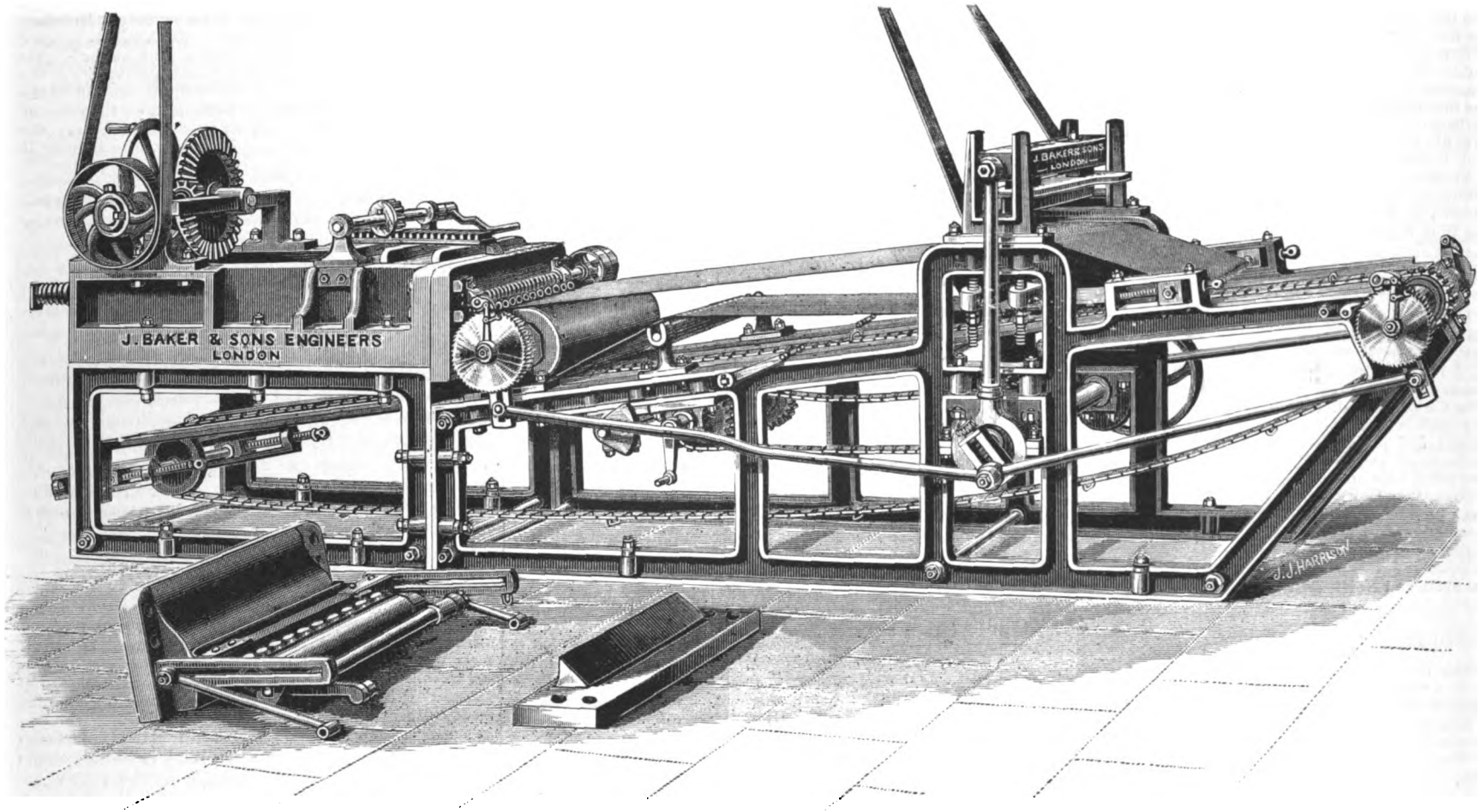


FIG. 7.—COMBINED PRESS AND CUTTING AND PANNING MACHINE FOR ORDINARY ROUT BISCUITS.

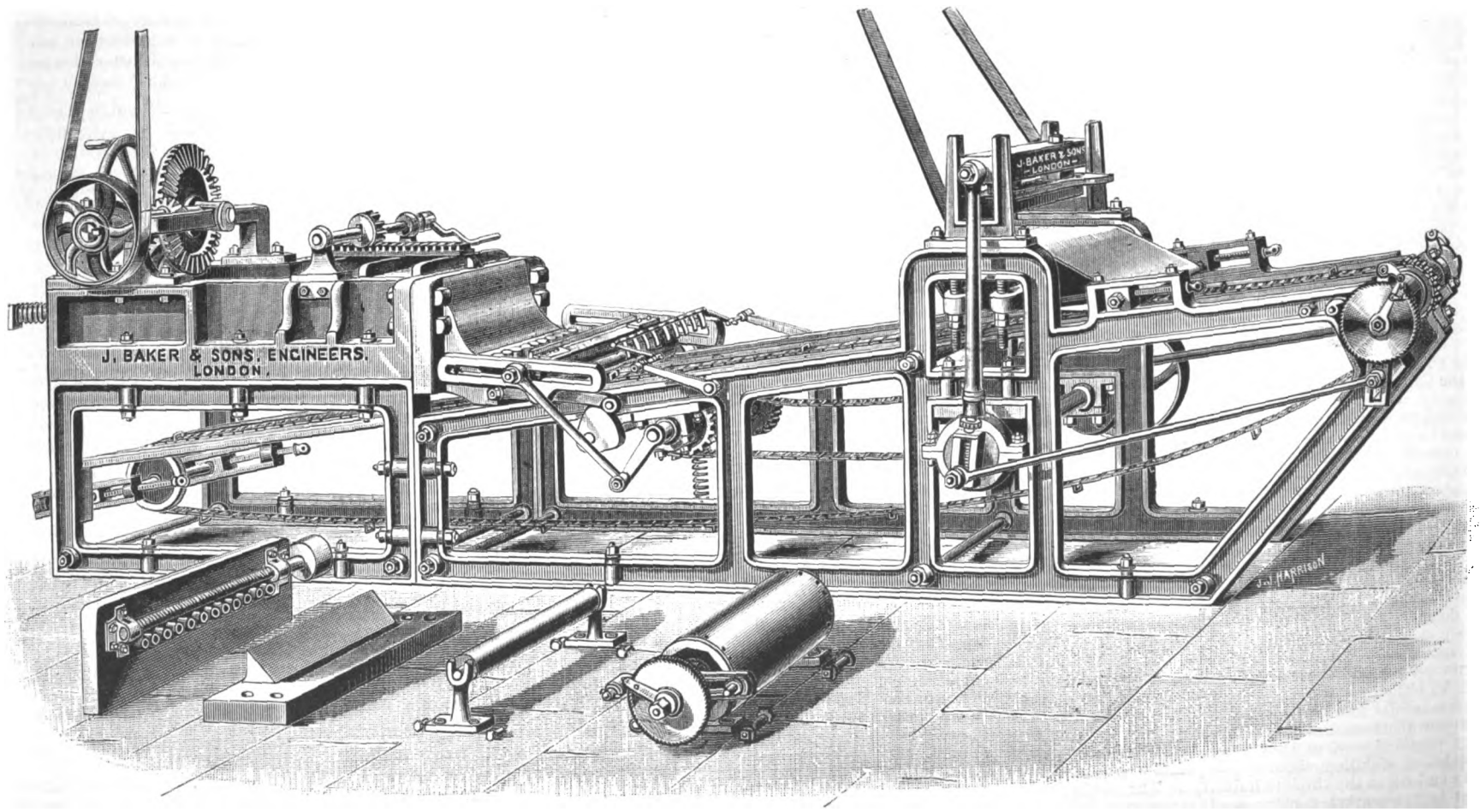


FIG. 8.—COMBINED PRESS AND CUTTING AND PANNING MACHINE FOR SPECIAL ROUT BISCUITS.

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As we go to press early with certain of our advertisement pages, all Alterations to Standing Advertisements should reach the Publisher not later than 2 o'clock on Wednesday afternoon in each week.

All accounts are payable to GEO. CAWLEY, 358, *Strand, London, W.C. Cheques should be crossed Manchester and Liverpool District Banking Co., Limited, 75, Cornhill, London, E.C. Post Office Orders should be made payable at the Post Office, 369, Strand, London, W.C.*

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93, *Hope-street, Glasgow.*

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

Contents.

	PAGE
The Institution of Naval Architects (*Illus.*)	361
Foreign Industries (Corres.)	366-367
Messrs. Joseph Baker & Sons' Biscuit Making Machinery (*Illus.*)	368
Notices of Meetings	369
Prices Current	369
Home Industries (Corres.)	370-371
Labour Movements on the Continent and at Home	373
Employers' Liability Bill, 1890	374
The "City of Paris"	374
Electric Lighting of Chelmsford	374
Letters to the Editor:—	
Compressed Air Tramcars	375
The London Electric Supply Corporation, Limited	375
Paying Cheques by Telegraph	375
The Proposed Forth and Clyde Canal: Its Importance—National and International	375
Smit's Combined Engine and Dynamo	376
The Institution of Civil Engineers	376
Books Received	376
Reviews	376
Automatic Feeding Apparatus for Printing Machines (*Illus.*)	378
A New Engine Packing (*Illus.*)	379
The Institution of Electrical Engineers	379
The Cardew Earthing Device (*Illus.*)	379
Notes	380
"Industries" Patent Record:— Applications and Acceptances	381
Illustrated Abridgments	382-384

To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

We cannot undertake to return manuscripts or drawings, and must request correspondents to keep copies.

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In half calf, gilt lettered, may be obtained at our London, Manchester, and Glasgow Offices, Price 20s. each.

Industries:

FRIDAY, 18TH APRIL, 1890.

LABOUR MOVEMENTS ON THE CONTINENT AND AT HOME.

On the 1st of May, in Germany, Austria-Hungary, Switzerland, France, and Spain, unless the respective Governments interdict—and some have shown discouragement—there will be an international holiday, and a workmen's demonstration. It would be useless to disguise the fact that labour on the Continent is in a state of ferment. Excited meetings are being held in every European capital, violent harangues are being delivered where they have hitherto been wont to result in violence of another sort. In Paris and in Vienna the police and the agitators have already come into conflict, and the beginning of May is being looked forward to with much anxiety in both capitals. In Germany the great strikes of last year conveyed the unmistakable lesson that labour combinations had taken root. What may be called English ideas have been long in developing; but there can be no doubt that this development has begun, and that, once the German workman suspects how strong he is, he may be trusted to use his strength, perhaps too exclusively to his own advantage. German industry has been far behind; in some industries their technical methods are perhaps superior to ours, but in many they are quite archaic, and the prevailing temper of mind of the employing class is similar to the unbending and arrogantly selfish temper of the typical English employer of the early part of the century. The autocratic character of the Government, too, and the excessive fostering of the military spirit, have had their share in retarding the emancipation of the German working class. These latter elements also have practically determined the character of German industrial ideals. The Germans are, in effect, a nation of State Socialists. They are accustomed to live and move in rank and file. They prefer to be told what to do, and they do it with all their might. One need not infer from this that German policy is quite destitute of originality; but it is at least remarkable that Germany has almost always followed where others have led, and where it has not been led by foreign nations it has been led by foreigners. The recent Labour Conference, with its slight tangible result, was the first incident in the attempt of the Emperor William to seize the "slowly creeping lion" and to tame him to his own uses; whether the lion will be satisfied, and will submit to the grasp upon his collar, remains to be seen.

The recent industrial history of this country is rather different from that of Germany. We passed through the State-Socialistic phase in the later Middle Ages, and have since thrown off a good many of the shackles forged by it. We may have to go through a similar experience again; but Germany is a new nation, and may probably have to pass through an acute phase of it, which, contagious as it is, we may be able to escape. While the attitude of the State towards labour in Germany is partly one of fear and partly one of patronage, and while the attitude of our own Parliamentary Government is not very different from this, our public opinion is, in other regards, far in advance of German. The strident attitude of German employers towards labour and labour questions is, by common consent, out of date in this country. We have become, at least in theory, extremely eclectic, and, without risk of losing the esteem of our friends, may even subscribe to strike funds or aid in the formation of trade unions. We have, indeed, proceeded some distance along the path of voluntary ungovernmental industrial organisation, while the Germans seem resolved to try the other, the path of industrial control by the State. We have, it is true, trodden also in this latter path, but its inadequacy has of late years become too obvious, and Germany and the other Continental nations who seem disposed to follow our lead may find that they have erred, as most imitators err, in pursuing an abandoned method. The conception of the function of the State which prevails in Germany, as declared in the Rescript of the Emperor William, involves the domination by the State of the industrial life of the people, and this method of industrial organisation may be that best suited to the genius and habits of the people; but in England this conception has never in recent times been more than a "pious opinion." Of late years, with us, statesmen have been more or less guarded in extending the State functions, and have rarely done so without vigorous protests from some one who saw whither the pursuit of such a plan would lead. It might well be argued, however—German character and German industrial history being what they are, with military traditions and characteristic readiness to submit to external control—that State regulation and management of industry would likely suit the nation so well that they might with propriety be adopted, at all events as a temporary expedient.

And if the Fates are propitious, it may be that ere long we shall have the spectacle of a practically autocratic Government establishing an industrial State inside of a military one. It seems, indeed, within the bounds of possibility, that what would amount to a Socialist State might be established in Germany, whose enormous military power might suffice to defend it against all comers, or even impose it on the rest of Europe. This is admittedly far-fetched, but its realisation does not in the least depend upon the emancipation of the people, for this must be a slow process; but solely upon the continued enslavement of them and the binding of them more rigorously than ever into an iron routine. On the other hand, if, instead of copying the industrial legislation of England, whose effects, on the whole, have probably been bad, the Germans set themselves to copy the voluntary organisations which are far more powerful than governmental ones, and which form the most effective barriers against the encroachments of these upon personal freedom, Europe will be rid of a possible and serious danger. The bearing of these considerations upon the question of shorter hours is not remote. If in any industry it is found, on hygienic or other grounds, that the hours of labour are too long, it is surely wiser that those who carry on that industry, employers and employed mutually of course, should come to a common understanding, spontaneously, as to the number of hours during which work should be carried on, rather than that an arbitrary number of hours should be fixed by Act of Parliament. For the State to step in and determine the number of hours during which a man or woman should work is not only a serious infringement of personal liberty, but in many cases might result in a practical diminution of the level of comfort of the class whose benefit it is intended to secure. Unless it can be shown that compulsory shortening

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of hours will not have this effect, it would be hard to make out a case for it. The shortening of the hours of labour, and the consequent diminution of the production, in the case of a commodity like coals, where the bulk of the cost consists of wages, is a very different matter from the case of a commodity like cottons, where the bulk of the cost of production is interest upon capital. The effect upon the cost of production, and through that upon prices, is different in each case, and thus substantial injustice to the working classes themselves would be done by the arbitrary fixation of their hours of labour by statute. So long as the members of a trade, employers and employed, acting together by common consent, determine spontaneously to diminish the number of their hours of labour, but little objection can be laid against their so doing; their action might lead to hardship among the rest of the community, but it has been found almost impossible to devise any general statute to prevent such inconvenience arising. But when such a body is compelled by an external authority to work such a time, and such a time only, we find ourselves back in the days when our clothes, our food, and our journeys were controlled by statute; in which a man's life was not his own—but the king's. If the miners are desirous of working only eight hours a day, if the general conditions of the trade require this and this alone, then their unions are surely weak if they cannot make an effective claim of this kind. The miners, with their strong unions and their naturally powerful position, standing as they do at the source of industrial motive power, ought certainly to be strong enough to maintain any reasonable claim either for reduction of hours or advance of wages. On the Continent, the incohesive character of the working class may meantime perhaps not improperly employ the State to secure an immediate accession of strength to their position; but with us the danger of the future is not that the working class may have too little power, but that it will have too much prematurely. Even if it were granted that the organisation of industry is defective on many points, it is by no means to be held as proved that an organisation, or even a regulation, imposed in obedience to pressure from below would be any less productive of social inconveniences and inequalities than the regulation that now is. With all its faults, it has spontaneously arisen without State domination, or at all events with comparatively little of it. Some have advocated a plan whose adoption would at any rate have the advantage of not being compulsory. This is the extension of the system of working in "shifts," with the view of utilising the machinery for even a longer period than is customary, while securing the employment of individual workers for even shorter hours than as at present. The only valid objection to this plan is the probably excessive work which it might cost the managers and foremen, though this, perhaps, might be obviated. There is no reason why mines should not be worked on a three-shift principle; the cost would not be greater, and the men would be fresh instead of jaded. Alert study of such methods, and enlightened adaptation of them to the special needs of particular cases, must yield results vastly more fruitful than arbitrary and ill-considered general legislation. No one can suppose that an Eight Hours Act for miners would be a final settlement even for them, and it is at least doubtful whether it is a step in the right direction. All the indications are the other way. The question is not exactly a party one; but although there are not the usual party prejudices to reckon with, for or against, the circumstances of the case render it unavoidable that the subject should have been discussed, for the most part, in a sentimental fashion. Hyde Park demonstrations are not quite the best arena for the discussion of a question which is, after all, in the main, a scientific one. If each person who has influence on the decision frankly put the questions, What are the ostensible grounds for the passing of such a Bill? and What are the probable effects of its passing? there is little doubt that the Bill would be thrown out. Amid the clash of opinions one point emerges most clearly, and this is, that the passing of an Eight Hours Bill would still more definitely tie up our industry in official routine, which over and over we have found wanting, and would be a fresh prostration of ourselves before the fetish of Government. It requires some courage for those who depend for their political existence upon the favour of the working class to stand up and say that an Eight Hours Act would injure them, but it is worth doing, for the gain of the passing moment is not worth the risk of the throng of troubles such a measure would bring in its train.

EMPLOYERS' LIABILITY BILL, 1890.

On previous occasions we have reviewed the whole question of the liability of employers for injuries to their workmen from an independent standpoint, having regard to the incidence of a fair pecuniary compensation on the one hand and the restriction imposed on industrial operations on the other. Last year an attempt was made by Parliament to amend the Act of 1880, but the Bill had to be abandoned at the close of the Session. A further effort in this direction is being made by the Government, who have introduced a Bill with the above title, the main provisions of which we propose to summarise. While the various sections of the first clause, which deals with the cause of action, have been somewhat amplified, they would not materially alter the working of the Act of 1880. Briefly, it may be said that in case of proof being given of any defect in the condition or arrangement of the works or plant, or of negligence on the part of a person entrusted with superintendence or the delegation of orders, or of any person controlling locomotion, the employer is liable. The mixed question of liability in case of work being done by contract is settled in the second clause, whereby an action will lie against the contractor or the principal, but not against both. With regard to contracting out of the Act, which is general in some mining districts, the Bill provides that all such contracts shall be void unless made in pursuance of a request in writing from the workman and for a consideration which, in the opinion of the Court trying a case, is sufficiently substantial to justify the workman for depriving himself of his legal rights, and which must be other than that of entering upon or remaining in the employment. The time in which notice may be given of injury to a workman has been extended from six weeks to three months, and no action commenced in the County Court can be removed into a superior Court except by mutual consent, unless the compensation claimed exceed £100. The amount of compensation recoverable under the Bill is a sum equivalent to three years' earnings or £250, whichever is larger. Where compensation is awarded in case of death the judge is empowered to apportion the amount awarded between the wife, husband, parent, and child of the deceased. The operation of the Act is extended to seamen.

An effort will be made to insert a provision in the Bill making employers liable for an accident caused by the wrongdoing or negligence of any person in his employ, thus removing the defence known as that of "common employment." We have no hesitation in condemning such a proposal. An employer cannot be expected to govern the actions of all his workmen, and the limit of his pecuniary liability in case of their default to those to whom he directly entrusts the duties of superintendence is a just one. Under the above proposal, were it clearly demonstrated that a miner fired a gaseous mine by an act of wilful disobedience to the rules of the colliery, and that many lives were lost by an explosion in consequence, the colliery proprietor might be held liable.

We always deprecate any legislative proposals which tend to the promotion of litigation and ill feeling between employers and their workmen, and, in the case of the dangerous occupation of mining, would much prefer to see a system of mutual insurance, contributed to by both masters and men, than frequent recourse to law.

THE "CITY OF PARIS."

We have been informed that when the "City of Paris" was being examined in the graving dock at Birkenhead, on Friday last, an incident occurred which seems to clearly explain the cause of the breakdown of the engines. When the casing in which the propeller shaft revolves was opened the end and intermediate sections of the shaft, along with the propeller, dropped into the dock below with a terrific crash, cutting the heavy beam of timber which forms the floor of the dock right through with one blade, while another, which struck the stone of the dock, was curled up by force of the impact. It seems, then, as if the cause of the accident was the breaking of the propeller shaft, which would of course make the engines run at a tremendous speed and knock the ends out of the cylinders. The theory of water in the cylinders, which was put forward when the breakdown was first heard of, is thus disproved. In any case, whatever further investigation may show as to the cause of the disaster, there can be no doubt that if it had not been for the watertight bulkheads a most terrible catastrophe might have resulted.

ELECTRIC LIGHTING OF CHELMSFORD.

Chelmsford is the first town in England to be lighted throughout by electricity. The inauguration of the new system took place on Monday last, in the presence of a large and distinguished gathering.

The contract for the public lighting of the town was given to Messrs. R. E. Crompton & Co., Limited, of Chelmsford, who have carried it out by putting down central station plant at their works. The boiler capacity of the works has been increased, and a special vertical engine, by Messrs. Marshall & Co., of Gainsborough, has been put down in the building devoted to the lighting plant. With light loads at any time during the day, or in early evening, the works plant is used; and when the main lights come on, the special vertical engine is started, driving its own plant, and the works plant then remains as spare. This arrangement is exceedingly economical, as the shop engines are naturally running in any case, so that the expense of keeping a special day engine going, as is otherwise necessary in alternating current systems, is avoided. Changing over from one engine to the other is, of course, done without any stoppage, as the alternators can be put in parallel. If a serious accident, such as a broken crank pin, were to occur, about five minutes would be needed to change over, as one engine would be cold, and would require to be warmed up. This delay is only unavoidable in case of a sudden and total breakdown, such as that mentioned. The dynamos are all belt driven. The arc lights are on direct current series circuits, and the incandescent lamps are run from transformers in parallel. There are 18 arc lamps of 1,500 candles nominal, run from series wound, smooth commutator arc lighters made by Messrs. Crompton & Co. We should have thought it better to arrange the arc lights either in series, or in parallel with choking coils on the alternating circuit, but many people hold that an alternating arc gives a lower efficiency because the power is split over two craters, so that the temperature of each is somewhat lower, and, therefore, the light of each much lower. Moreover, the lower crater is rather wasted, as it radiates its light upwards into space.

The lights and wires are generally on one side of the road, but in the chief street they are on alternate sides, the leads being taken across underground. There are 210 incandescent lamps of 32 c.p. each, from 45 to 75 yards apart. These are hung in lanterns 16ft. from the ground on graceful brackets fixed to the poles. The lamps are in groups of 12, each group having its own transformer. The incandescent circuit is fed by Mordey alternators. There are four circuits for the public lighting, and four for the private consumers. There are about thirty miles of overhead conductor, and about 250 yards of Callender's bitumen casing where underground work has been necessary. The connections between the overhead and underground conductors have been made by lead-covered cables inside hollow iron standards. The overhead wires and lamps are mounted on neat pitch pine poles fixed to iron sockets which are set into 4ft. 6in. of concrete. The wires are hung on steel bearers at a minimum height of 25ft. The whole of the wiring arrangements are designed in perfect taste, and have a light and graceful appearance. The Board of Trade rules are adhered to throughout. In fact, the entire installation reflects the greatest credit on the contractors, and on Mr. A. H. Pott, who has engineered it, and borne the brunt of the work.

We also had an opportunity of going over the Messrs. Crompton's Arc Works, which are at present exceedingly busy. They have been enlarged, and have the neat, orderly, and business-like appearance of a well-managed factory. The works manager, Mr. Hayward, is introducing the interchangeable system more or less on American lines. All the parts are ordered from the works by the stores in quantities, and a dynamo has no individuality until its parts are given out to be erected. On the English plan a machine or engine has its number as soon as it is ordered from the drawing office, and the various parts are made from the beginning to this number.

In the evening a public dinner, with the Mayor of Chelmsford in the chair, was held to commemorate the inauguration of the public lighting of the borough. There were a great many very complimentary speeches, and general satisfaction was expressed all round.

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Letters to the Editor.

COMPRESSED AIR TRAMCARS.

To the Editor of "Industries."

Sir,—The opening paragraph of Messrs. Hughes & Lancaster's letter in your last issue on the subject of the low-pressure tramcar system is rather self-contradictory, for whereas they state in one line that it can be applied to any existing roadway "without any alteration whatever," they say in the next that it is necessary "to lay the air main under the footway with branches across to the valve boxes." It thus appears that they draw a distinction between pulling up the centre of a street and pulling up the sides; the fact, however, is, that before the system can be applied a trench has to be dug all along the route. This does not matter greatly, however, if the system proves economical in its working. The figures given in the table are interesting, but will be more valuable when verified in practice on any of the lines which have been tendered for. I trust that Messrs. Hughes & Lancaster, when any of these lines have been fitted and have been running for a few months, will publish the actual cost and working expenses, together with the estimate already quoted by them. Any means of saving, combined with efficiency, is sure to be welcomed by tramway companies.

With reference to the statement that it is impossible to obtain reliable data as to the cost of electric traction, this, if it be accurate, ought to be set right in the interests of electric traction people themselves. On the Barking line, I understand that the Electric Traction Company, Limited, are under contract with the North Metropolitan Tramways Company to run the cars at 4½d. per car mile, including the wages of the drivers and conductors. The average of the working expenses of the four lines tendered for by Messrs. Hughes & Lancaster comes to 4·4d., so there is but little difference under this head on the average. The question, however, arises as to whether the Electric Tramway Company are making a profit or a loss on their contract. As a further means of comparison, the results of the working of the Northfleet line by the Series Traction Company would be welcome; it has been running for some time now, and figures may possibly be procurable.

Yours, &c.,
CAR.

Portsmouth, 12th April, 1890.

THE LONDON ELECTRIC SUPPLY CORPORATION, LIMITED.

To the Editor of "Industries."

Sir,—If the Deptford Electric Light Station proves a failure owing to the cables not being satisfactory, there is no doubt that it will have an injurious effect on the public mind as regards electric lighting in general. For this reason, if for no other, it is to be hoped that Mr. de Ferranti will succeed in carrying out his original scheme, but Mr. J. S. Forbes, the Chairman of the London Electric Supply Corporation, in his recent speech to the shareholders, was somewhat unsatisfactory. He stated that the mains which have proved unfit for their duties were not designed by Mr. de Ferranti, but in concert with Mr. de Ferranti, and that they were carried out by a great manufacturing firm. They were, according to the lights possessed by this particular firm, calculated to do a certain thing. They were to be tested up to 10,000 volts, and they were tested up to that, and beyond. Among other things they had to find out was that there was a great difference between tests in the laboratory and after the things were put in the earth. 10,000 volts was in excess of anything they had to stand, and if they had been able to stand half of 10,000 they would have been considered to perfectly answer the purpose for which they were conceived and laid. Unfortunately, however, they did not. Mr. Forbes would not go farther into that matter, as it was possible that they might have to resort to law to recover damages for unworkable construction or want of skill. With reference to the question of permanent mains, plenty of mains had been laid for low tension, but for high tension Mr. de Ferranti, among other things, had invented his own main—or what is called the permanent main—and that main had been manufactured and tested, as far as a test could be applied on a limited length of it, on the company's own premises, up to 2,000 volts; and what Mr. de Ferranti predicted was this—that whatever the reason of the defects might have been in the particular main constructed and laid, which had failed, these permanent mains were so different in the principles of construction that they would not fail.

The whole of this is very unsatisfactory to an electrical engineer. What we want to know is, who was responsible for the design of the faulty cables. Mr. Forbes admits that Mr. de Ferranti partly designed them, and the suggestion is that the makers did not fulfil the conditions imposed. It is also suggested that the makers in question are incompetent manufacturers. The concentric tubes of Mr. de Ferranti have been described in various journals, but it does not appear whether the faulty ones are those which he designed "in concert" with the manufacturing firm or whether they are those which are now being constructed. The remark that the company might sue the makers in the Law Courts is one of those indefinite assertions frequently made by chairmen at company meetings, but in justice to other central station engineers it should be stated who are those cable manufacturers who do not carry out instructions and who turn out bad work. Giving the name will not, I take it, subject Mr. Forbes to an action for libel if he already intends to bring the law against them for non-fulfilment of contract.

Yours &c.,
F. S.

London, 12th April, 1890.

PAYING CHEQUES BY TELEGRAPH.

To the Editor of "Industries."

Sir,—In your issue of the 28th of February, page 194, you were good enough to describe and illustrate my method of sending pictures by telegraph, and I now desire to put forward a scheme for paying cheques by the same agency. Permit me to state, then, as regards the utility and the practicability of transmitting cheques, or, in other words, of making payments by telegraph, that such a scheme should prove of material benefit to the commercial world.

The question of making payments by telegraph by means of the telegraphic postal order has ere this been suggested. This, in many instances, may no doubt prove a great boon to the general public. But the fact of being able to make payments by telegraph through our bankers, and with less fear of fraud than attends the ordinary process of cheque payments, should prove a step towards the advancement of commercial enterprise, for a cheque thus transmitted would bear upon it a talisman verifying its validity, and thus render such a document payable at sight. It is not necessary here to enter into a description of the process through which a cheque must pass, and the time required before the receiver of the same per post from a distance is made cognisant as to the said cheque being honoured by the banker upon whom the same has been drawn, as my purpose is simply to show how payments may be made without fear of fraud or unnecessary delay by means of telegraphic communication.

First, let us suppose that a firm in Manchester, Glasgow, or any other provincial town find it to their benefit, or perhaps essential, that they should complete by speedy payment a business transaction with another firm in London, New York, Melbourne, or, in fact, in any city in the civilised world possessed of bankers working in connection with our English bankers, and to which communication by telegraph is established. Such a payment might with safety be completed by telegraph in the following manner:—In the first place a telegraphic form (which I would have supplied by the bankers only) should be used, and, after being duly filled in by the payer, it should then receive the bankers' signature, and also the impression of an embossed design specially prepared for this service. This form on being presented at the telegraphic office would not only ensure its despatch, but would qualify the report on reaching the receiving station being duly committed to a similar form and signed by the postmaster or other authorised person. This being done, the document, on receiving the impression of a facsimile of the bankers' embossed design, would be rendered complete for delivery at the bankers appointed for the cashing of the same, and would by the telegraphic messenger be delivered to the bankers, while to the party to whom the cheque is made payable would be delivered a duplicate in part of the substance of the cheque—that is to say, an ordinary telegraphic form containing the amount of the cheque and the name of the place where sent from, leaving out the names of the sender and the receiver, it being understood that the receiver would know the name from whom such an amount was expected. In exchange for this duplicate the messenger would take a receipt from the receiver, as in the case of a registered letter. On presenting at the bank this duplicate, and furnishing the names of the sender and the receiver, a receipt would be signed by the receiver, and the handwriting of which corresponding with that of the receipt received by the telegraphic messenger (which of course would be delivered by that functionary at the bankers') the receiver would then obtain the money from the bankers. This method is suggested for the use of those transmitting payments from the provinces.

The method suggested for the metropolis would be to have one central station for the discharging of cheques and for the issuing of telegraphic cheques to those having accounts with provincial bankers and not banking with any London bank. At the London office a registry of the signatures of all persons entitled to transact business in this manner would be kept. No person except those entering themselves as members or subscribers to be permitted to transmit cheques by telegraph. The signatures of provincial and foreign subscribers might be furnished to the London office through their bankers in the following manner:—The signature would be written by the subscriber on a small form, the back of which being prepared with an adhesive substance (such as that on postage stamps), and, as a proof of the authenticity of such signatures, the form should also receive the signature of the banker, and be impressed with the embossed telegraphic seal before mentioned. On reaching the London office the signature of the subscriber would be cut from the form, and carefully stuck in its alphabetical place in the reference book of signatures. The issuing of telegraphic cheques at this London office would be a simple matter, as none would be issued but to those having accounts with provincial bankers, and telegraphing payments to be discharged by such provincial bankers except when the payment was to be made in a foreign country. In this case, on receiving an advice by telegraph from the banker of a certain person wishing to make a payment abroad, then a telegraphic cheque would be granted. Hence the security against fraud, as the signature of a payer would be checked at the London office before the cheque was despatched, and the question as to balance or the discretion as to over-draft would rest with the bankers discharging the cheque.

Yours, &c.,
H. Rickinson.

57, Compton Road, Highbury, London, April 14th, 1890.

THE PROPOSED FORTH AND CLYDE CANAL: ITS IMPORTANCE—NATIONAL AND INTERNATIONAL.

To the Editor of "Industries."

Sir,—At a time when such desperate efforts are being made to reduce the time and length of voyage to America, perhaps I may be allowed to refer to a matter of importance in this and other respects which a lengthened study of the subject has evolved. The matter in question has reference to a proposal to construct a canal between the Forth and Clyde, opening communication for vessels of the largest class between the east and west coasts of Britain, and which would also be of the greatest importance in the communication of the east coast with the continent of America, and, *vice versâ*, of the West with the continent of Europe. The latest proposal for shortening the voyage from this country is for the establishment of a route between Milford Haven and St. Charles Bay, near the Straits of Belleisle, on the Canadian coast, by which it is expected that the time from land to land will be reduced to three days thirteen hours. Referring to a notice of this in a London paper, I pointed out a plan whereby, according to the calculations in the proposal referred to, the voyage could be still further reduced to about three days. I also showed whereby steamers to London and the east coast of Britain could avail themselves of this advantage by adopting the route *viâ* the proposed canal.

My wish is now to point out not only the advantage to London, the east coast of England, and the middle western States of Europe, which, as a means of communication with America, the opening of the proposed canal would provide, but also to show the importance that it or such another waterway would assume, as a means of intercommunication with the shores of Britain itself. As regards the latter part of the subject, perhaps it is from being accustomed to it that such a state of things have been allowed to remain for so long. But it does seem strange that a mercantile power of the magnitude of Great Britain should remain indifferent to maritime intercourse between her own coasts. One might as well undertake a voyage to the capital of Portugal as go from Liverpool say to Hull by sea. By either the northern or the southern route a voyage of ovey 1,000 miles would be required to reach the places named, although separated by little more than 100 miles. The same fact applies in a lesser degree to numerous other places on the British coast. When consideration is extended beyond these, the deficiency presented is quite as glaring. From the east coast of Britain to the Irish coasts a long detour either north or south is necessary. From the west coast to the Continental countries bordering the North Sea and the Baltic, the same is applicable. In the direct communication of these countries with America, Britain blocks the way in some instances to places as far south as New York. Would not, therefore, such a means of communication as the proposed Forth and Clyde shipway be a real desideratum, saving, as it would, distances reckoned by hundreds of miles, and also providing a direct intercontinental route? That such a route, either betwen the Forth and Clyde, or the Solway and the Tyne, will be opened sooner or later there can be little doubt, and the sooner those concerned in either of the routes are alive to the importance of the matter the better. The enterprise of Manchester, given it sufficient time, might also find ways and means of bringing about such a desirable result in her own locality, backed as she would be by the immense manufacturing interests of that part of England, which it might be expected would give the proposal the utmost encouragement.

Continental nations, too, when the shortest route, the Forth and Clyde, is considered, may be expected to give the matter some attention. As an alternative route to America to that by the English Channel and Southampton, the proposed route offers several advantages; amongst others, that of enabling fast steamers to land passengers from America with the shortest possible sea voyage. This could be accomplished by Broadhaven (at present without railway communication), on the wes coast of Ireland, and in the line of the northern route, being made a port of call. From New York the advantage of quite a day would be gained by the adoption of this route, compared with a call first at Southampton. Broadhaven is situated, in respect of distance from Kingston, very much as Queenstown is. Even landing at Greenock there would be a much shorter sea passage than to Southampton, and the time from New York to London, *viâ* Greenock, would practically be the same as *viâ* the southern port. The distance between New York and Hamburg is very much the same by either route, that *viâ* the canal being the shorter, but the difference in its favour might be allowed for the time which the passage of the canal would occupy. For trading vessels the advantage which a cheap supply of coal on the route *viâ* the canal would afford (the line of route being through the midst of an extensive coalfield) might be an additional inducement for them to use it.

The importance of the canal in communication between the Canadian ports, the east coast of Britain, and Europe will be apparent. Even should the extreme short sea passage project talked of not be carried out, the whole of the other Canadian ports would be benefited, and Halifax especially, a port open all the year round, and already adopted as the port of destination for a line of swift steamers in connection with the Canadian Pacific Railway. When the efforts that are being made to divert traffic from the west of Chicago *viâ* Canadian ports are considered, the importance of the canal in this direction cannot be lightly estimated.

Considered in all its varied aspects, the question of the communication under review is one bristling with importance, and the wonder is that a nation like the British, with such mighty interests in maritime and naval affairs, should have remained so long apathetic to a matter so intimately concerning herself and her own best interests. The practicability cannot be doubted, and the cost, it has been shown, will be such as to put it on the basis of comparison with a local enterprise, which one enterprising city in the kingdom has tackled almost single-handed.

If there is the matter of dividend in the one, the other must be a splendid affair—and from an exhaustive study of the matter the writer is inclined to think it will, should the matter be considered in all the aspects of construction which it is capable of presenting.

I give the following as the calculation of the time from Chicago which the journey by the proposed new Canadian short sea route will occupy compared with present time to Liverpool:—

Viâ New York.	Dys.	Hrs.	*Viâ* St. Charles Bay.	Dys.	Hrs.
Chicago to New York	0	23½	Chicago to St. Charles Bay	1	23
New York to Liverpool	6	8½	St. Charles Bay to Milford Haven	3	13
	7	8		5	12

To Glasgow the time would be—

	Days.	Hrs.
Same as Milford Haven	5	12
Passage of canal (as recently estimated)	0	8
The canal to Hamburg	1	12
	7	8

The time from Chicago to Hamburg, *viâ* the canal, would thus be the same as to Liverpool at present.

Yours, &c.,
"Eon Strathaar."

London, April 16th, 1890.

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SMIT'S COMBINED ENGINE AND DYNAMO.

TO THE EDITOR OF "INDUSTRIES"

SIR,—In reading the description of the Smit combined engine and dynamo, illustrated in *Industries* last week, I was much struck by the remark that "Messrs. Smit have used an open engine instead of the closed-in type, and thus have sacrificed efficiency, durability, and freedom from breakdown."

I note Messrs. Smit's little engine has a 4in. cylinder, 5in. stroke, and runs 450 revolutions per minute, with 100lb. to 150lb. pressure. I presume "the closed-in type" means one of the numerous arrangements of small single-acting engines now in the market, which are mostly all boxed-in, although there are some double-acting engines arranged in that way. If Messrs. Smit had adopted a single-acting cylinder of the same diameter the engine would have to run at 900 revolutions, or if the same speed as now was kept with a single-acting cylinder double the area of piston and double strains on the parts would be necessary for the same power, so I fail to see where the superior efficiency, durability, or freedom from breakdown would come in; probably it would be the other way. The single-acting engine has the advantage that, the push being in one direction, there is no noise from slack bearings; but as to freedom from breakdowns, perhaps it is because these single-acting type engines are either subjected to double strains to compensate for being single-acting, or else are set to run at undue speeds for the same object, that they are more than any other type noted for smash-ups.

Yours, &c.,

AN ENGINEER.

Bolton, April 14th, 1890.

THE INSTITUTION OF CIVIL ENGINEERS.

AT the nineteenth ordinary meeting of the session, on Tuesday, the 15th inst., Sir John Coode, K.C.M.G., President, in the chair, the paper read was on "The Application of Electricity to Welding, Stamping, and other Cognate Purposes," by Sir Frederick Bramwell, Bart., D.C.L., F.R.S, Past President Inst.C.E.

Although large structures of wrought iron and of mild steel commonly had their parts united by bolting or by riveting, and although much ingenuity had been expended in so arranging and proportioning riveted joints as to obtain, in the joint, the greatest percentage of the strength of the material, nevertheless cases occurred in all structures where the union of these metals by welding became almost a necessity, or if not a necessity, a matter of convenience and economy. Wrought iron, in addition to its many other merits, had the merit of being, *par excellence*, the weldable metal; mild steel also possessed this merit; but nevertheless there was always a feeling of doubt about a weld, although welds were of necessity largely trusted. No better illustration of this could be given than that of a common chain, each one of its manifold links having a separate weld. In the early days of making suspension bridges, the links, unless the wasteful process of cutting away a large portion of the bar was resorted to, were made by forming the eyes separate from the bar, and by welding them on. To obviate these difficulties, as long ago as 1845 Mr. Howard, of the firm of Howard & Ravenhill, of the King and Queen Ironworks, Rotherhithe, devised a plan which, while avoiding the necessity of welding on the eyes, avoided also the waste of material before alluded to. Within the last few years a plan of "upsetting" the ends of the bars by mechanical means, so as to obtain the requisite material for the formation of the eye, had been introduced in the United States. Although imperfection in a weld might arise from insufficient heat, or indeed from an excess of heat, or from the application of inadequate power to bring the heated surfaces together, probably by far the greater proportion of defective welds arose from the presence of some foreign body between the surfaces to be welded, or, as it was expressively called, "dirt" of some kind or another. Attempts had been made to obviate these difficulties, by employing gaseous or liquid fuels, and, in rare cases, by the removal of the oxide of the metal from the surfaces, by turning or planing. Allusion might be permitted to the welds that were successively employed for the welding of railway tires in the days prior to the present system of making these tires by continuous rolling, and in the hoop form. These comprised an ordinary scarf weld, bird-mouth welds in both directions, single-wedge welds, and double-wedge welds. In all these cases hammering was employed: but for carriage tires, at all events, the butt-weld was used. In the early days of wrought-iron ordnance, where it was desirable to have in one piece a wrought-iron tube so long in relation to its diameter that it would have been difficult to have welded it up as a single coil, it was made by welding two coils together, each of about half the length of the desired tube. It need hardly be said that everyone of the modes of heating employed involved that the heat should proceed from the outside inwards. There were also the chances of inadequate heat; of an excess of heat; and, as had already been stated, of the presence of "dirt" in the weld. Moreover, there was the difficulty of ascertaining to what state the heat had attained; commonly in small welds the pieces were withdrawn from the fire, with the consequent risk of picking up "dirt" during re-introduction. Among the desiderata for heating for welding purposes, the mode adopted should admit of uniform heating throughout the sectional area to be welded; it should admit of absolute regulation of the heat; it should be free from the possibility of introducing either particles of fuel or gases between the welding surfaces, and it should admit also of complete inspection during the time the heating was going on. All these desiderata were afforded by electrical heating. As regarded the power of an electric current in passing through substances to develop heat, the most familiar instance was probably that of the carbon filament of an incandescent lamp, now so largely used in theatres, in clubs, and in private houses. It was common knowledge that electrical energy was compounded of electromotive force or potential, or preferably "pressure," multiplied into the amount of the current, or the pressure multiplied into the quantity. Whenever this electrical energy had to pass through a conductor, the resistance of that conductor to its passage destroyed a certain portion of the electrical energy, which energy so destroyed reappeared in the form of heat, and must appear in the very conductor which had been the cause of the destruction of the electrical energy. Therefore the amount of heat produced must be that which was the thermal equivalent of the electrical energy destroyed. What the temperature would be, and in most cases it was the temperature reached by the conductor, as the result of the passage of a given quantity of current, which was of importance, depended not only upon the heat-units produced but upon other considerations. Although electric energy was represented by the multiplication of the pressure into the current, it would be found that the heating effect of any given current was independent of the pressure, and that the heat produced was in proportion to the current employed. As regarded the heating effect of any given current upon different materials, if there were an absolutely perfect conductor, which offered no resistance to the passage of an electric current, no amount of electrical energy could heat it, because no extent of conductor could destroy any part of that electrical energy. On the other hand, in the case of a material absolutely impermeable to an electric current, it need hardly be said that no heating could result, as no current could pass. Fortunately the materials commonly welded, iron and steel, held a very happy position as conductors in the scale of metals for the purposes of being electrically heated. The electrical resistance of metals increased, however, with an increase in their temperature. This question of the increase of resistance due to increase of temperature had been investigated by Dr. Hopkinson, and the results obtained had been published in the Philosophical Transactions for the year 1889. This increase of resistance to the passage of the current, as the temperature increased, was of great utility in electrical welding. Consider the two ends of bars to be welded, mere ordinary rough surfaces, the first contact was made upon numerous points, through these the current passed, and they became rapidly heated, and offered more resistance. As endway pressure was applied the surfaces in contact became of larger and larger area, until all were heated up uniformly. The greater current sought those parts which, although in contact, were at a lower temperature, and this went on until contact and uniform temperature were obtained. Having regard to the fact that the particular form of electrical energy needed for imparting heat was that of large current and low pressure, it would be seen that there was very great difficulty, amounting almost to a commercial impossibility, of transmitting electrical energy in such a form over any but very short distances, for, unless the conductors were of enormous size, they themselves would be injuriously heated by the passage of the current; and, moreover, the pressure required to drive these large currents through any considerable length of conductor would be so large a percentage of the working pressure as to add very greatly to the power required. For these reasons it was desirable that the electrical energy should only take the form of large current and low pressure in the very neighbourhood of the welding machine itself. In all probability the great use of electric welding machines would be for uniting pieces of special and difficult form, and for dealing with refractory metals, refractory in the sense that they did not lend themselves to successful welding by any of the ordinary processes. Metals which had been dealt with in such machines comprised:—

Steel.—Every variety seemed to be weldable.
Iron.—Cast, wrought, malleable, case-hardened, ferro-aluminium.
Copper.—Cast, rolled, drawn.
Brass.—Cast, rolled, drawn.
Delta metal.—Muntz metal.

Aluminium.	Tin.	Cobalt.
Silver.	Lead.	Manganese.
Gold.	Zinc.	Bismuth.
Platinum.	Nickel.	Iridium.

Bronze.—Aluminium, phosphor, silicon, &c. Gun-metal.

Gold to platinum.	Bronze to iron.
Iron to steel.	German silver to iron.
Brass to iron.	German silver to brass.
Copper to iron.	Copper to brass.

At the Crewe works, Mr. Webb had one of these welding machines in use. He had it at work at present "shutting" on eyes to screwed rods of some ⅜in. diameter; the weld was made close up to the screw, which was in no way injured in the process. It had also been employed to weld ends to tubes, to weld together the parts of twist drills which had been broken, and to weld best steel for tools on to commoner materials. It was obvious that a machine that gave the power of heating any material with an absolutely controllable heat, and that enabled that heat to be inspected and to be communicated without the advent of impurities, must have many uses in the arts, in preparing pieces for brazing, for stamping, and in a variety of other ways; in fact, there could be no doubt that the existence of such a machine would itself give rise to a large number of new uses.

Books Received.

Die Entwickelung der Schiffsmaschine in den letzen Jahrzehnten. Von CARL BUSLY. Berlin: Julius Springer.

Transactions of the American Society of Civil Engineers, November, 1889.

Losses in Gold Amalgamation, with Notes on the Concentration of Gold and Silver Ores. By WALTER MCDERMOTT and P. W. DUFFIELD. London: E. & F. N. Spon.

Pumps: Historically, Theoretically, and Practically Considered. By PHILIP R. BJÖRLING. London: E. & F. N. Spon.

Electrical Transmission of Energy: A Practical Handbook. Second Edition. By GISBERT KAPP, C.E. London: Whittaker & Co.

The Cornell University Register, 1889-90. Second Edition.

The Country Roads of England. By URBAN SMITH, A.M.I.C.E. Hertford: S. Austin & Sons.

Electrical Influence Machines. By JOHN GRAY, B.Sc. London: Whittaker & Co.

Leçons sur l'Electricité. Par ERIC GERARD. Tome I. Paris: Gauthier-Villars et Fils.

Des Ingenieurs Taschenbuch. Herausgegeben vom Verein Hütte. Berlin: Ernst & Korn.

A Treatise on the Arc Indicator. By THOS. HAWLEY. Boston: *Boston Journal of Commerce* Publishing Company.

Reviews.

HALF-A-CENTURY OF AUSTRALASIAN PROGRESS. By William Westgarth. London: SAMPSON LOW, &c. 1889.

In taking stock of the progress which we are making at home it is very necessary that we should also make ourselves acquainted with the advances which are being made by the Colonies, for progress can never be measured in absolute measures, but only in relative. Our own progress in every department has during the past fifty years been immense, but when we compare it with that which has been made by our Colonies, in some respects it seems small. The book we are about to notice is one of the best we have seen for giving some idea of the progress which has been made in Australasia during the past half-century, and its author, Mr. Westgarth, has been able to give his personal experiences over the whole of that time. He first went to Australia in 1840, where he resided until 1857, when he returned to London, where his business required him to keep up his interest in the Colonies, and in the volume before us he has given the public the results of his long experience in commercial and financial affairs, and his opinions on a very large number of questions, all of the highest interest to merchants and statesmen.

The first part of the book, and the most generally readable part, is taken up with a personal retrospect, and an account of the author's travels, but it differs very much from an ordinary traveller's book. Along with an account of what he sees he gives his experience and observations on many varied subjects, and there are few pages which do not contain some points which will be of value to a large variety of readers, while the whole account forms a most valuable guide even to an ordinary traveller. Our space will not allow us to enter into details, but we can recommend its careful perusal to our readers, as well calculated to afford a great deal of useful

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information. It is, however, the second part of the book to which we wish specially to direct attention, as it is taken up with the consideration of questions which are now being carefully studied by statesmen, as well as by all who are interested in the industrial development of the Empire. He discusses such questions as the prospects for a still further improved service of intercommunication between England and Australasia, the policy of the Empire's extension, the socio-political principles of the Empire's Government, Intercolonial Federation, or the federating of natural colonial groups into one Government, the political unity of the entire Empire. He even makes suggestions for a monarchic-democratic peerage of the Empire. On each of these subjects he has much to say that is well worthy of study, when Imperial Federation is believed by some statesmen to be the most important problem of the day. So rapidly does the problem advance that he has written a long preface, which is of the nature of a postscript, bringing all the points up to the date of the publication of the book. He dwells on the importance of Imperial Federation, which he says is undoubtedly the greatest, as well as the most urgent, question of the day. He finds that the colonists are desirous to be united, or to remain united, with the great Empire of their fellow-countrymen; but as soon as suggestions are made for bringing about a closer connection than exists at present differences of opinion arise. They dislike the idea of an Imperial Executive overshadowing them, they dread a Parliamentary rule which is over their own, they are nervous even about a federated English Cabinet. Mr. Westgarth thinks that these objections arise in great part from the utterly anomalous position which the Colonies have held for the past thirty-five years, in being practically their own masters, and yet, while on their part responsible for nothing, full members of an Empire every part of which the mother country is bound to cherish and defend. He thinks the equities of the case are well exemplified in the apostolic argument about the body and its members. In the colonial case each member thinks to live for itself, because that is so safe and pleasant under the powerful shelter of the whole body, and yet each is grudging and jealous of the strength which it is to contribute thereto. We do not know that we can agree to all the proposals made by Mr. Westgarth, but we feel that he has given a most valuable contribution to the literature of the subject, and taken an important part in that discussion which must precede all legislative action. We, however, thoroughly agree with the results which he says would flow from a well-considered scheme of Imperial Federation. He points out that if we had an imperial policy in which the colonial element duly weighs we would probably steer still more clear, if possible, of foreign complications than has been the later steady aim of our Home Government; that when the power of the whole Empire is grasped by an adequate and constitutional Executive, every section of it, even the least, is assured that in case of need the whole Empire stands behind it; and lastly, when the rest of the world realises this new position of the Empire, the prospect of any attack from other Powers will be materially diminished. Such a united Empire would be of the greatest value in advancing industrial and commercial progress, and in solving the most important economic problems of the day, but it would also, practically, rule the destinies of the world, and that always for good.

THERMODYNAMICS OF THE STEAM ENGINE AND OTHER HEAT-ENGINES. By Cecil H. Peabody, Associate Professor of Steam Engineering, Massachusetts Institute of Technology. London: MACMILLAN & Co. 1889.

In previous notices of books on the steam engine we have made the remark that *the* textbook on this subject had still to be written. Our present object is to ascertain if that has been produced by Mr. Peabody. The methods of treating the subject have hitherto been very varied. The ordinary or popular method is to make a considerable number of assumptions, and then to reason as if these were well-established truths. Theory of this kind is apt to be very misleading unless its limits are distinctly mentioned, which, unfortunately, they seldom are. Then we have the mathematical treatment, which is chiefly useful as an exercise in the application of mathematics, but which by itself leads to few useful results. Then, again, we have a combination of the popular and the mathematical methods, with a slight addition of information regarding the physical properties of the steam used and of the materials of construction. These three methods may be looked upon as stages in the evolution of the theory of the action of steam in engines. When, however, he has got thus far, the young student may be led to study the writings of Hirn, and there he will be informed that, in the present state of our knowledge, a theory of the steam engine is impossible, and that we must depend almost entirely on the results of practice. He will naturally then ask himself, What is the use of all the mathematical work in which I have been engaged? and he may find it difficult to obtain a satisfactory reply. Should he, however, come across such a book as Professor Cotterill's treatise on the steam engine, he will be pleased to find that it is possible to combine his mathematics with a considerable amount of practical experience. But that book is only a first step in the direction of providing a complete theory of the subject with which it deals, and, moreover, it does not put its results in such shapes as enable the engineer to utilise them. This is a point which is too often forgotten by writers on engineering subjects. They ought to remember that, however deep they may go into theory, or however interesting they may make their discussions of the results of experiments, unless they show their bearings on the ordinary practice of engineers, almost all their work is in vain.

Mr. Peabody says that his work is designed to give instruction to students of technical schools in the methods and results of the applications of thermodynamics to engineering, and, while he has considered it desirable to follow commonly accepted methods, his treatment differs from that of other writers, either in substance or in manner of presentation. The general theory or formal presentation of thermodynamics is that employed by the majority of writers, and was prepared with the view of presenting clearly the difficulties inherent in the subject, and of giving familiarity with the processes employed. However, in the discussion of the properties of gases and vapours, the original experimental data on which the working equations, whether logical or empirical, must be based are given fully, in order to afford an idea of the degree of accuracy attainable in calculations made by their aid. Rowland's determination of the mechanical equivalent of heat has been adopted, and with it his determination of the specific heat of water at low temperatures. The author's "Tables of the Properties of Saturated Steam and other Vapours," which we noticed shortly at the time they appeared, were calculated to accompany this work, and may be considered to be an integral part of it. The first nine chapters form a very concise statement of the facts and mathematics of thermodynamics, and are very well suited to the purposes to which they are intended—that is, for use in technical schools. The two main laws are stated in a very distinct manner, and the deductions from them are clearly worked out, and without any display of unnecessary mathematics. There is nothing, however, very original about the treatment, and those who are acquainted with the French and German treatises on the subject will recognise the origin to which a considerable amount of it is due. The chapters on the flow of gases and vapours, and on the injector, present some novel features, especially in the comparisons with experiments.

All this, however, is merely preliminary to the main object of the book, which is the treatment of the problems connected with the steam engine. Mr. Peabody states that he has deemed it advisable to avoid all approximate theories based on the assumption of adiabatic changes of steam in an engine cylinder, and instead to make a systematic study of steam engine tests, with the view of finding what is actually known on the subject, and how future investigations and improvements may be made. For this purpose a large number of tests have been collected, arranged, and compared. Special attention is given to the investigations of the action of steam in the cylinder of an engine, and considerable space has been given to Hirn's researches, and to experiments that provide a basis for them. Directions are given for testing engines, and for designing simple and compound engines. This is all very well in its way, and is a considerable advance on the majority of previous writers, but still there is the want of a connection between all the theory of the earlier part of the book and the experiments of the latter part. The young student may well ask, "Why give a treatise on the steam engine an imposing look by crowding it with mathematics unless you show its application?" and with much reason too. Mr. Peabody does occasionally use some of his mathematical results, but he makes no attempt to develop a complete theory founded on the experiments he quotes and on the mathematics which he employs, and in this respect his treatise is defective. He, however, gives a great deal which will be found useful. In Chapter XII. he gives the theory of an engine which works in a Carnot cycle, and compares the results with those obtained from Hirn's experiments. He, however, explains clearly the position he takes in the matter, which is more than most writers on the subject do. He points out that a complete working theory of the steam engine should take into account the differences from the Carnot cycle, as well as the action of the walls of the cylinder, the incomplete expansion and compression, the losses from radiation and friction, and the effect of the clearance or waste space at the ends of the cylinder. He enumerates the theories of Rankine, Clausius, Jenner, and others, and points out wherein each is deficient, and he considers them as first approximations, without which the existence and amount of the error would never have been known, and he points out that at the present time a complete theory cannot be stated, as the form even of the factors depending on the thermal action of the walls has not been discovered, and all attempts to introduce such factors have led to unsatisfactory results. The proper direction of investigation therefore appears to him to be to determine the action of the walls quantitatively, in engines of different forms, and working under different conditions. Although a large amount of experimental information exists the greater part of it cannot be used, because the experiments, though sufficient for the purposes sought by the experimenters, fail to give certain essential data, and Mr. Peabody says that this, together with the complexity of the subject, has made all attempts to complete the theory unsatisfactory up to the present time. While admitting the force of all this, we think that Rankine's method of treatment might have been taken and brought down to date. Instead of doing that, Mr. Peabody enters into a rather full account of Hirn's method of analysis, and gives much useful information regarding the methods of testing steam engines, which of course will be found very valuable by all students of the subject, but a great part of which would be more in place in what might be called an engineering laboratory handbook than in a systematic treatise on the steam engine. Treatises of this kind have very often sins both of omission and commission. An ideal treatise on the steam engine, intended for engineers and not for physicists, should contain no theoretical work except what is used in the subsequent applications, while these applications should always be put in such a form that engineers saw at once how they were to be utilised in their daily work. Mr. Peabody's work will be found most useful to students as well as to practical engineers, and in many respects is in advance of what has previously appeared, at least in the English language; but notwithstanding that, we feel that more might have been made of the materials at his command. In short, we feel that *the* treatise on the steam engine has still to be written.

THE STEAM ENGINE AND THE INDICATOR. By William Barnet Le Van. Philadelphia: HENRY CAREY BAIRD & Co. London: E. & F. N. SPON. 1890.

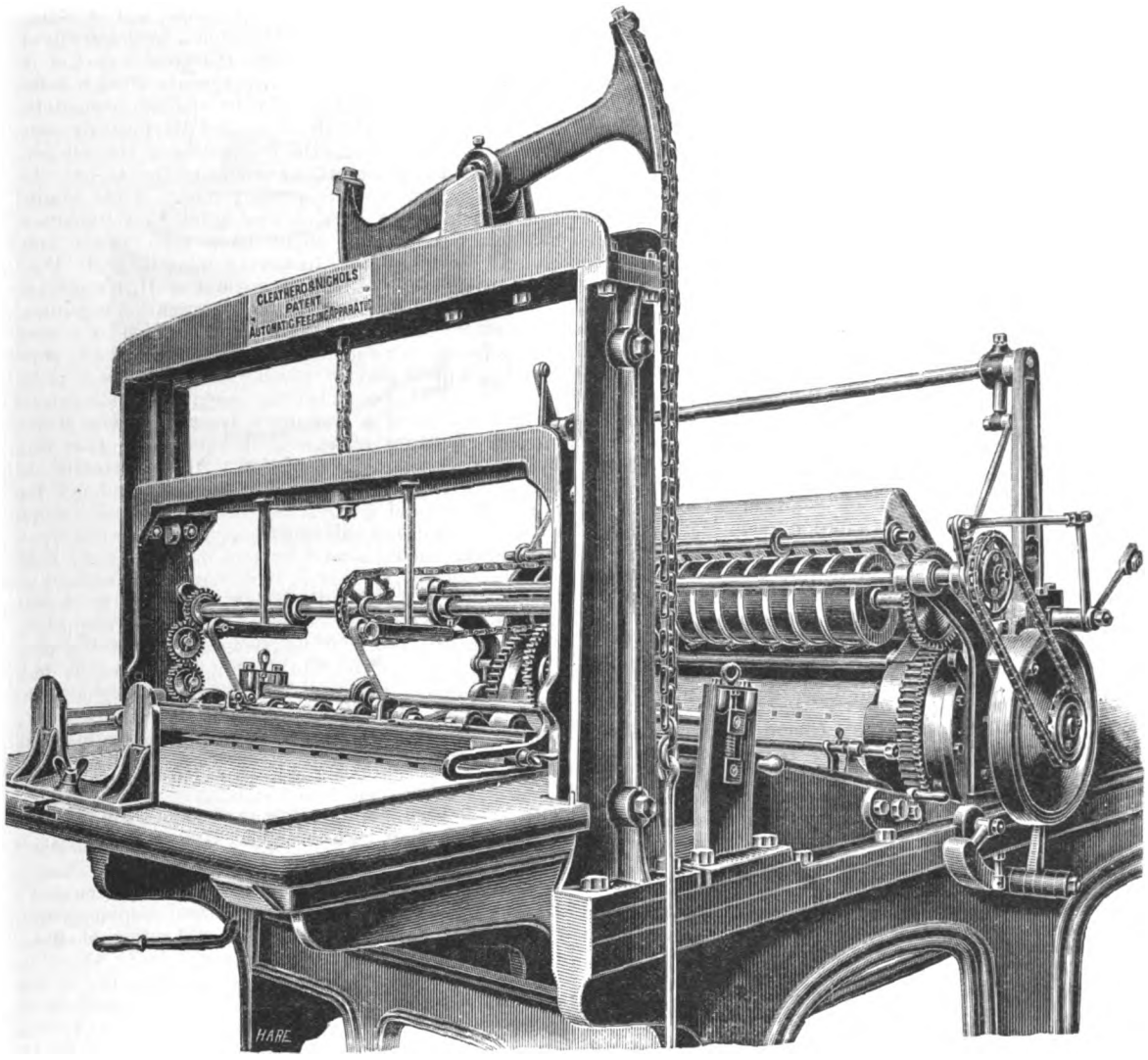
This book will be found a most useful supplement to the more systematic treatises on the steam engine, giving, as it does, an account of the theory and action of steam in engines in language which is intelligible to the ordinary student, and at the same time conveying a vast amount of information on points which is only to be gained by practical experience. It is intended chiefly to be a guide to the use of the indicator, and as such is now the most complete treatise of the kind in the English language, and also the one which contains the greatest amount of information on the applications of the indicator to the most recent forms of steam engines. Those who are acquainted with the older books on the subject will recognise how much the author is indebted to them, but they will also recognise that he has availed himself of the resources of the engineering periodicals both in Britain and America, as well as of his own practical experience, to bring his present work up to date. Some years ago Mr. Le Van published a small volume on the Steam Engine Indicator, in Van Nostrand's Science Series, which consisted chiefly of matter which had appeared in the American *Mechanical Engineer*, and which was very well received by engineering critics. Since that time we have observed that he has been a very constant writer in American scientific journals, so that the present book is the result of long and careful study, and of a great amount of practical experience, extending, as he tells us, over a period of more than thirty years, and is therefore worthy of a careful and favourable consideration.

The historical introduction may be thought by some to be unnecessary in a book like this, but we have a strong leaning in some cases towards the historical treatment of any subject, as it is only when a student understands how a thing came to be what it is that he fully appreciates what it is. Unfortunately history is too often written with a national or a personal bias, and on the steam engine it cannot be denied that British writers have as a rule paid too little attention to the claims of American inventors. It is probable that it will be found that Mr. Le Van has given too prominent a position to the latter. He has at least given evidence of the existence of the "Savannah," which anticipated the "Sirius" and the "Great Western" by nearly twenty years, and dispelled the idea that the whole story of its crossing the Atlantic was a myth. After a chapter taken up with an account of the properties of steam, and its action in the

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cylinders of engines, we have a chapter on "Horse-Power" as an introduction to the main subject of the book, and in connection with that a considerable amount of useful information is given regarding apparatus, and methods of application and calculation, in each case illustrated by concrete examples which cannot fail to make their meanings clear to the readers. Then follows an exhaustive description of the various parts of the indicator diagram, with examples of the various peculiarities to be met with in practice, and a comparison with correct diagrams, by which we are able to diagnose the faults of the engine. The next three chapters may be looked upon as containing the theory of the steam engine in non-mathematical language, and will be read with profit even by mathematicians. The action of steam jackets is explained in a very clear manner, and their uses and abuses pointed out, and may be read with advantage at the present time when the question is now being actively discussed by engineers. The longest and most important chapter in the book is that which treats of the different varieties of steam engines, and especially the methods of treating their indicator diagrams. Our space will not allow us even to enumerate the various points and designs discussed; it is sufficient to say that, not only are the applications to the older forms fully considered, but also the most recent developments in land, marine, and locomotive engines. A special chapter is devoted to gas engines, in which a sketch is given of their action and of the methods of applying the indicator to their different varieties. Chapter XV. is taken up with showing the superiority of the automatic cut-off engine over the positive cut-off engine, and shows that in many cases the coal consumption of the latter is very often double that of the former. The concluding chapter gives a considerable amount of miscellaneous information, especially regarding the leakage of steam engines, while an appendix gives descriptions of the most recent forms of indicators, and tables and formulæ relating to steam. If we have any criticism to make on the book as a whole, it is that its arrangement might be improved and its matter placed in more logical order. As it is, however, we have no hesitation in stating that it contains a great amount of information which will be useful to engineers, and we have much pleasure in commending it to our readers.

NAVIGAZIONE; NAVIGLIO. Per Salvatore Raineri. Estrallo dall' Enciclopedia delle Arti e Industrie. Pubblicata dall' Unione Tip. Editrice Torinese. 1889.

Whatever diverse opinions may be entertained in this country regarding the practical knowledge and skill of our Continental neighbours as builders of ships and engines, there can be but one opinion as to their keen and intelligent interest in all that is progressive in these important industries. The work named at the head of this notice forms a striking example of the closeness and intelligence with which the various steps in advance are followed by Italians. "Navigation" and "Navy" are two articles republished under one cover. They originally appeared in the Italian *Encyclopædia of Art and Industries*. The writer of this work is Captain Salvatore Raineri, already favourably known on the Continent through his "Storia tecnica e annecdotica della Navigazione a Vapore" and other works. His long practical experience, and especially his present eminent position of technical secretary to the vast shipping concern "Navigazione General Italiana," qualifies him to write with discrimination and authority. It is not very often that anything so comprehensive and, at the same time, so exhaustive on essential points, has come under our notice as these articles, which, together, form an excellent compendium of existing knowledge on the extensive subjects they deal with. Every available source, apparently, has been requisitioned for authoritative information, and many valuable tables are given, while a conspicuous feature of the work is the number and beauty of the illustrations. Many of these are full-page engravings both of vessels and engines recently built for merchant and war purposes in Italy as well as in this and other maritime countries. The author's treatment of the subject of navigation is very comprehensive, concerned as it is with everything relating to the movement of a ship from port to port. In addition to an historical sketch of the subject, he describes the most approved modern methods of navigation and seamanship, and the various appliances, charts, and books involved. Propulsion by sail is next considered, theory and actual practice receiving due attention, and an exhaustive record is made of noteworthy performances by celebrated clippers and modern yachts. Steam navigation is then dealt with historically and critically, and here the author is on firm ground, his official position and experience enabling him to throw much light on steamship performances. The subject of economy in speed and coal consumption is thoughtfully discussed, and much information is given, both in the form of tables and plans, of steamships belonging to the principal companies of the world. Not the least interesting of the many illustrations given is one which is unfamiliar, if not quite unknown, to English students of marine inventions, this being the screw propeller of Leonardo da Vinci, from which it will be seen that a share of the credit attaching to the invention of this propulsive agent must be accorded to this old time authority.

The article "Navy" is necessarily, in some measure, a duplication of "Navigation," but is concerned more with the construction than with the management of ships. The art and science of naval architecture from ancient times down to the very moment of writing are traced in a most comprehensive and instructive way, the letterpress being much assisted by copious illustrations. The construction of vessels of war is illustrated by engravings of some of the principal ships of the Italian Navy, together with a few typical vessels belonging to other countries; while torpedoes and torpedo boats are duly described, and the book appropriately concludes with the tabular statements of the amount of shipping, &c., owned in the chief countries in the world. As a book of reference on all matters pertaining to the history and present state of shipbuilding, shipping, and navigation, Captain Raineri's work is admirable, and a feature which adds much value to it is the copious and well-arranged lists of original sources of information enabling those whose who may wish or require full details to know where to find them.

AUTOMATIC FEEDING APPARATUS FOR PRINTING MACHINES.

THIS apparatus, of which we give an illustration above, has been devised by Messrs. Cleathero & Nichols, 23, Manchester Avenue, Aldersgate Street, London, E.C. It is attached to the end of a Wharfedale printing machine on the premises, though it is applicable to any class of cylinder machine. A difficulty that has been found in automatically feeding printing machines is that sometimes more than one sheet is fed in at a time. This is overcome in the present apparatus by having a shaft, the rollers of which are shown near the front of our illustration, in which, by a backward revolution, the sheet of paper uppermost is caught by segmental fluffing rubbers of cushion shape, and raised from the underlying sheet. By means of gearing of ingenious arrangement, the same shaft is then reversed and other segmental rubber-covered rollers carry the paper forwards. The first operation allows air to get underneath the required sheet of paper, which is then fed over tapes to the grippers of the printing machine. The driving power of the feeder is taken direct from the machine, so that, though the speed of the machine may be varied, the supply of sheets of paper is in unison with its printing capacity. For the same reason there is no over-inking.

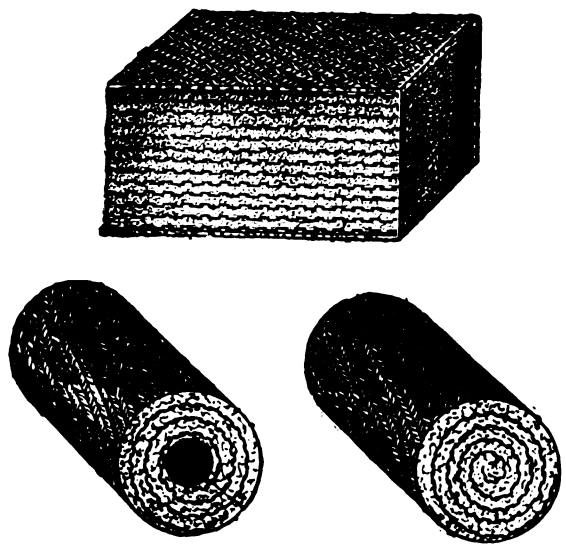
The pressure on the shaft is regulated by a chain, at the end of which there are weights suspended: the chain is shown about the centre of our illustration, the weights being attached below, and the thicker the paper to be operated on the greater is the weight applied.

The apparatus can be attached to any existing machine, and no extra floor room is required. It dispenses with the labour of the "layers on," saves time, and is more accurate than hand labour. The patentees, one of whom is an engineer and the other a practical printer, claim that they have an absolute and certain feeding of a single sheet to each revolution of the cylinder, an increased amount of work done, a saving in labour, as already said, and an absolute register. The last named and most important feature is attained by the ingenious application of the shove register attachment, mostly used on litho machines for colour work.

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A NEW ENGINE PACKING.

Messrs. David Moseley & Sons, Chapelfield Works, Ardwick, Manchester, have introduced a new engine packing, to which they have given the name of "Duriflex." The object of the manufacturers has been to combine the durability of a metallic packing with the flexibility of a fibrous packing, and in their efforts to attain this combination they appear to have been generally successful. It is especially applicable for marine work and for other cases where long engine runs are a necessity. For such purposes it has, in the opinion of the several engineers running in vessels to the Black Sea, shown itself superior to any other packing, and it is about to be used in the famous liners "City of Paris" and "City of New York."



The packing, it will be seen, is constructed of wire gauze and a fibrous material such as asbestos or cotton, and, from the nature of its construction, it follows that it must possess the qualities of durability and flexibility in a great degree. It may be constructed in any form, and with or without an indiarubber core, but the forms represented in the engravings are generally used. In the engravings the wire gauze is indicated by the thicker black lines. This is prepared before insertion in the packing by cutting or corrugating it diagonally and by placing it between the layers of fibrous material with the corrugations diagonally arranged. By this means the rigidity of the wire gauze is entirely destroyed, and the packing has practically as great a flexibility as engine packing made entirely of fibrous materials.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

At a meeting of this Institution, on the 10th inst., Mr. W. F. Melhuish read a paper "On Signalling Across Rivers in India," of which we give the following abstract:—

It not unfrequently happens that a river cable fails entirely, or becomes imperfect at a time when, owing to the force of the the stream, a new cable cannot be immediately laid, or when there is no ready-made cable available, or when a considerable period must elapse before the new cable can reach the river. To provide for these contingencies attempts have from time to time been made in India to signal across rivers without cables. Three different methods appear to have been discussed and attempted, viz.:—1. Signalling through an imperfectly insulated wire. 2. Signalling through an ordinary bare wire. 3. Signalling without any metallic conductor.

During May, June, and July of the year 1888 Mr. Johnston made a long series of trials across the canal and the river Hooghly, and the subsequent measurements and experiments led him to come to the following conclusions, viz.:—That up to 1½ miles it is perfectly easy and practicable to signal through a bare wire under water; that for greater distances, judging from experiments, it is not possible to signal in this manner. In April, 1889, Mr. W. P. Johnston died, and the duties of electrician were entrusted to me. I resolved to change the class of signalling apparatus and to continue the experiment. Discarding continuous steady currents and polarised receiving relays, I adopted Cardew's vibrating sounder. I began from the beginning, and tried to signal across a waterway without a metallic conductor by laying down two earth-plates on each of its opposite banks. Readable signals having been exchanged, the distance separating each pair of plates was varied with the view of ascertaining how close the plates might be brought together, the signals remaining still readable. Readable signals were exchanged when the distance separating the plates was equal to the breadth of the river, reading becoming more difficult as the plates were made to approach each other, and clearer and more distinct as the distance between the plates was made to exceed the breadth of the river. I learnt from these experiments that in order to obtain signals of sufficient distinctness for the practical purpose of transmitting messages, it would be necessary to construct a line on each bank of a river much longer than the breadth of the river; and as the rivers along the coasts in India are extremely wide, I became impressed with the impracticable character of such an undertaking, and decided to strike out a new line. This new line was the laying of two bare uninsulated iron wires across the waterway parallel to each other, and separated by a certain distance, the ends on each bank being looped together by means of an insulated conductor. Hence, though much of the circuit was laid under water, it was nevertheless a continuous metallic circuit. Beginning first with a complete square by laying the wires as many yards apart as the river was wide, signals were instantly exchanged that were incomparably louder than those that were exchanged when the same area was bounded by four earth-plates. The length of each of the two wires under water was next gradually increased to 740 yards, and the distance separating them gradually diminished to 35 yards, the strength of the signals diminishing proportionately, and ceasing to be readable when the wires were further prolonged. The conclusion arrived at from these experiments was that for the practical and useful purpose of signalling messages across a broad river in the absence of an insulated cable, a complete metallic circuit was at least desirable. Acting on this conclusion, it was sought to apply it practically, and the following experiment was carried out:—At a distance of 15 miles west of Calcutta a cable is laid across the river Hooghly, which at this point is 900 yards wide. The iron guards of this cable were employed to form one of the metallic conductors, and at a distance of 450 yards down stream a single wire, weighing 900lb. per mile, was laid across the river to form the second metallic conductor, insulated land lines having been run up to loop the two parallel conductors together. The experiment was quite a success, the signals being readable without difficulty.

The local line from the Central Office, Calcutta, to Garden Reach is about four miles in length, and at about midway the wire spans a small river. Vibrating sounders having been put in circuit at each end of this line, the wire where it crosses the river was taken down and laid along the bed of the waterway. Signals were loud and clear at both ends. From the success of this experiment it may be inferred that on any ordinary line, should the wire from accidental causes come off the insulator and make earth by touching the bracket, standard, or ground, or should the wire break and both ends of it be lying on the ground or in a watercourse, communication could still be maintained by means of the vibrating sounders.

The line wire which connects the town of Chandernagore with Barrackpore is about 10½ miles long, 900 yards of which consists of a cable laid across the river Hooghly. Vibrating sounders having been joined up in the telegraph offices at Barrackpore and Chandernagore, the insulated conductor of the cable was thrown out of circuit, and the line wire on each side of the river was joined to the iron guards of the cable; thus for a length of half a mile out of 10½ miles the conductor was wholly under water, yet it was found quite feasible to transmit messages between the two offices. From the success of this experiment it may be reasonably inferred that in the case of certain cable crossings where the rivers are not too wide, should the copper conductor of the cable make dead earth or become insulated by parting, communication could still be kept up between the two offices on either side.

Each of these three experiments may properly be described as a delicate experiment. With so much of the conductor under water, the quantity of current which reaches the receiving telephone is so infinitesimal that signals could not be successfully transmitted if the vibrator were joined up in the ordinary manner. It is desirable in circumstances similar to these to reduce all the resistance external to the actual connecting lines to as small a quantity as possible, and therefore, when messages are being transmitted, the telephone at the sending end should be removed from the circuit, as also should the vibrator from the receiving end.

In the discussion which followed this paper, Major Cardew said he did not consider himself entitled to much credit for his sounder, as similar instruments had been used by others before him. The idea of obtaining communication by bare wires as mentioned seemed to him good, and he thought copper wires would be better than iron ones. In addition to the armour of cables being used as a local talking circuit, it was easy, he said, by using the vibrator, telephone, and small condensers, to talk along the main conductor without interfering with the through traffic.

General Webber considered the questions dealt with in the paper of considerable importance in practical telegraphy. The life of river cables in India was, he said, very uncertain, due in some measure to the great variations of depth which the rivers undergo; in some cases the depth changes from 5ft. to 60ft. in a single season. Sounders for signalling without wires were employed some years ago in signalling across the Solent between Hurst Castle and Yarmouth.

Mr. Chas. Bright said he understood Mr. Willoughby Smith had been successful in signalling to boats without communicating wires.

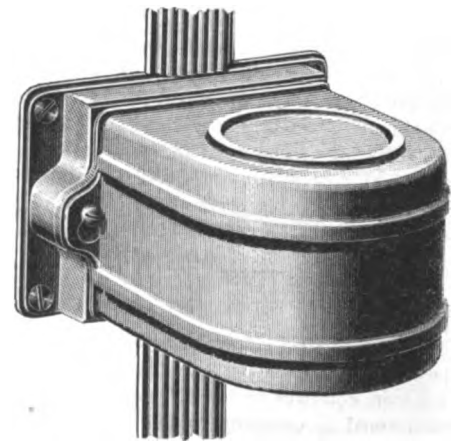
Mr. Granville said Mr. Willoughby Smith's experiments were quite satisfactory, and they had been discontinued partly because the Telegraph Construction and Maintenance Company had overcome the difficulties in signalling to lightships in another way, and partly owing to Mr. Smith's ill health.

Mr. Mordey said Mr. Preece had informed him that the dynamos at Deptford affected the telephones in Paris; if this were so, signalling across seas was already accomplished.

A paper was also read by Mr. F. Higgins, on "The Diathermancy of Air in Relation to the Efficiency of the Electric Lamp."

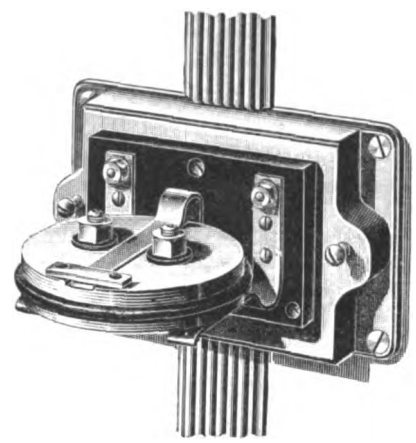
THE CARDEW EARTHING DEVICE.

We give herewith an illustration of the latest pattern of the Cardew earthing device as modified by Messrs. Drake & Gorham, Victoria Street, Westminster, and adopted by the London Electric Supply Corporation. The action of the device is to connect the secondary circuit to earth automatically whenever a dangerous difference of potential is established between the lamp circuit and earth. This result is obtained by interposing some medium which will be of infinite resistance until a dangerous difference of potential exists, when a free passage for the leakage current is provided.



View of Device as in Use.

In the device illustrated the static arrangement is adopted, as it is found to give the best results. It consists of two brass plates placed near but insulated from each other. Between these lies a thin foil of aluminium, which is retained in position by ebonite pegs, one plate being connected to earth and the other to the secondary circuit. A flat projection is formed on the upper plate over one end of the foil, so that as soon as a difference of 400 volts is established one end of the foil lifts by static attraction, and a metallic contact is made between the two plates. If there is a serious leak between the primary and secondary, and if the primary is also completely earthed elsewhere, the primary fuses in one or both of the houses in which the leaks occur are blown. These fuses will go with a current too small to cause a fire, even if one earth is through a house



View of Device with Cover Removed.

secondary—that is to say, if in one house the primary is in contact with the secondary in the transformer, the secondary will have been already earthed on one side by leakage. The plates are all made interchangeable, so that when the foil has acted it is merely necessary to slide in some fresh plates.

It has been suggested that the permanent earthing of the secondary does all that the static contact will do. Earthing the middle of the secondary circuit reduces the stress on the secondary insulation, but admits of danger from fire, as it only requires one leak to earth on the secondary to make a short circuit. With the static contact two are needed.

It is evident that the apparatus can be modified to act as a relay, and cut off both poles of the circuit, or to ring a bell and drop a danger disc, as has been arranged for the Chelsea Electric Supply Company, where continuous currents are used.

This apparatus has been adopted by the Deptford Company, the Newcastle Electric Supply Company, the Lynmouth Central Station Company, the Shanghai Electric Company, &c.

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Notes.

SOUTH AFRICAN RAILWAYS.

It is stated that arrangements have been concluded by Mr. Rhodes on behalf of the British South African Company with the Cape Government for the immediate extension of the railway northwards from Kimberley, and that already considerable progress has been made. These extensions will have the effect of greatly extending British trade and influence in the district.

BRITAIN'S WHEAT SUPPLY.

As indicating the great decrease in the price of wheat during the past thirty years, it may be interesting to note that in 1851 the whole supply of wheat for a population of 27,000,000 amounted to 317lb. per head. The cost was £53,500,000. The wheat supply of 1889 was at the rate of 400lb. per head for a population of 37,000,000, and the cost was £43,700,000. The consumption of flesh foods advanced within the same period from 90lb to 115lb. per head.

STEEL SHIPBUILDING IN CHICAGO.

It is reported that steel shipbuilding on a large scale is going to be carried on upon the American lakes, and that a Cleveland iron company and a Chicago steel establishment have formed a company to build steel vessels in Chicago. The yards are to be on the east side of the Calumet river in South Chicago, and it is stated that in a few months the company will have six steamers on the stocks. There cannot be the slightest doubt but that these semi-British, American, and Colonial companies, when fully developed, will have a very great effect on our home manufactures.

A BRIDGE OVER THE BOSPHORUS.

Encouraged by the success of the bridge across the Forth, engineers are now considering the equally great scheme of a bridge across the Bosphorus, to connect Europe and Asia and their present and future railway systems. A Turkish newspaper gives some particulars of an offer by a French syndicate to build a bridge of 800 metres in length and 70 metres high between Roumeli and Anatoli Hissar. The bridge would consist of one span, which will much exceed in length the longest span of the Forth Bridge. The Anatolian railway will make the construction of such a bridge a necessary undertaking before many years are gone.

THE OPENING OF THE UPPER YANGTZE.

Some time ago we alluded to the proposal that Chung-King should be opened to foreign residence and trade, on condition that no attempt should be made by foreigners to place steamers on the Upper Yangtze for a period of ten years. It is thought, however, that the Chinese will themselves start a line of steamers, so that at the end of ten years a considerable development will have taken place. The good feeling with which these negotiations have been carried on will do much to promote friendliness, and a large and healthy trade will, no doubt, be the result.

DRAINING THE ROMAN MARSHES.

The draining of the "Agro Romano" has now reached an advanced state of completion. The main object of the works is to drain the marshes of Ostia, Isola Sacra, and Maccarese, bordering the coast about fifteen miles from Rome, and the works consist of defence banks, canals collecting high waters with a direct outlet into the sea, embankments for the area to be drained, and canals within the area. The water of the area is raised by means of machinery on the turbine system, and is discharged into the sea. The chief difficulty in carrying out these plans is the unhealthiness of the place, which sometimes renders it necessary to suspend the work for some months. Perhaps it would have been impossible to carry out the undertaking by employing ordinary labourers belonging to the Campagna and paid by the day. However, near Ravenna, there is an extensive association of labourers for this particular kind of work, and several squads are selected and are despatched to Rome every year. The men, who are of a robust constitution and sober, are not subject to a master, and have a direct control over their food, wine, and housing, as well as over their hours of work; they perform their task peacefully, and divide among themselves the price agreed upon with the contractor. Their earnings range from 3s. 4d. to 4s. per diem, and enable them to save money, which is the constant thought of the Italian workman. The amount spent by Government up to the end of 1888 in the undertaking was £139,580. The estimated cost of all the works to be executed by Government was at first fixed at £160,000, which was subsequently raised to £300,000.

LOCOMOTIVE BUILDING IN NEW SOUTH WALES.

Recently proposals were advertised by the New South Wales Railway Commissioners in the British and Colonial papers for the establishment of an engineering concern for the production of locomotives, and we understand that a contract has now been made between Sir Saul Samuel, the Agent-General for the Government of New South Wales in London, and a syndicate in this country, for the establishment in that colony of locomotive works upon an extensive scale. The company will be known as "The Australasian Locomotive Engineering Company," and Mr. Dugald Drummond, locomotive superintendent of the Caledonian Railway Company, will be the managing director.

MANUFACTURES IN HONG-KONG.

A very common impression in this country is that Hong-Kong is only a mercantile emporium or centre for the distribution of merchandise all over China and neighbouring countries. It is, however, developing into an industrial centre of considerable importance. It has now three very large sugar refineries, which have practically monopolised the trade of refined sugar in China and Japan. There are factories for ice making, rope making, and there is also a company which has a large establishment for supplying bricks and cement. There is also, we are sorry to say, a large distillery, with a very large output of rum. All these concerns are British, or at least are under British management.

PRODUCTION OF COAL IN JAPAN.

The production of coal in Japan continues to increase rapidly. The official returns for 1888 have just been published, and they show that the entire production in that year was 3,488,629,684 catties (1 catty being equal to 1·3lb. avoirdupois). Of this quantity 632,440,957 catties were produced from the Miike mines, and 149,849,861 from that of Kuratsu, both of which are under Government control. The aggregate of the production of private mines, therefore, was 2,706,638,246 catties. Compared with 1887 this was an increase of about 30 per cent. in the quantity produced. The quantity sold was in excess of that produced, the balance being made up from stocks of former years. The amount realised from abroad from the sale of coal was $17,700,000, but this does not include the value of the coal from the Government mines, the greater part of which was used in the country itself and for Government purposes. The development of the Japanese coal mines has been of the greatest service both to the ships of foreign navies and to merchant steamers.

THE KRUPP WORKS AT ESSEN.

The United States' Consul at Düsseldorf devotes a recent report to a history of the Krupp works at Essen, especially since the death of the elder Krupp, the founder, in July, 1887. It was feared by many that the great establishment would not in future enjoy the same reputation and prosperity as in the past, but, to the surprise of many, his only son assumed charge with the same spirit of energy and businesslike management that made the father so famous throughout the world, and increased business and prosperity have attended his efforts. His first act after the death of his father was to give to the city of Essen, now a place of about 70,000 inhabitants, 300,000 marks for public improvements; he then created a fund of 1,000,000 marks for the benefit of poor, sick, and disabled workmen who had devoted their lives to his and his father's service. All this rendered it an easy matter to get the best and most skilled workmen at reasonable rates of pay. Access to the establishment has been denied of late to every sightseer. The works cover about 1,000 acres. The number of men employed in all the departments three years ago was 20,000; at the present time the number reaches about 25,000 or over. Cast steel works at Essen, three coal mines near Essen and Bochum, 547 iron ore mines in Germany, several iron ore mines in Spain, four forges in other parts of Europe, a trial shooting ground 16·8 kilometres long, a trial shooting ground 7·5 kilometres long, four ocean steamers, 11 large furnaces, 1,542 smelting stoves, 439 steam boilers in actual use, 82 steam hammers, 450 steam engines, 1,622 tool-making machines, 14 large locomotive engines, and 40 small locomotive engines form part of the plant of the works. The consumption is roughly as follows:—Coal and coke, an average of 4,000 tons per day, 2,000 of which are used in the forge works and steamers; water, about 18,834 to 26,898 cubic metres per day; gas, about 13,350 to 42,700 cubic metres per day, and 400 to 1,500 tons of iron ore.

THE COAL DEPOSITS OF EUROPE.

The German *Handel's Museum* has recently published some statistics relating to the coal deposits on the Continent of Europe which are of considerable interest. The Low Countries, Belgium and Holland, Switzerland, Denmark, Germany and Bohemia, possess a coal area of nearly 60,000 square miles. Then Austria, Spain, Portugal, Italy, and Greece contain deposits estimated to cover an extent of between 30,000 and 40,000 square miles, of which only a fractional part has yet been touched. Russia has already surveyed coalfields extending over 2,200 square miles, and, in addition, the mineral is widely distributed throughout the Russian empire, in Poland, and in Siberia, in the Ural region and in the Caucasus. Careful surveys are now being made, and many of the deposits are already being worked. The production of the Central Russian collieries has been attracting a good deal of attention lately by reason of the growing output. In 1888 the collieries of the Kursk-Kharkow, Sea of Azov, and Donetz districts produced about 1,500,000 tons of coal. In 1889 they had raised the output to nearly 2,225,000 tons, an increase of nearly 50 per cent.

A PAN-AMERICAN ZOLLVEREIN.

In writing on the subject of Imperial Federation we have several times suggested that the first steps should be in the direction of trade arrangements of a more satisfactory kind than those which at present exist between this country and the Colonies. If we do not tackle the subject in real earnest we may find that in a short time we shall be driven to it by force of circumstances. For instance, it is rumoured that one of the probable consequences of the Pan-American Congress is likely to be a Pan-American Zollverein, in which there would be absolute reciprocity among all the American countries. If the proposal be adopted, it, of course, means the adoption of free trade over all the American Continents, and if that be agreed to, under such varying conditions of resources, climate, and state of industry, it is certainly possible among the various parts of the British Empire if vested and personal interests could only be set aside. It seems too much to expect a European Zollverein for many years to come, but the tendencies of the times all point in that direction. If we have international conferences to settle labour questions, it is not going very much further to suggest similar conferences for tariff and other trade purposes, as well as for purposes which are only indirectly connected with trade.

THE TRANS-SAHARA RAILWAY.

At a recent meeting of the French Académie des Sciences, M. Georges Rolland, a well-known engineer, read a paper on the subject of the above railway. He pointed out, in the first place, those regions of the Western and Central Soudan upon which French commerce might reasonably reckon, and said it was about time that France should decide the position she intended to take in the economic conquest of Africa. He was of opinion that nothing durable or really useful could be effected in the Soudan without the assistance of Algeria, while in order to take any effective action in Algeria that colony would need to be connected with the Soudan by means of a railway across the Sahara. Dwelling upon the necessity of a Trans-Sahara railway from a strategic, political, and commercial point of view, he asserted that the route from Algeria to the Soudan, although it might be the longest, might be made the most expeditious if proper influence could be exerted over the natives of the district through which it passed. He suggested that a column of two hundred French soldiers should be sent along the route for the purpose of establishing commercial stations and conciliating the natives. His conclusion was that the only practical and speedy method of opening up the Sahara was to construct a light railway of the Decauville type by way of Onarghi and Amguid.

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Patent Record.

(Compiled from "The Illustrated Official Journal (Patents).")

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

1st April, 1890.

5034. Maxton, J. ..... Submerged buoyant bridges.
5038. Trott, H. ..... Valves for controlling passage of fluids.
5041. Buckley, J. ..... Mules and twiners.
5042. Ryder, G. ..... Cutting tools.
5043. Sellars, J. ..... Spindles for centrifugal machines.
5045. Haigh, Walker, & Mitchell ..... Apparatus for drilling fallers.
5047. Wrightson & Holt ..... Knitting machines.
5050. Harris, J. B. ..... Rotary engines.
5051. Barnsley, R. G. ..... Chains for transmission of power.
5060. Pearsall, H. D. ..... Valves.
5061. Rose, J. ..... Machines for cutting soles, heels, &c.
5063. Smith & Knapp ..... Steam boilers.
5064. Towne, N. P. ..... Steam boilers.
5068. Sleeman, C. W. ..... Ascertaining direction of torpedoes.
5071. Boult, A. J. ..... Piston packing (*Child*).
5073. Haensel, G. ..... Belt and fast and loose pulleys.
5074. Thompson, W. P. ..... Grain clipping machines (*Knight*)
5076. Chandler, N. ..... Single acting engines.
5077. Newton, H. E. ..... Joint for flexible shafting (*Howard*).
5078. Hunt, C. ..... Gas retorts and apparatus for charging.
5086. Lake, H. H. ..... Machines for cutting soles of boots (*Hartford*).
5088. Lake, H. H. ..... Machines for manufacture of metal screws, pins, &c. (*Worsley*).
5091. Pitt, S. ..... Machine for hulling grain (*The Engelber Huller Company*).
5092. Jones, E. R. S. ..... Ramps.
5093. Pœtsch, F. H. ..... Sinking shafts.

2nd April, 1890.

5100. Morfittt, A. ..... Platen printing machines.
5103. Reade & McKibbin ..... Flyers of spinning machines.
5115. Cripps, F. S. ..... Channel-Tee iron.
5117. Wilson & Welsh ..... Boiler furnaces.
5118. Besson, H. ..... Machinery for bevelling glass.
5120. Young, A. ..... Railway chairs.
5123. Birchenough & Wood ..... Looms.
5126. Cox & Gordon ..... Typewriters.
5127. Banks, K. ..... Apparatus for shaping nuts, &c.
5129. Plumbridge, Sen., Plumbridge, Jun., & Jackson Band saw guides.
5130. Lapworth & Hayes ..... Water tube steam boilers.
5133. Matthias, E. A. ..... Apparatus applicable for cutting coal (*Plowman*).
5134. Thompson, W. P. ..... Grain elevators (*Rostand*).
5142. Theissen, E. ..... Condensing steam.
5152. Garden, W. ..... Refrigerating machines.
5153. Garden, W. ..... Stuffing boxes.
5154. Thomson, J. ..... Platen printing presses.

3rd April, 1890.

5163. Woodhouse, S. J. ..... Charging retorts.
5165. Knight & Higgins ..... Steam generators.
5166. Kollén, A. B. J. ..... Machinery for finishing horseshoe nails.
5173. Winchester, J. ..... Tramcars.
5175. Shanks, Tardew, & Andrews ..... Brick moulds.
5179. Sample & Ward ..... Boat detaching gear.
5180. Witt, S., Jun. ..... Brick making machine.
5183. Sykes, J. ..... Preventing running back of tramcars.
5188. Dixon & Dixon ..... Brick machines.
5192. Melhuish, A. G. ..... Gas motors.
5194. Waller, G. ..... Cooling and conveying coke.
5198. Rauhe, C. ..... Drilling machine for cartridge shells.
5211. Lye, H. J. ..... Sifting machines.
5213. Collins, J. ..... Brake for railways.
5220. Comerford, J. ..... Apparatus for drying grain.
5222. Boult, A. J. ..... Shells for high explosives (*Justin*).
5223. Cooper, Roe, Cooper, & Taylor ..... Rotary knitting machines.

5th April, 1890.

5231. Shardlow, A. ..... Split pulleys.
5232. Milnes & Birks ..... Shaping spherical projectiles.
5238. Hersey, J. ..... Pipe wrenches.
5241. Rowley & Rowley ..... Apparatus for mixing sand.
5244. Guest & Brookes ..... Reeling machines.
5247. Burman & Burman ..... Shearing and clipping machines.
5248. Priestley, G. F. ..... Valve for gas engines.
5254. Young, Young, & Wright Hydraulic lifting jacks.
5255. Cooke, W. ..... Steam generators.
5256. Mills, B. J. B. ..... Jacquard apparatus (*Ronze*).
5265. Koch, E. ..... Differential friction wheels.
5267. Chapman, A. ..... Evaporating apparatus.
5273. Otto, N. A. ..... Gas engines.
5275. Otto, N. A. ..... Petroleum engines.
5276. Cameron, D. ..... Anti-friction bearings (*Millhauser*).
5277. Kirkaldy, J. ..... Reducing valves.
5278. Kirkaldy, J. ..... Steam boilers.
5281. Stevenson & Milburn Rotary motors.
5284. Nilsen, A. B. E. ..... Manufacture of casks.

ELECTRICITY.

1st April, 1890.

5048. De Méritens, A. ..... Sterilising liquids by magnetism.
5049. De Méritens, A. ..... Sterilising liquids by electricity.
5054. Kellner, C. ..... Bleaching fibrous material by electricity.
5062. Van Depoele, C. J. ..... Electric railways.
5087. Lake, H. H. ..... Electric cables (*Barrett*).

2nd April, 1890.

5135. Belfield, R. ..... Cores for transformers (*Westinghouse*).

3rd April, 1890.

5219. Andersen, F. V. ..... Electric arc lamps.
5228. Thompson, W. P. ..... Galvanic elements (*Hoppe & Hoppe*).

5th April, 1890.

5235. Sayers & Sayers ..... Electric generators and motors.
5274. Abel, C. D. ..... Telephonic and telegraphic transmission (*Société Générale des Téléphones (Réseaux Téléphoniques et Constructions Électriques) & Picou*).

CHEMISTRY.

1st April, 1890.

5058. Delplace & Delplace ... Sulphuric acid.
5072. Mond, L. ..... Treating phosphatic minerals.

2nd April, 1890.

5140. Thoms, W. A. ..... Coating metallic surfaces with metals.
5155. The Clayton Aniline Co., Ld., & Hall ..... Colouring matters.

3rd April, 1890.

5199. Electric Construction Corporation, Ld., Parker, & Robinson Copper nickel matte.
5205. Wilton, T. ..... Sulphate of ammonia.
5209. Lake, H. H. ..... Explosives (*Maxim*).

5th April, 1890.

5239. Blum, J. ..... Water gas.
5243. Fourness, H. ..... Carburetting water gas.
5287. De Graef, L. J. ..... Phosphates.

MISCELLANEOUS.

1st April, 1890.

5026. Russell, J. ..... Sound signalling at sea.
5031. Drayton & Wilkins ... Gradient indicator.
5033. Philburn, A. ..... Flyers used in spinning.
5040. Taylor, J. ..... Extinguishing fires.
5053. Kellner, C. ..... Softening paper pulp.

2nd April, 1890.

5106. Tuquet, Boudard, & Crawley ..... Fasteners for driving belts.
5128. Kellner, C. ..... Manufacture of paper.

3rd April, 1890.

5177. Morice, J. L. ..... Distributing oil on water.
5185. Jackson, I. ..... Joining driving belts.
5187. Dennis & Naylor ..... Taps and cocks.
5196. Walliker, J. G. ..... Manufacturing barrels from paper pulp.
5200. Vickers & Vickers ..... Distributing oil.
5226. Thompson, W. P. ..... Lanolin as a lubricant (*Krause*).

5th April, 1890.

5279. Smith, E. H. ..... Pantographs.
5285. Kellner, C. ..... Bleaching vegetable fibres.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form, of such opposition.

Year 1889.

3997. Blackwell.
5430. Lautz.
5558. Downie & Snowdon.
5704. Pickerings, Ld., Pickering, Sant, & Davies.
5896. Matthews & Verrall.
6084. Brotherhood.
6333. Rose.
6391. Hucks.
6750. Rylands, Crowder, & Morant.
7174. Buschek.
7232. Scheuer.
7375. Jones.
7408. Barron.
7427. Zimer.
7445. Robottom.
7480. Fuhmann & Trenckmann.
7667. Bamberg.
7691. Avery & Avery.
7796. Benson.
7932. Howarth.
8136. Thomas.
8230. Edge.
8250. Edwards (*Platenius*).
8422. Nuttall.
8451. Gollop.
8511. Bussy.
8539. Henderson.
8654. Davies.
8797. Porion.
8868. Edwards (*Matejec*).
8893. Collier.
9002. Vorbach.
9040. Wood & Wood.
9103. Menzies.
9115. Metcalf.
9121. Green.
9156. Campbell.
9162. Brown.
9172. Yorke & Godfrey.
9189. Duff. (17th December, 1888.)
9193. Hirst.
9232. Humphreys.
9246. Bramley.
9273. McDougall, McDougall, & Fowler.
9279. Loomis.
9297. Lake (*Wheeler*).
9304. Barnicoat.
9326. Dobson, Hamer, & Butterworth.
9340. Husbands.
9354. Brougham (*Jönsson*).
9358. Green.
9389. Gee.
9592. Alley.
10042. Simpson & Puplett.
10162. Gauttard.
10928. Gaul.
11456. Meiklejohn.
13957. Mertelmeyer.
14787. Mitchell.
14986. Dredge.
16592. Clark.
16741. Hoyes.
17622. Bettney.
19193. Chalon.
19246. Wilson.
19724. Aland.
20761. Boult (*Krieger, Dallmer & Schoen*).
4044. Ousey.
5544. Matthews & Buckland.
5716. Fleischhauer.
5853. Hattersley & Ayres.
6008. White.
6172. Lyte.
6346. Page.
6410. Burnell (*Wilms*).
7090. Dreyfus & Robinson.
7151. Airey.
7220. Neuhaus.
7363. Parsons.
7380. Riekmann (*Davis*).
7422. Tulloch.
7433. Savin.
7477. Whitney.
7546. Loynd.
7592. Hogan.
7684. Cannon.
7696. Young.
7929. Sturgeon.
8030. Unger.
8151. Yorke.
8241. Hahn.
8283. Whittaker, Whittaker, & Whittaker.
8510. Keile.
8523. Clarémont.
8650. Hargreaves & Gillow.
8776. Hasselbach, Hyman, & Alexander.
8882. Branson & Neild.
8956. Truffault.
9019. Leach & Haskins.
9058. Taylor, Sen, & Taylor.
9113. Rosoman.
9119. Fiford.
9133. Lake (*Messrs. Lacombe & Co.*).
9170. Beguz & Boecker.
9186. Boult (*Streubel*).
9190. Duff. (17th December, 1888.)
9195. Ozouf & Leprince.
9239. Fothergill, Swale, Swale, & Walker.
9274. Hall.
9277. Degrémont-Samaden.
9286. Robinson.
9303. Coustas.
9322. George & Hooper-Rastrick.
9327. Fox & Blass.
9349. Tangyes, Ld., & Barnes.
9367. Hamelle.
9531. Golding.
9816. Hopcraft.
10092. Chapman.
10324. Boult (*Bookwalter*).
11000. Lake (*Oehler*).
12540. Barrow.
14021. Riedler.
14807. Spencer.
15314. Clews & Payton.
16733. Beal.
17447. Christie.
19138. Spiro.
19225. Wilton & Wilton.
19334. Wise (*Natusch*).
20290. Joyce.
20917. Redman.

1890.

224. Driver.
740. Clark (*Clark*).
991. Seymour.
1677. Monk.
1878. Williams.
1895. Heywood.
2239. Milligan.
2450. Dorr.
2619. Schultz & Hopf.
2629. Thompson (*Barr*).
2744. Servus.
2773. Osmond.
2966. Bayley.
3008. Hollingshead & Carney.
3020. Van Steenbergh.
3270. Mistovski.
3326. Anderson (*Singer Manufacturing Company*).
3365. Dane.
3388. Gürtler.
3403. Hudson & Hudson.
3407. Lane.
3438. Boult (*Benton & Waldo*).
3457. Lake (*Copeland*).
3465. Justice (*The Willcomb Knitting Machine Co.*).
3480. Heaton.
3484. Schweizer.
3516. Thompson (*Ford & Whitworth*).
3531. McDougall.
295. Kneen.
936. Hardie.
1499. Stiles.
1876. Broad & Harris.
1887. Fuller & Griswold.
2228. Bruce.
2422. Beschoren.
2568. Marshall. (28th August 1889.)
2635. Whipple.
2748. Nolte.
2870. Thompson (*Maurin*).
2986. Wollin & Werline.
3013. Hartmann.
3029. Herbert.
3290. Scruby.
3330. Fisher.
3357. Boult (*Welde & Welde*).
3366. Depressbux.
3399. Davis.
3404. Legge.
3437. Menke.
3453. Gordon.
3464. Brewer.
3476. See.
3477. See.
3481. Spencer.
3485. Brotherhood.
3518. Flachs.
3526. Shepherd.
3538. Haddan (*The Bissell Carpet Sweeper Co.*).

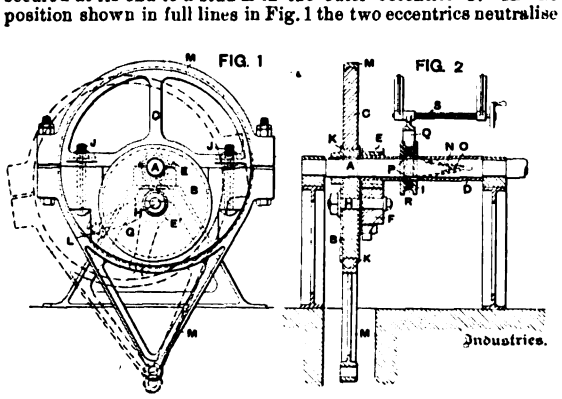
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ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

STEAM BOILERS.—*H. Tomkin & T. Sudron & Co., Stockton-on-Tees.*—A new arrangement of the cross-tubes and combustion chamber in vertical boilers constitutes this invention. The cross-tubes extend the full distance across the boiler to the shell on either side, to which they are riveted or otherwise secured. The boiler shell is thus reduced in strength only by the loss of sectional area of the tubes, and the loss may be compensated by plates extending round the holes cut. The cross-tubes communicate at one end with the combustion chamber and at the other end with the smoke box, the combustion chambers and smoke-box being situated on and secured to the outside of the boiler shell, which consequently is not cut away for their accommodation. The water space is also not encroached upon by the combustion chamber and smoke-box. The combustion chamber communicates with the top part of the fire-box by short tubes of large diameter passing through the fire-box lining and outer shell. The cross-tubes are arranged in series one above another, and the combustion chamber and smoke-box divided off by horizontal partition into two or more compartments. The products of combustion thus pass from the top of the fire-box into the lower part of the combustion chamber, from there through the cross-tubes to the lower part of the smoke-box, and then back again from one to the other through the cross-tubes until it finally escapes to the uptake. Claims: (1) In vertical steam boilers arranging the cross-tubes to communicate directly between the combustion chamber and smoke-box by extending them across the full width of the boiler to be connected with or without compensating plates directly to the boiler shell; (2) in vertical boilers arranging the cross-tubes in tiers or sets communicating with the combustion chamber and smoke-box and with each other for diverting or reversing the currents of hot gases, which tubes are connected with or without compensating plates directly to the boiler shell.—No. 5627. April 2nd, 1889. 8*d.*

ADJUSTABLE ECCENTRICS OR CRANK PINS.—*G. H. Townsend, Queenstown, Ireland.*—An eccentric constructed according to this invention may be readily adjusted, and, if desired, whilst in motion. Fig. 1 is a front view of the eccentric, and Fig. 2 a longitudinal central section upon a side view. The working eccentric C is combined with an inner adjustable eccentric B which is keyed to the shaft A. Upon the shaft A is fitted a sleeve D having fast to one end a pinion E. The pinion E gears with a second pinion E^1 upon the boss of an arm G, which is secured at its end to a stud L in the outer eccentric C. In the position shown in full lines in Fig. 1 the two eccentrics neutralise

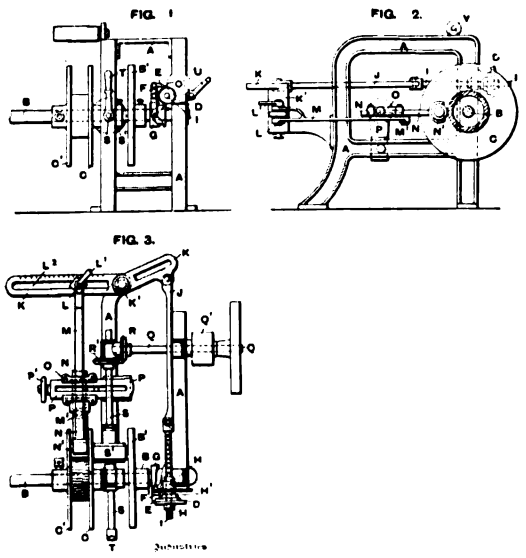


one another, and the stroke is therefore *nil*; if, however, the outer eccentric be turned, as shown by the dotted lines, about the inner eccentric, it acquires a throw proportional to the amount turned. To turn the outer about the inner eccentric, means as illustrated in Fig. 2 are used. The sleeve D has a helical groove, and the shaft A a straight groove; in the grooves works a pin secured to the flange collar I, and being with it moved backwards and forwards by the screw S. With these slots and pin the relative position of the sleeve to the shaft may be changed, and so the pinion E revolved, moving the arm G and causing the outer eccentric to assume any desired position upon the inner eccentric. Four claims are made.—No. 6818. April 23rd, 1889. 8*d.*

PICKING-STICK TAPPETS OF LOOMS.—*B. Berry & D. B. Briggs, Bradford.*—An improvement is made in the male clutch tappet or shuttle picking-stick tappet, to facilitate the lubrication of the steel runner or bowl attached to it. The tappet is cast hollow to form a chamber for the reception of the lubricant. A small aperture is made in the lower part of the chamber and immediately over the bowl to permit the lubricant to drop on to the bowl and so lubricate it. A small air valve is fitted in the upper part of the chamber for the admission of air. Claims: (1) A tappet for weaving looms provided with an oil or lubricating hollow chamber having a duct leading to the anti-friction roller or bowl carried by the said tappet adapted to supply the said steel roller or bowl with oil or lubricant; (2) the combination with a tappet provided with an oil or lubricating chamber and an educt of air valve arranged for the passage of air as described.—No. 7167. April 30th, 1889. 6*d.*

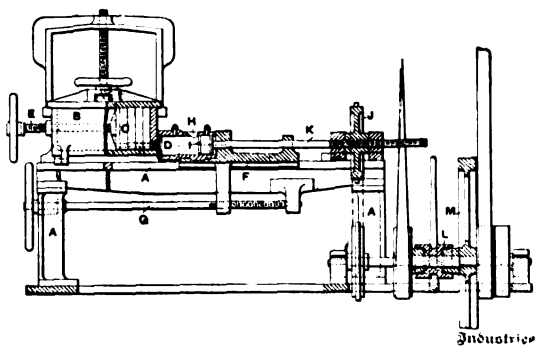
STEAM GENERATORS.—*J. W. Boulton, Ashton-under-Lyne.*—To the upper end of the common cross-tubes fitted to the flues of boilers, the inventor fixes an upright tube of sufficient length to conduct the hot water in the tube to the surface of the water in the boiler. In the case of horizontal tubes in vertical boilers, extensions are fitted to both ends, one extending downwards and the other upwards, the water being fed into the tube by the downward one and passing to the surface of the water in the boiler by the upward one. To prevent priming, the end of the upper tube is closed, and one or more openings made in the side, in order that the water may be cast downwards and not into the steam space. By this construction of cross-tubes the heated water contained in them is allowed to rise to the surface without coming into contact with the colder body of water which is between the top of the flue and the working level, and therefore causes a better circulation in the boiler. Claim: As means for obtaining an improved circulation of water in steam boilers by means of extending the cross or heating tubes at one end or both to, or near to, the surface of the working level of water over the flue or flues, and by extending the lower ends to, or nearly to, the bottom of the boiler shell.—No. 5957. April 8th, 1889. 6*d.*

SECTIONAL WARPING MACHINES.—*E. Rothwell & W. A. Rothwell, Bolton.*—Most of the usual complicated mechanism is dispensed with, and a positive equal traverse is given to the "presser" for each revolution of the shaft on which the section blocks are mounted. To effect the above, the inventors make use of the usual shaft B (see Figs. 1, 2, and 3), and cause it to give motion to a ratchet wheel D. The wheel D is mounted



upon the framing, and its boss threaded to receive the screwed rod I. The screwed rod I is connected to the lever K, which is pivoted to the framing at K^1. The presser holder N is connected to the rod M, whose other end is secured to a block L adjustable in the slot L^2. The presser holder rod M is supported in slideways O, which are adjustable by means of the hand wheel P^1. Previous to winding a trial section, the block L is slackened so as to determine the position of the block, and after the trial section is formed it is tightened. The machine can then be started, and the presser N^1 will be moved automatically as the section increases in size. Claims: (1) In a sectional warping machine the combination with a pivoted slotted regulating lever actuated by a ratchet motion or equivalent mechanism from the section shaft, of a rod pivoted at one end to a stud fitted in the slot of the regulating lever and at the other end connected to the presser holder which is guided in adjustable slideways as described; (2) the combined arrangement of parts as described.—No. 6639. April 18th, 1889. 8*d.*

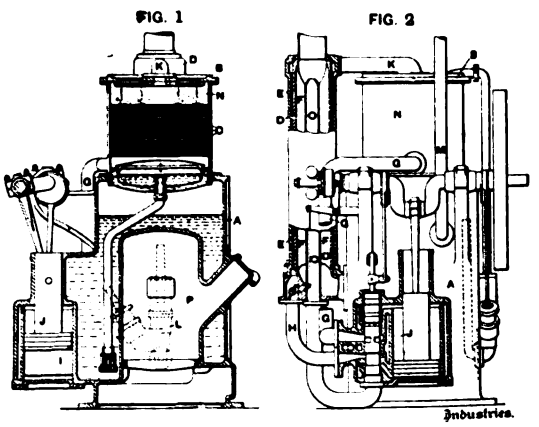
CASTING UNDER PRESSURE.—*J. Mackintire, London.*—The apparatus here described is particularly adapted for the manufacture of elbow-pieces, T pieces, and similar articles in steel. The inventor overcomes one of the difficulties of casting in steel under pressure—viz., the metal losing its fluidity before the mould is filled—by keeping the molten metal in motion until the moulds are filled. A is a frame or table, on one end of which is fixed a mould box B; C are the moulds, which are forced and held together by a screw E and follower; D is the metal cylinder, which is placed on a sliding bed F, capable of being moved horizontally by the screw G. The metal cylinder D is formed with a charging mouth H, of considerable width and depth, which will allow the molten metal to run easily and rapidly into the cylinder, and also permit of the egress of all air before the piston closes up the charging mouth as it moves forward. I is a piston working in the cylinder D, and capable of being moved in either direction



by the pulley J and screw K. The pulley J is driven by the gear shown above, the gear having a controlling clutch arrangement L. The apparatus works as follows: The molten metal is poured quickly into the cylinder D, and before its movement is arrested the clutch H is put into gear and the piston I is driven rapidly forward, forcing the molten metal into the moulds. When the moulds are full the momentum of the fly wheel M gives the metal a final squeeze. Claims: (1) In machinery for casting in metal under pressure applying the momentum of a fly wheel to actuate the piston of a cylinder into which the molten metal is run previous to being forced into the moulds; (2) in machinery for casting articles of metal under pressure the combination with the piston rod of the metal cylinder of means as described for communicating motion to the piston rod in either direction; (3) refers to a form of press for making cores; (4) making pipe fittings in cast metal with rounded corners or angles, as described; (5) in machinery for casting articles in metal under pressure the use of a cylindrical molten metal receiver having a wide and deep charging mouth, for the purpose set forth.—No.5651. April 2nd, 1889. 8*d.*

COLLIERY TUB WHEELS.—*W. F. Butler, Wrexham, Denbigh.*—The application of this invention is for the purpose of improving the lubrication of colliery tub wheels, especially such as travel fastly around tracks of small radii. The wheel has a rim constructed in the ordinary way, but it is provided with an annular box or chamber around its hub. This box is cast in one piece with the hub and rest of the wheel; it is opened upon the outer side of the wheel, but covered by a loose cap which encloses at the same time the end of the axle and the hub. This annular box is used as a lubricating box, an aperture being made in the cover for the purpose of filling it with lubricant. Claims: (1) A colliery tub or other wheel, as described—that is to say, a wheel having a chamber round the hub adapted to serve as a lubricant chamber to the axle upon which the wheel works; (2) a colliery tub or other wheel comprising an outer rim, a hub, and an intermediate ring or web, and a cap or cover, the chamber formed between said hub and said ring or web being constructed and adapted to be used as a lubricant box, and whereby a casing or covering is provided and the axle fittings protected; (3) a colliery tub wheel constructed as illustrated in the specification.—No. 7683. May 8th, 1889. 8*d.*

MOTORS.—*W. Schmidt, Halberstadt, Germany.*—In motors for light work driven by steam and air mixed, a great improvement is effected by the use of two boilers separated and working under different pressures. The application of this idea is shown in Figs. 1 and 2 of the accompanying drawings. Fig. 1 is a vertical section through the motor; Fig. 2 is an elevation with the steam and air cylinder in section, as also a part of the superheater. A is the low-pressure part of the boiler where the water is heated by the fire in the fire-box P. The hot water is then pumped by means of the pump L into the upper part of the boiler or evaporating boiler N; it then flows through the cover B on to and through the sieve C, where it becomes separated into very small particles. These falling particles of water are met by the current of air driven into the evaporating boiler from the air chamber J of the cylinder through the pipe G. Some of the hot water will now rapidly evaporate, whilst the remainder cools. The cool water then sinks to the bottom of the boiler, where, by means of an outlet pipe or, as shown in the drawing, the arrangement with a float, it is taken again into the low-pressure boiler A. The mixture of air and steam, produced in the high-pressure boiler, is now passed through the superheater D E, where it is superheated or dried, and then enters the cylinder. The superheater consists of the two pipes D and E, between which the steam and air mixture passes. The inside pipe D has the ribs F in order to catch off more heat from the escaping fire-gases. Inside the pipe D the steam outlet



pipe O is fixed, so that the exhaust mixture of steam and air is used for increasing the fire draught. Claims: (1) The method of first heating the water in a low-pressure boiler, pumping the same into an evaporating boiler from above, where it is met by air compressed into the boiler from below, thus causing rapid evaporation, then superheating the mixture and using the same as motive power; (2) the combination of a boiler A, an evaporating boiler N, a steam and air cylinder, a pump L and superheater; (3) the combination with boiler A of the evaporating boiler N, having cover B, sieves C, hot water inlet, air inlet G, and connected with the superheater by pipe K, and with the water of the low-pressure boiler by float arrangement; (4) in combination with boilers A and N and pump L, the superheater, consisting of pipe D, having ribs F, outer pipe E, and exhaust pipe O, and having connections with boiler N and cylinder as described.—No. 4237. March 11th, 1889. 6*d.*

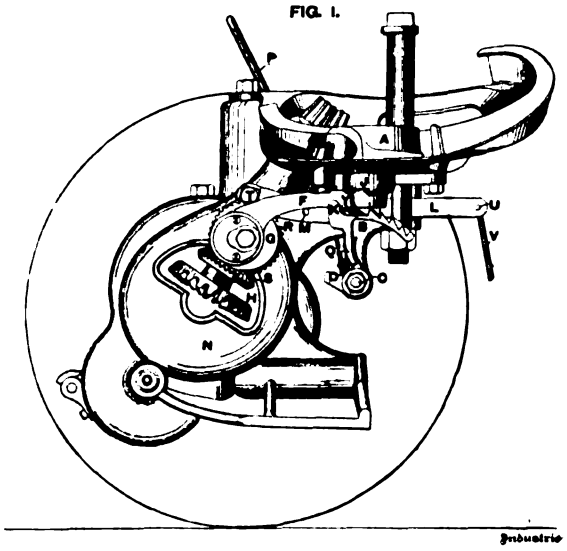
STEEL ARMOUR PLATES.—*J. Y. Johnson, London.* (*C. Pieper, Berlin.*)—The plates are composed of a number of thicknesses or layers of metal of different hardness and tenacity. The layers of metal are so arranged that taking a plane in the interior of the plate the hardest layer is inwards, being enclosed outwardly on both sides by a softer layer, or the hardest layer—hard steel, for instance—is covered on both sides with a layer of less hard steel, this less hard steel being again covered by a still softer layer of metal, such as soft tough cast iron. The several layers or thicknesses are welded together. In the production of the compound plates the metals employed in the formation of the several layers or thicknesses are cast either simultaneously or in immediate succession in a mould provided with as many compartments as there are different thicknesses of metal. For example, a mould employed in the manufacture of a plate with a hard internal core placed between two softer layers is made with three compartments. This mould consists of a shell, in which is placed a box made of sheet iron or steel, the sides being made so thin that they are completely or almost completely fused between the hard and soft metal run into the box. By these means the several layers are firmly united. Two claims are made.—No. 10472. June 27th, 1889. 8*d.*

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SHAPING MACHINES.—*T. M. Bear & J. Paxman, Colchester.*—This improvement is to enable the work beds of shaping machines to be moved in a horizontal, vertical, or circular direction. To the front of the vertical face of a shaping machine bed is attached by bolts, the heads of which engage in the usual horizontal slots, an apron capable of a horizontal movement when the bolts are loosened. This apron has vertical V-shaped slides, on which works a correspondingly grooved plate carrying the usual circular work table. The plate is moved vertically (and, consequently, the table) by means of a worm operating a worm wheel upon a vertical screwed spindle, which travels through a nut connected to or forming part of the plate or work table. To give a circular movement to the work table, it is affixed to the plate so as to be capable of revolution, and its inside face is provided with a worm wheel, which is operated by a worm, so that the table can be rotated by hand to bring any face of the work under the tool. Three claims are made.—No. 7697. May 8th, 1889. 8*d.*

REAPING MACHINES.—*P. Pierce, Wrexford, Ireland.*—This invention consists in improvements in the mechanism for controlling the action of the rakes of self-delivery reaping machines whereby the rollers of the rakes are caused to run either on the outer surface of the "switch" or behind it as desired. The invention will be understood by reference to Fig. 1, which is a side elevation of the framing of a reaper provided with the improved construction of controlling device, Figs. 2 and 3 are side

FIG. 1.



and end elevations of the device, and Figs. 4 and 5 are plans of same. The gearing is enclosed in a box N. A is the ordinary switch, shown in Fig. 1, closed or in its normal position. The object of the controlling device is to automatically open the switch A and permit the rake roller to pass behind it, allowing the rake to sweep the platform. In connection with the switch A is employed a toothed sector B which is capable of oscillating to an adjustable extent upon the pin C. The sector has two rows of teeth, an inner row which is acted upon by a pawl F, and an outer row in which engages a drop catch T mounted in a guide on the thimble J. The thimble J is secured to the same pivot as the switch A, and the latter is thus kept in its closed position by the coiled spring W upon the thimble J. By suitable bevel gear wheels H, S, and G, and an eccentric, the pawl F is given a to and fro motion, which causes the sector B to advance tooth by tooth, whilst the catch I retains it. When the sector B is sufficiently advanced a projecting part K strikes a second projection X upon the thimble. The thimble, and consequently the switch A, are partially revolved, opening the latter and allowing the rake to sweep the platform. At the time the thimble is thus partially revolved the drop catch I is removed from the teeth of the sector, and the catch F in making its backward

FIG. 4

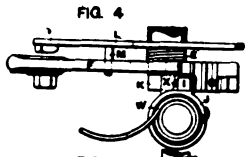


FIG. 5

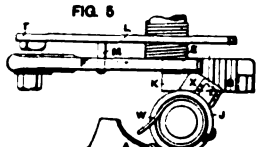


FIG. 2

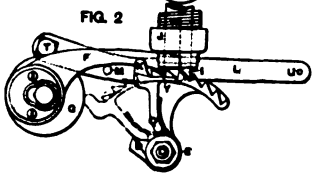
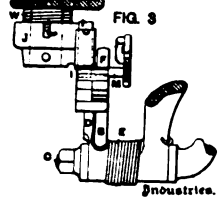


FIG. 3



movement is lifted by the pin M also out of the teeth, so that the sector, being freed of its catches, returns to its starting point. The number of teeth the sector B is advanced before opening the switch A may be regulated by adjusting the extent of its movement upon the pivot C. The sector B may be returned to its starting position at any point by the attendant lifting the end U of the lever L. Claims: (1) In a rake controlling mechanism the dropper latch I working in a guide thimble J or its equivalent, and acting in the manner set forth; (2) in a rake controlling mechanism the dropper latch I working in a guide thimble J or its equivalent in combination with the toothed sector B; (3) in a rake controlling mechanism the dropper latch I working in a guide thimble J or its equivalent in combination with the pawl lever F and sector B as set forth; (4) the construction of automatic rake controlling mechanism for reaping machines as shown and described.—No. 2968. February 19th, 1889. 8*d.*

STRETCHING LACE.—*L. Lindley, Nottingham.*—Improvements are here made in the ordinary tentering frame, for enabling the fabric to be stretched longitudinally as well as laterally. The regular extension of the sections carrying the tentering hooks, pins, or clamps is caused by elastically connecting the sections together in the following way: At one end of each section is an extension in the shape of a long stud, which enters the end and passes into a space of the adjoining section. Around that part of the stud which projects into the space of the adjoining section is coiled a spring. The spring is compressed against the end of the space by a washer and nut screwed upon the end of the stud, thus tending to keep the ends of the two sections together. In using tentering apparatus constructed as above described, the fabric is placed upon the tentering hooks when the sections are in a closed position; the ends of the fabric are attached to cross bars, one of which is fixed stationary, and the other to a travelling longitudinal bar. The sections of tentering hooks adjoining the stationary cross bar are fixed, whilst those at the farther end of the fabric are attached to the travelling cross bar. By giving motion to the movable cross bar the fabric will be equally stretched throughout its entire length. Claims: (1) In machinery or apparatus of the character herein referred to, employed in stretching, dressing, and finishing lace and other like fabrics, the method of elastically connecting the sections or links carrying the tentering hooks, pins, or clamps for the purpose described; (2) in machinery or apparatus of the character herein referred to, employed in stretching, dressing, and finishing lace and other like fabrics, the employment of elastically connected sections or links carrying tentering hooks, pins, or clamps, in which an extension from one end of each section or link extends beyond the adjacent end of an adjoining section or link and has a spring interposed between such parts as and for the purpose described.—No. 5702. April 3rd, 1889. 8*d.*

ROTARY ENGINES.—*L. Bohnen & M. Kleber, Berlin.*—The illustrations given of this rotary engine show—Fig. 1, a plan; Fig. 2, a section upon a side elevation; Fig. 3, a section upon an end view; Fig. 4, a side view of the piston and parts in connection with it; and Figs. 5 and 6, details. In a bored cylindrical casing A moves the rotary body or piston B. The piston is cut out, or has a semi-circular groove, in which are provided two helical ribs D E. These ribs bear closely against the inner wall of the cylinder, and a semi-circular shoulder L fixed to the cylinder. A disc I, whose periphery exactly fits the groove in the piston, is free to rotate upon an axle O, placed at right angles to the piston rod. The disc I separates the steam inlet and outlet ports, and has slots, which allow the ribs of the piston to pass as the latter is revolved. The piston is revolved by

FIG. 2

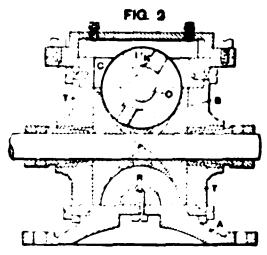


FIG. 3

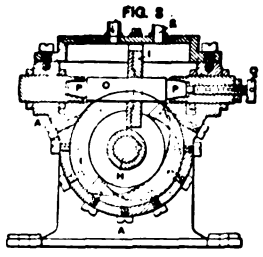


FIG. 1

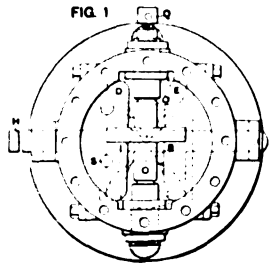


FIG. 4

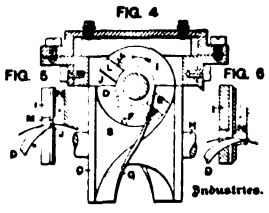


FIG. 5

FIG. 6

admitting live steam between the disc I and the ribs D E. The inlet port for the steam is directly behind the disc I, so that the ends of the ribs are immediately acted upon as they pass through the slots in the disc, and the piston is ratated. When the ends of the ribs have passed the disc, the dead steam is exhausted through the tube S. Claims: (1) A rotary motor, working by steam or other elastic fluid, consisting of a casing A, wherein a rotary piston B and a disc I are placed at an angle to one another, and work in the manner set forth; (2) in a motor constructed as hereinabove specified a rotary piston, grooved or recessed, and provided with the ribs as described; (3) in a motor such as hereinabove specified, the disc I having slots for the passage of the ribs B and fitted with the movable slide L.—No. 3782. March 4th, 1889. 6*d.*

CLEANSING FILTERS.—*H. W. Berkefeld, Celle, Germany.*—The cleansing device is attached to filters whose body is of a tubular form closed at the bottom. The device consists of a series of brushes arranged to be revolved in contact with the outside of the body. The body of the filter is enclosed in a vertical cylindrical chamber, which has openings in the top part for the inlet and outlet of the water filtered, and at the bottom a third opening for flushing and cleansing purposes. A spindle enters at the bottom, and projects up into the filter, supporting the frame carrying the brushes which surround the body of the filter. This spindle is screwed to the filter, and carries the valve closing the flushing outlet; a hand wheel is also secured to it outside the filter. The water filtered enters the annular space between the body and case of filter, and, after percolating the body, passes out at an opening in the top of the filter. When cleansing the filter, the hand wheel of the spindle is turned, thus screwing up the spindle and opening the flushing valve, and revolving the brushes in a helical direction around the body of filter. The dirt is thus removed from the body and carried away by the water passing out through the flushing valve. Claims: (1) A cleansing and scouring device for filters with cylindrical filtering bodies, characterised by a spindle carrying the flushing valve, the brushes or scouring device, whereby the outside of the filtering body is cleansed and the filter casing flushed and washed out as described; (2) in a cleansing and scouring device for filters or tubular filtering bodies, the cleansing of such bodies by means of a brush or similar scouring device, which, by the operation of a spindle, is simultaneously moved along and around the filtering body as described.—No. 7609. May 7th, 1889. 8*d.*

SELF-ACTING MULES.—*J. Clegg, Oldham.*—These improvements in self-acting mules are to overcome the tendency of the pinion on the drag lever to jump out of gear with the spur wheel on the back shaft just at the moment when the carriage starts on its outward run. Illustrations are given of a mule with the invention applied, Fig. 1 being a side elevation and Fig. 2 a plan. Of the usual parts of the mule, A is part of the headstock, B the carriage, C the tin roller, D the backshaft, E the drag pinion, F the drag lever. To prevent pinion E jumping out of gear with the wheel O when the carriage B starts upon its outward run the inventor employs an elbow lever G pivoted to a bracket at W. The short arm of this lever is weighted at T, and its long arm provided with an adjustable catch V, which engages at the proper time with the square stud K and holds the drag lever F down. A second lever L is pivoted at W, and its short arm connected by the coiled spring M to the weighted end of the lever G. The long arm of the lever L is depressed by a bowl N upon the inward motion of the carriage B. The appliance works as follows:—Before the carriage B commences its outward run the link X actuated by the cam fork lever J in the ordinary way lowers the drag lever F and brings the pinion E into gear with the wheel O. This movement lowers the stud K, and it is immediately latched

FIG. 1

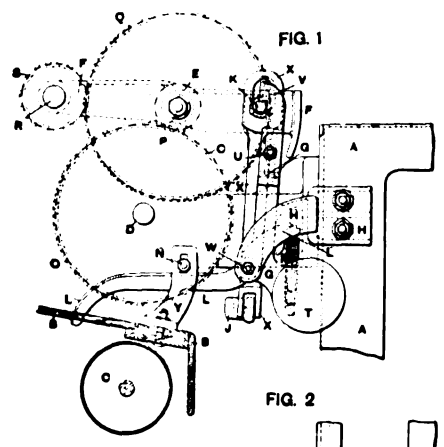
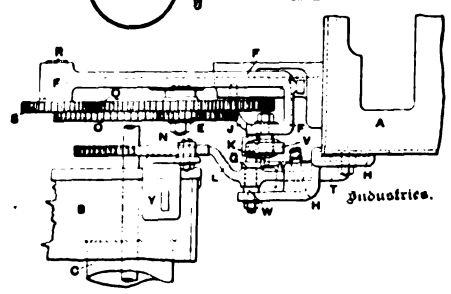


FIG. 2



by the elbow-lever G by reason of the tension put into the coiled spring M by the bowl N depressing the lever L. After the carriage has run out a few inches the bowl N leaves the lever L and releases the spring M, allowing the weighted arm T to remove the catch from the stud K. Claims: (1) Locking the drag lever at the moment when the mule carriage starts on its outward run by means of a combination of mechanism such as that herein described which consists of a square ended stud or equivalent projection on the drag lever, a weighted elbow lever fulcrumed on a stud, a second lever also fulcrumed on said stud, and connected at one end by a coiled spring to the weighted arm of the elbow lever and at the other end adapted to be acted on by a bowl on the mule carriage; (2) a latch lever for locking the drag lever of a self-acting mule, said latch lever being operated from the mule carriage by the connections described.—No. 20325. December 18th, 1889. 8*d.*

ELECTRICITY.

ELECTRICAL TRANSFORMERS.—*W. C. Johnson & S. E. Phillips, London.*—The object of this invention is to reduce the number of breaks in the magnetic circuit of an electrical transformer, to reduce its resistance. The core is constructed of thin soft iron plates separated by paper or coated with a varnish containing French chalk. The plates are made of different lengths, and their ends beveled to form angular or V-shaped ends to the core. After winding upon the core so formed the primary and secondary coils, the core is surrounded by a loop or shell built up similarly to the core of thin plates. Two V-shaped notches are cut in this laminated loop to receive the correspondingly shaped ends of the core. The whole thus represents the shape of a chain link with a bar constituting the core passing across its middle, the laminations being at right angles to the plane of the link. According to another construction two separate closed loops or links are employed, placed side by side so that a central core is formed by the two contiguous sides of the loops. In like manner a single closed loop may be employed, cut through at one point to allow of the coils being wound on one side of the loop. Or the loop may be left entire and have circular or other shaped holes cut in opposite sides to admit the ends of a laminated core, a close contact between the ends of the core and the loop being ensured by the use of wedges to expand the core. Five claims are made.—No. 7856. May 10th, 1889. 8*d.*

ELECTRIC SWITCHES.—*A. G. Goldston, Middlesbrough.*—An oscillating switch lever is pivoted at its centre to suitable brackets upon the base plate. A handle is attached at right angles to and at the centre of the lever, and constitutes the means for oscillating it. The ends of the lever when pressed down pass between pairs

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of spring contacts attached to the switch base in such a manner that as one end of the switch lever is lowered it makes and the other end breaks its circuit. One pair of contacts has attached to it the terminals of the lamp, and the other pair are for short-circuiting the circuit, whilst the main line circuit is attached to the lever supporting brackets Claims: (1) In an electrical switch the combination of a switch lever provided with two conducting pieces insulated from each other, and adapted to be permanently connected to the main circuit, and two pairs of contacts, one of which pairs is designed to be connected with the terminals of the circuit to be introduced, while the other pair is in electrical connection; (2) an electrical switch adapted to cause the main line current to pass through an "introduced" circuit or through a short circuit, the arrangement being such that when the current is passing through the short circuit the terminals of the "introduced" circuit will be out of electrical contact with the switch or with themselves; (3) the manufacture and use of the improved electrical switch as described.—No. 6384. April 13th, 1889. 8*d*.

DYNAMOS.—*W. Thompson, Dresden.*—This dynamo is designed without commutator or brushes. The accompanying illustrations show Fig. 1 a front elevation, and Fig. 2 a section upon a side elevation of a dynamo constructed according to this invention. The armature consists of four electromagnets, H, H^1, H^2, and H^3, which are wound in such a manner that two opposite magnets are negative and two positive poles. The ends of the wires are brought through the hollow shaft to the metallic plugs D D^1, which are insulated from the shaft by the bushes E E^1. In the plugs D D^1 are inserted cones F F^1, which are mounted upon springs G G^1, and so form a continuous contact with the plugs. On the shaft are secured the pulley C and a gear wheel I, which gears with the wheel J, free to revolve upon its stud L. To the wheel J is pivoted an arm T, by whose means the field magnets K K^1

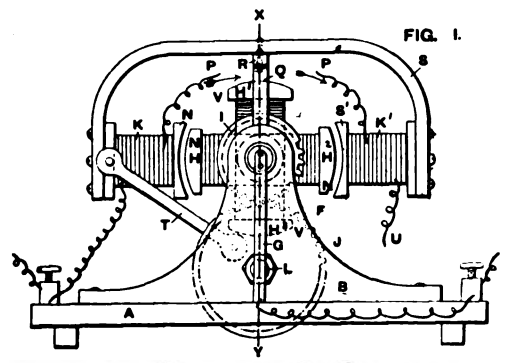


FIG. 1.

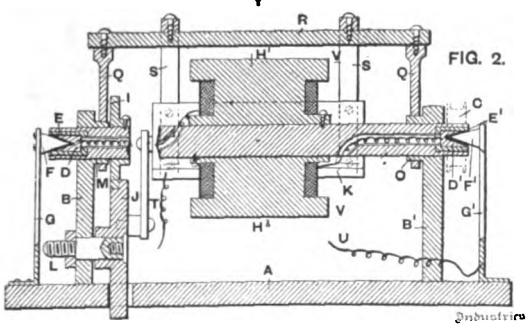


FIG. 2.

are made to oscillate. The magnets K K^1 are supported by soft iron bars S, cross-bar R, and standards Q. The connections are made as follow:—From field K, wire I^1, field K^1, through wire U, to spring G^1, cone F^1, plug D^1, through the armature to plug D, cone F, spring G, to outer circuit and back to field K. The current is generated by the quick approaching and receding of the armature's poles to and from the fields during the rotation of the armature. Claims: (1) The improved dynamo, combining therein a revolving armature, consisting of four or more electromagnets and two or more oscillating field magnets; (2) the improved dynamo, combining therein an armature revolving on a shaft with insulated metallic plugs, corresponding cones on metallic springs oscillating field magnets; (3) the improved dynamo, combining therein an armature revolving on a shaft carrying a gear wheel, which transmits its movement to a second gear wheel, connected by an arm with the field magnets, and by which motion the fields are made to oscillate.—No. 950. January 18th, 1889. 6*d*.

ELECTRICALLY-DRIVEN FANS.—*H. G. Watel, London.*—The fans are driven by electricity, applied in such a manner that there is no strain of bands or other connections for transmitting power, nor any torsional stress on the shaft. For this purpose the rim of the fan is converted into the armature of an electro-dynamic machine, or the ring armature of such a machine is applied to the periphery of the fan, and the fixed framing within or against which the fan works converted into field electromagnets or such field magnets applied to the framing. The coils of the armature or those of the field magnets are connected to a suitable commutator on the axis of the fan, and thus when the machine is put in circuit with a suitable source of electricity the fan is caused to revolved by the magnetic action applied at its periphery. Instead of employing an armature of complete ring form it may consist of segments of a ring or it may be of spoke form, the magnetic force acting at the outer extremities of the spokes which correspond with the periphery of the fan. Permanent magnets may take the place of the electromagnets which in the working of the machine undergo no change of polarity. Claims: (1) The hereindescribed method of driving a fan by providing the fixed framing and the revolving fan with suitable coils and commutator so that when supplied with electricity they operate together as an electro-dynamic machine; (2) the combination of a stationary coiled ring frame with a fan having its spokes or rim coiled and a suitable commutator, operating as an electro-dynamic machine to drive the fan, substantially as described.—No. 6675. April 18th, 1889. 6*d*.

CHEMISTRY.

COLLECTING CARBONIC ACID.—*C. R. C. Tichborne, A. F. Darley, & M. F. Purcell, Dublin.*—This specification describes a method of collecting and purifying the carbonic acid and other gases given off by liquors in the process of brewing. The gases evolved are carried by pipes, conduits, or other conducting apparatus through a refrigerating medium, the gases being either at the normal pressure of the atmosphere or under such pressure as may be deemed most suitable for procuring the deposition of the bye-products contained in the gases evolved. The gases when freed from such bye-products are compressed by the most suitable means, to such an extent as is required for the various purposes the gases may be employed for in the arts and manufactures. Five claims are made.—No. 3707. March 2nd, 1889. 8*d*.

MANUFACTURE OF WHITE LEAD.—*P. Bronner, Stuttgart, Germany.*—The method of manufacturing white lead which forms the subject ot this invention is based upon the discovery that lead sulphate can be very readily decomposed by heating it together with a certain quantity of soda lye, if this quantity be determined, so that the product will be, not hydrated oxide of lead, but a basic salt. If this quantity be such that the compound $2PbSO_4,Pb(HO)_2$ is produced, the latter can immediately be transformed into excellent white lead, $2PbCO_3,Pb(HO)_2$, by heating the same together with a suitable quantity of sodium carbonate. The bye-product obtained is Glauber's salt. The lead sulphate, which has been freshly precipitated and purified by washing, is heated together with two molecules of caustic soda for three molecules of the sulphate, the basic salt $2PbSO_4,Pb(HO)_2$ being very readily formed. This basic sulphate can be completely decomposed by heating it together with a solution of sodium carbonate and transformed into white lead. This process enables the lead sulphate obtained as a bye-product in cloth printing works, in the preparation of the red mordant, to be transformed with profit into saleable white lead. It is, of course, understood that the sulphate can also be produced at will from litharge or from sugar of lead or lead nitrate, and treated so as to obtain white lead at a comparatively low price. Claim: The process of transforming lead sulphate first into basic sulphate, preferably into $2PbSO_4,Pb(HO)_2$, by heating it with caustic alkaline lye, and then into white lead, by heating the basic sulphate with carbonate of sodium.—No. 16706. October 22nd. 1889. 6*d*.

PURIFYING AND PRESERVING MILK.—*J. T. Appleberg, Knoxville, U.S.A.*—The method consists in heating the milk to a sufficiently high temperature to destroy the bacteria, &c., contained in it. The apparatus used consists of a square box, whose front and top are hinged. In the bottom of the box is a coil of tubing upon which the receptacle containing the milk rests. A small aperture is made in the top of the box to admit a thermometer to the mouth of the milk receptacle immediately beneath. The milk receptacle is placed upon the coil, the lids of box closed, and the thermometer placed through the aperture at the top into the body of the liquid. Steam is then passed through the coils, heating the milk rapidly to 160° Fahr., and more slowly until it reaches 190°, and after standing at this heat for a sufficient length of time the steam is cut off, the milk removed, and the receptacles closed ready for shipment, &c. Two claims are made.—No. 1328. January 25th, 1890. 8*d*.

STEEL.—*J. Riley, Glasgow.*—The improved steel or steel-like compounds are manufactured in a crucible, Bessemer converted, or open-hearth furnace, but preferably in the latter. When using a crucible, nickel is added in the form of bars, cakes, or granular pieces mixed with iron or steel scrap. When the contents are melted, a proportion of ferro-manganese is added, and finally some metallic aluminium. In a converter the charge of metal is decarbonised to the required extent, and sufficient ferro-manganese added to insure deoxidation, and then nickel; subsequently ferro-manganese is added, and immediately after aluminium or its alloy. The method of proceeding with an open-hearth furnace is that usually adopted in the manufacture of steel until a proper degree of decarbonisation of the charge has been reached, when a sufficient quantity of ferro-manganese is added to ensure deoxidation. Next nickel is added, and then again ferro-manganese, and finally aluminium or its alloy. Instead of introducing nickel alone, a compound of nickel, copper, and iron may be used, and preferably the compound produced as a matte in the primary smelting of ores. Four claims are made for the above-described methods of making steel or steel-like compounds.—No. 8492. May 22nd, 1889. 6*d*.

ETHYL-MERCAPTAN.—*C. J. Steinhart, London.*—Chemically pure ethyl-mercaptan is obtained by this invention from methylated spirits, instead of, as hitherto, from strong pure alcohol. One part by weight of ordinary methylated spirits is mixed with two of concentrated sulphuric acid, and the mixture gently heated for one hour. The mixture is then slowly poured into about three times its bulk of cold water, and carefully neutralised with carbonate of potash. The neutralised solution is next evaporated, and thus the greater part of the alkaline sulphate, as well as resinous matter due to the impurities in the wood spirit, are eliminated. The solution remaining is mixed with a strong aqueous solution of hydrosulphide of potassium. The product thus obtained may be separated by distillation into methyl-mercaptan and ethyl-mercaptan. The resulting ethyl-mercaptan may be freed from remaining portions of the methyl compound and other impurities by fractional distillation. The process may also be conducted in the following manner:—The methylated spirits are saturated with hydrochloric acid. A gaseous ethyl-chloride, contaminated with methyl-chloride, results, which upon further treatment with alcoholic solution of sulphydrate of potash yields an impure mercaptan. Claim: The manufacture ot pure ethyl-mercaptan from commercial methylated spirits, by transforming the methylated spirit into either sulpho-vinate of potash or into ethyl-chloride, treating the same with hydrosulphide of potassium (in aqueous or alcoholic solution), heating the resultant liquid, and finally dis illing the same, all as set forth.—No. 6494. April 16th, 1889. 4*d*.

NEW RED COLOURING MATTERS.—*S. Pitt, London. (L. Casella & Co., Frankfort-on-Main.)*—In the class of azo colours derived from benzidine and other paradiamines red colouring matters have only been obtained by combining the amines with naphthylamine sulpho acids. The combinattion of paradiamines with naphthols or their sulpho acids yields but blue to violet colours. The inventors have found a method to get brilliant red colouring matters from naphthols and benzidine or its homologues. 18·4 kilos of benzidine are diazotised and added to a cooled solution of 40 kilos of β naphthol γ disulphonate of sodium; after a short time 10 kilos of phenol are introduced, then heated to boiling, and the colouring matter is precipitated by common salt and separated by filtration. The precipitate is again dissolved in 200 litres of water and 200 kilos of alcohol, with 4·5 kilos of caustic soda, and heated together with 12 kilos of ethylbromide during 24 hours in a closed vessel to about 60° C. After cooling the new colouring matter separates in shining crystals. Instead of benzidine other paradiamines, such as methylbenzidine, toluidine, instead of γ naphthol disulphonate, β naphthol α monosulphonate and instead of phenol cresol may be employed with a similar result. Claims: (1) The process substantially as described for the production of red colouring matters by alkylating or benzylating the substances formed by the combination of one molecule of β naphthol α monosulphonate or γ disulphonate and of one molecule of phenol or cresol with one molecule of tetrazo-diphenyl or its homologues; (2) as new articles of manufacture the red colouring matters obtained by the said process.—No. 12560. August 8th, 1889. 4*d*.

MISCELLANEOUS.

COKE OVENS.—*A. M. Chambers, Thorncliffe, & T. Smith, Chapelton.*—These improvements in coke ovens are to better the quality of the coke and obtain larger pieces. The improvements are specially adaptable to coke ovens constructed according to a previous patent, No. 7385 of 1885. The volatile and other liquids such as tar, produced from the carbonisation or coking of the coal, are discharged by a pipe below the floor of the oven near its front and an opening at the back of the oven near its top. The second opening is surrounded by a straight or conical pipe of fireclay. The two pipes lead to a condenser by which the products are collected for utilisation. By means of these pipes the products evolved in the carbonisation of the coal are partly discharged at the top and partly at the bottom of the oven. In this method of coking a more uniform heat is produced throughout the whole mass of the coal from the beginning to the end of the process, and permits the use of inferior classes of coal and slack in coking. Two claims are made.—No. 7424. May 3rd, 1889. 8*d*.

PRESERVING GRASS, &c.—*T. Pearson, Wolverhampton.*—The grass is preserved as ensilage for cattle in the following manner:—It is first placed in a silo or other receptacle of any form, and the receptacle sealed. Air is then exhausted from the receptacle by means of a fan or pump worked from the outside. The air thus drawn off effects the preservation of the contents. The grass may be rolled or compressed in addition to rarefying the surrounding air. By exhausting the air from the receptacle, the temperature and fermentation of the contents may be regulated or destroyed. Claims: (1) The use of a silo or receptacle, of any form or structure, air-tight or nearly so, in combination with an exhaust fan or equivalent appliance and connecting pipe with valve or tap, to draw off or expel the air or vapour in said silo, for the effective preservation of the contents as silage or food for cattle, &c.; (2) the use of silo or receptacle, with exhaust fan and connecting pipes, &c., having outlets or drains to open and shut for the emission of fluids or juices from the contents.—No. 4363. March 13, 1889. 6*d*.

ANNEALING FURNACES.—*A. W. Turner, Birmingham, & G. Tomkinson, Oldbury.*—The furnace is designed for annealing sheet castings and other metallic bodies in the process of manufacture. It is built of two side and two end walls forming the outer room of the furnace; within this room are built one end and two side partitions forming an inner room of smaller dimensions. The side partitions are pierced or provided with a series of holes, and in the space between the back end of partition and the outer room is the heating furnace. The spaces between the side partitions and the outer room communicate with the space containing the heating furnace. The entrance is at the end opposite the furnace, and upon each side of the entrance are flues for conveying away the fumes from the furnace. The products of combustion are thus passed from the furnace to the back of the side partitions, through which they percolate to the inner chamber and then travel towards the entrance and away by the flues upon both sides. Claim: The making of an annealing furnace with the walls of the inner room built up to the roof or top of the furnace, such inner walls being perforated with holes or passages, so that the flames and heated gases produced on the fire-grate of the furnace will be compelled to pass through the perforations formed in the walls of such inner room in order to reach the flue or flues connected with the stack.—No. 5138 March 26th, 1889. 8*d*.

FILTER PRESSES.—*J. Hill, Stoke-on-Trent.*—The presses referred to in this invention are those used for making potters' clay, compressing yeast, or such like purposes. The chief feature of this invention is in the method of constructing the presses with porous slabs which can be removed and reversed so that the liquid flows through them alternately in opposite directions. A press so constructed consists of several sections, each formed of two or more porous tiles of suitable thickness carried in a wooden or other frame. These tiles are bolted or cramped together side by side so as to leave spaces between each set. The slurry or other semi-fluid is forced into the said spaces between the sets of tiles. The liquid escapes through the tiles and the solid matter is retained and compressed in the spaces. When the spaces have become filled with solid matter the slabs and the solid matter are removed from the press. The slabs are then replaced with their surfaces reversed so that the liquid passing through the slabs in a contrary direction tends to force out any solid matter that has blocked up the pores from the previous operation. Three claims are made.—No 7087. April 29th, 1889. 8*d*.

Copies of the British specifications may be obtained on application to H. READER LACK, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every 10d. or fraction of 10d. Remittances exceeding one shilling must be made by Post Office Order.*

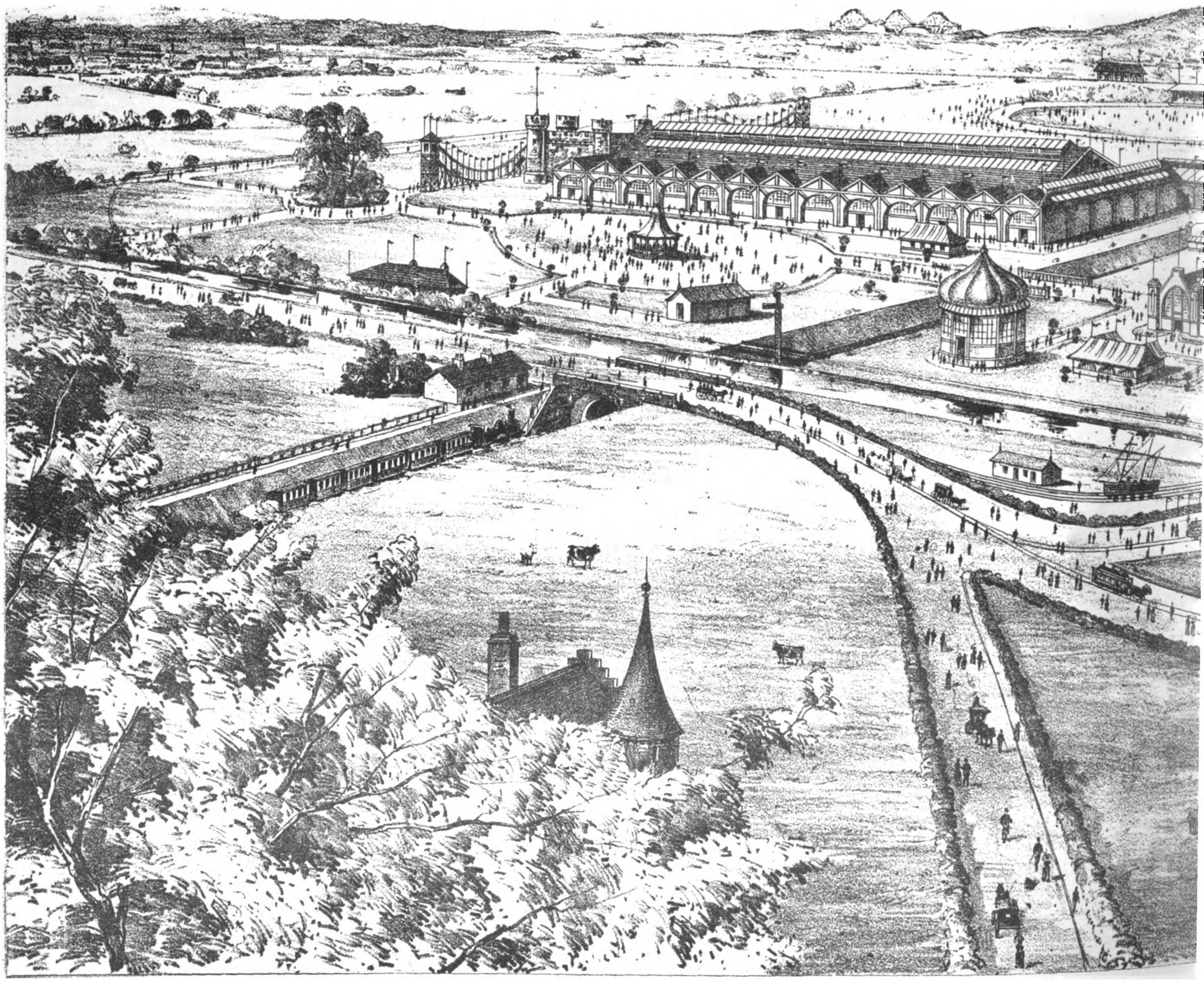
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THE EDINBUR

OF ELECTRICAL ENGINEERING, GENERAL INVENTIONS, A

(For Descripti



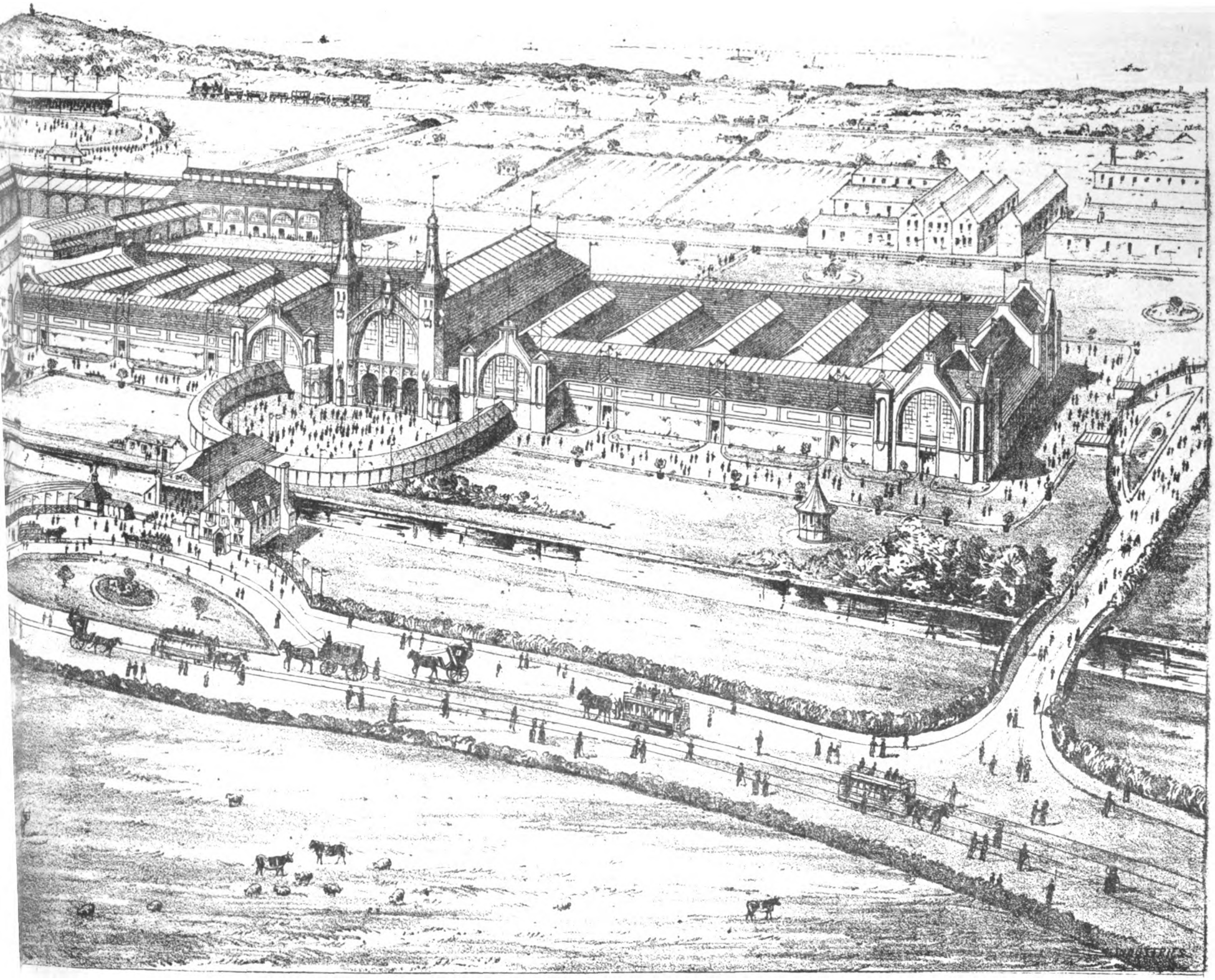
GENERAL VIEW OF THE

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URGH EXHIBITION

S, AND INDUSTRIES, TO BE OPENED ON THE 1ST MAY, 1890.

Description see page 400.)



BUILDINGS AND GROUNDS.

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MUMFORD & MOODIE'S SEPARATOR.

We illustrate herewith Mumford & Moodie's patent separator for separating hard substances and obtaining a uniform fine product. Briefly described, it is an apparatus wherein a current of air circulating continuously through a descending stream of ground material separates the finer particles from the coarser, the latter being then returned to the pulveriser, millstones, or other grinding machinery, to be further reduced. In Fig. 1 we show a section of the apparatus, which is made of cast iron. The outer casing A collects the finer dust, which falls to the spout at the bottom, and is collected in bags or casks, as desired, while the coarse particles fall into the inner casing B, and are delivered to the right and left through the branch pipes *a a*, by moving the valve *c*. The material is thrown against the hood D, which is made in different sizes and forms, so as to

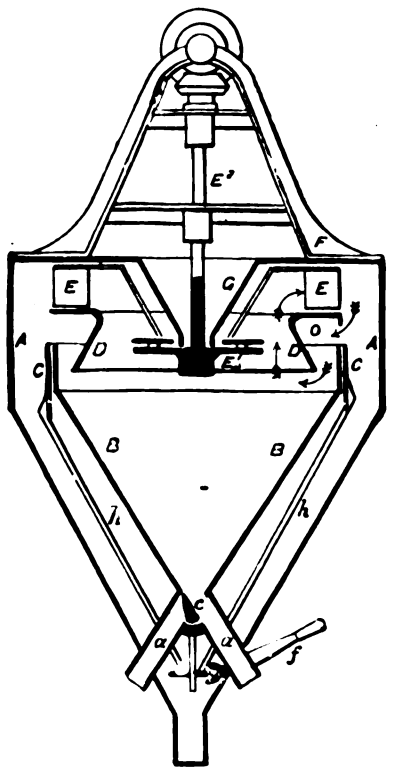


Fig. 1.—Vertical Section.

vary the degree of separation and quality of the separated products. The blades of the fan E are connected by arms to the disc E^1, which is rotated by gearing attached to the fan spindle E_2.

The machine will be found useful in many industries, and we understand that it has already been supplied for separating the finer particles from the coarser in ground basic slag, chrome ore, gold quartz, cement, phosphates, limestone, coal, charcoal, coke, animal char, bones, paint, indigo, tanning materials, and for cleaning linseed and other seeds. It can be used in the place of sieving, and will be found to work more economically and with greater efficiency than any hand process. The makers are Messrs. Askham Bros. & Wilson, Limited, of Sheffield.

MUMFORD & MOODIE'S SEPARATOR.

Constructed by Messrs. Askham Bros. & Wilson, Engineers, Sheffield.

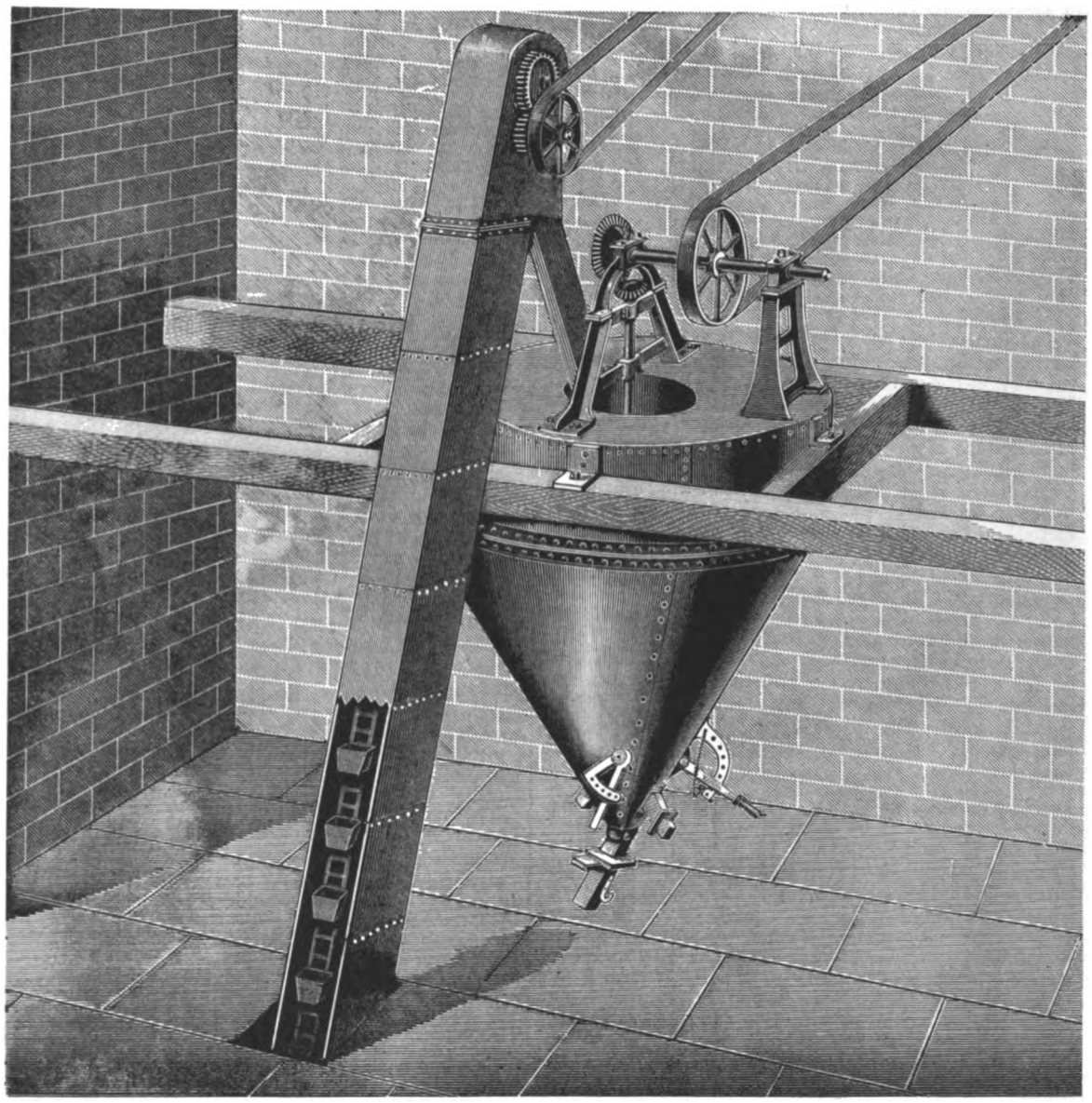


Fig. 2.—General View of Apparatus.

THE INSTITUTION OF NAVAL ARCHITECTS.

(*Concluded from page* 365.)

The next paper read on the 28th ult. was by Mr. T. C. Read, on "The Variation of the Stresses on Vessels at Sea Due to Wave Motion." This paper deals with the dynamical effect on the longitudinal and other stresses, due to the vertical motion of vessels when among waves. The vertical oscillations caused by wave motion are due to the repetition of forces alternately raising and lowering the vessel; if these forces act at irregular intervals, the amplitude of the oscillations will not be so great as when the forces act at regular intervals, and further the maximum range will be reached when the natural dipping period of the vessel and the period of action of the disturbing forces are the same or nearly the same. The waves which will throw the greatest stresses on the structure are those of the same length as the vessel and having the maximum ratio of depth to length. For these reasons the vessels considered are supposed to be placed bows on to a regular series of waves of their own length. Owing to the fineness of the ends the vessel will sink deeper into the wave when the ends of the vessel are in the crests and the trough amidships than when the crest is at the middle of the length of the vessel. There will therefore be, as the waves pass the vessel, a reciprocating force acting on her, alternately raising and depressing the vessel, and it is the effect of the motion thus set up that is considered in this paper. The resistance of the water to this dipping motion is also an important factor in determining the range of the oscillations, and this part of the subject is dealt with in the latter part of the paper, the amplitude of the unresisted vertical oscillations being first investigated. The pitching and 'scending motion of the vessel is neglected, as it has no effect on the stresses at the midship section of the vessel.

Suppose the vessel to be in statical equilibrium, with its ends in the crests of a wave of its own length. As the wave passes the vessel, to maintain statical equilibrium the centre of gravity will rise, and will continue rising, until the crest reaches the middle of the length of the vessel. The equation of motion of the centre of gravity is given approximately by the equation $h = a \sin \pi t/T$, where T is the half period of the wave, and a = half the total rise or fall of the centre of gravity.

Now, if S be the actual position of the centre of gravity above the axis of t at any time t, then the upward force acting on the vessel at this instant will be

$$p\left(a \sin \frac{\pi t}{T} - s\right)$$

where p is the tons per foot immersion, which for the present is assumed to be constant near the water line. If, therefore, M be the mass of the vessel, the equation of motion will be

$$\frac{d^2 s}{d t^2} = \frac{p}{M}\left(a \sin \frac{\pi t}{T} - s\right)$$

The author then proceeded to solve this equation, but we cannot give more than the results. The maximum value of s occurs when

$$\cos \frac{\pi t}{T} = \cos \sqrt{\frac{p}{M}}\, t$$

and will therefore depend on the relative values of $\frac{\pi}{T}$ and $\sqrt{\frac{p}{M}}$. In a special vessel, the registered dimensions of which are 380ft. × 46ft. × 30ft., the moulded draught 24ft. and displacement 7,830 tons, the value $\frac{p}{M}$ is $\frac{390 \times 32}{7{,}830} = 1{\cdot}6$ approximately. The speed of trochoidal waves 380ft. long is about 26·6 knots per hour, and the still water speed of the vessel considered is 12 knots; consequently, 38·6 knots may be regarded as the greatest relative velocity of ship and waves. The minimum value of the virtual period of the waves is therefore $\frac{380 \times 60 \times 60}{38{\cdot}6 \times 6{,}080}$ = a little more than 5·8 seconds. Hence the maximum value of π/T is 1·083, and of π^2/T^2 1·173. The limiting positions of the vessel when on the crest is about 11½ft., or nearly 10ft. above the position of statical equilibrium. The lowest position when on the crest is found to be ·89ft.—*i.e.*, the vessel is ·76ft. below its position of statical equilibrium.

When the vessel is across the hollow of a wave an exactly similar process will show that the maximum depth reached is 11½ft. below the base line used, while the minimum depth will be ·89ft. or ·76ft. above the position of statical equilibrium.

As regards resisted motion the methods of calculation are very approximate owing to mathematical and experi-

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mental difficulties. The value of the resistance at any velocity has been found thus: The length of the vessel was divided into several parts according to the shape of the bottom; the midship portion was then taken as flat; lengths before and abaft the midship part as semi-circular in section; before and abaft these, lengths were taken as represented by parts of circles of radius = the breadth of the vessel meeting at the keel, and finally for the ends wedges of a suitable angle. Summing the results thus obtained the resistance to the vessel entering the water at a speed of 12ft. per sec. (downward velocity) is estimated as 450 tons, and this resistance varies practically as the square of the speed. Introducing, then, the factor of resistance, the equation of motion becomes:—

$$\frac{d^2 s}{d t^2} = \frac{p}{M}\left(a \sin \frac{\pi t}{T} - s\right) \pm \frac{R}{M}$$

This does not admit of an exact solution, and the method of graphic integration has, therefore, been adopted. The author then illustrated the variation in the results by means of diagrams for which we have not sufficient pace here.

The author then proceeded to find the effect of oscillations on the stresses, and considered first the vessel on the crest of the wave. The centres of buoyancy of the fore and after bodies of the fine vessel when in statical equilibrium are found to be 120ft. apart. The positions of the centre of gravity of weight of the fore and after bodies will, of course, depend upon the stowage of the cargo, but if it be assumed that the statical bending moment for this vessel is the displacement × one-fortieth of the length, the distance between the centres of gravity required will be 158ft. Now suppose the vessel in its limiting position—that is, 9·2ft. above the base line, or 7·55ft. above the position of statical equilibrium. The centres of buoyancy of the fore and after halves of the layer of displacement lost will be 143ft. apart, and the buoyancy lost = 2,550 tons. The weight of the vessel determining the longitudinal bending moment will therefore be reduced to 7,830 − 2,550 tons = 5,280 tons. The distances apart of the centres of buoyancy for the reduced displaced will be 106ft., so that the

$$\text{Bending moment} = \frac{5{,}280}{2} \times \frac{158 - 106}{2} = 68{,}640 \text{ ft. tons.}$$
$$= D \times 8{\cdot}77$$

The statical bending moment is assumed to be = D × 9·5. Hence the effect on the bending moment of this position of the vessel is to reduce it by about 7·7 per cent. In a similar manner the effect on a statical bending moment of different value may be found and the effect on the sagging moment of the vessel being immersed below its position of statical equilibrium. These results have been worked out for sagging and hogging moments of $\frac{D\,l}{40}$ and $\frac{D\,l}{50}$ for each of the vessels considered, and the results are given in the following table:—

			Fine Vessel.		Full Vessel.
Tonnage coefficient			0·67	...	0·79
Percentage decrease of hogging moments when at maximum elevation over crest	Statical moment	$= \frac{D\,l}{40}$	7·7	...	4·2
	Statical moment	$= \frac{D\,l}{50}$	1·5	...	0·0
Percentage increase of sagging moments when at maximum depression in hollow	Statical moment	$= \frac{D\,l}{40}$	24·1	...	10.7
	Statical moment	$= \frac{D\,l}{50}$	21·0	...	8·4

It is only the cases where increases in the stresses occur which have any value, since, from what has previously been shown when dealing with unresisted rolling, the hogging stresses may be slightly increased beyond the statical values, owing to the vessel when at her minimum height being a little below her position of statical equilibrium. As regards the sagging stresses, it is interesting to note that the increase to the fine vessel is more than double that to the full vessel.

In the discussion which followed, Professor Jenkins said his mind was carried back to a period when Mr. Read and he jointly undertook the investigation of this subject. They had not proceeded far when they found there was an absence of experimental data upon which to work. Their method was not so good as that now adopted. In his own paper the day before he had made some remarks upon the behaviour of a vessel on a series of waves. Those remarks were somewhat general, and he was glad to find that in the main they had been borne out by the detailed calculations of the present paper. When a vessel was crossing a series of waves, she behaved very much as a vessel rolling in the trough. The amplitude of her oscillations would grow, reach the maximum, and then decrease and become almost *nil*, and then begin increasing again. It had long been a point for discussion as to how far the bending moment borne by the vessel was affected by this oscillation, and they found that when a laden vessel was poised on the crest of a wave, there was an actual decrease in the bending moment; while, when she passed beyond that position in the other direction, with the increased water support, there was also an increased bending moment. The consideration which governed this question was entirely one of the longitudinal positions of the centre of gravity. At first sight it would be thought that the fine vessel had a bad time on the crest of a wave. The displacement of the fine vessel was very much smaller than that of the full vessel, and, if they allowed for that, the fine vessel would still have the same advantage over the full vessel with regard to the longitudinal bending moment. He hoped the paper would induce more people to take up the question of vertical resistance.

Mr. Martell said no one knew better than he the labour required in getting out these results. The work was more important to them, because, as many would know, Lloyd's had been pressed to make some reductions in the scantlings of fine vessels as compared with full ones. Their experience had taught them, and these calculations confirmed the view, that fine clipper ships were more liable to alter their form owing to the stress brought on them at the ends, and, therefore, they had refused to diminish the scantlings.

Mr. Biles thought they should not accept too rashly all the conclusions brought out in this paper. Mr. Martell said they confirmed him in his objections to reducing the scantlings of fine-ended ships. There were, however, too many assumptions to arrive at definite conclusions. If a section is considered which is not the midship one, the strains of pitching and 'scending are much more than the total moments of inertia and the difference due to the ends. A ship must be fully laden before any such deductions can be drawn at all. The bending moments had been assumed to be the same for fine-ended and full-ended ships, but they were really not so. The resistance must be found for a ship moving vertically. There was the resistance also of the vertical movement of the propeller, and it was more in full ships than in fine ships.

Mr. A. Denny was of opinion that fine-ended ships could be built of lighter scantlings, and he was willing to build such a ship on trial, because he was quite sure of his results.

The next paper read was by Professor Vivian B. Lewes, on "The Spontaneous Ignition of Coal Cargoes." We give this paper in full as follows:—

Fifteen years ago the loss of life and property caused by the spontaneous ignition of coal cargoes became so serious that the Board of Trade, acting in unison with the Committee of Lloyd's, urged upon the Government the necessity for appointing a Royal Commission to inquire into and report upon the *possibility of preventing a class of disaster* as appalling in nature as it is destructive in result. The Commission, which was appointed in April, 1875, had the good fortune to be aided in their inquiry by the scientific knowledge of Dr. Percy and Mr. (now Sir Frederick) Abel, and after collecting and collating all the evidence which could be obtained, they in the following year published their report upon the subject. In this report much valuable evidence is passed in review, and much sound advice is given for the guidance of those employed in the shipment of coals; but whether it is that the sight of a blue book scares the ordinary reader, or that the circulation of such literature, often of the most valuable character, is of necessity very limited, the fact remains that the conditions at present existing are nearly as bad as they were before the publication of the report. In the nine years immediately following the report—viz., 1875 to 1883—57 coal-laden vessels are known to have been lost from spontaneous ignition of their cargoes, whilst during the same period 328 were missing from unknown causes, a large percentage of these losses being undoubtedly due to the same cause; and these, again, form but a very small percentage of the cases in which cargoes have heated and fired, but in which the vessel has been saved; and now, within the last few years, the statement has gained ground that with the general increase of temperature in steamships, due to the introduction of triple-expansion engines and high-pressure boilers, spontaneous firing in the coal bunkers and coal cargoes is very much increased, and that many accidents arise from this cause. Under these circumstances, Mr. Martell suggested to me some time ago that an inquiry into the causes and possible prevention of this very serious evil would be work, not only likely to be acceptable to the members of this Institution, but also one that was needed in the Service, as well as in the mercantile marine; and I have now much pleasure in bringing before you the results obtained in a long series of experiments, and which, taken in conjunction with the work done by others on the subject, throws a somewhat clearer light upon the causes of this particular class of phenomenon, and enables suggestions to be made for its prevention.

Coal is a substance of purely vegetable origin, formed out of contact with air by long exposure to heat and pressure, from the woody fibre and resinous constituents of a monster vegetation which flourished long before the earth was inhabited by man; and coal may therefore be looked upon as a form of charcoal, which having been formed at a temperature lower than that of the charcoal burner's heap and under great pressure, is very dense, and still retains a quantity of those constituents which, in the latter case, are driven off, as tar, wood naphtha, &c.; and these bodies consist essentially of compounds containing carbon and hydrogen, together with a little oxygen and nitrogen, and form the volatile matter and hydro-carbons of the coal. Besides the carbon and hydro-carbons, coal also contains certain mineral bodies, which were mostly present in the sap and fibre of the original vegetation, and which give the ash which is left behind when the coal is burnt. These substances consist chiefly of sulphate of lime or gypsum, silica, and alumina, whilst in nearly all kinds of coal is to be found a substance called disulphide of iron, coal brasses or pyrites, which has been formed by the gradual reduction of the sulphates by carbonaceous matter in the presence of iron salts, and which, during the combustion of the coal, is decomposed, giving off sulphur compounds and leaving behind oxide of iron, which gives the reddish brown colour to the ash left by many kinds of coal. Of these constituents of coal, the only ones which play no part in the phenomena attending heating and spontaneous ignition, are the mineral constituents other than the pyrites, and we have therefore to deal with the chemical actions which take place when the carbon, hydro-carbons, and brasses contained in newly won coal come in contact with air and moisture.

The Influence of Carbon in Producing Heating.—Carbon is one of those substances which possess to an extraordinary degree the power of attracting and condensing gases upon their surface, this power varying with the state of division and density of the particular form of carbon used. The charcoal obtained from dense forms of wood, such as box, exhibit this property to a high degree, one cubic inch of such charcoal absorbing:—

Ammonia gas	90	cubic inches.
Sulphureted hydrogen	55	,,
Carbon dioxide	35	,,
Ethylene (olefiant gas)	35	,,
Oxygen	9·25	,,
Nitrogen	6·5	,,

whilst certain kinds of coal also exhibit the same power, although to a less degree. The absorptive power of newly won coal due to this surface attraction varies, but the least absorbent will take up 1¼ times its own volume of oxygen, whilst in some coals more than three times their volume of the gas is absorbed. This absorption is very rapid at first, but gradually decreases, and is moreover influenced very much by temperature, for reasons which will be explained later. The absorption is at first purely mechanical, and itself causes a rise of temperature, which, in the case of charcoal formed in closed retorts, as in preparing alder, willow, and logwood charcoal for powder making, would produce spontaneous ignition if it were not placed in sealed cooling vessels for some days before exposure to air. The rate of absorption varies with the amount of surface exposed, and therefore able to take part in this condensing action, so that when coal or charcoal is finely powdered, the exposed surface being much greater, absorption becomes more rapid, and rise of temperature at once takes place. If charcoal is kept for a day after it has been made out of contact with air, and is then ground down into a powder, it will frequently fire after exposure to the air for thirty eight hours; whilst a heap of charcoal powder, of 100 bushels or more, will always ignite. It is for this reason that, in making the charcoal for powder, it is always kept, after burning, for three or four days in air-tight cylinders before picking over, and ten days to a fortnight before it is ground. In the case of coal, this rise in temperature all tends to increase the rate of the action which is going on; but is rarely sufficient to bring about spontaneous ignition, as, only about one-third the amount of oxygen being absorbed by coal that is taken up by charcoal, and the action being much slower, tends to prevent the temperature reaching the high ignition point of the coal. Air-dry coal absorbs oxygen more quickly than wet coal.

The Action of the Bituminous Constituents of the Coal in Spontaneous Ignition.—All coal contains a certain percentage of hydrogen, which is in combination with some of the carbon, and also with the nitrogen and oxygen, and forms with them the volatile matter in the coal, and the amount present in this condition varies very largely, being very small in anthracite and very great in cannel and shale. When the carbon of the coal absorbs oxygen, the compressed gas becomes very chemically active, and very soon commences to combine with the carbon and hydrogen of the bituminous portions, converting them into carbon dioxide and water vapour. This chemical activity increases rapidly with rise of temperature, so that the heat generated by the absorption of the oxygen causes it to rapidly enter into chemical combination. Chemical combination of this kind—*i.e.*, oxidation—is always accompanied by evolutions of heat, and this further rise of temperature again increases rapidly of oxidation, so that a steady rise of temperature is set up, and this taking place in the centre of a heap of small coal, which, from the air and other gases enclosed in its interstices, is an admirable non-conductor of heat, will often cause such heating of the mass that if air can percolate slowly into the heap in sufficient quantity to supply the necessary percentage of oxygen for the continuance of the action, the igniting point of the coal would be soon reached. The effect of rise of temperature in increasing the rapidity of chemical actions of this kind can be realised from the effect which it has in the spontaneous ignition of oily waste or rag. If a substance like cotton waste be rendered oily with anything except the mineral oils, it acquires the power of taking up oxygen from the air, and this oxidising the oil gives rise to heat. At ordinary temperatures this oxidation is slow, and, consequently, it may be days before the rise in temperature becomes sensible, but when this point is reached the oxidation proceeds with remarkable rapidity, and in a few hours the point of ignition is reached and the mass bursts into flame, whilst if the oily waste be placed in a warm place at first, spontaneous ignition is only a question of hours or sometimes even minutes. Galletley found that oily cotton at ordinary temperatures took some days to heat and ignite, whilst placed in a chamber warmed to 130° to 170° F. (54° to 76° C.), the cotton greasy with boiled linseed ignited in one hour fifteen minutes, and olive oil on cotton in five hours, and in a chamber heated to 180° to 200° F. (82° to 93° C.) olive oil on cotton ignited in two hours. It has been suggested that very bituminous coal, such as cannel, shale, and coals containing schist, is liable to spontaneous ignition from the fact that a rise in temperature would cause heavy oils to exude from them, which, by undergoing oxidation, might cause rapid heating. But experiment not only shows that it is not the case, but that the heavy mineral oils have a remarkable influence in retarding heating, cotton waste, oily with easily oxidisible oils mixed with 20 per cent. of heavy mineral oil, being exempt from heating.

The Action of Iron Disulphide, Pyrites, or Coal Brasses in Promoting Spontaneous Ignition.—Ever since Berzelius first expressed the opinion that the heat given out by the oxidation of iron disulphide into sulphates of iron might have an important bearing on the heating and ignition of coal, it has been adopted as the popular explanation of that phenomenon; and although the work of Dr. Richters clearly proves this not to be the case, the

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THE SPONTANEOUS IGNITION OF COAL CARGOES.

Temperature Records. H.M.S. "Malabar" and "Crocodile."

"CROCODILE,"
Original Simple Low-Pressure Engines.

Locality.	Date.	Deck.	Coal Bunkers.	Engine Room.	Stoke-hold.
	1871.				
Channel and Bay	Jan. 15	52	72	98	90
	,, 18	58	80	99	92
Mediterranean	,, 23	65	86	98	92
	,, 27	66	84	100	92
Red Sea	Feb. 6	68	92	108	106
	,, 10	81	100*	114	110
	1875.				
Channel and Bay	Feb. 11	46	66	90	105
	,, 12	54	70	94	102
Mediterranean	,, 19	53	74	92	89
	,, 26	66	74	98	104
Red Sea	Mar. 4	77	90	104	115
	,, 6	82	94	98	120
Indian Ocean	,, 12	79	98*	104	114

"MALABAR,"
Old Compound Engines.

Locality.	Date.	Deck.	Coal Bunkers.	Engine Room.	Stoke-hold.
	1885.				
Channel and Bay	Oct. 3	59	85	82	89
	,, 6	63	86	86	110
Mediterranean	,, 8	72	90	98	94
	,, 9	73	90	96	100
	,, 10	70	90	90	110
Red Sea	,, 19	81	92	95	107
	,, 20	84	100	96	108
	,, 21	88	104*	104	119
	,, 23	87	102	97	112
	1888.				
Channel and Bay	Dec. 4	55	78	78	90
	,, 6	54	85	80	84
	,, 8	60	92	82	88
Mediterranean	,, 12	64	97	80	100
	,, 15	60	95	78	90
	,, 17	62	112	83	94
Red Sea	,, 22	74	113	92	100
	,, 23	80	115	96	103
	,, 24	82	116*	98	110
Indian Ocean	,, 31	78	99	97	118

"MALABAR,"
New Triple Engines.

Locality	Date.	Deck.	Coal Bunkers.	Engine Room.	Stoke-hold.
	1888.				
Channel and Bay	Dec. 13	49	77	78	72
	,, 14	56	86	86	88
	,, 16	62	80	84	90
Mediterranean	,, 18	63	88	90	94
	,, 19	62	88	90	94
	,, 22	68	87	90	100
	,, 23	74	89	90	98
Red Sea	,, 28	79	96	102	110
	,, 29	82	100	100	110
	,, 30	84	105*	100	108
	,, 31	83	104	104	110
	1889.				
Channel and Bay	Oct. 5	65	84	86	94
	,, 7	67	84	90	102
Mediterranean	,, 10	76	100	92	102
	,, 11	80	100	93	99
	,, 15	79	104	96	100
	,, 16	80	106	96	106
Red Sea	,, 19	83	106	103	102
	,, 20	86	110	102	110
	,, 21	89	115	108	108
	,, 22	92	120*	112	122

* Maximum temperature during voyages from Portsmouth to Bombay.

NOTE.—The registers of the original engines of "Malabar" are destroyed; temperature records of "Crocodile" are given in lieu for a period when she was fitted with old low-pressure engines.

old explanation is still given, a notable exception, however, being in the case of our great metallurgist, Dr. Percy, who, as early as 1864, pointed out that probably oxidation of the coal had also something to do with spontaneous combustion, a prediction amply verified by Dr. Richters' researches some six years later. This disulphide of iron is found in coal in several different forms, sometimes as a dark powder distributed throughout the mass of the coal, and scarcely to be distinguished from coal itself. In larger quantities it is often found forming thin golden-looking layers in the cleavage of the coal, whilst it sometimes occurs as large masses and veins, often 1in. to 2in. in thickness, but inasmuch as these masses of pyrites are very heavy, they rarely find their way into the screened coal for shipment, many hundreds of tons of these "brasses" being annually picked out from the coal at the pit's mouth, and utilised in various manufacturing processes. If the air is dry the pyrites undergo but little change at ordinary temperatures; but in moist air they rapidly oxidise when in a finely divided condition, the first action being the formation of ferrous sulphate and sulphur dioxide, together with the liberation of sulphur, the relative amounts of the two latter being regulated by the temperature and the supply of air, whilst longer contact with moist air converts the ferrous sulphate into a basic ferric sulphate generally termed "misy." It is during this process of oxidation that the heat supposed to cause the ignition is evolved. But when it is considered that some of the coals most prone to spontaneous combustion contain only eight-tenths of 1 per cent. of iron pyrites, and rarely more than 1¼ per cent., the absurdity of imagining this to be the only cause of ignition becomes manifest. If 100lb. of coal were taken, and the whole of the pyrites in it concentrated in one spot and rapidly oxidised to sulphate, the temperature would barely be raised to 100° C., if all loss of heat could be avoided. Besides which, in certain manufactures pure iron pyrites are largely used, and, when free from carbonaceous matter, may be kept in a state approaching to powder in heaps containing many hundred tons; and although undergoing continual oxidation, I have been unable to trace a single case of heating, much less a rise of temperature which would approach the igniting point of coal. When, however, it is mixed with finely divided carbonaceous matter, then heating and ignition is a frequent occurrence in even moderate sized heaps.

I have carefully determined the igniting point of various kinds of coal, and find that—

Cannel coal	ignites at 698 degrees F.	= 370 degrees C.	
Hartlepool coal	,, 766 ,,	= 408	,,
Lignite	,, 842 ,,	= 450	,,
Welsh steam coal	,, 870·5 ,,	= 477	,,

So that no stretch of imagination could endow the small trace of pyrites scattered through a large mass of coal, and undergoing slow oxidation, with the power of reaching the needful temperature. Dr. Richters fully realises this point, and discards the idea of the pyrites doing anything more than adding their mite to the causes which bring about rise of temperature. In this, however, I think he is mistaken, my experiments, which will be published when complete, pointing to the fact that they may increase the liability to ignition when present in large quantities, and do so by liberating sulphur under certain conditions. Now, sulphur has an igniting point of 482° F. or 250° C., so that the presence of free sulphur would lower the ignition point of the coal by considerably over 100 degrees Centigrade, the sulphur in this case playing exactly the same part that it does in gunpowder, in which it lowers the point of ignition and increases the rapidity of combustion. A still more important part played by the pyrites is that as they become oxidised to ferrous sulphate they swell in size, and so tend to split up the coal into small pieces, and by exposing a large extent of fresh surface to the air cause increase of temperature and energetic chemical action.

We can now trace the actions which cumulate in ignition. The newly won coal is brought to the mouth of the pit, and at once commences by virtue of its surface action to absorb oxygen from the air, but unless piled in unusually large heaps, and a good deal broken, it does not, as a rule, show signs of heating, as the exposed surface is comparatively small, and the air finding its way freely between the lumps keeps down the temperature. The coal is now screened, and the obtrusively large lumps of brasses picked out; it is then put in the trucks and enjoys the disintegrating processes of joltings and shuntings innumerable, every jar adding to the percentage of small coal present, and a corresponding increase in the size of the surface exposed to the air. Arrived at the docks it has to be transferred from the truck to the ship, which is done by one of the numerous forms of tips, shoots, or spouts employed for the purpose, and it is during this operation that more harm is done than at any other period. The coal first shot into the vessel by reason of the distance which it has to fall is broken down into small lumps, and having to bear the impact of the succeeding load falling upon it from a height, rapidly becomes powdered into slack, whilst the succeeding loads falling in on the cone so formed get more or less broken down, so that by the time the cargo is all taken in, a dense mass of small coal is to be found under the hatchway, and it is invariably at this point that heating takes place, as the large surface exposed fresh to the air by the breaking down of the coal causes rapid absorption of oxygen, and consequent rise of temperature. This sets up chemical combination between the oxygen absorbed by the coal and the hydrocarbons and coal brasses. The combination of the brasses with oxygen causes the swelling of the oxidised mass and splitting up of the coal; fresh surfaces are exposed, and more absorption of oxygen takes place, and the igniting point of the sulphur vapour and sulphur compounds distilled out of the pyrites is reached, and rapidly raises the temperature to the ignition point of the coal. It is only in cases where large quantities of dense coal brasses are present that this action can take place, as in the ordinary case, where 1 or 2 per cent. only of pyrites are present, the sulphur vapour distilled out from the pyrites is oxidised to sulphur dioxide at temperatures far below the point of ignition of sulphur vapour; and in such cases the heat of absorption and oxidation of the bituminous portions of the coal is amply sufficient to raise the temperature to the requisite 752° to 932° Fahr. (400° to 500° C.).

On examining the evidence to be obtained as to the conditions under which spontaneous ignition of coal in ships usually takes place, it is found that liability to ignition increases with:—

1. *The Increase in Tonnage of Cargoes.*—Thus, in cargoes of under 500 tons the cases reported amount to a little under ¼ per cent. for shipments out of Europe; from 500 to 1,000 tons, to over 1 per cent.; from 1,000 to 1,500 tons, to 3·5 per cent.; 1,500 to 2,000 tons, to 4·5 per cent.; and over 2,000 tons, to no less than 9 per cent. The evidence demonstrating this very remarkable result is to be found in the Report of the Royal Commission for 1875, p. viii., and clearly shows the influence of mass upon this action which acts in two ways:—(*a*) The larger the cargo, the more non-conducting material will there be between the spot at which heating is taking place and the cooling influence of the outer air. (*b*) The larger the cargo the greater will be the breaking-down action of the impact of coal coming down the shoot upon the portions first loaded into the ship, and the larger therefore the fresh surface exposed to the action of the air.

2. *The Ports to which Shipments are made*—26,631 *shipments to European ports in* 1873 *only resulting in ten casualties, whilst* 4,485 *shipments to Asia, Africa, and America gave no less than sixty.*—This startling result is partly due to the length of time the cargo is in the vessel, the absorption and oxidation being a comparatively long action, but a far more active cause is the increase in the action brought about by the increase of temperature in the tropics, which converts a slow action into a rapid one, and if statistics had been taken, most of the ships would have been found to have developed active combustion somewhere about the neighbourhood of the Cape, the active action developed in the tropics having raised the temperature to the igniting point of the coal by that time.

3. *The Kind of Coal of which the Cargo consists—some coals being specially liable to spontaneous heating and ignition.*—This is a point on which great diversity of opinion exists, but I think it will be pretty generally admitted that cases of heating and ignition are more frequent in coals shipped from East Coast ports than in shipments of the South Wales coals. As has been pointed out, however, so much depends on the amount of small coal present that a well-loaded cargo of any coal would be safer than a cargo

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of Welsh steam coal in which a quantity of dust had been produced during loading. The idea that the percentage of pyrites present is any indication of the liability to spontaneous combustion must be entirely discarded, as experiment shows that many coals poor in pyrites frequently ignite, whilst others rich in them are perfectly safe. A much surer guide is to be found in the quantity of moisture present in an air-dried sample of coal, which is a sure index to the absorptive power, the higher the amount of moisture held by the coal after exposure for some time to dry air, the greater will be its power of absorption for oxygen, and the greater therefore its liability to spontaneous heating and ignition. This is shown by the following table, in which the percentage of pyrites and moisture present in some coals are contrasted with their liability to self-ignition:—

Liability to Spontaneous Ignition.	Pyrites per Cent.		Moisture per Cent.
Very slight	1·18	...	2·54
	1·01 to 3·04	...	2·75
	1·51	...	3·90
Medium	1·20	...	4·50
	1·08	...	4·55
	1·15	...	4·75
Great	1·12	...	4·85
	0·83	...	5·30
	0·84	...	5·52
	1·00	...	9·01

4. *The Size of the Coal—small coal being much more liable to spontaneous ignition than large.*—This, as has been pointed out, being entirely due to the increase in active absorbent surface exposed to the air, a fact which is verified by the experience of large consumers of coal on land; gas managers recognising the fact that coal which has been stamped down or shaken down during storage being more liable to heat than if it has been more tenderly handled, the extra breakage causing the extra risk.

5. *Shipping Coals rich in Pyrites whilst Wet.*—The effect of external wetting on coal is to retard at first the absorption of oxygen and so to check the action, but it also increases the rate of oxidation of the pyrites, and so causes disintegration of the coal, with consequent crumbling and heating due to exposure of fresh dry surfaces.

6. *Ventilation of the Cargo.*—The so-called ventilation which has from time to time been introduced into coal ships is undoubtedly one of the most prolific causes of spontaneous ignition. For ventilation to do any good, cool air would have to sweep continuously and freely through every part of the cargo, a condition impossible to attain, whilst anything short of that only increases the danger, the ordinary methods of ventilation supplying just about the right amount of air to create the maximum of heating. The reason of this is clear. A steam coal absorbs about twice its own volume of oxygen, and takes about ten days to do it under favourable conditions, and it is this oxygen which in the next phase of the action enters into chemical combination and causes the serious heating. A ton of steam coal occupies 42 to 43 cubic feet, and if properly loaded contains between the lumps as nearly as possible 12 cubic feet of air space—that is to say, of the 42 cubic feet, 12 cubic feet is air and 30 cubic feet is coal. Thirty cubic feet of coal, with its fresh absorbing surfaces laid bare by the crushing incidental to loading, will, in the first ten days after being taken on board, absorb 60 cubic feet of oxygen, if it can get it. Now, air contains only, roughly, one-fifth of its volume of oxygen, so that 60 cubic feet represent 300 cubic feet of air, or twenty-five times as much as is present; so that it is evident that if air could be excluded there would be only one twenty-fifth the quantity of oxygen present which is needed for complete action, and any heating would, in consequence, be very slight; whilst to produce the greatest heating it would be necessary to change the entire air in the cargo twenty-five times in the first ten days, and this is just about what the ordinary method of taking a box shaft along the keelson with Venetian lattice upshafts from it would give. The most forcible illustration of the evil of such ventilation is to be found in the case of the four colliers, "Euxine," "Oliver Cromwell," "Calcutta," and "Corah," which were loaded at Newcastle under the same tips, at the same time, with the same coal, from the same seam. The first three were bound for Aden, and were all ventilated. The "Corah" was bound for Bombay, and was not ventilated. The three thoroughly ventilated ships were totally lost from spontaneous ignition of their cargo, whilst the "Corah" reached Bombay in perfect safety.

7. *Rise in Temperature in Steam Colliers due to the introduction of Triple-expansion Engines and High-pressure Boilers.*—It has been fully pointed out that anything which tends to increase of initial temperature increases the rapidity of chemical action. Steam at 80lb. boiler pressure has a temperature of 324° F. (162° C.), and a common stoke-hold temperature with boilers worked at this pressure is 100° to 130° F. (or 38° to 54° C.). Steam at a boiler pressure of 155lb. has a temperature of 368° F. (or 186° C.), and gives a corresponding increase of temperature in the stoke-hold and other adjacent portions of the vessel, the temperature in the stoke-hold under these conditions being from 110° F. (43·5° C.) to 140° F. (60°), an increase of about 10° F. It is, however, difficult in the mercantile marine to get a direct comparison of the increase in temperature due to this cause; but in the Service, some of the troopships have been from time to time refitted, and in the case of the "Malabar" and "Crocodile," the temperatures existing with the old simple low-pressure engines, the old compound engines, and the new triple expansion engines can be contrasted, and will be found in the Table on page 387, for which I am indebted to Mr. White. From this it will be seen that, taking the voyage through, the average increase of temperature in the stoke-hold from the use of the triple-expansion engines is about 5 degrees. This table is of great interest, as the temperatures taken during the outward voyage of the "Crocodile," December, 1883, point to the coals in the bunkers commencing to heat, and also illustrate where and at what temperature it commenced. Crossing the Bay, the stoke-hold and bunker temperatures agree fairly well, but entering the Mediterranean the stoke-hold, having become heated to 100° F. on the 12th, action commenced in the bunkers, and this rapidly raised their temperature higher than that of the stoke-hold, the action, however, not being violent, and the bunker temperature rapidly falling below that of the stoke-hold as the chemical action died away.

Having now discussed the chemical and physical conditions which lead to the phenomenon known as "spontaneous ignition," we can formulate precautions which will tend to prevent such disasters.

1. *The Choice of Coal for Shipment to Distant Ports.*—The coal should be as large as possible, free from dust, and with as little "smalls" as can be helped. It is better as free from pyrites as possible, in order to prevent disintegration after shipment, and it should contain when air-dried not more than 3 per cent of moisture.

2. *Precautions to be Taken during Shipment.*—No coal should be shipped to distant ports until at least a month has elapsed since it was brought to the surface at the pit's mouth. Every precaution should be taken to prevent breaking up of the coal whilst being taken on board, and on no account must any accumulation of fine coal be allowed under the hatchways. When possible the coal should be shipped dry, as external wet, by producing oxidation of the pyrites, causes disintegration.

3. *Precautions to be Taken on Board Coal-laden Ships.*—This phase of the question is undoubtedly the most important, and in order to ensure any successful treatment of the coal cargo at sea to prevent undue heating and ignition, the means adopted must be as nearly automatic in their working as possible, as it is useless to expect the master or any officer on board a collier during rough weather, &c., to comply with any instructions, such as daily taking the temperatures in various parts of the cargo, and so on. The coal compartments should be made gas-tight, as far as the bulkheads separating them from the rest of the ship is concerned; and as no difficulty is found in doing this when provision for forced draught is being made, no difficulty should be found in this case. When the coal has all been taken in, it should be battened down, and the hatches should not be again opened until the vessel reaches her destination, the only ventilation allowable being a 2in. pipe just inserted into the crown of each coal compartment, and led 12 feet up the nearest mast, the top being left open. This would be quite sufficient to allow free egress to any gases evolved by the coals, but would not allow undue access of air. Into the body of the coal cargo itself would be screwed, at regular intervals of about 6ft., iron pipes, closed at the bottom, and containing alarm thermometers, constructed in the following way: A long bulb of glass, containing mercury, has an insulated wire inserted into the quicksilver, and making contact with it, whilst the stem attached to the bulb has a second wire in it, so arranged that when a rise of temperature causes expansion of the mercury, in rising in the tube it makes contact, and the wires from these tubes are in connection with an electric bell, index board, and battery in the captain's room, so that the moment the temperature is reached to which the thermometers have been set, the bell rings, and will continue to ring until the temperature again sinks, the spot in which heating is taking place being indicated by the index board. In the evidence given before the Commissioners in 1875, Mr. J. Glover strongly advocated the use of carbon-dioxide, or carbonic acid gas, as it is more usually termed, for extinguishing ignition when it had broken out in a coal cargo, and for stopping heating when it had reached a dangerous pitch. His proposal was to generate the gas by the action of hydrochloric acid upon chalk, and to lead it by gas pipes to the compartment affected, and this gas, being heavier than air and a non-supporter of combustion, was to displace the air and its contained oxygen, and so to prevent further action by surrounding the coal with an atmosphere which could not carry on combustion. The idea was a good one, but there were many difficulties in the way of carrying it out, one being that for every thousand tons of coal carried, 80 cwt. of hydrochloric acid would have had to be shipped, also the gas could not have been driven down into the hold if any serious heating had taken place, as an up current would have been formed and would have carried it away, whilst in this state of gas it fails to give any great cooling effect, and so would have exercised but little influence upon the mass of red hot fuel. These objections weighed so strongly with the Commissioners that in their final report we find the following sentences:—"Several methods for generating carbonic acid gas and applying it to the ignited portion of a coal cargo have been proposed for our consideration. We consider, however, that although this gas might be useful by excluding atmospheric air (which is essential to support combustion), yet it will not, as water does, exert any very sensible cooling effect, *which is a point of vital importance in the case of a mass of ignited coal.* We are of opinion that water and steam are the only agents practically available for the purpose of extinguishing fire in coal cargoes." Applied in the way which was suggested, there is no doubt but that the carbonic acid gas would have been practically useless; but there is another way in which it could be used, which would make it a most powerful cooling agent, an instantaneous quencher of fire, and would prevent any further tendency to heat on the part of the coal treated with it. If carbonic acid gas is compressed under a pressure of 36 atmospheres at a temperature of 32° F. (0° C.), it is condensed to the liquid state, and can be obtained in steel vessels, closed with screw valves. On opening the valve some of the liquid is ejected into the air, and on coming into the ordinary atmospheric pressure, is in a moment converted into a large volume of gas. Conversion from the liquid to the gaseous state means the absorption of a large amount of heat, and so great is this that everything near the stream of new-born gas is cooled down, and some of the escaping liquid is frozen to a solid, having a temperature of - 78° C., or —108·4 F. This liquid carbonic acid gas is now extensively manufactured, and is used abroad to a large extent for aërating waters, driving torpedoes, and for freezing machines; and I should suggest its use in the following way for the checking of ignition in the coal cargo: The nozzle attached to the screw-valve on the bottle of condensed gas would have a short metal nose-piece screwed on to it, the tube in which would be cast in solid, with an alloy of tin, lead, bismuth, and cadmium, which can be so made as to melt at exactly 200° F. (93° C.). The valve would then be opened, and the steel bottle buried in the coal during the process of loading. The temperature at which the fusible metal plug will melt is well above the temperature which could be reached by any legitimate cause, and would mean that active heating was going on in the coal; and under these conditions the pressure in the steel cylinder would have reached something like 1,700lb., and the moment the plug melted the whole contents of the bottle would be blown out of it into the surrounding coal, producing a large zone of intense coal, and cooling the whole of the surrounding mass to a comparatively low temperature. The action, moreover, would not stop here, as the cold, heavy gas would remain for some time in contact with the coal, diffusion taking place but slowly through the small exit pipe. When coal has absorbed as much oxygen as it can, it still retains the power of absorbing a considerable volume of carbonic acid gas; and when coal has heated, and then been rapidly quenched, the amount of gas so absorbed is very large indeed, and the inert gas so taken up remains in the power of the coal, and prevents any further tendency to heating; indeed, a coal which has once heated, if only to a slight degree, and has then cooled down, is perfectly harmless and will not heat a second time. It is not by any means necessary to replace the whole of the air in the interstices of the coal with the gas, as a long series of experiments show that 60 per cent. of carbonic acid gas prevents the ignition of the most pyrophoric substances. One hundred cubic feet of gas can be condensed in the liquid state in a steel cylinder 1ft. long and 3in diameter, and it has been shown that a ton of coal contains air spaces equal to about 12 cubic feet; therefore, one of these cylinders would have to be put in for every 8 tons of coal, and these would be distributed evenly throughout the cargo and near the alarm thermometers, which would be set to ring a degree or two below the point at which the fusible plug would melt. The bell ringing in the captain's room would warn him that heating was taking place, and the bell would continue to ring until the cylinder had discharged its contents and had cooled down to a safe degree, so that the whole arrangement would be purely automatic, and yet the officers would know if everything was safe. This liquid is now being made at a comparatively cheap rate, and with any demand for it machinery could be put up at the principal coaling ports to charge empty cylinders at a very low rate, so that the initial cost of the steel cylinders once got over the expenses would not be worth considering, more especially as one, or two at most, would be likely to go off. If the precautions advocated were taken no danger could arise until the arrival of the ship at her destination, and the commonest precautions would then suffice. On removing the hatches, no naked light must be allowed near them, and no one must be allowed to descend into the hold until all the gases have had time to diffuse out into air. If the cylinders have gone off there will be but little fear of explosion, as a high percentage of the carbonic acid gas lowers the explosive power which the mixture of marsh gas (given off from some coals) and air possess; but the carbonic acid gas would overcome and suffocate a man descending into an atmosphere containing any considerable percentage of it. When a safety lamp, lowered into the hold, continues to burn as brightly as it did in the open air, then it is perfectly safe to descend. When once coal in a cargo has fired, pumping in water is of practically no use, as the fire is, as a rule, near the bottom of the mass of coal, and the flow of the water is so impeded that, in percolating through the interstices of the heated coal, it is converted into steam before it can reach the seat of combustion. The most effective way to apply water would be to have four 3in. pipes laid along the floor of the coal compartments, about 6ft. apart, these tubes having a ¼in. hole bored in the upper side every foot or so, and each pair of pipes coming through the bulkhead, and connecting on to two 6in. pipes passing through the side of the vessel, the sea water being prevented from entering by means of screw valves. As soon as the alarm thermometer gave notice that heating had reached a dangerous point, these valves could be opened, and the lower portion of the cargo drenched with salt water. This, evaporating rapidly, would give large volumes of water vapour, which, passing up through the heated coal, would lower its temperature, but would not be nearly as effective as the method before advocated. It might, however, be used in conjunction with that method, and would, in many cases, save the carbonic acid gas. The question of preventing the heating and ignition of stores of coal on land and ready for use in bunkers cannot be met so well by the use of the liquid gas, and, in these cases, it would be found beneficial to dress the coals with a little tar or tar oil, which would close the pores and, to a great extent, prevent oxidation. I believe this was advocated by Lachman about 1870. Crude petroleum in small quantities for this purpose would also be found valuable, for, as already shown, it has no tendency to oxidise itself, and lowers the tendency in other bodies, besides coating them, and so preventing access of oxygen.

The labour trouble in the coal trade is hampering all branches of industry, and, with increasing difficulty in obtaining coal, all sorts of rubbish will be shipped, and many a cargo of coal will go out during the next few months which, under normal conditions, would never have been allowed on board; and we may expect a heavy increase in the loss of life and property from spontaneous ignition. This will probably result in a rise in the rate of premium, and further check to our export coal trade; and I sincerely trust that, should these gloomy forebodings be fulfilled, the suggestions made in this paper, and based on experimental facts, may be found of value. In conclusion, I wish to acknowledge my indebtedness to the researches of Dr. Richters, whose papers on the weathering of coal are to found in *Dingler's Polytechnisches Journal* for 1870; to the report of the Royal Commissioners on this question in 1876; and, finally, to Mr. Martell for suggesting the subject of this paper.

In the discussion which followed, Dr. Elgar pointed out that, notwithstanding the great dangers arising from spontaneous combustion, it did not cause great losses. He argued that a fire which was generated in the centre of a cargo of coal took a considerable time to reach a point of danger to the ship. Meanwhile the ship could make for a port. As a fact, he had known fires to occur in the bunkers of large passenger steamers where thousands of tons were stored, and the passengers were in blissful ignorance of the dangers by which there were beset. He also drew attention to the American law, by which all ships had steam pipes running through their holds for the purpose of dealing with fires, and he thought the plan should be adopted through coal bunkers in order to furnish a means for coping with danger should any arise.

Mr. Parker said the subject had been brought before his notice by the Committee of Lloyd's Register, and he was requested to give his views. It was thought by steamship owners to be due largely to the higher steam temperatures in vogue in steamers and steam colliers.

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He could corroborate Professor Lewes that this was not the case in what had come under his notice. The fires had always commenced in the centres of the bunkers, and not at the sides nor near the boilers, and so did not lead to the supposition that heat had led to the ignition. He had had ample opportunity of studying the matter, for one or two vessels came into the port of London every week with their bunkers on fire. He considered there were two distinct reasons for spontaneous combustion. It was well known that all coal was more or less contaminated with iron pyrites. The sulphur in the pyrites was liable to be slowly oxidised by the oxygen in the air mingled with the coal. Heat was generated by this oxidation, and the heat in turn promoted further oxidation. If sufficient air was present, the oxidation became more and more rapid, the temperature rose and the coal began to burn. Oxidation was promoted by moisture in the first instance, as the oxygen in the air was thus brought into more intimate contact with the sulphur. The precautions necessary were to keep the coals dry, to exclude air from penetrating the body of the coal, and to avoid the accumulation of small coal, which, by its fine division, multiplied the surfaces exposed to oxidation. The absorption of oxygen took place mostly when the coal was exposed to the air after being sent up from the pit. The more porous the coal, the more capable was it of taking up the air. With regard to the higher temperatures caused by the introduction of triple expansion engines, he had asked the officers of several steamers to obtain for him some figures bearing on the subject from their own observations. They agreed very closely with those given in the paper. He found where steam pressure was 80lb., a temperature of 324° Fahr. was developed, and the common stokehold temperature under those conditions was from 100° Fahr. to 130° Fahr. When the steam was 155lb., the temperature became 368° Fahr., or 44° higher than with 80lb., and there was a corresponding increase of temperature in the stokehold to 110° and 140° Fahr. He had written to the engineers of the principal steamship owners in the Kingdom, and the general answer was that the number of accidents arising from the cause stated was now less than when steam of 60lb. pressure was used.

Mr. McFarlane Gray said he had been asked by the Board of Trade some years ago to prepare a book of instructions upon the subject of spontaneous ignition. There was a doubt, however, whether it would be right to issue official instructions deprecating ventilation, and so nothing came of his work. He thought the appointment of an official chemist would be a good thing, as with shipowners and others interested in shipping many important questions appeared every day.

Mr. Eckersdale thought moisture was one cause of spontaneous combustion in coal, and the Admiralty rule was that no coal should be put on board during the wet season.

Mr. Stromeyer asked how the air could get to the centre of the cargo. He thought that it was absorbed during its passage from the pit's mouth to the ship's hold, for when a ship's hatches were battened down very little air could find its way through, say, 20ft. thick, to the centre, where ignition has usually been found to take place.

Professor Lewes then replied. He said that in wooden ships the spontaneous combustion was due to the difficulty in keeping the ships dry. There was no doubt that moisture made the coal crumble up, and so a larger surface was exposed to the action of the atmosphere. As regards the steam pipes used in American vessels through the bunkers, it must be remembered that English coal and American coal were not the same. These pipes were kept cold when not in use, and were of great service in extinguishing fires. He knew the abhorrence there was to all sorts of fiddling contrivances of all kinds, but he did not think if one of his apparatus were dropped in the cargo here and there any serious difficulties would be encountered. Referring to Mr. Parker's remarks, he said he was somewhat astonished when he knew that gentleman had drawn up a report bearing on this subject, but was relieved to know that it had not been published. It appeared that much the same results had been obtained practically as he had advanced from theoretical reasons. As regards his carbon-dioxide experiment, it was not intended to apply it in the case of a fire, though he had no doubt if it were placed in the centre of a large fire it would reduce that fire considerably. He thought it would be a poor fire that would burn 10° below the boiling point of water, yet so soon as the fuel had reached this heat the carbon-dioxide would be liberated; it would thus lower the temperature and cause a thin film of gas to surround the fuel and prevent combustion. Mr. Stromeyer had asked how the air managed to get at the centre of the coal, and how it happened that it took in gas instead of giving out gas when heated. There were several matters connected with the occlusion of gas which were very interesting indeed. He had shown them how a piece of charcoal would absorb many times its own volume of oxygen. In the same way the coal absorbed the oxygen present in the small interstices between the separate particles forming the heap of coal. They should therefore batten down their hatches in order to exclude the air.

Mr. J. Corbett then read a paper on "Experiments with Lifeboat Models." The author has been engaged for many years in experiments on models to ascertain the best forms of lifeboat, and these experiments were renewed after the failure of the Southport lifeboat in 1886. We summarise the recommendations contained in Mr. Corbett's paper in the following paragraphs:—

Form of Side and Gunwale.—It is usually the blow of a sea on the upper part of the side that does most injury; it is therefore desirable to keep the sides as low as practicable. Low sides are also less distant in height above the centre of gravity of the boat. The blow of a sea broadside on, when it cannot be avoided or reduced, may be evaded by means of sloping or "tumble-home" sides to the boat.

Relative Form of Bow and Stern.—If the boat be sailing or rowing to windward against a heavy sea, the bow must be comparatively fine in form to reduce the shock of each wave. It must have a considerable surplus of buoyancy so as to rise to each wave, but must not have such an excess of buoyancy or of horizontal area as would raise it high above the wave, thereby losing way and giving the wave a chance of turning the boat end over end. The bow should be decked over for some length, so as to permit of running into a wave and rising through it without taking much water on board. The stern has altogether different duties when the boat is going to windward. Any reasonably fair form will enable the water to close in the boat's wake without undue drag. Full quarters would so extend the water-plane area as to offer a valuable resistance to depression when the bow is rising to a wave, thereby maintaining headway, and preventing the boat's rising on end; and this can be effected with comparatively little surplus buoyancy at the stern. The rudder power would be increased by comparatively fine lower lines below the full quarters. Stability for sailing, or to resist capsizing, would be greatly increased by thus continuing the breadth further aft; and in every way it appears that for going to windward a fine and moderately high bow, and a broad and comparatively low stern, and fairly deep keel and rudder, would best give the qualities required.

For running free the very same qualities are required, with the additional consideration that the bow must not have too lofty a side, since the blow of a sea on one side of the bow has been one of the causes of capsizing. If the gunwale amidships can be kept low, or made of a tumble-home form, it will further help to reduce the blow of a sea.

In running before the sea, and especially in landing through heavy breakers, somewhat opposite conditions are met with, but none which would render it desirable to take such a lifeboat in stern foremost. The great desiderata here are, that the bow end shall have ample buoyancy to prevent its burying when a wave overruns the stern; and that the stern shall have a deep grip of the water, and comparatively low sides, to prevent its being turned aside by the blow of a sea on one quarter, the most frequent cause of broaching to and capsizing. Being overtaken and pooped by a following sea, the direst peril of an open boat running through breakers is comparatively harmless to a lifeboat whose buoyancy depends on air-cases: and therefore a low stern with somewhat deep keel, and a high bow with considerable surplus of buoyancy, will best meet the requirements.

Thus, whether rowing or sailing to windward, running free, or running before the sea, a fine bow with considerable surplus of buoyancy, and a broad stern with but a moderate surplus of buoyancy, seem the safest and best for lifeboat work.

Curves of Sectional Areas.—A number of diagrams of the curves of various boats were given. One of the many detriments involved in the self-righting system is the possession of angular lines of sectional areas above water.

Proportions of Weight to End Area.—The total end area of a boat, in comparison with its weight, is almost a criterion of its power of facing rough water, since impetus is essential to holding the boat's way when meeting a sea.

Towing Resistance against Head Wind and Sea.—When going to windward, just as much resistance is caused by the above-water surfaces, which meet the flying spray and broken water, as that caused by the immersed parts, which are in less disturbed water. Also fineness of form, and absence of flat or blunt ends, either above or below water, tends to easy progress to windward.

Curves of Stability.—The author has also found the curves of stability of the various types of boat.

Self-Righting Powers.—The officers of the Lifeboat Institution have recently effected a great increase in the entire self-righting power of their boats, by the enlargement of the end air-cases, greater rise of floor amidship, the addition of two inches depth of keel, and the reduced beam in the lifeboat of 1887 as compared with that of 1862. But this increased righting power when capsized is obtained by sacrificing one-fifth of the stability when not capsized; and it is quite evident that the common statement, that the features which give the self-righting power also increase the stability of a lifeboat, is utterly erroneous and misleading. It appears certain that the frequent disastrous capsizes of the small rowing lifeboats might be almost always prevented by giving them considerably more stability. It is possible by heavy ballasting, and by a modification of the usual proportions of the boat, without any increase of draught, or of weight when on shore, to provide a lifeboat with fully twofold greater stability, and with threefold more resistance to capsizing by a sea, than a self-righting boat has; and the author thinks that this greater stability, with better rowing and sailing qualities, would compensate for the absence of the self-righting quality.

The Side-Decked Lifeboat.—The author then described an attempt to embody in one design many of the good features of the five existing types of boat. This boat is 34ft. length over all, and 8ft. 9in. beam, rowing ten oars; its most peculiar feature is side-decks, or tumble-home sides, whichever they may be called, at about 45° angle from the gunwale to the low fenders. These, together with the deep sides of the hull, give a lateral stability at load draught 160 per cent. greater than the approved rowing self-righting boat. The sloping sides give little hold to a sea striking the broadside. The rowlocks, placed on a gunwale of 7ft. 6in. beam, like an ordinary lifeboat, will heel much less than rowlocks at the full breadth of the boat. The low but unusually low bow air-case is intended to give an easy lift in entering a wave; while the full stern steadies the boat, and prevents the bow from hammering unduly over short waves, or rising on end against a high breaker. The narrowed bow end of the working space tends to keep out water when heeling over. The slight coamings at bow and stern and on the gunwales are shaped to give a good hand grip. The end outline area is rather less than that of the self-righting boat, though the total bulk is 1·6 tons more. The displacement is 1·4 tons more than that of the self-righting boat, and this would be utilised for water ballast, so as to increase the stability and momentum of the boat without adding to its weight when on shore. By thus adding 1·4 tons of ballast to the boat, its great water-plane and plan-outline areas are more heavily weighted per square foot than the rowing self-righting boat. The lateral outline area is one-tenth less than the self-righting boat, and, having much less vertical side, the boat would be able, by this and its stability together, to resist much more of a wave blow than would capsize the self-righting boat. The weight per square foot of end area, being one-third more than that of the self-righting boat, would give great impetus for resisting a breaker or sea. Its towing resistance is the same as the self-righting boat, and as its sail-carrying power is 160 per cent. greater, its comparative power of sailing to windward is 160 per cent. greater than the self-righting boat. The horizontal square tube or casing within the bow air-case, and the opening in the second thwart, provide for easily stowing the masts below the thwarts, and so leaving working room for longer oars. The large recess in the boat's floor and the ball valves and canvas curtain ensure a rapid discharge of any water coming on board. A drop-keel of short length would be fitted, but even without this valuable appliance the boat would be well able to beat to windward, from having a deeper keel and lower end air-cases than usual. By omitting two of the usual three battens over the side air-cases, these cases are raised 2in. without raising the seat height; and the thwarts are also raised to the rowers' seat height, omitting the usual raised seats. The side air-cases above deck are of 104 cubic feet, or just double the bulk of those in the ordinary lifeboats, include in this cube the cork filling up to the side decks and gunwales.

The last paper was by Mr. James Howden, on "Various Theories of the Screw Propeller." Mr. Howden is well known as an expert in the design and construction of screw propellers, and also as an opponent of the generally accepted theory of propellers which was propounded by Rankine and further elaborated by Greenhill, Froude, and Cotterill. Former papers read before various societies by Mr. Howden have been ineffectual in dislodging Rankine's theory from its position, and the alternative theory contained in them has been all but forgotten. The object of the present paper was to resuscitate the discussion on the merits of the two conflicting theories. As the paper was chiefly a reiteration of former statements and arguments we think it unnecessary to reprint it here. The discussion was without interest.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 22nd April, 1890.

Iron.—The iron market here has changed but little in the course of the last week. Business is slack and without immediate prospect of improvement. Prices remain nominally at 152s. for bars, and 156s. for joists; but terms are offered which practically makes the latter 154s. Some slight changes have occurred in the provincial centres of the iron trade. Thus there is less activity in the Haute Marne, and the improvement which appeared last week in the markets of the Nord has been lost. On the other hand the export trade in pig iron from the Meurthe-et-Moselle has increased, and more favourable reports are to hand from the Ardennes. The galvanising industry is about to be founded in the latter locality at Sedan.

Coal.—The scarcity of coal continues to favour the import trade, which has more than recovered the loss it sustained last year. The quantity of foreign coal received and delivered for consumption in France in the first three months of the current year amounted to 2,080,794 tons, against 1,875,128 tons in the corresponding period of 1889, and 1,974,715 tons in 1888. Of this quantity England furnished 1,047,157 (895,438) tons; Belgium, 880,211 (816,863) tons; and Germany, 150,786 (162,566) tons, the figures in parentheses being those for last year. The imports of coke amounted to 291,834 tons, against 161,115 tons in 1889. The whole of this increase is in the trade with Belgium.

Metals.—Business in the metal markets continues to shrink, and prices follow a downward course. Copper quotations show but little change from those of last week, but the tone of the market is weaker. The same remark applies to the market for tin. Lead has given way considerably. The present quotation is £13 5s. for Paris. Spelter, too, is steadily declining. Silesian is quoted £22 16s. at Havre. Consumers are now buying in very small quantities, sufficient only for the requirements of the moment, which are not large.

Trade with Portugal.—With a view to enable his countrymen to profit by the ill feeling against England now existing in Portugal, M. Dejante, a member of the Council of the French Chamber of Commerce at Lisbon, has prepared from official statistics a set of tables and classified lists showing the imports from the five great producing countries of Europe, copies of which have been sent to all the Chambers of Commerce in France as well as to a large number of individuals. These documents indicate where trade hitherto in the hands of the English may be diverted in favour of French industry.

French Railways in 1888.—Recently published returns show the results of the working of the six principal lines of railways in France during 1888. It seems rather strange that they should be more than a year behind date, but that is the way with things here. The lines of which particulars are given are those of the Compagnies du Nord, de l'Est, de l'Ouest, d'Orléans, de Paris-Lyon-Méditerranée, and du Midi respectively. The total capital raised by the six companies up to December 31st, 1888, amounted to 11,903 million francs, of which 11,711 millions had been actually expended. The total mileage authorised to be constructed was 35,852 kilometres, while that open for traffic was 29,529. The cost of construction, including rolling stock, amounted to 386,708 francs. Deducting the cost of the rolling stock, the cost of the permanent way in pounds sterling was very nearly £18,000 per mile, which is very high. The total receipts of the six principal lines in 1888 for an average mileage open to traffic of 29,144 kilometres was 1,005,523,210 francs, the total expenditure amounted to 502,661,436 francs; the net receipts were consequently 502,861,774 francs, and the proportion of the expenditure to receipts was 49·99 per cent., compared with 50·53 per cent. in the preceding year. The expenditure was increased in 1888 by 0·78 per cent., against an increase of 1·74 per cent. in the receipts, and an augmentation of the mileage open for traffic of 1·06 per cent.

BERLIN, 21st April, 1890.

Iron.—The business of the iron market has been visibly affected by the result of the tendering for locomotive coal at Magdeburg and Elberfeld. Buyers see in the event a near prospect of cheaper fuel, and, consequently, of cheaper iron, and they manifest a disposition to delay the placing of fresh orders. On the other hand, sellers are more desirous of booking fresh orders at the current rates, and offers are made of conditions which amount to slight concessions on those rates. The Breslau merchants have even reduced their prices for rolled iron 10s. a ton, making the latest quotation for bars 210s.

Coal.—The event of the last week has been the tendering for the locomotive coal required during the ensuing year for the Magdeburg and Elberfeld railways. The lowest offers were 13s. 6d. a ton in the former case and 12s. in the latter. These prices are so much below the current rates that the whole of the industrial world of Germany has been thrown into a state of commotion, the obvious inference being that the colliery owners expect much lower rates for coal before the end of the year. From Upper Silesia we learn that though the demand for house coal is now rapidly falling off prices are firmly maintained. But it appears that this firmness is due to the prospect of labour difficulties, for we are told that in several places the miners have come out on strike for the eight hours shift. There is no prospect of this demand being granted, but the refusal may lead to some conflict. A number of deep-earth borings are now in progress for the purpose of further developing the coal-fields of Upper Silesia. One of these has been brought to a stand by a strike for higher wages; another has just reached a thick seam of the coal.

Metals.—Business in the metal markets continues to decline. Transactions are few and of little importance. Consumers buy only sufficient to cover the most pressing needs of the moment, the general belief being that prices will go lower. Copper has receded a little, Mansfeld refined being now quoted £58 10s. to £60, and English brands from £55 10s. to £57. Tin is very weak at £97 10s. to £98 for Banca. Lead continues firm; but zinc has further declined. Silesian W.H. spelter is quoted £23 15s. Berlin zinc dust is in demand, but zinc white is neglected. Antimony regulus is a little cheaper.

India-rubber Goods.—At a meeting of the convention of German manufacturers of india-rubber goods, held the other day at Hanover, it was resolved to advance the prices of their produce from 10 to 20 per cent., to cover the increased cost of the raw materials. The quantity of india-rubber and gutta-percha in the unmanufactured state imported into Germany in the first two months of the current year amounted to 11,982 cwt., against 11,034 cwt. in the same period of 1889. The exports of manufactured rubber and gutta-percha goods in the same periods amounted to 2,224 cwt., against 1,856 cwt.

Railway Rolling Stock.—Never has there been greater activity in the production of railway rolling stock than now. The locomotive shops are gorged with work, and the makers of goods waggons are scarcely able to meet the demands made upon them. Within the last week some of our locomotive builders have been asked to tender for a number of engines required for one of the Russian lines.

An Electric Railway for Russia.—It is proposed to have an electric railway to connect St. Petersburg with Archangel, and to span a wide stretch of country between the Baltic and the White Sea. The project is backed by Archangel interests, and the name of Siemens & Co. is connected with the enterprise. The plan is to furnish the current from a series of generating stations distributed along the line. The distance is over 500 miles, and the estimated cost a little over £3,000 per mile, including rolling stock. The scheme is a daring one, and its progress will be awaited with interest by the advocates of electric traction.

Steamers to East Africa.—A company has been formed at Hamburg for the establishment of a German line of steamers to East Africa with a capital of 6,000,000 marks, of which 25 per cent. has already been paid up.

VIENNA, 21st April, 1890.

The Iron Market.—In well-informed spheres it is felt that some change is visible in the position of the market. Works still have many orders on hand, but new ones do not seem to come in so fast as hitherto. The prospect of new increases in prices has now disappeared, and dealers and consumers are waiting for a crisis. As I reported last week, the locomotive manufactory of Wiener-Neustadt received an order from the Saxony State railways for eleven locomotives. Messrs. Kraup & Co. of München, Sachsische Maschinen-fabrik of Chemnitz, Messrs. Schwarzkopf of Berlin, and Hentschel & Sohn of Cassel tendered for the order also, but the firm of Sigl & Co. obtained all the orders that did not go to Wiener-Neustadt, because their term for delivery was the shortest. Another order is to be given by the Dux-Bodenbach Railway for four locomotives at a price of 152,000fl., and a sum of 282,950fl. has been set apart by the same railway company for the construction of 123 coal waggons. A good business is being done in agricultural machines. The Budapest agents of Messrs. Ruston, Proctor, & Co., of Lincoln, have delivered some machines in Vienna for electrical purposes.

The Coal Market.—The situation of the coal market continues very firm, and prices are steadily increasing. The prices of some sorts are also kept high by the insecurity caused by the labour question. The Silesian works are threatened by strikes, and at Ostrau the labourers have already ceased to work. The Vienna supplies will now have to be procured in greater quantities from Bohemia. Already the Bohemian collieries have hard work to answer the demand. The Brüxer Kohlenbergbau-Gesellschaft has bought two new pits near Dux, and in order to work them it is increasing its capital by 10,000 shares of 100fl. This company pays this year a dividend of 7 per cent., against 6½ per cent. last year.

Gas Lighting in Austria.—The other day the Gas Company of Vienna held its annual meeting. During the past year it has made a clear profit of 549,000 florins on a capital of 4,000,000 florins, and a dividend of 9½ per cent was declared. The remainder went to swell the reserve fund, which, however, for all practical purposes, has been quite large enough hitherto. By many this constant addition to capital is considered highly injudicious. This gas company owns a large number of installations in other towns of the empire besides Vienna—*e.g.*, Fiume, Pressburg, Graz, Brünn, and Temesvar.

Transmission of Power by Compressed Air.—The scheme for the establishment of a central station for the distribution of power by means of compressed air is now taking a defininite shape, and a suitable site has been acquired for the erection of the buildings and machinery.

The Wood Wool Industry.—The demand for wood wool is very animated at present, and it is generally hoped that the market for this commodity will now be able to throw off the sluggishness which has characterised it lately. The last business year has not been particularly satisfactory, and only one works—viz., the Felixdorf—could show a large balance at the stocktaking.

The Zone Railway Tariffs.—The latest Hungarian railway returns show that, during the period from 1st of August, 1889, to 31st of March, 1890, the traffic on the State railways amounted to 7,770,876 passengers, against 2,891,332 in the corresponding period before the introduction of the zone tariffs, which is an increase of 169 per cent. The result is still more remarkable with regard to the traffic between neighbouring stations. Whereas under the old tariffs, in 1877, only 255,000 persons used the railway for such short journeys, their number during the above-mentioned eight months rose to 4,367,586. It is reported here that the Hungarian Government are contemplating a further reduction of passenger fares, especially with a view of transferring the great summer traffic from the Austrian Alps to the Carpathians.

BRUSSELS, 22nd April, 1890.

The Iron Market.—The position of the iron market is becoming more and more serious. The price of coal is likely to retain its high level, and pig iron makers find it perfectly impossible to make any abatement in their quotations. The consequence is that trade is very much narrowed and orders are difficult to execute. One of the ironworks, that of which M. F. Bailly is head, has obtained a large order for material for Portugal, and M. Bailly has received the distinction of the Cross of the Order of Christ. There is also a large order for locomotives for Russia on the point of settlement. The prices at present are stationary, on account of the impossibility of business. They are compared with the prices during April, 1889, in the following table:—

	1889.		1890.
Grey pig	45·95fr.	...	48·55fr.
Forge pig	52·93fr.	...	59·41fr.
Bessemer pig	58·86fr.	...	66·17fr.
Joists and large bars	113·92fr.	...	121·72fr.
Small bars	118·05fr.	...	132·90fr.
Angles	124·03fr.	...	131·98fr.
Sheets	146·38fr.	...	160·33fr.
Steel rails	105·62fr.	...	108·89fr.

The Glass Trade.—No particular feature has distinguished the trade of the past week. There are not sufficient orders to keep pace with the production, and the production will therefore have to be reduced. The continued steadiness of the prices of coal has damped all hopes of a cheaper production of glass. Several good orders have come to hand from the United States, but England is asking for very little at present. The exports of window glass during the first two months of the present year amounted to 13,280 tons, as compared with 14,891 tons during the corresponding period of 1889.

The Coal Market.—Ever since the last adjudications of the contracts for the supply of coal for the State railways the prices have remained very firm, and the present position of the market seems to be impregnable. The exports and imports of the first two months of 1889 and 1890 are compared in the following table:—

	Tons. 1889.		Tons 1890.
Coal imported	170,612	...	324,871
„ exported	599,739	...	666,514
Coke imported	3,323	...	5,176
„ exported	187,398	...	221,192
Briquettes imported	—	...	—
„ exported	44,678	...	40,502

The number of trucks employed on the State railways for goods traffic during the past week is compared in the following table with the number during the similar week last year:—

	1889.		1890.
Coal and coke	18,731	...	21,673
Other merchandise	34,669	...	34,993
Other fuel	3,248	..	2,586

DÜSSELDORF, 22nd April, 1890.

Iron.—The declining tendency of the iron market in this locality has become more distinctly marked since it became known that the recent tendering for locomotive coal opened up a prospect of lower prices for fuel. Buyers now will not go beyond present requirements, and even in these transactions they manifest a disposition to stand out for some concession in prices. Business in pig iron is very slack. With the exception of foundry pig, however, which has receded two or three shillings a ton, prices are scarcely altered from what they were a week ago. But the offers of foreign pig which are being made at greatly reduced rates cannot fail to bring down in a little time the syndicate minimum for German pig. The current quotations are: Ordinary spiegel pig, 102s.; Rhenish-Westphalian forge, 89s. to 90s.; Siegen forge, 89s.; foundry pig No. 1, 95s.; Thomas pig, 78s. to 80s.; and Bessemer, 93s. to 94s. a ton. Business in finished iron and steel is fairly active; but it

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is wanting in that life and vigour which characterised it a few weeks ago. The merchants are making considerable concessions in prices.

COAL.—The relatively low prices tendered for the Magdeburg and Elberfeld railway contracts for locomotive coal, the deliveries of which are distributed over the next twelve months, have greatly disturbed the markets. It is evident from these tenders that the colliery owners have begun to realise the necessity for cheaper fuel, and that they have convinced themselves that the present rates cannot be much longer maintained. Buyers are, in consequence, disposed to press for immediate concessions, and sellers are showing themselves more willing to discuss terms with their customers. It is now pretty certain that no general strike will take place this year.

ENGINEERS' VISIT TO THE UNITED STATES.—The invitation of the American Institute of Mining Engineers to the Vereindeutscher Eisenhüttenleute, an association similar in character to the English Iron and Steel Institute, has been accepted, and it is now certain that a large number of the members will visit the United States next autumn. Already upwards of eighty have signified their intention to be of the party. The latter will leave about the 22nd of September, and the visit will be of four weeks' duration.

LILLE, 22ND APRIL, 1890.

IRON.—The increased demand of last week has died out, and the market is again languid. The slackness of business in Paris has a most depressing effect here, for the capital is our most important market. For the present manufacturers have plenty of work on old contracts, but, fresh orders being scarce, they have cause for anxiety. Prices are maintained with some firmness, but with falling markets abroad and shrinking business at home the prospect is not encouraging to sellers. It is not to be wondered at that in such circumstances consumers abstain from buying beyond the needs of the moment.

TEXTILE MANUFACTURES.—The busy period in the linen goods trade is now past, but though the current of business is gradually slackening, it still keeps above the average strength for this time of the year. The situation must, therefore, be considered satisfactory. There are fewer buying agents to be seen now at Armentières, but orders continue to come to hand freely through the post. The export trade is fairly active. The Customs' returns for the first three months of the year show the declared value of the exports to have been £105,840 for linen and hempen piece goods, and £115,840 for flax and hemp yarns, against £73,600 and £108,320 respectively.

FLAX AND YARNS.—The demand continues strong for home-grown flax, and as the quantity on offer is not large, prices are easily maintained, especially for the better sorts. Business is somewhat less active in Russian produce. Tows of good quality are inquired for, but there is not much doing in the middling and the lower qualities. Jute yarns are in strong demand. For linen yarns the market is more active, and prices are very firm at last week's quotations. The declared value of the raw flax imported in the first three months of the year amounted to £780,520, against £933,400 in the corresponding period of 1889.

AMSTERDAM, 21ST APRIL, 1890.

THE ROYAL MACHINERY FACTORY AT AMSTERDAM.—This factory, which has been forced into liquidation by an unfortunate combination of circumstances, has discharged some 200 artisans. It is hoped no more need be sent away at present if the Government contracts with the company are kept up.

THE GOLDFIELDS OF GUIANA.—It is understood that the Dutch Government has withdrawn its reserves regarding the subject of the delimitation of the extent of the goldfields in Guiana which is in dispute. The Emperor had declined the proffered arbitration of the rival claims of Holland and France, owing to Holland's reserves. These having been withdrawn, the Czar has consented to act.

STEAMBOAT COMPANIES.—The Steamship Company "Nederland" (Amsterdam-Batavia) is enabled to distribute a dividend of 10 per cent. to its shareholders on account of the operations in the past year. The directors of the Netherlands American Steamship Company state in their report that the results of the trips to the Argentine Republic have not been so profitable in 1889 as those to the United States, but, on the whole, the operations of the company have been very satisfactory. The directors, however, opine that 1889 has been an exceptionally busy year, and they doubt very much whether 1890 will show an equally brilliant result—17 per cent. dividend—the less so because the capital of the company has been doubled lately, and the new ships are not yet completed.

RAILWAYS AND TRAMWAYS.—The sections of the Second Chamber have issued a rather unfavourable report on the Government proposals regarding the State purchase of the Dutch-Rhenish Railway and the conventions with the State Railways and Holland Railway Companies. The majority doubts the wisdom of the Government proposed system, and thinks the price paid to the Dutch-Rhenish shareholders too high. Meanwhile the various conditional conventions have virtually lapsed, and the shareholders of the different companies have been convened afresh to sanction a short postponement of the dates of ratification pending the passing of the Government Bills in the two Chambers. The Dutch District Railways and Tramways Union held its annual meeting last week. Various points of mutual interest were discussed, among others new modes of heating carriages and obtaining cheaper fuel for motive power.

DRAINAGE IN FRIESLAND.—A drainage syndicate has been formed in Friesland to drain the low-lying lands which separate the mainland from the North Sea islands. It requires, however, a Government subsidy of 4 per cent on a capital of £1,000,000 for six years, and a further payment or grant for each acre of land laid dry. In answer to a request to that effect which the syndicate forwarded to the Government, the latter has replied that it could not ask the sanction of the States-General on the plans as made. An inquiry by experts, said the official reply, had shown that the proposed drainage of the indicated lands would not have necessarily the anticipated results. Moreover, the financial proposals were not of a nature to be taken into consideration. But if others, less onerous, were propounded, the Government would examine them with a view to acceptance.

COALS IN BORNEO.—The Dutch East Borneo Coal Company has received favourable advices from its collieries, and the developments of the mines at Kutei are better than the directors anticipated. Under these circumstances the shareholders have resolved to increase the capital of the company by a further issue of shares, which have already been taken up at a premium.

COPENHAGEN, 19TH APRIL, 1890

A LARGE SWEDISH CONCERN.—Large manufacturing establishments, with several distinct departments and vast estates, are not uncommon in Sweden, but none can probably vie with the Ljusne-Voxne Company, Sweden, of which a few particulars will no doubt be of interest. The beginning was modest enough, when thirty or forty years ago Mr. Wilhelm H. Kempe, from Stockholm, commenced business on the coast near where the Ljusne river runs into the sea. The Ljusne harbour can now accommodate steamers of 2,000 tons. The two principal articles of export are timber and iron. The export of timber, which is the most important one, amounts to about 30,000 standards every year. The company owns some very extensive forests in Dalarne. The flooding of the timber takes place down the Ljusne river, and is under the control of a special "flooding manager." It was a difficult undertaking, in the first instance, to regulate this transport by water, and for the first couple of years the greater portion was lost in the sea. The saw mills are on a very large scale, working day and night; the timber is dragged from the river by iron chains. With regard to the iron industry, the development has been gradual but steady, and continuous blast furnaces were erected in the year 1873, engineering works in 1876, and rolling mills in 1883. In the year 1886 the company bought South Ljusne Ironworks, the concession of which dates as far back as 1671. The North and South Ljusne Ironworks now comprise three blast furnaces, fifteen forges, and fourteen rolling mills, which are all worked by water taken through canals from the Ljusne river. The manufacture of pig iron amounts to some 300,000 cwt. annually, and this is afterwards further handled at the establishment for export. The company has its own mines as well as its own forests. The number of people attached to the Ljusne establishments is about 4,000, and the wages are generally very good, so there have been no strikes.

MADRID, 21ST APRIL, 1890.

FIRE AT THE MADRID GAS WORKS.—A fire, which has lasted more than twenty-four hours, broke out in the gas works of Madrid, on the 14th inst. This accident was very serious, and caused an interruption in the gas supply, which was, however, only temporary.

PAPER MILLS.—No sooner has a company, at the head of which are some of the partners of the rich house of Messrs. Ibarra, decided to establish a first-rate paper mill, than other parties are following in the same track, and in the course of the present year Biscay will possess two paper mills, which will include every recent improvement.

IMPROVEMENTS IN BILBAO.—This town is being continually improved by the wealth which the iron ore mines are putting in the hands of every class. At this moment a very large and luxurious hotel is being erected in connection with the railway station. The electric station of the Electric Company is in an advanced state, and will be ready to commence service by the end of May.

MINING MOVEMENTS AT BILBAO.—Business in mines is in a flourishing state. A company with a capital of £600,000 is to be floated to work the Parcocha mine, which is supposed to contain a large quantity of ore of the excellent but now scarce Campanil variety. Another mine, only six hectares in extent, is reported to have been sold for £170,000, and an unexplored claim has brought £20,000 cash.

THE RAILWAY MANIA IN BISCAY.—The railway mania prevailing in this province is greater than was imagined at first, and in a few months from now every line of any kind that can be reasonably constructed will be taken up and carried out. The shares of the Bilbao and Portugalete Railway are sold at 268 per cent. premium, and many holders will not sell under 400 per cent. This is anything but unreasonable, it being a fact that, though their fares are very low, 14 per cent. is earned.

NEW YORK, 12TH APRIL, 1890.

THE IRON TRADE.—There has been something of an improvement in the iron market, although prices still remain low. The demand is rather better in almost all lines. In pig iron prices about hold their own. Some outside brands are being offered at very low figures, but little business is done in them. Production is still very heavy, and is likely to continue so, unless there is a serious drop in prices, and consumption must be well kept up if prices are to remain at their present level. Manufactured iron is more active, and although prices are yet unchanged, the increased demand will in a short time, if maintained, start them upwards again. There is considerable demand for bars from car-builders, and plates are a little higher. There is more inquiry for steel rails, but prices barely hold their own. Slabs and billets are lower, and the decline in prices has made orders for rails more desirable.

THE COAL TRADE.—There has been little change in anthracite. Prices are about the same, and cutting is confined to white-ash coals and odd cargoes generally. There is more inquiry for future delivery, and the leading operators unite in refusing to make any contracts for delivery ahead at anything like present rates. The Delaware, Luckawanna, and Western Railroad Company has announced to shippers that it would hereafter charge as freight on coal 50 per cent. of the net f.o.b. selling price at tide. This is equivalent to a reduction in freight rates of about 20 per cent. per ton. This new departure will force the other carrying companies to reduce their rates. The taking of such a step without consulting the other companies does not promise well for the continuation of the present combination. The H. C. Frick Coke Company have closed down 676 ovens indefinitely because of the lack of orders. The labour leaders say that there is a probability that all the works in the region will be put out of blast owing to the great dissatisfaction it is causing among labourers.

BESSEMER STEEL WORKS.—The West Superior Iron and Steel Company, of West Superior, Wisconsin, have decided to construct a Bessemer steel plant for the manufacture of steel plates and other iron and steel work.

THE LATEST AMERICAN SYNDICATE.—Syndicates are extending in every direction in America, and now every important industry is more or less under their control. One has lately been formed to obtain control of all the lithographing business throughout the country. The capital at the back of this big venture is stated to be $200,000,000.

THE "PLYMOUTH."—The third large side-wheel steamboat, built at Roach's ship yard for the Old Colony Steamboat Company, was launched last week. She has a double hull, and is built of steel on the bracket plate longitudinal system, with seven watertight bulkheads and fifty watertight compartments. Her engines will be of the four-cylinder triple-expansion type of 5,000 horse-power. There are 250 state-rooms, and there is accommodation for 1,200 passengers.

THE NORTH RIVER TUNNEL.—A serious accident has occurred at the New York end of the North River Tunnel, which has been in process of construction for the last fifteen months. At the foot of the shaft on the New York side is a caisson 48ft. by 23ft., having its roof 35ft. below the top of the shaft. From this caisson the tunnel has been carried 150ft. under the river. On Sunday morning last a workman searching for possible leaks between the timbers in the roof of the caisson set fire to the oakum with which it is caulked. The shaft was flooded to prevent the fire destroying the caisson, since which time it has been impossible to clear the caisson of water. From the New Jersey end the tunnel has been carried 2,000ft. under the river. The flooding will cause considerable loss of time and money, and may necessitate the securing of a new terminus on the New York side of the river.

SOUTH PENNSYLVANIA RAILROAD.—Numerous efforts have been made to revive this road, but none have so far been successful, and a short time since it was sold. The purchase was probably in the interest of the Reading Railroad. For a long time the Reading Road has been seeking an outlet to the West. At present all its south-western business ends at Harrisburg, and has to be transferred to the Pennsylvanian road at that point The Reading is now building a new line from Harrisburg to Bowmansdale, and it would cost very little to connect with the South Pennsylvania. The road is partly graded, most of the tunnels are built, and a number of bridges are up, so that it would require a small amount of money to finish the road. Its completion would be of great service to the Reading Company.

HUDSON RIVER BRIDGE.—The House of Representatives has passed a Bill authorising the construction of a bridge from New York City across the Hudson River. The bridge is not to have less than six railroad tracks, with a capacity of four additional tracks for future enlargement. It is to be constructed with a single span between the towers located between the shore and the established pier head lines in either State. It is to be as high above the water in the clear as the present Brooklyn Bridge, and no pier or other obstruction, either temporary or permanent, is to be erected between the towers. The construction is to be begun within three years, and it is not to take over ten years in building. The plans are to be approved by the Secretary of War. The company is authorised to issue bonds secured by mortgage on its property. All railroad and telegraph companies are to be entitled to equal rights in using the bridge for a reasonable compensation to be approved by the Inter-state Commerce Commission.

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DIRECT ACTING HYDRAULIC PUMPING ENGINE.

CONSTRUCTED BY MESSRS. KNIGHT & CO., ENGINEERS, SUTTER CREEK, CALIFORNIA.

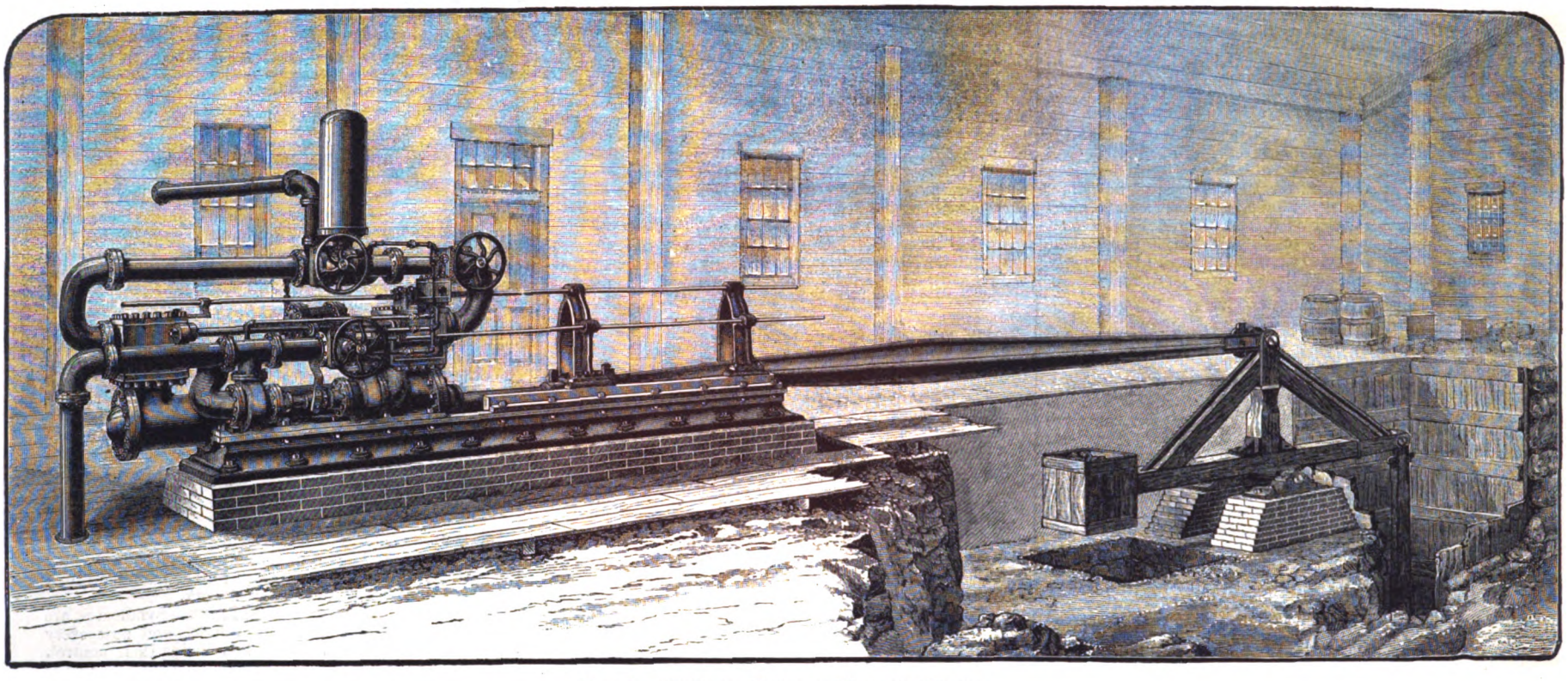


FIG. 1.—GENERAL VIEW OF PUMPING PLANT.

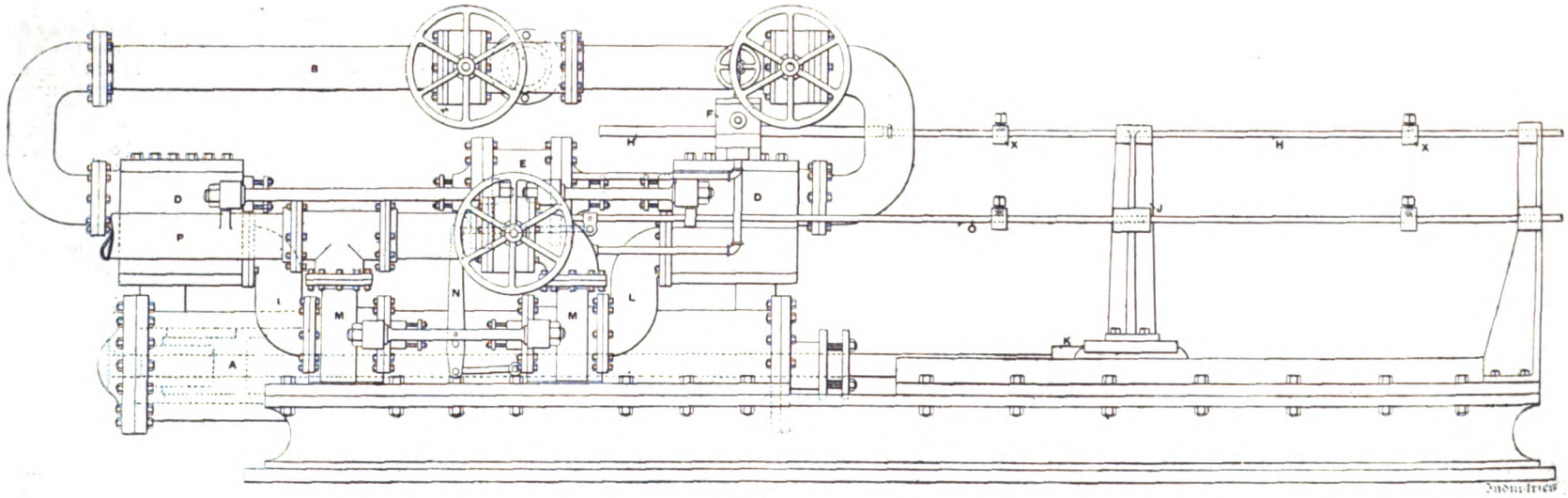


FIG. 2.—SIDE ELEVATION OF PUMP.

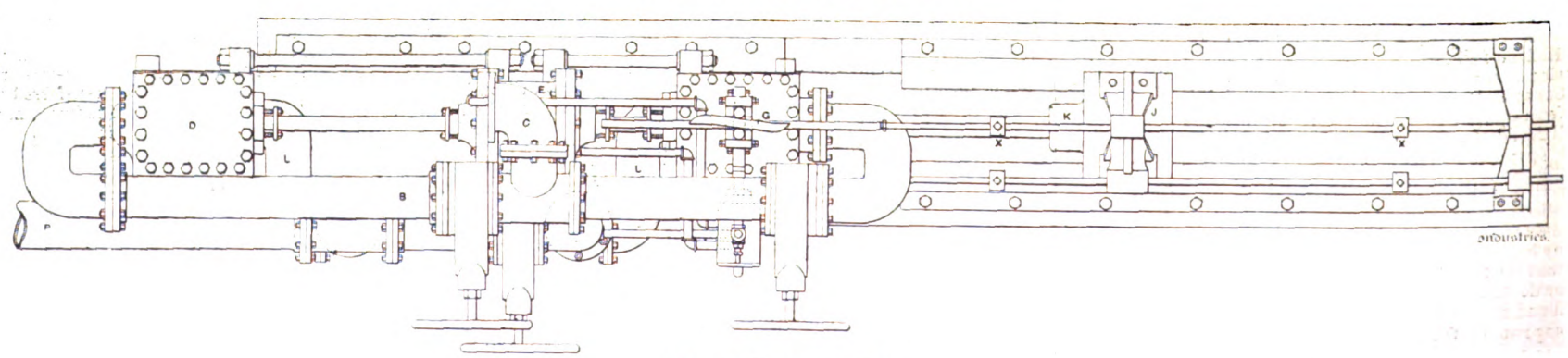


FIG. 3.—PLAN OF PUMP.

DIRECT ACTING HYDRAULIC PUMPING ENGINE.

WE illustrate above a type of direct acting pump which is designed to be driven by water pressure having "heads" from 300ft. to 500ft., or even 1,000ft. The pump has been designed and constructed by Messrs. Knight & Co., engineers, Sutter Creek, Amador County, California, and the credit of its gradual evolution is mostly due to Mr. Samuel Knight, who has devoted many years to the application of high-pressure water power to mining operations.

The main cylinder is 12in. diameter, and is of wrought iron, and the side pipes are steel castings. The principal feature, and the one that finally led to noiseless and successful working, is the use of independent exhaust valves. The induction valves are moved by the auxiliary cylinder shown on the top. The working of the machines is quite noiseless, and there is not the least jar even when 500ft. of heavy pump rod are connected with the engine.

Four of these large pumping engines are now working with driving "heads" as follow:—One with 336ft., two with 460ft., and one with 720ft. The efficiency of the engines has been carefully tested, and is found to be 75 per cent. The firm guarantee this efficiency for all engines when the diameter of the main cylinders is 12in. or more.

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The illustrations show the details of one of these pumping engines constructed for the Plumas Eureka mine in California, to operate under a head of 720ft.—*i.e.*, with a pressure of 310lb. per inch. A is the main cylinder, B B induction pipes, the water entering at C. In the two boxes D D are two plain slide valves actuated by the auxiliary hydraulic cylinder E. This cylinder E is controlled by a small slide valve in the box F, which is operated by the sliding tappet G and the rod H. The stop collars I on H are moved by the bracket J, which is mounted on the cross-head at K. The tappet G, shown in the plan, is one of the "pass through" type, and acts some time in advance of the main valves. The exhaust pipes L L extend from the valve boxes D D down to two balanced cylindrical valves at M, which control the exhaust flow as it passes to the waste pipe P. This is the main point in Mr. Knight's invention, and the

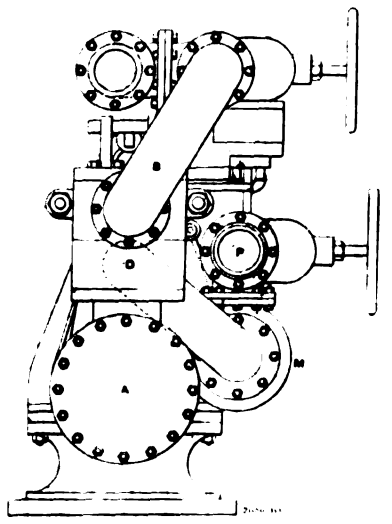


FIG. 4. BACK END VIEW.

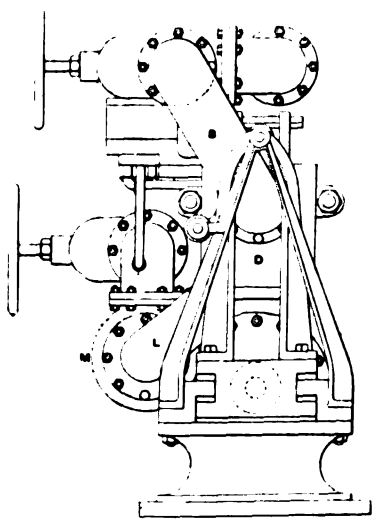


FIG. 5.—FRONT END VIEW.

secret of smooth working in his machines. These two piston valves at M are operated by a lever N, and a second tappet rod O, which imparts a slow movement to the valves. The valves thus begin to close and choke the exhaust soon after the piston has reached its maximum velocity, and gradually bring the water, and also the heavy pump rods, to a state of rest at the end of the stroke, just as a crank would do. As the tappets on the rod H outrun the main valves at D D by a foot or more of piston movement, it leaves the range of stroke to be controlled by the rod O and the retarding valves at M, so that by shifting the collars on the rod O the reciprocating parts can be cushioned and brought to a state of rest, avoiding all shock and danger to the pipes or machinery. We may explain that the pipes for conveying water in the mining districts of California are mostly of thin sheet iron, and so connected that the least shock is liable to rupture them. In this matter Mr. Knight has found his greatest difficulty, and, besides arranging his engines in the manner explained for easy cushioning, has to place air vessels on the pipe lines to avoid shock.

Notices of Meetings.

INSTITUTE OF MARINE ENGINEERS.—Tuesday, April 29th, at 7.30 p.m. Paper on "The Churchill Governor," by Mr. J. D. Churchill.

SOCIETY OF ARTS.—Wednesday, April 30th, at 8 p.m. "Photographic Lenses," by Mr T. R. Dallmeyer.

PHYSICAL SOCIETY.—May 2nd, at 5 p.m. (1) "The Distribution of Flow in a Strained Elastic Solid," by Mr. Charles A. Carus-Wilson; (2) "Photographs of Rapidly Moving Objects" and (3) "The Oscillating Electric Spark," by Mr. C. V. Boys.

THE INSTITUTION OF CIVIL ENGINEERS.—Students' Meeting, Friday, April 25th, at 7.30 p.m. Paper to be read: "Some Applications of Electricity in Engineering Workshops," by Mr. C. Frewen Jenkin, B.A. Ordinary Meeting, Tuesday, April 29th, at 8 p.m. Resumed discussion upon the papers by Sir Frederick Bramwell, on "Welding by Electricity," and by Mr. John Robinson, on "The Barry Dock Works"—the latter time permitting.

ROYAL INSTITUTION.—Annual Meeting, Thursday, May 1st, 1.30 p.m.

GEOLOGISTS' ASSOCIATION.—Friday, May 2nd. Papers to be read: "On the Manufacture of Serpentine in Nature's Laboratory," by Major-General C. A. McMahon, F.G.S.; "On a New Species of Capulus," by Professor G. S. Boulger, F.L.S., F.G.S.; "Note on the Occurrence of Amberite (Retinite), or Fossil Gum, in a Seam of Coal at Kawa-Kawa Colliery, Bay of Islands, New Zealand," by Mr. T. P. Moody.

INSTITUTION OF MECHANICAL ENGINEERS.—Thursday and Friday, the 1st and 2nd May. Paper to be read: "Further Report of the Research Committee on Marine Engine Trials," by Professor A. B. W. Kennedy.

PRICES CURRENT, 23RD APRIL, 1890.

Quotations at per ton, unless otherwise specified.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	6 15 0	.....	7 5 0	f.o.t. wks.
" Angles	6 10 0	.....	7 0 0	"
" Plates	6 12 6	.....	7 2 6	"
Staffordshire Bars (cheaper makes)	8 10 0	.....	9 0 0	London.
" Angles	8 10 0	.....	9 0 0	"
Crown Sheets	8 0 0	.....	8 10 0	"
" Hoops	7 12 6	.....	8 2 6	"
"Siemens-Martin" Steel Boiler Plates			9 0 0	"
" Ship and Girder			8 0 0	"

Market quiet.

PIG IRON.

Middlesbro' Warrants, No. 3	44/10½	Cash
Scotch Warrants, m/n	45/3	"
Hematite Warrants, m/n	53/4½	"

Stocks in Stores { Scotch ..... 795,906 Tons. Middlesbro' 135,159 " Hematite ... 349,200 "

Exclusive of stocks in makers' yards.

	No. 1.		No. 3.		
Coltness	68/-	.....	62/-	f.o.b.	Glasgow.
Gartsherrie	64/-	.....	58/6	"	"
Langloan	68/-	.....	62/-	"	"
Summerlee	66/-	.....	61/-	"	"
Glengarnock	69/-	.....	60/-	"	"
G.M.B. ex Store	45/6	.....	45/6	f.o.t.	Works.

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	74/-	65/6

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

METALS.

Spelter: Ordinary	£22	0	0	to	£22	5	0
Copper: British Cakes and Ingots	54	0	0	"	55	0	0
" Chili Bars, G.O.B.'s	48	2	6	"	48	10	0
" Other sorts, G.M.B.'s (equal to Chili Bars)	48	2	6	"	48	10	0
" Manufactured (strong)	61	0	0	"	.....		
Lead: Common Pig	13	12	6	"	13	15	0
" English Sheet	14	7	6	"	14	10	0
Tin: Straits	90	0	0	"	90	10	0
" Australian	.....			"	.....		
" English Ingots	95	0	0	"	.....		

Messrs. Carrick & Brockbank, Manchester, report as follows:—

COPPER: The visible supply of raw copper increased about 700 tons during the first fortnight in April, owing to the Chili charters having exceeded, and deliveries being less than, those of the previous fortnight. On the other hand, there is a scarcity of spot metal offering, especially of the better sorts, so that the market has been moderately steady. Quotations for Chili bars to-day are £48 2s. 6d. to £48 10s. cash. Manufactured continues in slow demand, and prices remain at £61 sheets and £64 bottoms.

TIN: An active trade has taken place in tin during the week, and prices are firmer. On the 16th foreign was quoted £89 2s. 6d. to £89 10s. cash, but, owing to the better demand, values have advanced, quotations to-day being £90 to £90 10s.

LEAD: A stronger tone is also noticeable in lead, and prices are slightly higher.

SPELTER keeps very flat, owing to the condition of the galvanising trade, and prices are lower in England, although on the Continent they are well maintained, stocks being inconsiderable.

CHEMICALS.

		£ s. d.		£ s. d.
Acid: Carbolic Crystals	lb.	0 0 10	to	0 0 11½
" " Liquid	gal.	0 1 2	—	.....
" Citric	lb.	0 1 7	—	.....
" Oxalic	"	0 0 3½	—	.....
" Sulphuric	ton	1 12 0	—	.....
" Tartaric	lb.	0 1 4½	—	.....
Alum: Lump (powder 10/- ex.)	ton	4 17 6	—	.....
Ammonia: Carbonate	lb.	0 0 3½	—	.....
" Muriate (Grey)	ton	22 15 0	—	.....
" " (White)	"	26 10 0	—	.....
" Sulphate	"	11 12 6	—	.....
" Liquor	lb.	0 0 3¾	—	.....
Antimony	ton	.....	—	.....
Bleaching Powder	"	5 2 6	—	5 5 0
Bisulphide of Carbon	"	13 10 0	—	.....
Borax	"	30 0 0	—	.....
Benzole (90 %)	gal.	0 3 5	—	.....
" (50/90 %)	"	0 2 8	—	.....
Copper Sulphate	ton	25 10 0	—	26 0 0
Copperas	"	2 0 0	—	.....
Kieserit	"	.....	—	.....
Lead: Nitrate	"	22 10 0	—	.....
" White Sugar	"	24 0 0	—	.....
" Brown	"	19 0 0	—	.....
Potash: Bichromate	lb.	0 0 4	—	.....
" Caustic	ton	22 0 0	—	.....
" Carbonate	"	19 10 0	—	.....
" Chlorate	lb.	0 0 5	—	.....
" Prussiate (Yellow)	"	0 0 9½	—	.....
" Sulphate (Basis 90 %)	ton	9 10 0	—	.....
Precipitate: Red	lb.	0 3 1	—	.....
" White	"	0 3 2	—	.....
Salts: Epsom { Bags	ton	3 0 0	—	.....
Salts: Epsom { Casks	"	3 15 0	—	.....
" Glauber	"	1 10 0	—	.....
Sulphur: Sublimed Flowers	"	9 0 0	—	.....
" Recovered	"	4 10 0	—	.....
Soda: Ash	deg.	0 0 1½	—	.....
" Caustic (White 70%)	ton	10 0 0	—	10 2 6
" " " 60%)	"	9 0 0	—	9 2 6
" " (Cream 60%)	"	8 12 6	—	8 15 0
" Crystals	"	3 0 0	—	3 2 6
" Bicarbonate	"	6 5 0	—	.....
" Hyposulphite	"	6 5 0	—	.....
Solvent Naphtha	gal.	0 4 0	—	.....
Tartar, Cream of	cwt.	5 12 6	—	.....
Zinc Sulphate	ton	7 10 0	—	.....

OILS.

		£ s. d.
Cocoanut: Cochin	per ton	28 0 0
" Ceylon	"	25 0 0
Cottonseed	"	22 10 0
Cod	"	21 0 0
Lard	"	37 0 0
Linseed	"	23 7 6
Palm, Lagos	"	24 10 0
Rapeseed: English	"	32 0 0
Seal: Pale	"	28 0 0
" Brown	"	22 0 0
Sperm	"	46 0 0
Whale	"	24 0 0
Turpentine	per cwt.	1 9 6
Coal	per gal.	
Petroleum (Refined)	"	0 0 5½
" Spirit	"	0 0 7

SHIPBUILDING NOTES.

ON the 19th inst. Messrs. Raylton, Dixon, & Co. launched from their yard, Middlesbrough, a steel screw steamer of the following dimensions:—Length over all, 287ft.; breadth, 39ft.; depth, moulded, 21ft. 3in.; and deadweight capacity, 3,300 tons. Her engines will be supplied by the North-Eastern Marine Engineering Company, Limited, Sunderland. On leaving the ways the boat was named "Dolores."

ON the 19th inst. a steel screw steamer, named the "Michigan," was launched from the shipbuilding yard of Messrs. Harland & Wolff, Belfast. Her principal dimensions are:—Length between the perpendiculars, 370ft.; breadth, 44ft.; depth, 30ft. 6in.; and tonnage, 3,700. The engines and boilers will also be supplied by Messrs. Harland & Wolff. The vessel will also be fitted throughout with electric light. The "Michigan" has been built to the order of the Atlantic Transport Line Company, and is intended for the American cattle trade.

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HOME INDUSTRIES.

LONDON, 24th April, 1890.

The Money Market.—Money has become very easy, and loans are obtainable to any extent at 1 per cent., and even under. The discount market is kept firmer by the lowness of the Paris rate of exchange and the consequent demand for gold for export to France. The stock markets maintain a healthy degree of firmness without much real strength. There is not a great deal of investment buying, and speculative activity is confined to professional dealers. The more substantial railway stocks are left alone, but there has been a good deal of activity in those of the passenger lines, notably the underground railways. The American railway department, which for weeks has been a dead letter here, has become much livelier, and there has been a good deal of buying of the cheaper stocks which are progressive. Mexican Central Railway bonds are being bought for investment. Canadian Pacific shares are strongly in favour, and a marked advance in price has been registered in the past week. Grand Trunks attract little attention for the time. Foreign stocks show few movements of note, and the tone is steady. South American securities have been prominent. Argentine stocks recovered steadily as the gold premium fell, and Uruguay bonds have risen in sympathy. There has been a considerable drop in Peruvian bonds, as the prospects of the new Development Corporation have not been regarded as immediately bright. Mines have been a neglected market, The Rio Tinto dividend of 10 per cent. for last year was not very heartily received. South African gold shares—at least, the best of them—have recovered a trifle. Industrial and miscellaneous securities present no special feature.

Companies.—The following companies have been registered since our last report :—Buersil Cotton Spinning Co., Ld., with a capital of £20,000 ; Edgar Allen & Co., Ld., with a capital of £100,000, to purchase a steel manufacturing business ; Llanbedr Mining Co., Ld., with a capital of £5,000 ; The Fibre Syndicate, Ld., with a capital of £50,000, to work a patent for the treatment of vegetable fibre ; The Canal Mills Co. (Clayton-le-moors), Ld., with a capital of £50,000, to carry on the business of cotton spinners, &c. ; Parcocha Iron Ore and Railway Co., Ld., with a capital of £510,000, to carry on business as miners, &c. ; Dutton-Green Brick and Tile Works, Ld., with a capital of £20,000 ; Caedafydd Colliery Co , Ld., with a capital of £3,000 ; The Transvaal Leather Co., Ld., with a capital of £100,000 ; Cheltenham Omnibus Co., Ld., with a capital of £5,000 ; Samuel Yarwood & Son, Ld., with a capital of £37,000, to carry on the business of tanners, &c. ; Stanley Gold Mines, Ld., with a capital of £130,000 ; Friedenthal & Co., Ld., with a capital of £20,000, to carry on the business of engine and boiler makers, &c. ; The Paszowa (Galician) Petroleum Co., with a capital of £55,000 ; The Robottom Boracic Acid Syndicate, Ld., with a capital of £5,000 ; The Mexican English Syndicate, Ld., with a capital of £50,000, to investigate mines, &c. ; Peter Walker & Son (Warrington and Burton), Ld., with a capital of £2,000,000, to carry on the business of brewers.

The Central Underground Railway.—The Bill for the construction of the Central London Railway is now before the Select Committee of the House of Commons. The line is to run from Bayswater, along Oxford Street and Cheapside, at a depth of 60ft. The cars are to be worked by electricity.

Pullman Cars.—Hitherto the Midland and the London, Brighton, and South Coast Railways have been the only ones to adopt the Pullman car as used in America, and even they have found that our insular prejudices on the point of privacy have been inimical to a great extension of the Pullman system. The London and South-Western have recently imported two cars from America, and they are to be used experimentally on their London and Bournemouth trains. The new service commenced on Monday last, and the Duchess of Albany was one of the passengers on the maiden trip.

Gunboats for the Zambesi.—The British Government has recently entrusted Messrs. Yarrow & Co., of Poplar, with the construction of two steel shallow draught steamers to serve as gunboats for the navigation of the Zambesi and Shiré. These boats merit attention owing to the novelty of their construction. They are of the stern-wheel type, 90ft. in length by 16ft. beam, and having a draught of from 18in. to 2ft., and are of about the same tonnage as the passenger steamers plying between London Bridge and Chelsea. They will be shipped in pieces and put together at their destination. The most remarkable feature of Messrs. Yarrow's contract is that they have undertaken to put them together at the mouth of the river and have them ready for steaming within twenty-four hours after arrival without going ashore or having any recourse to the land on either side of the river. At the same works there are being built, side by side with the English boats, six boats for the Portuguese Government, also for service in the same district.

The Iron and Steel Institute.—The annual meeting of the Iron and Steel Institute will be held on Wednesday, Thursday, and Friday, the 7th, 8th, and 9th prox., at 10.30 a.m. each day. After the Bessemer Gold Medal for 1890 has been presented to Mr. William D. Allen, of Sheffield, the following papers will be read and discussed : "A New Form of Siemens Furnace," by Mr. John Head ; "The Robert-Bessemer Process," by Mr. Lynwood Garrison ; "Some Critical Points in Iron and Steel Manufacture," by M. F. Osmond ; "The Carburisation of Iron by the Diamond," by Professor W. C. Roberts-Austen ; "The Action of Aluminium on Iron and Steel," by Sir Henry Roscoe ; "The Changes in Iron Produced by Thermal Treatment," by Dr. E. J. Ball ; "Certain Chemical Phenomena in the Manufacture of Steel," by Mr. W. Galbraith ; and "The Rollet Process for Producing Purified Pig Castings," by M. Rollet.

A New Chair of Electrical Engineering at King's College, London.—We understand that great efforts are being made by the Council of King's College to meet the growing need of additional teaching power in the department of electrical engineering. The engineering department of this college has always had a high reputation, and now, thanks to the munificenee of Lady Siemens, a new laboratory for electrical engineering, to perpetuate the name of her distinguished husband, and to be called the "William Siemens Laboratory," is to be constructed and fitted with every modern electrical appliance. Through the kindness of the well-known engineers, Messrs. Davey, Paxman, & Co., of Colchester, the Council are enabled to equip a fine engine and boiler room with all the machinery requisite to provide the necessary power, and it is hoped that by this means the whole College will ultimately be lighted by electricity. A new chair of electrical engineering has been established, and the first Professor has been appointed—namely, Dr. John Hopkinson, F.R.S., the President of the Institution of Electrical Engineers. We cannot but express our pleasure at this appointment, as no better selection could be made to undertake the direction of the new laboratory. It is hoped that the new arrangements we have mentioned will commence with the October session.

Electric Welding.—On Friday evening, the 18th inst., Sir Frederick Bramwell gave an interesting lecture on "Welding by Electricity," at the Royal Institution, Albemarle Street. The lecture may be considered as supplemental to one given by the lecturer on the previous Tuesday at the Institution of Civil Engineers. In the early part of his discourse Sir Frederick Bramwell gave a general description of the smith's art, especially in relation to welding, and expressed a high opinion of the smith's skill, with which we entirely agree. After this some experiments were shown of electric welding, in which hard cast steel, copper, aluminium, and iron tubing were welded, and afterwards bent over the anvil to show the quality of the welding.

The African Kola Nut.—A paper, by Mr. T. Christy, was read the other night at the meeting of the Balloon Society, St. James's Hall, on the African Kola Nut, concerning which many remarkable statements have recently been published. The kola nut is held in great respect by the natives of the Western Coast of Africa, on account of its wonderful stimulating and sustaining powers. The nut is ground into a fine powder and carried about the person during long journeys, when often the only sustenance consists of a "chew" of this kola ; thanks to it many have been able to stave off thirst and hunger, while others declare that after a severe day's work or marching nothing so revives the system as a kola nut. As a basis for a beverage, the analysis published comparing the nitrogenous principles, chemically defined and crystallisable, kola takes precedence over tea, coffee, and cocoa, while, owing to the almost entire absence of tannin in it, it does not injure or impair the digestive organs.

MANCHESTER, 24th April, 1890.

The Ship Canal.—A Bill is being promoted by the Ship Canal Company to authorise them to substitute fewer tidal openings into the Mersey than were fixed by the Act of 1885. The total width of the openings is to be reduced from 4,500ft. to 1,800ft. The Mersey Dock and Harbour Board oppose the Bill, on the ground of injury to the estuary owing to diminished flow, and the same ground is taken by the Widnes Corporation and the London and North-Western Railway Company.

Proposed High-level Bridge.—A company is being formed, with a capital of £100,000, to construct a bridge from the town of Douglas, in the Isle of Man, to Douglas Head, at the other side of the harbour. A large amount of capital has been already obtained in Manchester and district. A tower is to be erected on the Douglas side, 380ft. high, with five platforms, which are to be utilised for various purposes. From one of the platforms a lattice bridge will be carried over to the Head. Lifts are to be fitted similar to those in use on the Eiffel Tower. The engineer to the scheme is Mr. Thomas Floyd, C.E., 2, Victoria Mansions, London.

The Cotton Trade.—The condition of the cotton trade, so far as yarn is concerned, is not unsatisfactory, although the advance in cotton has rendered business somewhat difficult. The price of middling American is now $6\frac{5}{16}$d. per lb. in Liverpool. The consequent increase in the price of yarn checks the trade in cloth. An attempt is being made in Liverpool to create a market for futures in Egyptian cotton. The Bolton spinners entertain a strong opinion as to the unwisdom of any step of this kind, and they will probably resort to extreme measures to prevent it. This trade is in a comparatively limited number of hands, and spinners of Bolton counts are therefore able more easily to continue to promote their common interests than spinners of ordinary counts. Generally the tone of the market in yarns is firm, with no undue tendency to sell.

The Engineering Trade.—Employment in the general engineering trades does not yet show much sign of falling off, although there are complaints here and there. Tool makers are generally finding plenty of work, and for home and foreign railways especially there are a number of orders coming forward. Messrs. Craven Bros., Limited, are making an addition to their premises, and Messrs. Hulse & Co. have nearly finished their new shops. Machinists are mostly still well employed, although there is not quite the pressure in some departments that there was. Mules and ring frames are, however, well ordered, and in most cases sufficient work is in hand to last the year.

The Linen and Jute Trades.—Business during the week has been of an unsatisfactory character in the heavy departments. A little activity has been noticeable in fancy descriptions, but the total turnover has not been large. The complaint is general that orders in most branches of the trade have been scarce owing to the unsatisfactory weather that has prevailed for some time. Buyers are hanging back in consequence of this, and the leading home trade houses are feeling the effects of this condition of affairs. With regard to the shipping inquiry, trade is not brisk in the South American quarter. The high premium on gold, which was advanced still further the other day, is a serious drawback, not only delaying remittances, but causing orders to be withheld. United States buyers, however, have come forward more freely in view of contemplated tariff legislation, and have operated to a fair extent in both fine, medium, and coarse makes. Linen threads are inquired for to a considerable extent, especially in the ready-made clothing districts, which, notwithstanding the use of cotton thread for the common varieties of clothing, still absorb large quantities of the linen article.

GLASGOW, 24th April, 1890.

Pig Iron.—The heavy fall in pig iron prices during the past few days has brought several outside speculators into trouble. In January the price of warrants was up to 66s. 3d., on Tuesday last it reached 44s. 10d. This fall of 21s. 5d. in three months is quite phenomenal, and has, as might be expected, produced some failures, one to the extent of £100,000. This serious fall is all the more remarkable that shipments are going up and stocks are going steadily down. The explanation of it is that outside speculation rushed the price up above its normal amount and the reaction has come. So long as there is a feeling of uncertainty about the future of general trade, and so long as the stocks are so heavy, any permanent and considerable advance in the price is hardly to be looked for.

Shipping.—The Gem Line Steamship Company, Dundee, at a meeting on Thursday, declared an interim dividend of 5 per cent., making 10 per cent. for the year. The company are building a large steamer from the reserve fund.

Shipbuilding.—Messrs. Ramage & Ferguson, Leith, have secured an order to build a 350-ton steel steam yacht for Mr. Harry Taylor, late owner of the well-known schooners "Bluebell" and "Hildegarde." The vessel will be fitted with triple-expansion engines, having cylinders 15½in., 25in., and 40in. diameter, by 27in. stroke. Besides this steam yacht, Messrs. Ramage are laying down one of 600 tons.

Contracts Open.—The new railway which the Caledonian Railway are constructing from the extreme east end of Glasgow, underground to the west end, will require a large quantity—about 10,000 tons—of girders, &c.

Scottish Railways.—The centre of interest at the moment is the Select Committee of the House of Commons which has been appointed to consider a group of Scottish Private Bills. The first to come before the Committee was the North British and Glasgow and South Western Railway Bill, and it has been agreed to take the Caledonian Bill next. The preliminary statements were made this week. Mr. Pope, Q.C., appears for the North British Railway Company, and Mr. Bolton for the Caledonian. The subject is exciting great interest in Scotland, especially in the districts where the Glasgow and South Western and the Caledonian Railways now compete against each other. The west coast is the district mainly affected. Should the North British succeed with their scheme they would have lines on both sides of the Clyde, whereas, should the Caledonian succeed, they would have two lines on one side. Should the Glasgow and South Western Railway go over to the Caledonian, the Midland would be practically shut off from the west coast traffic, whereas acquisition by the North British Railway would maintain the *status quo* in this respect.

(From our own Correspondents.)

LIVERPOOL, 23rd April, 1890.

The Canadian Emigration Season.—The emigration season has now fully set in, and the various railway stations are occasionally crowded with emigrants from different European countries on the way to their new homes out West. The "Sardinian" and the "Lake Ontario" sailed last week with nearly 2,000 emigrants on board. There are several societies in England directed by philanthropic people, and formed to assist agricultural men and women to emigrate. They are sent out in batches under the care of an agent, who looks after their interests until they arrive at their destination. Seventy emigrants on board the "Sardinian" were going to Lord Brassey's farm of 30,000

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acres near Indian Head; each family will have secured to them 160 acres, and capital upon easy terms will be advanced to them.

THE DOCK LABOUR AGITATION.—A very determined attempt was made last Friday and Saturday by some agitators to induce the labourers to renew the dispute with the shipowners upon the paltry excuse of the half-day ceasing at 11 o'clock instead of 12. The movement was a failure, and with very few exceptions the men continued at their work. The agitators are very much chagrined that the last strike was settled over their heads; and, without any recognition, "their occupation's gone."

LEEDS, 23RD APRIL, 1890.

THE IRON AND STEEL TRADES.—The state of the manufactured iron and steel trades of Leeds and surrounding district is a reflex of the quiet tone which marks the English and Scotch iron markets. Business has decidedly fallen off during the last month or two, and though the outlook does not appear very bright, some are not without hope for a return to a better state of things ere long. The declared intention of blast furnacemen to restrict the output of pig iron finds support among the Cumberland men. A limitation of production would, it is said, have the effect of temporarily increasing prices and steadying the market, which has, more or less, been very fluctuating during the greater part of the present year. Although orders are not coming in quickly, and notwithstanding that there is a less demand for best Yorkshire iron boiler plate, Leeds iron manufacturers, unlike some of the makers in the Midlands, are able to keep their works going full time. Old orders are also keeping the engineering branches actively employed. In the local engineering trade the past week has been remarkable for a general meeting of the operatives. They gathered together on Saturday, and unanimously decided that the present time is opportune for making a demand for an increase of 2s. all round in the following trades:—Pattern makers, smiths, turners, fitters, millwrights, borers and planers. It was stated at the meeting that Leeds was the lowest paid centre of engineering, and that the General Executive (London) were determined that wages in the town should go up. The strike in the Halifax iron trade is not yet settled. Some firms have conceded the men's demand for an advance of 2s. a week, and the points as to overtime.

THE COAL TRADE. The collieries in West Yorkshire continue to be active, though prices have nearly dropped to what they were before the miners recently struck. Manufacturing fuel is easier to buy, on account of a lessened inquiry for coke. The consumption of coke, however, is larger than it was, some of the furnaces in North Lincolnshire having again been blown in.

SHEFFIELD, 23RD APRIL, 1890.

IRON AND STEEL.—A very quiet tone prevails throughout the whole district in the iron trades, and, although there is no scarcity of employment as yet, there is a downward tendency in prices all round. All the large firms continue to be well employed, particularly on railway materials of all kinds. Marine work is coming in rather slowly just now.

COAL AND COKE.—Coal is decidedly falling off in value. Coke is also slightly lower in value, due, no doubt, to the lessened demand of smelters in the North of England. Smiths' coke maintains its value all round.

NORTH STAFFORDSHIRE, 23RD APRIL, 1890.

THE IRON TRADE.—There is no improvement to be reported with regard to the iron trade. Many mills are standing for want of orders, and a feeling that the worst has not been reached appears to prevail. Buyers have no confidence in the market, and believe by withholding orders they will be able to place them at still lower prices. Pig iron has dropped to 52s. 6d. per ton, and it is difficult to see how it can be manufactured at that figure. Unless a change occurs, there will have to be some attempt made to reduce the cost of production.

THE COAL TRADE.—The demand for forge and manufacturing fuel has fallen off considerably since the commencement of the year, and prices are showing signs of weakness. As prices in this district have only been advanced in proportion to the rise in colliers' wages, any serious fall without a corresponding decrease in the cost of production will mean a heavy loss to colliery proprietors.

THE NORTH STAFFORDSHIRE CHAMBER OF COMMERCE.—The annual meeting of this chamber was held last week, when Mr. W. M. Edge was elected president for the ensuing year. The opening of the new technical museum by Princess Louise has had to be postponed owing to the preparations of the committee being still far from complete.

THE MASON SCIENCE COLLEGE, BIRMINGHAM.—At the last meeting of the Mason College Engineering Society, Professor R. H. Smith in the chair, Mr. J. Knight read a paper, "On the Use of Cast and Wrought Iron for Pipes, and the Relative Advantages of the Two Materials." Mr. R. Pierce followed by reading a paper "On the Use of Steel for Making Pipe Mains," and described the various processes of making riveted and welded pipes from steel plates. Mr. T. Arnall then read a paper, "On the Joints used for Various Kinds of Pipes, and the testing of pipes at the works of the manufacturer, and after they are laid in the trenches." The three papers were taken as one, and the reading of them was followed by a lengthy discussion.

CARDIFF, 23RD APRIL, 1890.

IRON AND STEEL.—The pig iron trade continues most unsatisfactory, and unless the prices rise makers will be compelled to reduce the output, as the difference between normal prices for raw material and fuel, as compared with pigs, is getting greater every week. There is a strong feeling that, the speculative element having had its day, a gradual and steady business will ensue. The ironmasters have decided to reduce the price of steel tinplate bars from £7 15s. to £5 10s.—a remarkably significant step. In iron ore a fair amount of business has been done during the week. Rubio ore is quoted at 15s. 9d. c.i.f. Cardiff and Newport, 16s. Swansea, 17s. Glasgow. Freights from the ore ports are a little easier.

COAL AND COKE.—There is very little inquiry for steam coal this week, but the large amount of coal sold forward under contract enables colliery owners to maintain their prices at last week's figures. In fact, those sellers who are independent of bye-orders are firm in their quotations. There is a feeling of depression gradually creeping over all departments of industry; shipowners seem to be affected most, as freights in all directions, with the exception of America, have been unremunerative. The demand for house coal is getting less as summer approaches, and a reduction of 1s. per ton has to be conceded in order to effect business. For coke prospects are fairly healthy, although the high prices of January have disappeared.

BARROW-IN-FURNESS, 23RD APRIL, 1890.

HEMATITE PIG IRON.—A further depression is noticeable in hematite pig iron. Buyers who have orders to place are only purchasing just sufficient metal to meet current wants, as they anticipate much lower prices; but it is probable that values will not go down to a much lower point because makers have agreed on a reduction in the output. During the week one of the furnaces at the Moss Bay Iron and Steel Works has been blown out. It is reported that the other furnace at Moss Bay will be blown out, and that the adjoining steel works will be kept going with supplies of hematite warrants. Several makers on the West Coast intend limiting the production of iron until prices have assumed such a position as to give a profit to the smelter. Hematite warrants have been freely bought at 53s. 6d. during the week.

STEEL. There is a still quieter tone in the steel trade, and orders are few in number. The business doing in rails is very limited, and makers have reduced their prices for heavy sections to £5 per ton. Steel shipbuilding material is in quieter demand, and makers are quoting £7 5s. for plates and £6 15s. for angles. It is thought highly probable that the cheapening tendency of steel shipbuilding material will lead to the placing of orders for large steamers.

IRON ORE.—There is less inquiry for iron ore, and prices are lower at 11s. 6d. to 16s. per ton net at mines for ordinary qualities.

MIDDLESBROUGH, 23RD APRIL, 1890.

PIG IRON.—The pig iron market is quite demoralised. Prices are falling, though the conditions are such that one would expect them to be rising. The calculations of the shrewdest have been baffled, and there is something like consternation all round. There is not much business done, as buyers are holding off for lower prices still. Meantime the makers are in a sad plight between high prices for raw materials and wages and low prices for the manufactured article. The makers' price for No. 3 G.M.B. Cleveland is about 50s. per ton, but warrants are only 45s. 6d. on the average, and therefore are preferred. Makers have had to break their price, and have made more sales than they have done for some time. East Coast hematites are quoted nominally at 70s., but nothing like this can be had so long as West Coast hematite is so low. The stock in Connal's stores on Monday amounted to 135,988 tons, against 139,359 tons a week ago, being a decrease of 3,371 tons.

SHIPMENTS OF PIG IRON.—The shipments are improving as the season advances, but they are still far behind those of last year. Up to Monday last they amounted to 54,905 tons, against 38,936 tons to the 21st of March, and 74,519 tons to the 21st of April last year.

MANUFACTURED IRON AND STEEL.—Iron and steel are duller than ever. There are few inquiries and fewer orders, and prices have fallen in consequence. Iron ship plates are at £6 5s.; angles, £6 2s. 6d.; bars, £6 7s. 6d.; steel ship plates, £7 7s. 6d.; angles, £7 7s. 6d.; steel rails (heavy section), £5 7s. 6s. per ton f.o.t. at manufacturers' works, less 2½ per cent.

SUNDERLAND, 23RD APRIL, 1890.

SHIPBUILDING.—The dearth of orders, and even of inquiries, continues, and there is now little prospect of an early improvement; in fact, a general feeling prevails that prices will before long be much lower. It is reported that existing contracts are being cancelled, and that shipowners are paying shipbuilders large sums as compensation for cancellation.

SHIPPING.—There is no marked improvement to note in the freight market, and opinions are divided as to whether this year rates will be lower or about the same as last year. In any case the prospect for shipping investors is not bright, as the working expenses have increased, and there is no probability of a curtailment in the cost of bunker coals. The local shipments of coal are about the same as usual. For home ports 33,620 tons were shipped, an increase of 3,802 tons, and to foreign 37,648 tons, an increase of 21,178 tons. The shipments coastwise also included 16,000 dozen glass bottles, 2,600 quarters of wheat, 250 tons of patent fuel, 180 tons of lime, 20 tons of cement and other British goods, and foreign shipments also included 300 tons of coke and 500 tons of pitch. The imports for the week comprised 19 cargoes of timber, silver sand, block ice, and 25,520 sacks of wheat.

NEWCASTLE, 23RD APRIL, 1890.

THE IRON TRADE.—In the pig iron trade business continues flat, and holders find it extremely difficult to get rid of their stocks, even at the reduced rates now ruling. The demand for finished iron has also largely fallen off, and prices have declined nearly 40s. per ton from the highest point attained. Many of the manufacturers have orders sufficient to keep their works fully going up to the end of the year, but specifications are now coming in very slowly, and some difficulty is, consequently, experienced in keeping the machinery continuously in operation. The outlook, on the whole, is depressing, and manufacturers themselves are the least sanguine as regards any prospective change for the better.

THE COAL TRADE.—A lessened demand for almost all qualities of coal is being felt, and it is scarcely probable that prices can long be maintained at their present level. There was a more than usually heavy shipment of coal and coke at Tyne Dock in the week ending April 19th, this being doubtless due to the deficient shipment effected in the previous week. The figures were 121,125 tons, as against 80,626 tons shipped in the six days ending April 12th.

GALVANISING WORKS.—The Tyne Galvanising Works are just now doing a very satisfactory business, the quantity of material dealt with being not less than 60 tons per month. The falling off of business in the iron trade, however, will naturally have an adverse effect on this minor industry, and coming dulness may therefore be looked for.

NEW ENGINEERING WORKS. Messrs. Haggie Brothers, wire rope manufacturers, colliery engineers, &c., Gateshead, are now erecting a large building, which is to be principally used for the extension of their engineering business. The building covers the extensive area formerly occupied by the firm's hemp rope factory, and is in the immediate vicinity of their present engineering and wire rope manufacturing works. It will be fitted with the best modern machinery, and will more than double the firm's present productive capacity in engineering specialties. The firm intend to develop the business of gas engineering, in which they have hitherto been engaged to a limited extent, and also contemplate utilising a portion of their new premises for the extensive carrying on of plumbing work and its auxiliary branches. The wire rope works, too, are to be extended, the business of the firm in this line being now very active, in spite of the keen competition existing. The firm's programme is a very comprehensive one, and when fully carried out cannot fail to be productive of great good to the locality in which the works were situated.

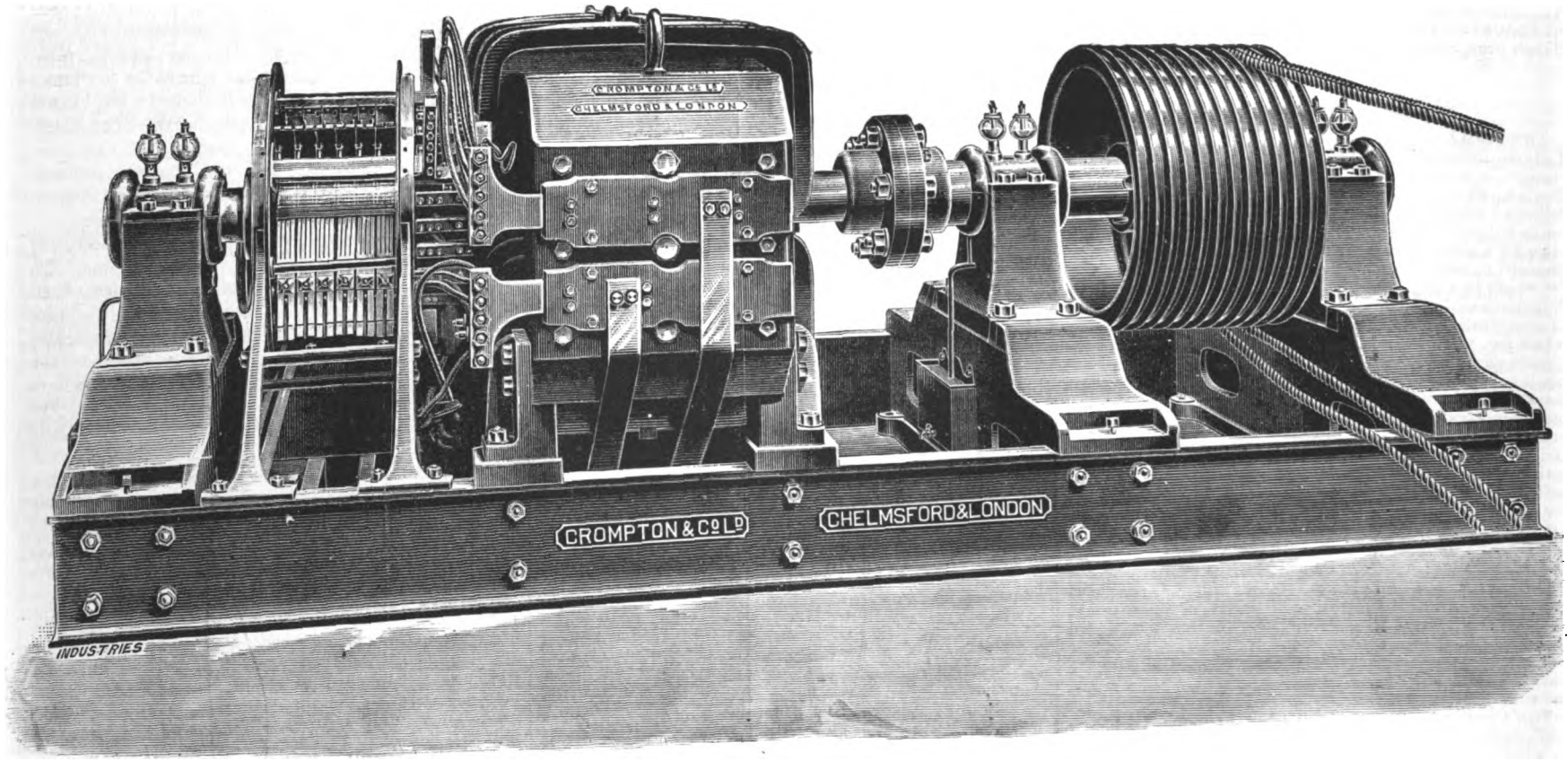
DUNDEE, 23RD APRIL, 1890.

JUTE AND FLAX TRADES.—There is a movement in the local trade here in favour of the conversion of some of the largest firms into limited liability companies. Two works in the district have already been some years in the hands of companies, and it is announced to-day that the business of Messrs. Gilroy, Sons, & Co., Tay Works, Dundee, has been sold to a London syndicate for £400,000. The firm takes £175,000 in part payment of its mills and calenders, which are very extensive. It is believed that the London syndicate which has purchased Messrs. Gilroy's business is negotiating for the purchase of several other large works in the town. The jute trade is at present showing signs of revival again. Prices have gone up in New York, burlaps 40 in 10½oz. being now quoted at from 5½c. to 5¾c. per yard. It is believed here that merchants on the other side are buying up in the expectation that jute bags will be extensively used in the construction of the Mississippi levees. Jute bags filled with concrete or other material have been used in this country in the construction of piers and breakwaters. The authorised copy of the New United States Tariff, which has now been published, tends to confirm the fear that the new duties will have an unfavourable effect on the Dundee trade should they obtain the approval of Congress. The arrangement made with Greece, whereby the import duties on jute and linen goods are to be reduced in return for the reduction of the duty on currants, will help to increase our trade in the East, which is already considerable. Manufacturers of jute goods are now well booked forward, and prices all over are firmer. Jute yarns are in strong demand, and prices are advancing. There is a fair business passing in linens on home account, and stocks are moving off. Flax and tow yarns meet with a good sale, but prices do not show signs of improvement.

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FOUR-POLE DRUM DYNAMO.

CONSTRUCTED BY MESSRS. CROMPTON & CO., ELECTRICAL ENGINEERS, ARC WORKS, CHELMSFORD.



FOUR-POLE DRUM DYNAMO.

THE above illustration shows a new four-pole drum machine made by Messrs. Crompton & Co., Ld., electrical engineers, Chelmsford. We feel confident that the single magnet two-pole drum dynamo now in almost universal use will give way to the four-pole type for sizes above 200 watts per revolution. The four-pole machine seems to have everything in its favour. The end couplings, which are the most troublesome part of two-pole machines, are beautifully simple when four poles are used, as the connections are only a quarter round the armature, and do not tend to foul the spindle or to block up ventilation spaces. Besides this, they are infinitely more accessible, a point of great importance with reference to repairs. If a four-pole machine has the same number of active conductors, the loss by hysteresis in the armature is approximately the same as in a two-pole machine, for, though the iron is reversed twice as often, there is only about half the volume; or if, on the other hand, the radial depth is kept as before, the induction is very much lower. For large currents the four-pole drum is especially suitable, as the current in each conductor is one-fourth of the whole current, and the commutator sections are more numerous than in the corresponding two-pole machine.

The machine we illustrate has an output of 50 volts and 2,500 amperes at 400 revolutions per minute. The armature has 48 external conductors of 185 strands of No. 16 B.W.G. twisted and compressed into a rectangular cross section. The armature diameter is 22in. It is built of discs keyed to a soft steel spindle. The spindle is made in two parts, coupled by a cast iron coupling, and fitted with a pulley for rope driving. There are three bearings, and these have only the bottom brasses lined with white metal. The magnets are wound with thirteen layers of copper strip 0·19in. by 0·24in., resistance cold 0·9 ohm, all in series. The magnets are 26in. by 11½in. There are four sets of six brushes each. The opposite brushes are coupled together in parallel. Each brush is 2in. wide. The machine is mounted on a bedplate built up of two channel girders of wrought iron, to which the pedestals of the magnets and the bearings are bolted.

One of the chief advances in this machine is the engineering design of the armature conductors. These have faced joints, and are screwed together with steel bolts and nuts. So perfect is this system, and so simple are the end connections, that the whole armature can be stripped in four hours, and put together in a somewhat longer time, including new bands. A repair, if ever necessary, could be executed in a very short time, unless, of course, the bands had to be taken off. This dynamo is for smelting work, a branch of electric business in which, as is well known, Messrs. Crompton have been particularly successful.

CLYDE SHIPBUILDING FOR MARCH.

THE general downward tendency of freights, together with the high prices paid for labour and material, is doubtless the cause of the almost total cessation on the part of shipowners of entering upon negotiations for new ships. Nothing of importance in the way of new work has fallen to the shipbuilders in the Clyde district, and as there are very few inquiries in the market, the outlook for this important industry is far from encouraging. The total tonnage booked aggregates about 800 tons, and is made up of five small launches, and a twin-screw steamer of 700 tons, to be built for service on the River Plate, by Messrs. Russell & Co., Port Glasgow.

The output of tonnage was fairly up to the average, and comprised 13 steamers and 4 sailing vessels, aggregating 23,785 tons. Most of the vessels put into the water were of small size, the largest—the Gulf liner, "Gulf of Lyons"—only measuring 3,000 tons, and, without a single exception, were built of steel.

The following are the particulars of the vessels launched:—

SCREW STEAMERS.

Built by the Ailsa Shipbuilding Co., Troon:—s.s. "Vasna," 850 tons, 950 i.h.p. Engined by Messrs. Dunsmuir & Jackson, Govan, for the Indian coasting trade of the British India Steam Navigation Co.

Built by Messrs Caird & Co., Greenock:—s.s. "Gulf of Lyons," 3,000 tons, 2,000 i.h.p. Engined by the builders, for the general trade of the Greenock Steamship Co.

Built by Messrs. Fleming & Ferguson, Paisley:—A steel bucket ladder dredger, 500 tons, 450 i.h.p. Engined by the builders. Shipped in pieces to destination.

Built by Messrs. William Hamilton & Co., Port Glasgow:—s.s. "Vauban," 1,800 tons. Engined by Messrs. Blackwood & Gordon, Port Glasgow, to the order of Messrs. Maurel & Prom, Bordeaux, for general trade between France and the Senegal.

Built by the London and Glasgow Shipbuilding Co.:—s.s. "Lien Shing," 1,850 tons, 1,200 i.h.p. Engined by the builders, for the China trade of the Indo-China Steam Navigation Co.

Built by Messrs. Mackie & Thomson, Govan:—s.s. "Corsican," 340 tons, 500 i.h.p. Engined by Messrs. Muir & Houston, Glasgow, for the Channel and Continental trade of Messrs. J. Macfarlane & Co., Glasgow.

Built by Messrs. M'Knight & Co., Ayr:—s.s. "Ethelred," 900 tons. Engined by Messrs. D. Rowan & Sons, Glasgow, for the American fruit trade of the Macgregor Steamship Co., Limited.

Built by Messrs. Murdoch & Murray, Port Glasgow: s.s. "Rio Paraguay," 430 tons, 340 i.h.p. Engined by Messrs. Rankin & Blackmore, Greenock, to the order of Messrs. Morton & Williamson, Glasgow, for South American owners.

Built by Messrs. Napier, Shanks, & Bell, Yoker:—s.s. "Claudine," 850 tons. Engined by Messrs. Dunsmuir & Jackson, Govan, to the order of Mr. C. Spreckels, of San Francisco, for trade at the Hawaiian Islands.

Built by Messrs. J. B. Seath & Co., Rutherglen:—s.s. "Hippolyte Dumois," 600 tons. Engined by Messrs. Hutson & Corbett, Glasgow, to the order of Messrs. Curwen Bros., Liverpool, for the fruit-carrying trade between the West Indies and the United States.

Built by Messrs. A. Stephen & Son, Linthouse:—s.s. "Highland Chief," 2,700 tons. 240 n.h.p. Engined by the builders to the order of Messrs. J. Nelson & Son, Liverpool, for their meat-carrying trade.

Built by Messrs. J. & G. Thomson, Clydebank:—s.s. "Brazil," 2,000 tons, 2,400 i.h.p. Engined by the builders, for the Brazilian Steam Navigation Company, for their coasting trade.

PADDLE STEAMER.

Built by Mr. D. M. Cumming, Parkhead:—A steel paddle steamer of 85 tons, 250 i.h.p. Shipped in pieces to destination.

SAILING VESSELS.

Built by Messrs. Chas. Connell & Co., Scotstown:—"Melete," ship, 1,780 tons, for Hamburg owners.

Built by Messrs. Russell & Co., Port Glasgow:—Four-masted barque, "Elmbank," 2,200 tons, for Messrs. A. Weir & Co., Glasgow; four-masted barque, "Simla," 2,200 tons, for Mr. G. M. Steeves, Liverpool; and barque, "Edenballymore," 1,700 tons, for Messrs. Thomson & Dickie, Glasgow.

ANALYSIS OF LAUNCHES.

	Steamships. No.	Steamships. Tonnage.		Sailing Vessels. No.	Sailing Vessels. Tonnage.
Great Britain	5	7,790	...	3	6,100
Germany	—	—	...	1	1,780
France	1	1,800	...	—	—
Norway	1	600	...	—	—
China	1	1,850	...	—	—
Brazil	1	2,000	...	—	—
South America	1	430	...	—	—
North America	1	850	...	—	—
Destination withheld	2	585	...	—	—
	13	15,905		4	7,880

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UNITED STATES.—FRANK BREWER, Assoc. Mem. Inst. C.E.
" INTERNATIONAL NEWS CO., 83 and 85, Duane-street, New York.

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As we go to press early with certain of our advertisement pages, all Alterations to Standing Advertisements should reach the Publisher not later than 2 o'clock on Wednesday afternoon in each week.

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

Contents.

	PAGE
Mumford & Moodie's Separator (*Illus.*)	385
The Institution of Naval Architects	385
Foreign Industries (Corres.)	390-391
Direct-Acting Hydraulic Pumping Engine (*Illus.*)	392
Notices of Meetings	393
Prices Current	393
Shipbuilding Notes	393
Home Industries (Corres.)	394-395
Four Pole Drum Dynamo (*Illus.*)	396
Clyde Shipbuilding for March	396
The Budget	397
Appointment of Assistant Engineers in the Navy	398
The Cotton Industry	398
The Railway and Canal Traffic Act, 1888	398
The Late Mr. William Inglis	398
Letters to the Editor:—	
Compressed Air Tramcars	398
The Friction and Lubrication of Cylindrical Journals	399
The Admiralty Dynamo Specification	399
Suggestion for a New Scottish Main Railway System	399
Smit's Combined Engine and Dynamo	399
Production of Coal in Japan	399
The Accident to the "City of Paris"	399
The Recent Boiler Explosion near Dudley (*Illus.*)	400
The Edinburgh Exhibition	400
Reviews	400
The Physical Society	401
Some Tests on the Efficiency of Alternating Current Apparatus	401
The Manufacture of Portland Cement from Slag (*Illus.*)	402
The Society of Chemical Industry	403
Nitric Acid Chlorine Processes	404
Notes	404
"Industries" Patent Record:—	
Applications and Acceptances	405-406
Illustrated Abridgments	406-408

Two-page Supplement giving a General View of the Buildings and Grounds of the EDINBURGH EXHIBITION.

To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

We cannot undertake to return manuscripts or drawings, and must request correspondents to keep copies.

BOUND VOLUMES OF **Industries,**

In half calf, gilt lettered, may be obtained at our London, Manchester, and Glasgow Offices, Price 20s. each.

Industries:

FRIDAY, 25TH APRIL, 1890.

THE BUDGET.

A SURPLUS of over three millions and a half is a substantial indication that the trade of the past year has been expansive, and that, even if we have begun to go down hill a little, the going down is extremely recent. Mr. Goschen has been among the luckiest of Chancellors of the Exchequer. His difficulties have always been connected with the disposal of a surplus; he has never, like Sir Stafford Northcote, had to manœuvre a series of deficits. Yet, notwithstanding the luck of always having had several millions to dispose of, each one of Mr. Goschen's Budgets has been more or less disappointing. With the solitary exception of the Conversion scheme, his plans have shown that he has not availed himself to the full of his stream of good fortune. He has made a bite into several cherries, but he seems to have an unaccountable reluctance to attempt anything heroic. The most important proposals are the diminution of the tea duty and the reduction of the house tax for houses of a rental below £60. Some of his smaller benefactions are noteworthy. The sop to the Volunteers, following upon the defeat of the Government on the subject, will help the Volunteer regiments to get out of debt; and the minor rearrangements, such as the provision for the recoinage of light gold out of the profit on the silver circulation, the abolition of the duty on plate, and the reduction of the stamp duty on apprentices' indentures, are certainly steps, if small ones, in the right direction. In the latter item the reduction might very well have been carried a little further at an insignificant cost to the revenue. A stamp duty of 2s. 6d., even on an indenture, is too much; all that is necessary is to secure the legality of the instrument, and a merely nominal duty, say 6d., would quite suffice. It is almost certain that this would bring in much more to the revenue than a higher sum, since the drawing of an indenture is frequently—we might almost say, in certain industries, universally—avoided because of the expense of it.

That nearly two millions of the realised surplus in the past year's accounts were due to the increased yield of the duties on spirits is sufficiently remarkable. The main item of increase is in home spirits, where more than a million was realised beyond the estimate. From the point of view of the social reformer, it is no particular subject for congratulation that increased prosperity should be so closely attended by a larger liquor bill. From the point of view of the student of taxation, too, it is a serious problem how far we are going on the right lines in loading a single article with the bulk of our taxes—moreover, an article which is subject to fluctuations so considerable as alcohol. Connected with this subject is the manœuvre by which Mr. Goschen initiates a system of compensation for the withdrawal of public-house licences, and meantime a suspension of the system of granting new ones. The cost of this operation is estimated by Mr. Goschen at £1,250,000. This sum Mr. Goschen, with characteristic ingenuity of statement, proposes to make the spirit tax meet. He therefore increases the duties on foreign and home spirits by a surtax of 6d. per gallon, which he passes to the Local Budget, in addition to 3d. per barrel upon beer, extracted from the Imperial Budget for this purpose. This manœuvre, however, hardly conceals the faultiness of the finance, as the question of compensation is by no means a foregone conclusion.

The leading feature of the Budget is, however, the reduction of the tea duty by 2d. per lb. Mr. Goschen's wail to the middleman to be less hard upon the consumer was amusing; but his proposed reduction does not exhibit any particular regard for the consumer, or at any rate for the small consumer. Sir Stafford Northcote made a similar blunder in reducing the tobacco tax, for in that case the advantage went almost wholly into the pockets of the trader. In this case there is little doubt that the same thing will happen. Purchasers of half a pound of tea and upwards may benefit, but the smaller purchasers certainly will not, and thus the income tax of the poor, as it has been called, will practically remain as it is. It is fair to say that an analogous result would be produced by reduction of the income tax on large incomes and leaving the small ones alone. No doubt many high claims oppress the mind of a Chancellor of the Exchequer, but as a matter of fact there were no very urgent demands for reduction of the tea duties. If, however, tea was meddled with at all by way of reduction, a substantial reduction, which would have been felt by the small purchaser, would certainly have been more desirable than a nibble which does good to nobody but the wholesale merchant and the comparatively large consumer.

The important omission in Mr. Goschen's Budget, which may perhaps cost him much of the popularity he has gained as a public financier, is any treatment of the income tax. There is a certain amount of acuteness in the omission, for Mr. Goschen must have realised that the class chiefly benefited by the Budget would be the *élite* of the working class. The increase of the spirit duties will not touch them, or will only touch them slightly; the decrease of the house duties, and of the tea and currant duties, will favour them, while a contrary effect will be produced upon the class below this one, for the increase of the spirit duties will touch them seriously, and the relief of taxation will not touch them at all. It cannot be said that the Budget is based in the least upon scientific principles of taxation; it is purely empirical. There is no attempt to adjust the incidence, or to take off burdens all round, by dealing with direct taxation. The suggestion which Mr. Goschen made about permitting incomes under £400 a year to escape the tax, though attractive enough at first sight, is not a sound one, taken by itself. Let us have a graded income tax by all means; but let us not be so absurd as to leave taxation practically to settle its own incidence by evading the responsibility of directly taxing particular classes because they happen to be numerous enough to make an outcry. Mr. Goschen's assumption that an income tax at sixpence was as low as need be, is too calm. Taxes on shops and dwelling houses are practically income taxes on a large number of income tax payers, and some relief is afforded to the lower grades of these by the Budget; but the income tax itself is untouched. It is quite true that the reduction of a penny, now that it yields £2,200,000, is a much more serious sacrifice of revenue than it was when a penny yielded only £800,000. If Mr. Goschen had dealt drastically with the tea duty, probably no one would have seriously objected; but if he had made a rearrangement of the income tax relieving incomes up to £2,000, say by twopence per pound, and graduating the incomes above this, he would

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have given an elasticity to trade which would have affected the whole industry of the country. The mere shuffling about of indirect taxation is after all a feeble method of finance, and, it goes without saying, gives nobody any satisfaction.

APPOINTMENT OF ASSISTANT ENGINEERS IN THE NAVY.

In a recent issue (see *Industries* of the 28th ult.), when writing of the position of engineers in the Navy, we mentioned that a step was about to be taken by which the teaching and practical advantages of different localities would be utilised in the training of young men who intended to enter the Navy as engineers, instead of taking them all from the same kind of establishment and forcing them all through the same narrow groove of instruction. We have now received copies of the regulations which have been made out by the Admiralty for the guidance of candidates for direct appointment as probationary assistant engineers in the Royal Navy, and, as they will interest a good many of our readers, we give their most important points.

Every candidate must not be under twenty nor over twenty-three years of age on the 1st of May in the year in which he is examined. He must produce a certificate of his birth or some satisfactory equivalent of it. He must produce evidence to show that he has passed through the regular course at a recognised college for technical education, and also that he has not been less than three years under training in an approved engineering establishment. Unless his certificates on these points are satisfactory, he will not be allowed to proceed to the examination. About ten appointments will be offered annually for competition among the candidates who fulfil the required conditions; the exact number will be fixed each year by the Lords of the Admiralty.

The examination for this year begins on the 29th of May, and will be held at the Royal Naval College, Greenwich. The following will be the subjects of examination, and the maximum number of marks for each subject:—

I.—Compulsory Subjects.

Statics, Hydrostatics, and Graphical Statics	600
Hydraulics, Pneumatics, and Dynamics	600
Elementary Theory of Mechanism and Machinery	600
Physics. I. (Heat, Light, and Sound)	500
" II. (Electricity and Magnetism)	600
Chemistry	500
Heat and Combustion	400
Steam and Steam Engine	600
Practical Engineering. I.	600
" " II.	600
Workshop Appliances and Practice	600
Mechanical Drawing	400
Total	6,600

II.—Optional Subjects.

Advanced Algebra and Trigonometry	500
Conics and Differential and Integral Calculus	600
Applied Mechanics and Strengths of Materials	600
Metallurgy	500
Design of Machine Details	600
Elementary Thermodynamics	600
Total	3,400
Grand Total	10,000

Candidates who obtain less than 30 per cent. of the marks for compulsory subjects will be considered ineligible for appointment. The eligible candidates will be divided into three classes:—First Class: Those who obtain at least 60 per cent. in the compulsory and optional subjects combined. Second Class: Those who obtain at least 50 per cent. in the compulsory subjects only, but fail to reach the standard of the first class. Third Class: Those who obtain at least 30 per cent. in the compulsory subjects only, but fail to reach the standard for a higher class. Appointments will be made in order of merit from the first class, according to the number which it may be decided to make each year. In the event of a less number than those required being in the First Class, their Lordships may complete the number from the Second and Third Classes in order of merit. Those who pass must be examined by a medical officer to ascertain whether they are physically fit, and produce a certificate of proficiency in practical workmanship from the firms at which they received their training in practical engineering, and another that they are able to swim.

On satisfactory evidence on these points being given, the successful candidates will be entered in the Royal Navy as probationary assistant engineers. Those appointed from the First Class will have the privilege of proceeding to the Royal Naval College, where they will pass through a course of higher instruction along with those who enter from the training college at Keyham. All the probationary assistant engineers will be confirmed at the end of their twelve months' probationary time if their conduct and qualifications are reported satisfactory; and those at the Royal Naval College who obtain First and Second Class Certificates at the final examination at the end of the first session will be allowed to count twelve months and six months of their probationary time towards promotion.

THE COTTON INDUSTRY.

An interesting feature of the cotton trade is the continued success of the Oldham Cotton Buying Company, Limited. This company has offices at Liverpool and Manchester, and buys raw cotton from merchants in Liverpool for spinners, charging the usual broker's commission, but returning, as a rule, 7s. out of the 10s. charged. For the past quarter the net profit declared is £1,515, being 330 per cent. on the capital employed. For some time this company has been a thorn in the side of the old-established Liverpool Cotton Association, Limited, the latter body having "boycotted" the Oldham company. However, the Oldham "limiteds" are supporting the buying company, and it continues to grow in membership and influence. The matter is being at present considered of sending out to the United States a representative to buy cotton direct from the planter. The Board of Trade returns for March respecting cotton goods have a poor look, but when the position is carefully looked into the figures are not really as bad as appears. The decline in our exports is owing partly, if not altogether, to the recent Liverpool dock strike. We venture to state that this month of April will bring up the full average of our shipments for this year. Since the holidays business in yarn has been in rather better demand. The margin, however, is a trifle worse, for whilst raw cotton has definitely hardened in price, cop twist and weft moves upward very slowly. The margin to-day is quite $\frac{1}{8}$d. per lb. worse against the spinners as compared with Christmas. The position, in fact, is that at present selling prices of yarn and cotton an average Oldham mill cannot make ends meet. The outlook, therefore, of the spinning trade is discouraging, and it looks as if the remainder of the cotton season would be adverse to cotton spinners. We have to report that manufacturers are still doing badly. Not only is the demand comparatively indifferent, but the margin between yarn and cloth continues extremely narrow. Altogether the prospects of the cotton trade are discouraging to producers, for, whilst the output of the spindles and looms was hardly ever so large, the margin of profit to the employer is not equal to change for a shilling.

THE RAILWAY AND CANAL TRAFFIC ACT, 1888.

There has just been published by the British Iron Trade Association the statement made on their behalf before the Commission of Inquiry by the Board of Trade on Railway Rates. The statement, with the accompanying statistics, was drawn up by Mr. J. S. Jeans, secretary of the Association, and contains much valuable information. We are only able to summarise it, and this places it to some extent at a disadvantage. The general outcome of Mr. Jeans' statement is that while for long distances the rates are not materially raised—in some cases they are even diminished—the rates for short distances are very seriously increased. Since the bulk of the heavy traffic of the country is conveyed for short distances, this increase of the maxima rates authorised by Parliament is regarded by the Association as inflicting serious disadvantage upon the industries represented by it. The estimate of the cost of transport made by Sir James Allport, and confirmed by Mr. Price-Williams, amounting to ·17d. per ton mile, was quoted by Mr. Jeans in his statement, and an estimate of ·25d. per ton mile based upon it. Taking the cost of transport, then, at $\frac{1}{4}$d. per ton per mile, Mr. Jeans considered that a maximum rate of $\frac{3}{4}$d. per ton per mile for mineral traffic would afford the railway companies a handsome profit.

The practical proposals of the British Iron Trade Association embodied the suggestion that for a 10-ton load the maximum should be $1\frac{1}{4}$d. per ton per mile; for a 50-ton load, 1d.; and for a full-train load, $\frac{3}{4}$d. The general principles of classification which the Association suggested should be adopted are these:—

(1) That no article should be rated higher than it is at present.

(2) Classification means liability to damage or special expense.

(3) Undamageable articles should be all placed in the lowest category, which should be varied in proportion to damageability and costliness of carriage.

(4) The nature of a commodity, its degree of safeness, its easiness of transit, its bulk, its quantity, and its traffic-producing qualities are the considerations that should regulate its classification.

Mr. Jeans states that the average ton mile rate over the whole of Germany is about $\frac{3}{4}$d. per ton mile, while in America it is ·45d. per ton mile. The statistics of these countries show a continuous fall in rates, whereas in our own country, he states that the rates have gone up during the past twenty years. As instances of the effect of the adoption of the proposed classification, Mr. Jeans takes a number of tables, from which we quote the following: The rates for coal and coke traffic on the Great Western Railway for 10 mile distances are proposed to be increased (inclusive of terminal charges) 150 per cent., and for 75 mile distances 24 per cent. The rate for pig iron on the same railway and for the same distances is to be increased by 216 per cent. and 80 per cent. respectively. The rate for bar iron is to be increased 408 per cent. and 136 per cent. respectively. The maxima in each case are of course alone dealt with. Mr. Jeans' calculation is that the proposed classification and increase of maxima will involve the trading community in an addition of £4,000,000 to the cost of transit.

THE LATE MR. WILLIAM INGLIS.

It is with great regret that we announce the death of Mr. William Inglis, engineer, of Bolton, which took place on the 22nd inst., after an illness of only two days' duration. Mr. Inglis was for many years the manager of the engineering department of Messrs. Hick, Hargreaves, & Co., but latterly became a partner in that firm. He received his early training on the Clyde, having been engaged in the works of Messrs. Robert Napier & Sons. He afterwards was for some time in Newcastle-on-Tyne, but about twenty years ago he became connected with Messrs. Hick, Hargreaves, & Co. Mr. Inglis was an engineer of distinguished ability, and at a time when the Corliss engine was a novelty in this country he was largely instrumental in introducing it to steam users. He devoted the whole of his persistent energy to his business pursuits, and undoubtedly did much to improve the construction of the large engines used in textile factories, the reputation always held by Messrs. Hick, Hargreaves, & Co. in this respect having been fully maintained, and even extended, under the management of Mr. Inglis. His sudden death is a great loss in engineering circles, especially in the Lancashire district, where he was well known. His work was not, however, confined to the Lancashire district, for his firm have made and have in hand from his designs the immense engines for the Deptford Electric Light Station belonging to the London Electric Supply Corporation, Limited. These engines alone are a sufficient indication of the great ability of Mr. Inglis as a mechanical engineer, but his skill is further shown in nearly every textile district of the world, to which his firm supplied their excellently made plant.

Mr. Inglis was a man of considerable literary ability, and contributions from his pen have frequently appeared in the technical press. As showing the suddenness of his death, we may say that our issue of last week contained a short contribution from him on a favourite subject.

Mr. Inglis was unmarried, and was 52 years of age. He was modest and unassuming in character, courteous and agreeable in his business relations, but rather of a retiring disposition. Those intimately acquainted with him, however, saw that beneath his quiet reserve there was a firm and persistent will, and, taking him altogether, he was a man of true worth, and his sudden death will be widely regretted.

Letters to the Editor.

COMPRESSED AIR TRAMCARS.

To the Editor of "Industries."

Sir,—With reference to the correspondence now proceeding in your journal on the above subject, I notice that Messrs. Hughes & Lancaster state that it is impossible to obtain reliable data as to the cost of electric traction. I should like to make a few remarks on this point, and mainly as regards traction by accumulators, this system being the most reliable and at the same time the most expensive.

The reason why the Julien accumulator car service was discontinued in Brussels is because the line was a commercial failure, but there were several obstacles in the way of the system being made a commercial success on that line. In the first place, the

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line was short with heavy gradients; in the second, the cars were small, and, consequently, contained but few passengers as compared with an ordinary sized tramcar; in the third, they were not worked to their fullest capacity; and in the fourth place, the power of the generating machinery was greatly in excess of that required for charging the accumulators, and for leaving ample reserve, it having been originally intended to run ten cars, and plant of this capacity was therefore installed. Consequently, it is not surprising that the undertaking was a failure. Now a totally different state of affairs is shown in the case of the four accumulator cars worked on the Madison Avenue in New York. On that line the working expenses, including maintenance of the accumulators, averaged about 3¼d. per car mile, excluding, of course, the driver's wages. Moreover, several accumulator cars on the Reckenzaun system are running with very satisfactory commercial results in Philadelphia.

It will perhaps be more interesting if I refer in detail to the six accumulator cars now in operation on the Barking line, and with which I am intimately acquainted, although not interested. The cars are worked for the tramway company by the Electric Traction Company at 4½d. per car mile, including the driver's wages, but not those of the conductor, as stated by "Car." When this particular line was worked by horse traction the working expenses per car mile were 6½d., but now the tramway company saves 2d. on every mile run. It is, however, with the working expenses incurred by the contracting company that data are required. The total mileage run since the opening of the line on the 14th June last year to the end of December was 34,366 miles. Now, from a personal knowledge of official statements regarding the total mileage run, the cost of drivers' wages, cost of coal, expenses at charging station, &c., I may state that the line for the period mentioned has been a commercial success. The main point in accumulator traction is the maintenance of the secondary batteries. The cost of renewals in accumulators is estimated by various authorities at from 1d. to 1½d. per car mile, the latter being the highest; but taking 1¼d. as the mean, I find that the profits made for the six and a half months' working of the Barking cars exceed the cost of renewals, leaving the balance for interest and depreciation on the plant. I may mention that Mr. Reckenzaun is now experimenting with an accumulator with which he expects to reduce the cost of secondary battery traction to 3d. per car mile.

With reference to the two cars on the "series" system at Northfleet, only one has for some time been regularly operated, the other being used on busy days. This line was only laid as an experiment, and not as a financial speculation.

Yours, &c.,
F. Baines.

London, 21st April, 1890.

THE FRICTION AND LUBRICATION OF CYLINDRICAL JOURNALS.

To the Editor of "Industries."

Sir,—There is a slight slip in your account of my paper on "Friction and Lubrication of Journals," which I should be glad if you would correct in your next issue. In giving the formula for determining the dimensions of brasses, you have omitted the last part of the expression, which is introduced to meet the case of very high speeds. The formula should stand—

$$\text{Area} = \frac{P\,u\,s}{772}\left(1+\frac{r}{600}\right)$$

where r = the revolutions of the shaft per minute; the value of u has been modified to suit. I also notice a slight slip in the value of u for bath lubrication. Below 100 feet per minute it should be $\frac{0{\cdot}10}{s}$, not $\frac{0{\cdot}12}{s}$. Apologising for thus troubling you,

Yours, &c.,
John Goodman.

The Yorkshire College, Leeds, 18th April, 1890.

THE ADMIRALTY DYNAMO SPECIFICATION.

To the Editor of "Industries."

Sir,—In the remarks under the above heading which appeared in your issue of the 11th inst., you say, dynamo makers are puzzled and discontented with the specification, especially as regards temperature tests and the way they are made. If this be so, the complaint should lie against the yard officers who make the tests, as nothing is said in the specification as to the method of making them. Probably the officers could explain, and make the meaning clear, but before asking them to do so it would be wise to read the specification carefully, without omitting or inserting words which materially alter the meaning,as you have done in your criticism, no doubt inadvertently.

In your opening paragraph you say, "It is specified that after running for six hours with full load, no accessible part of the armature or magnets should have a temperature of more than 20° Fahr.," &c. As a matter of fact, neither armatures nor magnets are mentioned in the clause of the specification from which you quote. You then go on to say that the temperature is taken at the end of one minute after stopping. There is no such statement in the specification. Having assumed a basis which is not specified, you proceed to construct a theory showing what will happen, which is curious if true, although it really has nothing to do with the question of the Admiralty specification.

Is it a fact that any and every machine will have reached its final temperature in a run of six hours with full load? and if this be so, how do you provide a store of heat if, as you say, the heat dissipated is exactly equal to the heat developed? But if it be true, as stated, that the core of the drum is colder on starting, and hotter at stopping, than the conductor, which is the main source of supply, how is the curious result affected by the greater capacity of the core for heat? You next proceed to show that a thermometer applied for a minute, covered with a bit of cotton waste, does not show the temperature of the part in contact. Observe here first that it is not necessary that it should, the condition of contract being that it shall not exceed the stated amount, and as it is not applied in the way or for the purpose you name, both you, and Mr. Willans, might have spared the criticism with advantage to yourselves.

You say the capacity of the thermometer for heat is very considerable compared with the rate at which heat can flow into it. Does this mean that the mercury can swallow up a good deal of heat without increasing in bulk, and if not what has the capacity to do with the result to be obtained? It is sufficient for the purpose of the contract that it shall show whether the amount is greater or less than that stated in the specification. This amount can be known as soon as the temperature of the room is taken. Assuming that in a particular case the room is found to be 100° F., would not a thermometer raised to 130° F. show whether the heat of the part in contact was more or less than this amount, which is all that is necessary to ascertain? You speak of it as taken at the end of a minute, but the instructions are that it shall be taken not more than a minute after stopping.

It is unnecessary to follow the reasoning by which you show that the maximum temperature may be higher somewhere else than where the thermometer can be applied. In the case you suppose, where the lagging or insulation has been removed and the machine run at full load again, you say that the same amount of heat will be generated and dissipated as before. I should have thought that neither would have been the same; that, in fact, the greater rate of dissipation from naked copper would keep the resistance lower and the generation of heat therefore less. This is a sample of the reasoning by which you arrive at the conclusion that the Admiralty are doing their best to select bad dynamos.

You next proceed to show that the exact temperature of the conductor can be readily found by the resistance method. Here we join issue again. A bad joint will affect the resistance test so seriously as to make it quite useless and misleading. Mr. Mordey recently stated that he had known cases where the resistance hot was less than when cold, the test in other words showing that no heat at all had been generated.

You state that ordinary dynamos made in this country have a maximum rise in the conductor of 30° F. in an atmosphere of 120° F. If this be so there should be no difficulty in conforming to the Admiralty specification even if the officers knew how to make correct temperature tests, which you throw doubts on. Some well-known dynamo makers will, I think, be surprised to hear so favourable an account of their work.

We next come to the question of charring, and your remarks would seem to apply rather to the waterproof varnish commonly applied to the fibrous material than to the fabric itself; and if so, the repair cannot be a very serious matter, as a fresh coat can be readily given; but if you mean that the canvas tape, or Willesden paper, commonly used, may soon perish and drop off, the statement is surprising. Mere drying, which takes place at the low temperatures you mention, can neither make them conductors or reduce them to a powder, which can be thrown off by centrifugal force from under or between the bars, without movement in the bars themselves, which should not exist.

Here it may be proper to remark that the Admiralty do not use a temperature test for determining the efficiency of dynamos, and do not apply any test for the purpose of receipt under contract to dynamos apart from the engine. They rely on a simpler and better test, by which they make one contractor responsible for the promised efficiency of both dynamo and engine in pounds of steam per electrical h.p. measured at the terminals of the dynamo. Again, you say, nothing is said in the specification as to whether the machine is to compound accurately in the room where it is tested in Portsmouth Dockyard, or in a 120° stokehold, and suggest a remedy which rests on an error in fact and a misapprehension. The specification does state that it shall compound in the testing room, and the Admiralty never place dynamos in stokeholds. Some of the regulations strike you as curious and even absurd. Perhaps your opinion might be modified by a fuller acquaintance with Admiralty business, such as the necessity of maintaining suitable supplies of such parts as brushes all over the world. You are particularly hard on the requirement of 96 per cent. conductivity copper. Are you quite sure that dynamo makers, honest and respectable as they may be, barring just a few tricks of trade such as you mention, really know that they get the best copper for the slightly higher price? I only know one firm who regularly test it, and should be pleased to hear that they all do.

Yours, &c.,
J. Farquharson.

London, April 19th, 1890.

[Our space is too limited for us to reply to Mr. Farquharson point by point. We wrote carefully, and we do not find anything in Mr. Farquharson's letter to lead us to alter our views. We shall be glad to have the views of some of our readers on this subject.—Ed. *Industries*.]

SUGGESTION FOR A NEW SCOTTISH MAIN RAILWAY SYSTEM.

To the Editor of "Industries."

Sir,—When amalgamation is the question of the hour with Scottish railway companies, the following facts and suggestion may be worthy of attention, namely:—

That it is possible by means of a main line connection, 90 miles in length, to form into one system the systems of the Glasgow and South Western, the Highland, the Callander and Oban, and the Great North of Scotland Railways, whose combined capitals amount to £24,000,000, with a mileage of 1,140 miles.

That in a portion of the line of route (nearly one-half of the total length and in the most barren part) a railway is under or awaiting construction to another part of the country, which might be utilised, and the joint arrangement be mutually advantageous to both interests. The other part of the route is for the most part of the most suitable nature for a line for fast running, being along the level shores of lochs and in straths.

That the route—which would be from Dalwhinnie, on the Highland Railway, to Johnstone, on the Glasgow and South Western, *viâ* Loch Ericht, Tyndrum, Loch Lomond, Leven Valley, and Dumbarton—would be the most direct from Inverness and Oban to Glasgow, Carlisle, and the South. It would also open up more direct communication between the North, North-East, the Western Highlands, the West and South of Scotland, and Ireland.

The crossing of the estuary of the Clyde at Dumbarton by a high level bridge need not be an obstacle as a matter of great cost, the width of the navigable channel being only 800ft. The elevation of the land on either bank of the river is also specially suitable.

That, through the new route, the Glasgow and South Western would have a share of the traffic to and from the North all at present passing along the lines *viâ* Perth and Stirling. The northern companies would also have the privilege of using a line for their South traffic in which they would be directly interested, and would have under their immediate control.

That to the Highland and Callander and Oban Companies especially, such a line would be of the greatest strategic importance, considering the encroachment that is being pushed forward; more so, when the developments which would naturally follow are taken into account.

That by the formation of a powerful company, as in the combination noted, a development of a part of Scotland is possible in a way not at present recognised, but which it is not thought necessary to indicate at present.

Thus, practically, by the addition of only fifty miles to the railway mileage of the country, a new direct route from north to south would be opened up, the amalgamation of four isolated companies made possible, and, in the powerful company which might be formed, a new adjunct created, to the further development of the parts of the country in which the individual systems are situated. The companies interested would be enabled to put themselves in the best position of self-defence against ambitious designs, while at the same time providing themselves with an alternative and more direct route—one, also, in which they would have the greatest interest. Extensions of the systems impossible under existing circumstances would follow the amalgamation and the construction of the new main line.

Would not, therefore, the consolidation of those companies (should neither of the present Bills pass), before they fall as an inevitable prey to their stronger brethren, be for their own benefit, and more to the good of the community and welfare of the country in general than the schemes for the absorption of the most important of them now before Parliament, and which are also being so vigorously opposed?

Yours, &c.,
"Eon Strathaar."

London, 23rd April, 1890.

SMIT'S COMBINED ENGINE AND DYNAMO.

To the Editor of "Industries."

Sir,—With reference to the letter from "Engineer" on the above matter, in your issue of last week, I think that a single-acting engine would have been much more suitable for driving the "Smit Dynamo" than the engine illustrated in your journal of the 11th inst. With a 5¾in. single-acting, single crank, "Silent" engine (working at same speed and pressure), a "smash up" would be far less likely; all the parts would have more than double the area of wearing surfaces, and be better able to deal with the various stresses. A speed of 450 revolutions per minute would be very slow for so small a single-acting engine, as scores of this size have been at work for years at 550 to 600 revolutions per minute without a single "smash up," and without even any adjustments or repairs. I fear that "Engineer's" experience has been with the wrong sort of single-acting engine.

Yours, &c.,
L. Chandler.

Cannock Chase Foundry and Engine Works,
April 22nd, 1890.

THE ACCIDENT TO THE "CITY OF PARIS."

To the Editor of "Industries."

Sir,—With reference to the recent accident to this vessel, will you kindly permit me to call attention to the desirability of having an auxiliary hydraulic propeller or turbine fitted to all large vessels, to act as a last reserve propeller in case of the breakdown of the main engines or screw propellers, and also to act as a very powerful pump in case of collisions, &c.?

In January, 1876, the late Admiral J. C. Wilson read a paper for me on "A Proposed New Combination of Propellers," at the Royal United Service Institution, treating on the centrifugal pump—1st, as a reserve propeller; 2nd, as a most powerful bilge pump; 3rd, as a most powerful fire engine.

Calculations showed that, with a very low efficiency, a centrifugal pump worked by a steam engine of 700 i.h.p. would alone drive H.M.S. "Devastation," of 9,300 tons displacement, at a speed of nearly seven knots per hour, and that it could remove 15,000 tons of water per hour from the ship. And, if only 400 i.h.p. were employed, the speed would be nearly six knots per hour, and the quantity of water that could be pumped out of the ship would be 8,500 tons per hour.

In the paper referred to, I suggested that, in lieu of one pair of engines working one centrifugal pump, it may be desirable to use two or more sets of independent engines and pumps of small power, separated from each other by watertight bulkheads. I know all the objections to the use of the hydraulic propeller, and the difficulties in the way of fitting it on board ship, but it appears to me that, with the high-pressure steam and high-speed engines of the present day, the difficulties are very much less than formerly.

I need not, I think, point out the advantage of having immense pumping power in combination with a small reserve propelling power in our vessels of war in case of injury to the hull or to the main engines during action; but I venture to submit that this is a matter which deserves some attention.

Yours, &c.,
George Quick,
Fleet Engineer, Retired.

Chipping Campden, 22nd April, 1890.

PRODUCTION OF COAL IN JAPAN.

To the Editor of "Industries."

Sir,—Referring to the paragraph in your issue of last week on this subject, permit us to point out that the Miike mines are not now "under Government control," as you state, but belong to our firm.

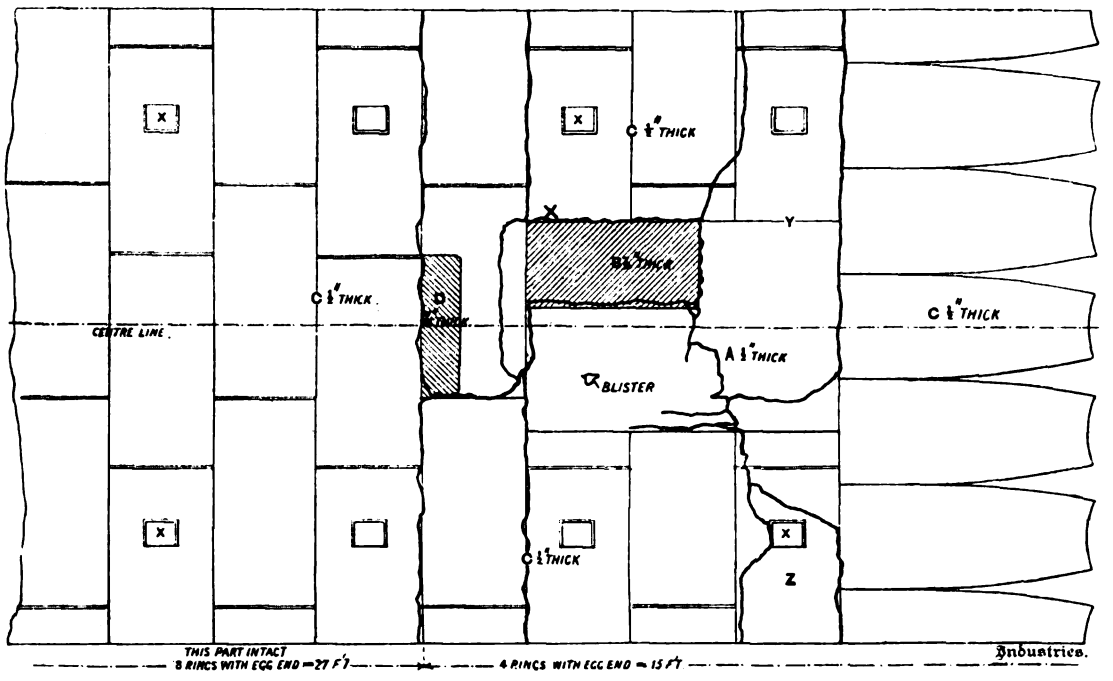
The Karatsu mines are owned by numerous proprietors—including the Japanese Government—and the name is a general one for a coal district.

Yours, &c.,
Mitsui & Co.

1, Crosby Square, London, E.C., April 22nd, 1890.

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THE BOILER EXPLOSION NEAR DUDLEY.



DEVELOPED PLAN OF THE UNDER PART OF BOILER.

THE RECENT BOILER EXPLOSION NEAR DUDLEY.

On Monday, the 13th inst., Mr. Howard Smith, barrister, and Mr. Hallet, consulting engineer, opened a Court of formal inquiry, at the Mechanics' Institute, Dudley, respecting the boiler explosion at the chain and anchor works of Messrs. Noah Hingley & Sons. The accompanying illustration represents a plan looking from the under side of the exploded boiler, the plates being flattened out for convenience of illustration. The boiler was of the egg-ended type, 42ft. long by 6ft. diameter, and fired underneath as usual. It was constructed of best Staffordshire plates, ½in. thick, with double-riveted longitudinal seams, represented by double lines in the illustration, except in a few seams over the fire. The circumferential seams were single-riveted, and are shown by single lines. An unusually large Lowmoor plate A, 9ft. 3in. by 6ft. by ½in., had been put in over the fire when the boiler was made, but it appears that a large piece of it had been cut away at some subsequent period, and another plate, shown at B, 5ft. by 2ft. 6in. by $\frac{7}{16}$in., of ordinary "Lion" brand, had been substituted. This plate should have been "Best Best Lion" or "Best Best Best Lion," as recommended by the makers for positions over the fire. A seam rip, between 2ft. and 3ft. long, had developed in this thin patch, as shown at the mark X, but it is not stated that the boiler gave way at this rip. The portions of plates Y and Z have not been found since the explosion. Another repair appears to have been made at D. The plate here was of "Best Best Staffordshire" brand, 4ft. by 1ft. 4in. by $\frac{7}{16}$in. The supporting brackets are shown at X...X. The boiler had often been repaired, but had not been thoroughly inspected since 1885. Neither had it been subjected to hydraulic tests after repairs. Shortness of water or excessive pressure does not appear from the evidence to have caused the explosion, inasmuch as the boiler is said to have been full of water and the pressure only 45lb. per square inch.

The greater part of Wednesday, the 16th inst., was occupied by the addresses of the solicitors appearing for the several parties interested. Mr. Waldron, on behalf of Messrs. H. & J. Danks, pointed out that both Mr. Hingley and Mr. Danks desired to have the best boiler possible, and agreed that the large Lowmoor plate was desirable, and he contended that the single riveting of that plate was not an element of danger. As regards the suitability of the plate of "Lion" brand used for repairs, he said he was prepared to admit that it was unsuitable for putting over the fire, as applied in this boiler; but because that admission was made, it did not follow that Messrs. Danks supplied the plate. He contended that the actual cause of the explosion was shrouded in doubt. Mr. Mills, an engineer to the Scottish Boiler Insurance Company, had conjectured that the cause of the explosion was a seam rip, but not a seam rip in the "Lion" plate. Mr. Arthur Smith, who appeared for Messrs. Hingley's engineer, considered that the crucial point of the inquiry was the "Lion" plate, the manufacturers of which had distinctly stated that it was unsuitable for placing over the fire, and was not equal to their "Best Best" quality. He contended that there could be no doubt that the plate was put in the boiler by Mr. Danks. As regards inspection, the reason why certain reports of the insurance company with regard to inspection had not been acted upon so quickly as they might have been, was because external examinations of the boiler were continually being made by properly qualified persons. Mr. Thomas Turner, manager of the New British Iron Works at Corngreaves', who had previously given evidence, and stated that "Treble Best Lion" plates were what they should recommend for positions over the fire, said that he trusted no erroneous impression would be created by what had been said regarding "Lion" iron, of which there were four qualities. Mr. Smith, one of the Commissioners, remarked that they were all good iron, but differently wrought.

Mr. Smith, in giving judgment, said that they could not trace when the "Lion" plate had been put in. The Lion brand of plate was made in four qualities:—(1) "Lion," (2) "Lion Best," (3) "Lion Best Best," (4) "Lion Best Best Best." The "Lion," the fourth quality, had been put in to replace a portion of the "Lowmoor" plate, 5ft. by 2ft. 6in., in which edge cracks had developed. On the morning of the 21st March, when the boiler exploded, it had been found sufficiently full of water, and carried 42lb. per square inch pressure of steam. He said they were of opinion that the boiler was properly constructed in 1877, and there was no question that the "Lowmoor" plate was fitted to be used over the furnace. Inasmuch, however, as the longitudinal seams of the boiler were double riveted, they thought that the "Lowmoor" plate that was put in should have been double riveted also. They held that the "Lion" plate, which was put on the "Lowmoor" plate, was not of sufficient quality to be used over the furnace, but he wished it to be understood that they did not find fault with "Lion" iron. The "Lion" iron was of good quality, but Mr. Turner, who represented the company manufacturing the iron, and other experts all agreed that it was improper iron to be used over the fire. Certain tests had been made, but they did not attach any importance to them except to show that the action of the fire rendered the plate brittle. The test given was not that of the iron when it was first used, but Mr. Danks was seriously to blame for employing it. Messrs. Hingley did not appear to have made any provision for a thorough examination of the boiler, and they found that there was never any hydraulic test after repairs. They had therefore come to the conclusion that Messrs. Hingley did not take all reasonable and necessary precautions with the boiler. They also thought that the engineer for Messrs. Hingley should have had more assistance. Messrs. Hingley had repeated reports from the insurance companies stating that their boilers were overdue for inspection. The last time the boiler was thoroughly inspected was in 1886. As regards the cause of explosion, he said that it must necessarily be a surmise. They thought it probably occurred from a rip in a plate over the fire, but there was no evidence to show that the rip started in the patch on the Lowmoor plate. How the explosion occurred they could not say, but the Lowmoor plate clearly showed traces of lamination, and if within a reasonable time prior to the date of the explosion a careful examination had been made lamination would have been apparent, and if a seam rip had existed in the other plate it would probably have been detected, and a lamentable catastrophe avoided. They had no suggestion of blame to make against Mr. Hingley himself, but the firm and their engineer were to blame, as well as Mr. Danks. They assessed the costs against Messrs. Hingley & Sons at £50, and against Mr. Danks at £20.

THE EDINBURGH EXHIBITION.

In our double-page supplement this week we give a general view of the buildings and grounds of the Edinburgh Exhibition, which is to be opened by the Duke of Edinburgh on the 1st of May. We are indebted to Messrs. T. & A. Constable, of Edinburgh, for the permission to reproduce this view.

Since we published our first view of this Exhibition considerable additions have been made to the buildings, and some slight rearrangement of the grounds has been found desirable. The total area now enclosed is about fifty acres. There are eight and a quarter acres of the buildings proper, of which the main building accounts for over four acres, and the machinery hall for about two and a half. The space allotted to exhibitors amounts to nearly a quarter of a million square feet. Compared with recent Exhibitions the present may be said to be intermediate in size between that held in Edinburgh in 1886 and that held in Glasgow in 1888. In several respects, notably in the display of general machinery and the extent and variety of outdoor exhibits and amusements, it will probably surpass any Exhibition ever held in the provinces. There is an electric railway, a line on the telpher system, the Smith ship-railway, and the "Chemin de Fer Glissant" from Paris.

It is not yet time to notice any of the exhibits in their incomplete state, but later on we intend to devote some space to their description in detail. We may mention, however, the splendid display of locomotives, old and new, and a horizontal compound engine by Messrs. Robey & Co., of Lincoln.

Reviews.

BABBAGE'S CALCULATING MACHINES. London: E. & F. N. SPON. 1889.

This is not a systematic treatise on Babbage's Calculating Machines, but only a collection of papers relating to them, as regards history and construction, and is intended to bring together as much as possible the information scattered in various places regarding them, and to make it available for those interested in the subject who may wish to pursue it further. It is not, therefore, a work to be reviewed in the ordinary manner, or, at least, criticised, either as regards matter or arrangement. It is intended to be a mine from which the historian of mechanics may collect information from original sources regarding the work of a man who devoted the greater part of his life to the solution of a mechanical problem. Opinions will, no doubt, differ as to the wisdom of that devotion, but all must admire the perseverance with which Babbage kept at his work, and the ability which he brought to bear upon it. The editor confesses that the arrangement of the book is unavoidably faulty, and promises that if ever a new edition is wanted, that the whole will be recast. The table of contents shows the names of the various papers which have been reprinted, but we do think they might have been arranged in an order more suited to show the development of the ideas involved in the work. For instance, what is the concluding chapter should either have been the first or very near the beginning of the book, as it explains, not only the genesis of the ideas, but also of the steps which were taken for carrying them out, and gives some notion of the sacrifices, both pecuniary and personal, which the invention of the machines entailed upon their author. His son says, however, that few can imagine, and none will ever know, the full extent of these sacrifices. The book should almost be read backwards, for possibly those who are not acquainted with the subject already will find the most easily followed account of Babbage's work in the three last papers, the last one being the one we have mentioned, and the other two a Report of a Committee of the British Association, pub-

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lished in 1878, and a paper read by the son of the inventor, and editor of this work, at the Bath meeting of the Association. This latter paper concludes by saying that the writer sees no hope of any analytical engine, however useful it might be, bringing any profit to its constructor, and he adds that beyond the preparation of the paper and the publication of this book there is little or no temptation to do more, as the history of Babbage's Calculating Machines is sufficient to damp the ardour of a dozen enthusiasts.

It is unfortunate that Babbage did not write a complete description of his machines and of the uses to which they might be put. He preferred, while his energies lasted, to devote them to the actual progress and development of the design, although from his book, "Passages from the Life of a Philosopher," published in 1864, and written with the object of interesting the public in these machines, he mentions on the last page a forthcoming "History of the Analytical Engine." This was never carried out, and we have to trust to detached papers for what we know of the inventor's ideas and hopes. Our space will not allow us to enter into details of these. The three papers we have mentioned give the simplest explanation we have seen, both of the principles and methods of using the machines, while that written by Count Menabrea takes up the mathematical side of the subject and gives a most interesting study of it from that point of view. Before Babbage's time many proposals had been made for calculating contrivances of various kinds, the oldest being the Chinese abacus, which is still in use, both in China and Japan. Then we have Napier's rods, and various simple contrivances of the same kind. Pascal invented a very complicated instrument for the simplest arithmetical processes. Leibnitz designed another, which proceeded no further, while various other mathematicians exercised their ingenuity towards the same end. The principle which distinguishes Babbage's inventions from all these is that it proposes to calculate a series of numbers following any law by the aid of *differences;* and that by setting a few figures at the outset, a long series of numbers is readily produced by a mechanical operation. The method of *differences*, in a very wide sense, is the mathematical principle of the contrivance. A machine to add a number of arbitrary figures together is no economy of time or trouble, since each individual figure must be placed in the machine. But it is otherwise when these follow some law. The insertion of a few at first determines the magnitude of the next, and those of the succeeding. It is this constant repetition of similar operations which renders the computation of tables a fit subject for the application of machinery to take the place of the computer. Mr. Babbage set the question to the instrument, or the instrument to the question, and by simply giving it motion the solution was wrought out and a string of answers exhibited. He moreover intended the machine to record its answer, and even multiply copies of it. For an account of the magnitude of the undertaking we must refer to the book. Unfortunately other difficulties besides the mechanical and financial ones intervened, of which some idea may be formed by referring to page 305, but into which we do not feel inclined to enter. We can only say in conclusion that, although the book only appeals to a limited class of readers, it will form a most interesting and valuable addition to the library of the mathematician and the mechanician.

THE PHYSICAL SOCIETY.

At a meeting of this Society, on the 18th inst., Professor Rücker described the results of "Some Recent Magnetic Work," undertaken by himself and Professor Thorpe in connection with their magnetic survey of the United Kingdom. In a paper read before the Royal Society last year they have shown that the United Kingdom can be divided into seven or eight distinct districts, in each of which a source of disturbance seems to exist. The probable cause of these disturbances the authors believe to be the presence of "magnetic rocks." If this be true an intimate connection should exist between the magnetic elements of a district and its geological structure. With a view to testing more fully than heretofore the magnetic constitution of the districts above referred to, the work—the results of which Professor Rücker now described—was undertaken.

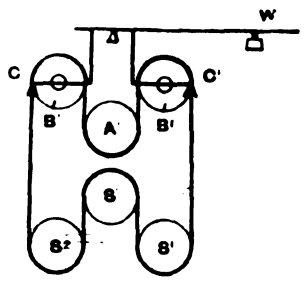
Two test districts were selected, in which numerous observations were taken; one of these is situated on the West Coast of Scotland, and the other embraces parts of Lincolnshire and Yorkshire. By the aid of magnetic maps Professor Rücker showed that a centre of disturbance exists to the west of Iona and south of Barra. In the Lincolnshire and Yorkshire district, extending from The Wash to Appleby, there is a region in which the horizontal disturbances along the east side tend towards the west, whilst along the west side they are, on the whole, directed easterly. This points to a ridge of magnetic material along the middle of the region, and from numerous observations the approximate position of the ridge line has been determined over a length of 150 miles. In Lincolnshire the ridge follows closely the line of wolds, whilst at the Kettlewell end it is directed towards the Cumberland Lake District. Places of maximum vertical force occur near Market Weighton and Harrogate. The observers were directed to Market Weighton by Professor Judd, on account of its being situated where the liassic strata thins out. Harrogate stands on the summit of an anticlinal. The fact that such places of maximum vertical force exist where, according to hypothesis, they would be expected, tends to confirm the supposition, and thus to demonstrate that a very close connection exists between the magnetic elements and the geological structure of a country. This is further confirmed by the observation that, in Lincolnshire, the line of disturbance follows closely the line of the wolds, and that from Market Weighton it passes across the plain of York to the millstone grit and limestone, which are the oldest rocks in the neighbourhood.

Mr. T. H. Blakesley read a paper on "A Theory of Permanent Magnetism," by M. Osmond. The author stated that iron exists in two distinct physical states, one soft, or "A iron," and the other hard, or "B iron." The B variety is non-magnetic, and is formed during heating, hardening, or by electrolysis, whilst the soft or A modification is produced by long annealing. In a piece of steel the author considers the B molecules to form a rigid framework in which the A molecules become interlocked under the influence of magnetising force, and on the degree of interlocking the permanent magnetism depends. By a graphical method it is shown that the permanent magnetism should be a maximum when the two varieties are present in equal quantities. If the proportions of carbon and manganese in the steel are considerable, then nearly all the iron is of the B variety and the steel is nearly non-magnetic. In hardening a piece of ordinary steel, the surface layers, being cooled most rapidly, contain more B molecules than the interior; hence, for a certain degree of hardness—when the outer layers have more A molecules than B ones—a laminated magnet will be a better permanent magnet than a solid one, but for a much greater degree of hardness the reverse may be the case.

SOME TESTS ON THE EFFICIENCY OF ALTERNATING CURRENT APPARATUS.*

The apparatus, the measurement of which is the main subject of this paper, consisted of a Westinghouse 750-light No. 1 dynamo, with a No. 2 exciter and an outfit of 40-light converters. This apparatus had been presented by the Westinghouse Electric Company to the Johns Hopkins University, and was tested a couple of months ago. The workmanship of the machines is excellent.

The plant consisted of a 75 h.p. Armington & Sims engine, driving the dynamo and exciter through a Tatham transmission dynamometer. Engine, dynamometer, and dynamos were firmly secured to heavy parallel timbers, which served as a foundation. The converters were banked on a wooden framework at a distance of some thirty yards from the dynamo, and their primaries were permanently secured to the dynamo circuit, a switch in the



latter serving to cut them off when desired. The ammeter belonging to the plant was put in this circuit, and was read when efficiency measurements were being taken. The secondaries of the converters were taken to a switchboard and then to incandescent lamps mounted on racks.

Power Measurements.—The Armington & Sims engine supplying the power worked regularly and satisfactorily, and the governor could be adjusted to give the speed required at the dynamo. The Tatham dynamometer was the one used for power measurements at the International Electrical Exhibition held in Philadelphia in 1884, where its accuracy was checked by making with it a determination of the mechanical equivalent of heat. The result obtained in the latter measurement was 772·8 foot pounds per degree Fahr., and show that the dynamometer is practically accurate. The figure above explains the principle of the dynamometer.

Electrical Measurements.—The energy in the secondary circuit was measured by means of a Cardew voltmeter and a Thomson ampere balance. Each converter had its separate lamp circuit.

Before making an efficiency test, the potential difference in the primary was regulated, and a separate measurement of the potential difference and current in each secondary circuit was made. When the test was actually in progress the voltmeter and ampere balance were used in one of the circuits, and the currents and P. D.'s in the others were calculated from the readings in this circuit together with the previous measurements. Both the voltmeter and ampere balance were accurately calibrated, the former being checked after each test, while the latter had its constant determined with both continuous and alternating currents. The P. D. at the terminals of a non-inductive German silver resistance in circuit with the balance was observed, when a continuous current was flowing, and also with an alternating current of the same period as that employed in the test. The current in each case was calculated from the resistance and P. D., and the results gave no appreciable difference in the constant for continuous and alternating currents.

The following table shows at once the order in which the tests were carried out and the results:—

Horse-power Absorbed at Varying E.M.F.'s.

	E.M.F.		H.P.
	Dynamo.	Exciter.	
Horse-power for exciter, field not made	0	0	·34
,, field made	0	110	·75
,, dynamo alone	0	0	2·73
,, dynamo and exciter...	0	0	3·04
,, ,, ,, ...	0	107	3·51
,, ,, ,, ...	1,376	124	12·5
,, ,, ,, ...	1,168	104	10·1
,, ,, ,, ...	1,099	105	9·60
,, ,, ,, ...	1,040	105	9·0
,, primaries of converters on	1,216	105	12·0
,, ,, ,, ...	1,171	104	11·8
,, ,, ,, ...	1,107	104	11·12
,, ,, ,, ...	1,048	104	10·64

Table of Efficiency of Varying Loads.

Approximate Load.	Exciter. E.M.F.	Exciter. Current.	Dynamo Primary. E.M.F.	Dynamo Primary. Current.	Converters. E.M.F.	Converters. Current.	Horse-power in Lamp Circuit.	Mechanical Horse-power.	Loss in Horse-power.	Efficiency.
½	105	9·4	1,107	10·0	49·5	153·9	10·21	21·83	11·62	46·8
¾	104	10·5	1,107	18·9	49·6	338·4	22·50	34·4	11·90	65·4
⅞	101	11·0	1,113	28·6	50·0	520·7	34·9	48·0	13·1	72·7
Full	112	11·5	1,123	38·1	50·9	739·8	50·48	64·44	13·96	78·3

Efficiency of Converters.

No. 8.—40-light Converter.

No. of Lamps.	Volts.	Watts in Secondary.	Loss in Watts.	Loss in Iron.	Efficiency.
40	50·0	2,001	109	—	94·8
0	50·9	0	84	84	—

No. 4.—20-light Converter.

No. of Lamps.	Volts.	Watts in Secondary.	Loss in Watts in Secondary.	Loss in Iron Watts.	Efficiency.
20	48·8	952	106·0	95·2	90·0
15	52·2	817	114·8	108·9	87·6
10	50·3	506	101·7	99·2	83·3
5	51·44	264	109·4	108·7	70·7
0	52·3	0	110·5	110·5	0·0

The efficiency of the converters was measured by placing them in a metal calorimeter, between the double walls of which water was allowed to flow. The temperatures of exit and entrance were observed, as well as the weight of water which passed through; at the same time the current and P. D. in the secondary circuit of the converter were measured. A separate observation gave the radiation, which was of course allowed for although it was made as small as possible. A number of converters were experimented on, but we give but two of them—a 40-lighter, such as was used in the tests, and a 20-light converter, which was very carefully tested by two of the students, Messrs. Bliss and McKeen.

Looking now at the figures given in the tables, we are struck by two things: the very large amount of power absorbed in the core of the armature, and the very small loss in the converters on open circuit. The dynamo losses due to reversals of magnetism and eddy currents at the e.m.f. used in the test are no less than 6 h.p., while the energy due to reversal of magnetism and eddy currents in the 16 converters is only 1·6 h.p. Another rather striking thing is the almost constant ratio of primary and secondary currents over a considerable range.

Suppose we have a plant such as is described above, and use it for commercial lighting. Taking data from one of the local companies employed in supplying incandescent lights on this system we have, for two 2,500-light dynamos, the following outfit of converters:—

Size of Converters.	Capacity.	Number in use.	Total Lamps.
No. 1	5 16 c.p. lamps.	44	220
No. 2	10 ,, ,,	61	610
No. 4	20 ,, ,,	43	860
No. 6	30 ,, ,,	49	1,470
No. 8	40 ,, ,,	64	2,560
Total lamp capacity			5,720
Number of lamps supplied			4,557

The converters being added are of the larger sizes.

* A paper read by Dr. Louis Duncan and Mr. W. F. C. Hasson, before the American Institute of Electrical Engineers, March 18th, 1890

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THE MANUFACTURE OF PORTLAND CEMENT FROM SLAG.

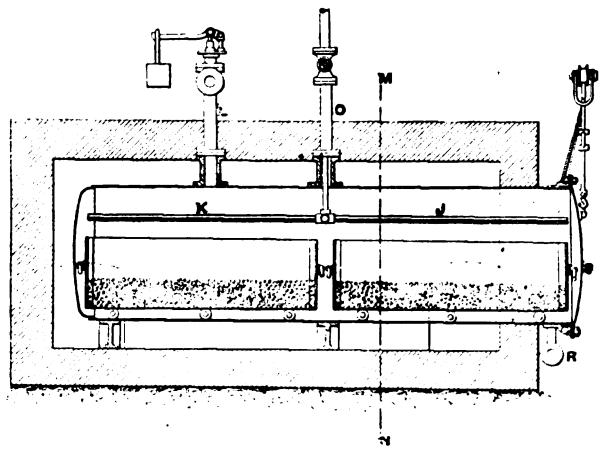


FIG. 1.

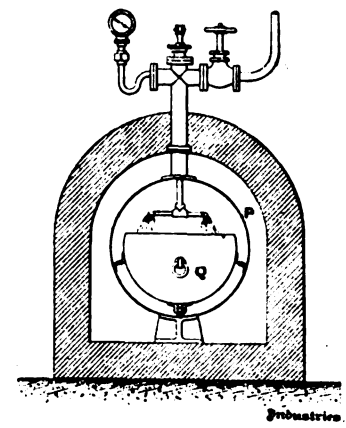


FIG. 2.

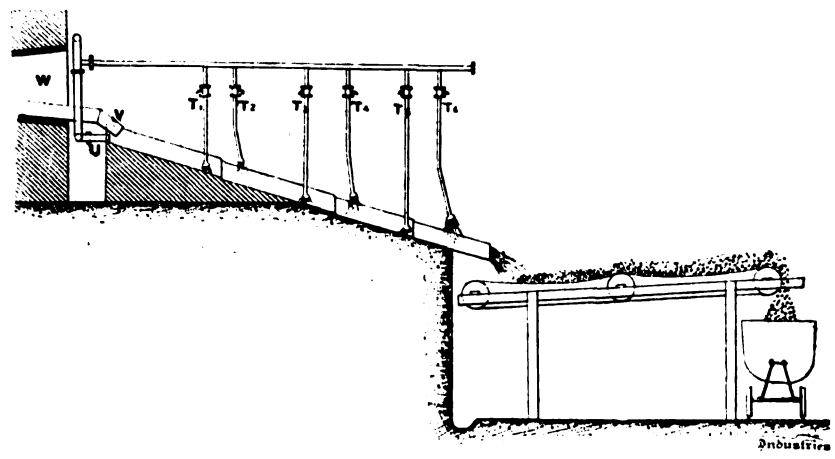


FIG. 3.

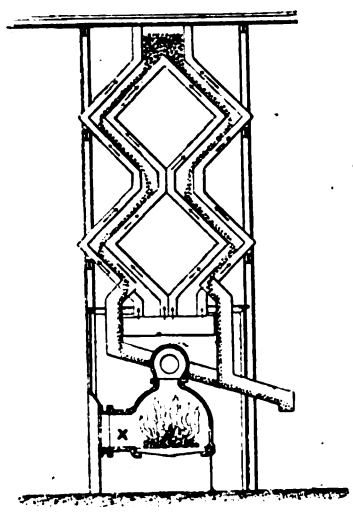


FIG. 4.

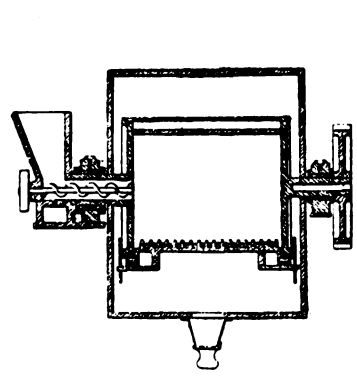


FIG. 5.

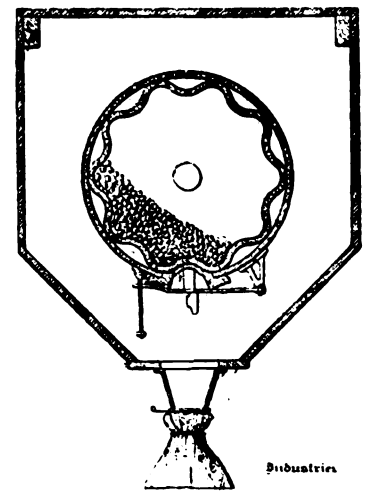


FIG. 6.

To show the disadvantage of the present system for domestic supply, suppose we have an ordinary house, such as one of us would live in; it would be necessary to have a converter of at least 20-light capacity. The constant loss is, say, 100 watts; so, leaving out the C^2R loss, we would have a total loss in 24 hours of $\frac{2400}{24}$, or about 3 h.p. hours, corresponding to, say, 45 lamp hours. Taking my own experience, the actual number of lamp hours used is about 30 lamp hours during 24 hours, so the efficiency of the converter would be something like $\frac{30}{75} = 40$ per cent. It is evident that, unless the losses in converters can be greatly decreased, a house-to-house distribution with a converter in each house would hardly pay.

It would seem, then, that if gas is to be really displaced, and serious competition with it is to be attempted, a different system of distribution must be worked out. We must replace the numerous small converters with one large converter supplying a comparatively extended district, thus decreasing the converter capacity, since the law of average can be taken advantage of, and greatly increasing the efficiency. If an extended secondary network is employed, some of the converters may be disconnected from the mains at the turn of minimum demand.

Probably, many of us have seen Mr. Swinburne's paper, which was read before the British Association last year, on the "Design of Converters," and have been struck by the fact that almost all of the converter dimensions given by him are impracticable, either on account of the disproportionate heating of the larger sizes, or the excessive fall of potential in the secondary. In increasing the size of dynamos we usually increase the output per pound weight, but there is the vital distinction between dynamos and converters that losses occur through the entire mass of the latter, and as we increase the volume we increase the losses in the same proportion. In the dynamo, on the contrary, there are practically no losses in the heaviest part of the apparatus —i.e., the field magnets. As a result, while we gain in efficiency in the larger sizes, yet we must decrease either our induction or the rate of reversal, and the output per pound is not increased.

THE MANUFACTURE OF PORTLAND CEMENT FROM SLAG.

In our issue of the 7th of February we gave an abstract of Mr. Gilbert Redgrave's paper on the utilisation of slag, read before the Society of Arts in the beginning of the year, and in which it was pointed out that the manufacture of Portland cement from basic slag sand is one of the more important methods of utilising this waste product. We said then that the system of cement testing used in this country militated against this cement having a fair trial in England, but we are glad to notice that contractors are beginning to imitate France and Germany in using this new cement, especially for making sea-walls and other works in water. We illustrate on pages 402 and 403 the plant necessary for the manufacture of this cement, and now give a brief outline of the mode of manufacture. A good Portland cement made from slag consists of an intimate mixture of granulated slag and about 25 per cent. of lime, reduced to a very fine powder by mechanical means. Early in the manufacture of this cement it was pointed out by Mr. C. Wood, of the Tees Ironworks at Middlesbrough, that a preliminary granulation of the slag was absolutely essential for the preparation of a satisfactory cement. This granulation appears to bring about both chemical and physical changes in the slag, causing the silica and alumina present to attain a condition of readiness to combine with the lime which is subsequently added, and when examined under the microscope the granulated slag is found to contain clear and brilliant grains imbedded in the matrix instead of the dark aggregates which are characteristic of the original slag. In fact, it is possible by a microscopical examination to judge of the value and completeness of the granulation process by noting the relative proportions of these two kinds of appearances, and it is customary to reject as unsuitable for the preparation of a hydraulic mortar those granulated slags which show a preponderating number of black granules. Early experiments also established the fact that the basic slags such as those obtained in the basic steel process were only suitable for this manufacture, and at present, even by largely increasing the percentage of added lime, the almost neutral and acid slags have not been rendered available for cement making. In calculating the amount of lime to be added, it is found that when the ratio of the sum of the oxygen in the silica and alumina of the slag to the amount of oxygen in the added lime is as 2:1 then the best quality cement is obtained. According to Tetmajer, when the ratio of lime to silica in the slag is less than one, then the slag is unsuitable for this manufacture. In those slags which contain an appreciable quantity of calcium sulphide this substance must be regarded as equivalent to so much lime present, since in the process of granulation it is decomposed by the water thus:—

$$CaS + H_2O = CaO + H_2S.$$

As pointed out by Mr. Redgrave in the discussion which followed the reading of his paper, the presence of calcium sulphide in the slag is of very small importance, as up to 3 per cent. it produces no injurious effects upon the quality of the cement, except rendering it slightly slower in setting. Sometimes it is found necessary to add, in addition to the lime, some gelatinous silica and alumina, both of which can readily be obtained from some unused slag by treating it with hydrochloric acid and filtering off the insoluble silica, when the alumina can be precipitated from the filtrate by the addition of lime. The additional alumina is also sometimes obtained from sodium aluminate obtained by fusing bauxite with soda.

In Figs. 1 and 2 are shown one of the forms of plant employed in Germany for converting the quicklime into dry slaked lime. It possesses the advantages of being very convenient for regulating the quantity of water to be added, of lessening the amount of hand labour, and preventing the formation of dust, which is so injurious to the workmen. The lime in coarse lumps is placed in the receiver Q, which rests on rollers and is enclosed in the larger cylindrical vessel P. This vessel P can be closed at S after the lime is introduced, L being a safety valve and pressure gauge to record the pressure, which may rise to 80lb. or 90lb. per square inch. The water is introduced by opening a cock which allows the water from a reservoir to flow down O into the pipe K J, which distributes the water uniformly over the lime. After remaining in the apparatus for some little time, the heat generated by the slaking causes the excess of water to pass away from the lime and condenses on the walls of the containing vessel, so that on removal the lime is found to be completely slaked and in the form of a dry powder ready for mixing with the slag.

The granulated slag often contains from 15 to 30 per cent. of water, and before being used it is necessary to remove this water by drying. The simplest method consists in exposing the slag in a thin layer on a hot plate,

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THE MANUFACTURE OF PORTLAND CEMENT FROM SLAG.

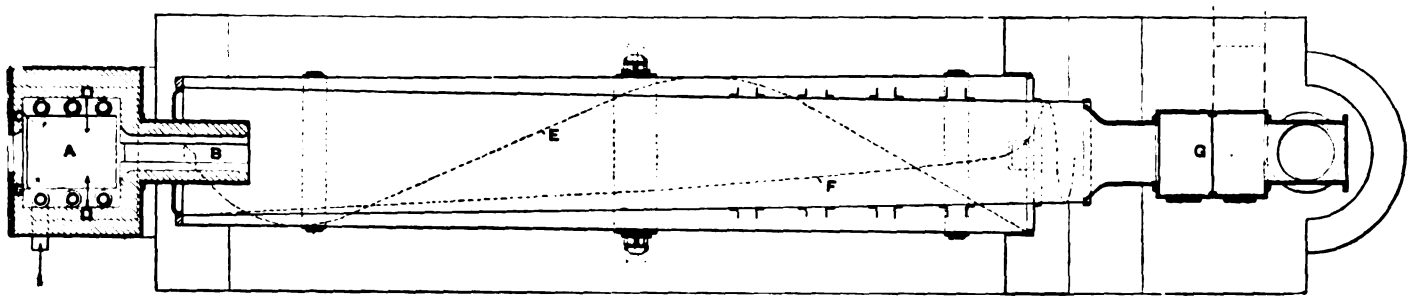


FIG. 7.

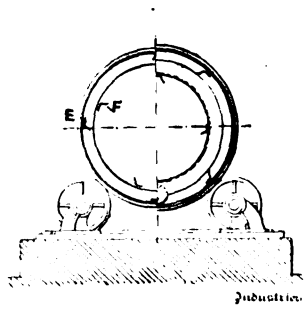


FIG. 8.

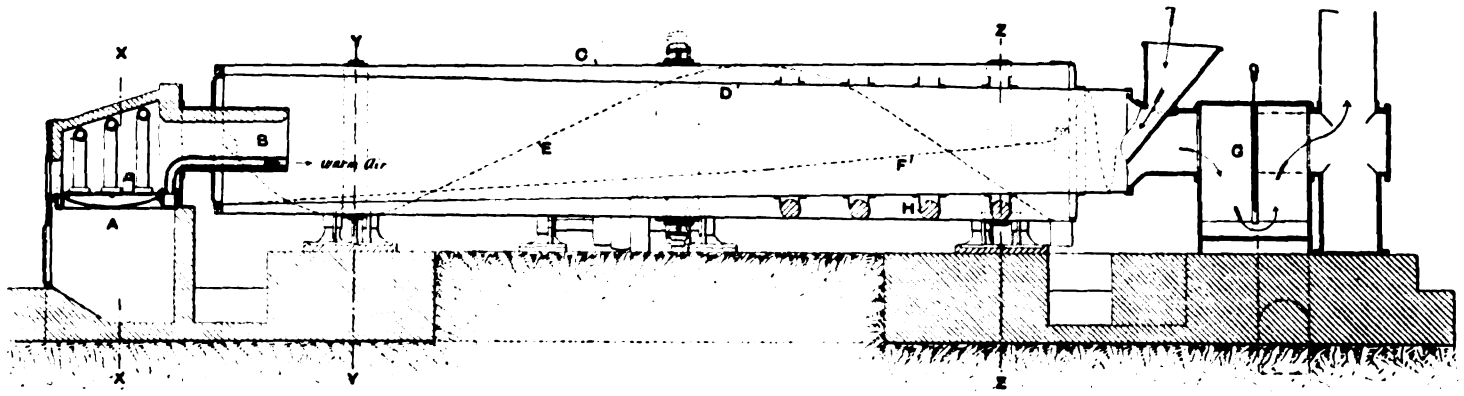


FIG. 9.

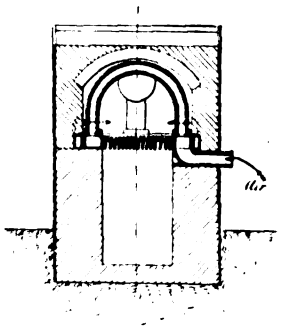


FIG. 10.

and it is possible to dry completely 100 kilog. per square metre of surface per 24 hours in this way, with a consumption of 6 to 7 kilos. of coal. There is, however, a good deal of handling and labour attached to this method, and many processes are in use which are more or less continuous in action and more economical in labour and fuel. The drying apparatus devised by Ruelle, and used in France in the phosphate industry, has been used with success for drying granulated slag. We illustrate this apparatus (Figs. 7, 8, 9, and 10), which, it will be seen, consists of a long rotating cylinder containing the slag, and through which a current of hot air circulates. At A the air is heated, and at B it enters the cylinder, through which it it is made to circulate by means of a ventilator. The rotating cylinder consists of two long slightly conical columns about 10 metres in length. The internal cone has its base nearest the fire, and is fitted with four helices, which regulate the motion of the slag within, so that it is uniformly exposed to the drying action of the hot air. The outer cone has its base away from the fire, and is supported at Y and Z, and within has four friction rollers on which the internal cone rotates. With this apparatus 25 tons of slag can be dried in 24 hours with an expenditure of 6 kilos. of coal per 100 kilos. of slag for heating the air and a motive power of 6 to 7 h.p. The apparatus, with ventilator, costs between £500 and £600. Other methods of drying the slag are in use at Choindez, in Switzerland, and at Saulnes, where recently M. Raty has erected important works for the manufacture of cement from slag. In the process patented by M. Raty the slag is granulated and dried in one operation. The apparatus is illustrated in Fig. 3. The slag, as it issues from the furnace in a molten state, flows down a metal channel, which is cooled by water (from T_2, T_4, and T_6) on the outside, and at the same time comes in contact with a small quantity of water (from T_1, T_3, T_5) within. It will be seen that in this method the cooling must be so regulated that the slag becomes hard and granulated, and also sufficiently porous, before it reaches the end of the inclined plane, and at the same time must not prevent the evaporation of the water from the pores of the slag, so that it may be delivered in a dry condition on to the metallic running band. The length of the channel depends on the nature of the slag. M. Grosclaude, to whom we are indebted for this description, does not state whether the process is one which has come up to the expectations of the patentee. It seems to us that when once the proper dimensions for the successful delivery of the slag in a suitable condition for cement making at the bottom of the channel are obtained, the process should be one of great value, but we are unable to say whether the inventor is prepared to give data for these dimensions for varying amounts of slag. Fig. 4 shows a section of an air drying arrangement in use at some works.

After the slag is granulated and dried it is next ground to a fine powder in an ordinary mill. It is then ready for mixing with the requisite amount of dried slaked lime, which operation is effected in a specially constructed ball mill. We illustrate in Figs. 5 and 6 the mill, which is constructed by Luther, of Brunswick, for this purpose. It consists of a cylinder which can be rotated about a horizontal axis, and containing a large number of metallic balls about 25–35mm. in diameter. The mixture of lime and slag is added by means of a screw feeder below the hopper. When the cylinder is nearly full, it is set in motion for about two hours, when the lime and slag are not only intimately mixed but reduced to an exceedingly fine powder. By an opening in the side of the cylinder the contents can be emptied into a bag placed for the purpose, a grating preventing the metal balls from falling with the powder into the bag. Other mills for this purpose have been constructed by Thivet-Hauctin, of St. Denis. M. Grosclaude concludes his description by giving an estimate for the cost of erection of an installation for the manufacture of cement from basic slag. He estimates that to produce 20 tons a day, or 6,000 tons per annum, the necessary outlay in plant, consisting of a Ruelle dryer, an engine of 150 h.p., a furnace, and all necessary mills, grinders, and mixers, as well as bags and barrels for holding materials and finished product, would be about £6,000. His estimate for cost of production, including labour and fuel, and interest on capital, is 18·584fr. per ton of cement; but he further adds that this estimate is probably much too high, and states that in France, in those ironworks which have erected cement-making machinery for utilising their slag, the cost of production does not exceed 12fr. per ton. As the selling price of cement in France is about 35fr. per ton, this shows that a considerable profit can be made out of this industry.

THE SOCIETY OF CHEMICAL INDUSTRY.

LONDON SECTION.

ON the 21st inst. Mr. Boverton Redwood communicated a paper on "The Indian Oil Fields," in which he reviewed our present knowledge of the extent of the oil-bearing districts in India and Burmah. He pointed out that, in addition to the oil fields of Upper and Lower Burmah, a large oil-bearing area existed in Assam, and that recently the Indian Government had made considerable progress in the development of wells in the Punjab and Beloochistan. The Lower Burmah deposits have been known for many years, and have been described by Mallet, Mendicott, and others. The chief centres are the islands of Ramri and Cluduba, and with proper methods of well-sinking there is no doubt that they would form the centre of a large industry. It is to be noticed, however, that the oil, which is dark brown in colour, is very variable in quality, that from East Baranga having a sp. gr. of ·835, and that from West Baranga being much heavier (·888). A still lighter oil (sp. gr. ·818) is obtainable from the mud volcanoes, and it can be burnt without previous distillation.

The Upper Burmah oil, which is shipped from Rangoon, and often known as Rangoon oil, has also been utilised by the natives for many years. It is a very viscid, almost solid, oil, of a dark brown colour, and contains a very large percentage of solid paraffin. Dr. Noelting, in his report of last year, draws attention to the fact that the district is of tertiary age, and that the oil-bearing sands belong to the miocene period. The oldest wells lie in the Yenangyoung district, but recently the newer fields of Twingoung and Beme have been opened up on either side. Messrs. Findlay, Hannay, & Co. have engaged American drillers, and their operations have so far shown that even at depths of 400ft. there is sufficient oil to yield a remunerative return to the capital invested, while there is no doubt that at greater depths further and larger finds of oil will be made. The Twingoung oil field has an extent of ninety acres, in which, according to Dr. Noelting, there are 375 wells, of which 120 are productive, yielding 80 to 90 riss per diem. The greatest depth of these native-dug wells is only 300ft., and considerable difficulties have to be encountered in sinking the well by manual labour, as the petroleum vapours prevent the workmen from being below for longer than 290 seconds. The author pointed out that these wells were not ventilated, and that although in Galicia efficient ventilation in the well-digging operations was compelled by law, and in Japan a blowing machine was invariably employed, yet the British Government had not as yet taken any steps towards preventing loss of life in these undertakings.

In the Beme oil field of 35 acres there were 151 wells, of which 72 yielded between 50 and 70 riss per diem. Messrs. Findlay, Hannay, & Co. commenced drilling operations in 1887 in this district, and have now nine drilled wells in their possession.

The following table gives the character of six samples of oil from the Yenangyoung district:—

No.	Sp. Gr.	Flashing Point.	Setting Point.
1.....	·887	110° F.	82° F.
2.....	·937	150°	below 0°
3.....	·869	62°	80°
4.....	·870	80°	78°
5.....	·873	83°	82°
6.....	·837	80°	60°

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It will be seen that the oil may be divided into two classes, No. 2 being distinguished by its high specific gravity and flashing point, the absence of any large quantity of solid paraffin, and its high viscosity, while No. 5 is an oil which gives a good kerosene on distillation and about 12 per cent. of solid paraffin.

It has further been noticed that, contrary to experience elsewhere, the wells of greatest depth do not yield the lightest oils, and at present a good deal of uncertainty prevails as to the kind of oil which any particular boring is likely to furnish. At Rangoon, belonging to the Burmah Oil Company, is a large refinery capable of distilling half a million gallons of oil per month, which is more than sufficient for the present requirements. The high temperature at Rangoon renders the refining process a difficult one, and it has been found impossible to manufacture any products from the solid paraffin obtained, which is therefore sent to England in its crude condition.

In the Pagan oil field, in Upper Burmah, the production is diminishing, and at Mindu, where the oil has never been commercially worked, drilling operations are now in active progress.

In the Assam district the author pointed out that, since 1860, when Goodenough obtained a concession to sink wells, and finally struck oil at a depth of 118ft., a good deal of progress has been made. The difficulties of transport are gradually being overcome, and the Assam Railways and Trading Company are now pushing on well-sinking operations in some of the best concessions in the district.

At Digboy oil has recently been struck at a depth of 275ft. in soft sandstone overlying shale, but the yield, which was at first 80 barrels a day, has since diminished. In the Punjab, at Rawal Pindi, there are at present sixteen wells, and the concession for this locality has been secured by Mr. Noble, of Canada. Mr. Townsend, on behalf of the Indian Government, has been recently engaged in prospecting in the Khatan district, where there are now five wells sunk to a depth of 500ft. The strata there dip at a considerable angle, which presents some little difficulty in ensuring a vertical drilling of the well. The oil has a very high specific gravity, due to asphaltum, and it is difficult to separate it from the water with which it is mixed. The supply is, however, practically inexhaustible, and as the district is one in which fuel is scarce, the importance of this liquid combustible in the district cannot be over-estimated, being situated, as it is, in the direct line of our railway system towards Kabool and Afghanistan. The climate of the district is unfortunately bad.

In conclusion the author gave as his opinion that of the Indian earth oils, the best for the kerosene refiner is that obtained from the island of Ramri, off the coast of Lower Burmah, while that obtained from the Yenangyoung field gives the best yield of solid paraffin. The author has lately, in conjunction with Professor Dewar, devised a method of treatment for this Yenangyoung oil which will considerably increase the yield of burning oil.

NITRIC ACID CHLORINE PROCESSES.

At the opening of the Manchester Permanent Chemical Exhibition, on Tuesday, the 15th inst., Mr. G. E. Davis read a paper on "The Process for Making Chlorine by the Reaction of Hydrochloric on Nitric Acid," recently patented by Mr. William Donald.

He first referred to the history and progress of chlorine making and the previous attempts which had been made to prepare it by the process under notice. The great difficulty had always been to get rid of the water which was produced in the reaction. No success had been obtained until 1885, when Taylor's process was patented. In this process hydrochloric acid is introduced into a vertical cylinder or tower containing coke or pumice soaked in strong nitric acid, whereby chlorine, nitrogen tetroxide, and water are formed. The products are passed into a similar cylinder containing pumice soaked in strong sulphuric acid, whereby the water and nitrogen compounds are removed with the formation of nitrosyl-sulphate, while the chlorine passes on and is absorbed in lime. Ninety-six per cent. of the hydrochloric acid used is decomposed into chlorine. The process, however, for various reasons, did not prove a complete success. In 1887 Mr. William Donald patented his modification of the process, which has now satisfactorily passed its trial stages, and promises great things in the future. In this patent the hydrochloric acid is taken direct from the salt-cake pan by suction. It is passed through nitric acid, and the evolved gases are sent through a cylinder containing strong sulphuric acid, and then again through nitric acid. Finally the chlorine is passed through sulphuric acid and is then absorbed by lime. It is very important that the reaction should take place at a low temperature, and therefore cold brine at 0° C. is kept in circulation round the cylinders by a pump. Mr. Donald expressed the reaction as follows:—

$$(1)\quad 2HCl + 2HNO_3 = 2H_2O + N_2O_4 + Cl_2.$$
$$(2)\quad N_2O_4 + H_2O = HNO_3 + HNO_2.$$

The reactions are the same in both processes described, the difference being in the arrangement of the plant and the method of working.

Notes.

A RAILWAY THROUGH PALESTINE.

A COMPANY is being promoted in America to be called the New England Land Company of Egypt, the objects of which are the development of the port of Alexandria and the construction of a railway through Palestine, *viâ* Hebron, Jerusalem, Jericho, Nazareth, and Galilee to Damascus. It is expected that the tourists to the Holy Land will profitably maintain a first-class modern railway.

ELECTRICITY IN JAPAN.

DURING the past few years the applications of electricity have made great progress in Japan, there being now five large companies carrying out the lighting of buildings, &c., from a central station. The stations at Tokio, Kioto, Kobe, Osaka, and Nagoya are stated to have lighting power for 22,300 lamps, 11,000 of which are said to be in use. Besides these ten other companies have received permission to erect works at Nagano, Kumamoto, Nagasakai, Hakata, Yokohama, Hiroshuna, Shidznoka, Hukodate, Niigata, with a total power of 16,800 lamps. The first company was established in Tokio in 1886.

THE STANDARD OF LIGHT.

THE London County Council have adopted the recommendation of their Sanitary and Special Purposes Committee to take immediate steps for the legalisation of a better standard of light and a standard type of photometer. Their letter to the Board of Trade last year was rendered abortive, mainly, no doubt, owing to their wish to introduce the portable photometer as a legal instrument. We hope that, by dropping this part of their former programme, their action will result in the long-wished-for dismissal of candles as the legal standard. We are confident that, with this alteration, most of the difficulties attending photometric measurement of light will disappear.

CHINESE GOLD MINES.

CHINA is no doubt progressing, though the rate of advance is slow, and it is always something when the Chinese themselves recognise that they might be doing better. A native paper at Shanghai draws attention to the question of gold mining in the empire, and points out that the Pingtu gold mines on the promontory of Shantung have failed to be remunerative on account of bad methods of working. At the Amur gold mines a better state of things exists, the local authorities having set to work to exploit them energetically, but it does not appear what machinery, if any, has been obtained. These latter mines lie on the Russian frontier, and at present are difficult of access, but new roads are to be opened up, and a steamer service organised.

THE CORINTH CANAL.

IT is eight years since the King of Greece cut the first sod of the Corinth Canal, and there is now a fair prospect, notwithstanding all the difficulties, financial and otherwise, which have come in its way, of the work being completed in about two years more, as a Bill granting a concession to a Greek company to carry on the work has been read a third time by the Chamber of Deputies. The new company is authorised to raise 5,000,000fr. capital in shares, and 15,000,000fr. by loan. The original contractors formed an over-sanguine estimate of the cost of the work, and came to a deadlock last year over arrears of payment. When the canal is completed, it will have cost at least £3,000,000, which is a considerable sum for a length of about 3¾ miles. It is intended to provide a navigable channel, 28ft. deep, 52ft. wide at the bottom, and 93ft. wide at the water level, and the advantages which it will offer to commerce will be considerable, affording, as it does, a short cut from the Adriatic to the Ægean, and saving all the perils of navigation around Peloponnesus. When it has been completed, we may yet see Corinth regain much of that commercial repute as a port and a centre of commerce which at one time made it so prosperous.

RUSSIAN INFLUENCE IN PERSIA.

FOR some time past there has been a considerable struggle for ascendency in Persia between the British and the Russians, not only in matters political, but also in those relating to industrial enterprise. The latter race have received some important concessions recently. It has apparently been arranged that the Russian Government shall receive notice of all projected Persian railways, and that Russian capitalists shall always get the refusal of railway concessions. A recent telegram from Vienna states that in accordance with this agreement an agent of the Persian Government will shortly arrive in St. Petersburg to begin negotiations with Russian financial houses for the construction of roads and railways in Persia.

PUBLIC COMPANIES IN SCOTLAND.

FROM a return recently published in the *Scotsman* we learn that in one week forty new joint stock companies have been registered in Scotland, with a total capital of £3,455,820. The capital of the 136 companies registered throughout the year 1889 was £8,844,604, which, however, included a number of private firms converted into limited liability companies, whose shares were not offered to the public. The largest individual share capital of the companies registered during the first quarter of 1890 was £700,000, being the businesses now amalgamated under the name of A. & T. Stewart, Ld., and made up of manufactories for pipes in iron and steel, and of works for the production of steel. Five shipping companies and two paper mill companies had been started, while two more breweries were converted into limited liability companies during the first quarter. A new gold mining company for Australasia has been formed with a capital of £250,000, and a coal company has been floated with £500,000 capital.

THE BELL ROCK LIGHTHOUSE.

THE effects of the recent explosion at this lighthouse have been repaired, and it is again in working order. As this is the first time the light has been interrupted since the lighthouse was erected, the accident has attracted considerable attention, and a question was addressed to the President of the Board of Trade in the House of Commons. From his reply, and from the published reports, it appears that the explosion was due to a neglect of the instructions issued to the keepers along with the fog signal. These provide for the signal being fired only at a due and safe distance outside of and above the lighting apparatus, and if they had been observed the disaster never could have happened. It must be admitted, however, that the instructions to the keepers are of a somewhat complicated nature, and the man in charge seems to have got confused and to have exploded the charge inside the light room with the disastrous results already known. The President of the Board of Trade has intimated that the Commissioners of the Northern Lighthouses have asked their engineer to report whether such modifications cannot be made on the apparatus as to render another accident impossible, and we have no doubt that this can easily be done. Accidents of this kind should always be utilised for the purpose of marking the limits of safety.

OXYGENATED OIL GAS.

DR. THORNE, of the Brin's Oxygen Company, has recently carried out a series of experiments with the view of testing the advantages of the Tatham patent for the manufacture of an oil gas of very high illuminating power. It will be in the recollection of our readers that Mr. Valon has shown, at Ramsgate, that oxygen may be used with advantage for the purification of coal gas, and that he found that in his process the addition of oxygen to the gas caused an increase in the illuminating power. The same is now found to be the case when oxygen is added to oil gas, and it has been shown that as much as 50 per cent. of oxygen can be added to the oil gas without any risk of forming an explosive mixture. The process at present used at the Brin's works at Westminster consists in first heating American petroleum to a moderate temperature in an iron retort, and then adding to the gases and vapours produced about 20 per cent. of oxygen, which prevents the subsequent condensation of the vapours and at the same time enormously increases the illuminating power. The necessary plant is of a very simple description, and, as far as one can judge from the experiments which have been carried out, there seems every ground for believing that the process is one which will be found to work well on a large scale and be capable of producing an illuminating gas of high intensity at a comparatively cheap rate.

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Patent Record.

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

8th April, 1890.

5289. Adair, T. ..... Scutching flax.
5291. Andrews & Berry ..... Protecting steel ropes.
5295. Dunsmuir, H. ..... Cranked shafting.
5301. Black, J. B. ..... Scutching machines.
5308. Nelson & Shaw ..... Mules.
5315. Jones & Jones ..... Impressing and printing wood.
5319. Lewthwaite, J. ..... Improving quality of iron.
5323. Burkhardt & Jackson ... Forming ornamental tubes.
5325. Grill, L. ..... Pumps.
5326. Haddan, R. ..... Train and locomotive (*Weigel*).
5328. Haddan, R. ..... Railroad switches (*Crepel*).
5330. Anderson, C. ..... Machinery for making paper bags.
5336. Brigham, M. E. ..... Box making machines.
5339. Grosselin, H. ..... Fulling machines.
5343. Lake, H. H. ..... Telpherage (*Maynadier*).
5345. Lake, H. H. ..... Manufacture of screws (*Russell and Erwin Manufacturing Co.*).
5350. Schütz, C. ..... Reducing valves.
5352. Cottrell, C. B. ..... Printing machines.
5355. Martin, W. E. ..... Utilising tides for producing motive power.
5358. Skinner, G. J. C. D. ... Slide covers of cylinders.
5361-2. Gaines, Pickens, & Gaines ..... Car couplings.
5365. Imray, O. ..... Steam pumps (*Irrigation Pump Company*).
5371. Leslie, R. D. ..... Stuffing boxes (*Leslie*).
5374. Nisbet, W. R. ..... Holding gear for ships' boats.
5378. Jensen, P. ..... Pneumatic buffer (*Riegel*).

9th April, 1890.

5383. Hamilton & Young ..... Torpedo booms.
5389. Houlden & Morris ..... Steam engines.
5393. Cameron, D. ..... Steam boiler (*Battin*).
5394. Cameron, D. ..... Car brake (*Brunquest*).
5396. Nittinger & Rotter ... Railway brakes.
5397. Whitfield, C. ..... Punching and eyeletting machine.
5398. Czischek, L. ..... Valve gear.
5402. Ockendon, W. ..... Shaping boiler plates.
5404. Grey, E. H. ..... Flying machine.
5408. Paulitschky, C. W. ... Machine for removing snow from railways and tramways.
5410. Lishman, T. G. ..... Boiler furnaces.
5415. Horn, W. W. ..... Brick machine (*Grant & Murray*).
5424. St. John, S. H. ..... Starting and moving cars.

10th April, 1890.

5427. Ibbotson, E. C. ..... Railway buffers.
5429. Tattersall, W. ..... Air compressor or blower.
5430. Williams, H. ..... Gas engines.
5431. Williams, H. ..... Riveters, punches, &c., worked by gas engines.
5432. Williams, H. ..... Governor for gas engines.
5433. Williams, H. ..... Governing admission valves of gas engines.
5445. Crocker, J. A. ..... Filtration of town water.
5446. Crocker, J. A. ..... Filtering machines.
5449. Tasker & Hargreaves... Machinery for opening cotton.
5450. Tweedale, S. ..... Spinning machines.
5453. Ackroyd, Ackroyd, & Willoughby ..... Boiler furnaces.
5461. Crowder, S. ..... Projectiles.
5470. Mügel, P. ..... Steam pumps.
5475. Booth, A. T. ..... Sawing machines.
5476. Higley, E. N. ..... Sawing and drilling rails, &c.
5478. Lake, H. H. ..... Bolster bearings (*Parker, Barber, Estens, & Atkinson*).
5479. Lanchester, F. W. ..... Gas engines.
5480. Wendt & Wendt ..... Car couplings.
5483. De la Sala, Don P. P.... Torpedo boats.
5484. Pratt, E. ..... Apparatus for raising and lowering trusses of hay.

11th April, 1890.

5485. Westray, J. ..... Boiler furnaces.
5487. Duff, E. J. ..... Boiler furnaces.
5489. Riley, J. ..... Boiler furnaces.
5494. Wallis, A. H. ..... Tools for cutting elliptical holes.
5496. Wastfield, E. G. ..... Gas engines.
5497. Kenyon, Sen., Kenyon, Jun., Kenyon, & Kenyon ..... Friction clutches.
5501. Hewitt, G. ..... Smoke consuming apparatus.
5503. Daw & Daw ..... Percussive rock drills.
5504. Barker, F. ..... Jacquards.
5510. Betteley, G. ..... Starting tramcars.
5514. Leloup, J. ..... Automatic measuring apparatus for liquids.
5517. Chambers, W. ..... Steam generators.
5525. Chasles, H. C. ..... Drying and ironing machines.
5526. Chasles, H. C. ..... Ironing, finishing, and drying machines. (14th March, 1890.)
5530. Low, R. ..... Machines for the manufacture of rolled metal balls.
5531. Imray, O. ..... Cradles and recoil buffers for field gun carriages (*English*).
5532. Field, C. L. ..... Decorticating ramie.
5537. Arnot, W. ..... Rock drills (*Brain, Arnot, & Baker*).
5538. Wells, C. ..... Steam engines.
5541. Cole, Dobson, De Mouzilly, & Richardson Weaving and knitting machines.

12th April, 1890.

5543. Manbre, E. ..... Furnaces for burning liquid fuel.
5545. Turner, Baird, & Baird Iron and steel.
5546. Mountain, B. ..... Manufacture of wire.
5548. Brindle, Reade, & Taylor Drilling machine.
5551. Walton, W. ..... Flats for carding engines.
5557. Gallaucher, J. ..... Lifeboats.
5560. Whitehouse, J. ..... Adzes, axes, hatchets, &c.
5565. Causer, W. ..... Machines for making cartridge cases.
5569. Kirk, A. C. ..... Armour plates.
5570. Riley & Duff ..... Water-tube steam boilers.
5572. Millington, W. J. ..... Tubular boiler.
5573. Cito & Funck ..... Lifting jack.
5578. McGlashan & Rawlings Raising and lowering ships' boats.
5581. Skelsey, G. H. ..... Cement kilns.
5582. Leigh, H. H. ..... Linotype machines (*Mergenthaler*).
5583. Mauser, P. ..... Breechloading guns.
5585. Longridge, C. C. ..... Railway axle boxes.
5590. Limborg, O. ..... Steamships.
5592. Martin, H. ..... Compressed air motors (*McCarten*).
5598. Fleuss, H. A. ..... Refrigerating apparatus.
5599. Hale, W. ..... Drilling machines (*Mickler*).

ELECTRICITY.

8th April, 1890.

5306. Langdon, W. E. ..... Detection of flaws in steel.
5313. Bruce, T. W. ..... Steering compasses.
5335. Lake, H. H. ..... Insulating electrical conductors (*Stetson*).
5344. Lake, H. H. ..... Measuring currents (*Garver*).
5368-9. Kellogg, M. G. ..... Telephony.

9th April, 1890.

5400. Schorch, R. ..... Dynamo-electric machines.
5409. Cappilleri, Kurmayer, Goldberg, & Latzko Arc lamps.
5423. Wenström, J. ..... Transformation and distribution of alternate currents.

10th April, 1890.

5474. Lyon & Leslie ..... Regulating and controlling currents.

11th April, 1890.

5490. Langdon, W. E. ..... Increasing adhesive power of railroads.
5518. Price, C. ..... Incandescence lamps (*Hadfield*).
5540. Higgins, F. H. W. ..... Electrical measures.

12th April, 1890.

5558. Smillie, R. D. ..... Telephone switch.
5562. Emmott & Rider ..... Dynamo-electric machines.

CHEMISTRY.

8th April, 1890.

5348. Martyn, T. G. ..... Uranium compounds.
5364. France, J. R. ..... Nitro-cellulose.
5366. Imray, O. ..... Guaiacol ether (*Farbwerke vormals Meister, Lucius & Brüning*).
5367. Lake, H. H. ..... Refining camphor, &c. (*McKenzie & Braker*).
5376. De Chardonnet, H. ..... Cellulose.

9th April, 1890.

5407. Lumaghi, O. ..... Argentiferous zinc ores.
5419. Guillaume, J. ..... Treatment of organic matters.
5420. Kellner, C. ..... Cellulose.

10th April, 1890.

5434. Williams, H. ..... Water gas.
5442. Burghardt, C. A. ..... Nitrate of ammonium.
5464. Hawkins & Barton ..... Gas retorts.
5469. Wilson, R. H. ..... Sulphuric acid.

11th April, 1890.

5488. Donald, W. ..... Chlorine.

12th April, 1890.

5571. Campbell & Boyd ..... Chlorine.

MISCELLANEOUS.

8th April, 1890.

5292. Morison, W. C. ..... Ammunition.
5340. Smith, H. J. ..... Recording and reproducing sounds.
5349. Weber & Freeman ..... Artificial stones.
5353. Fox, E. M. ..... Alarm thermometers.
5372. Mitchell & Lawson ... Gas meters.
5375. Noppel, Grosche, & Bigler ..... Purifying and refining oil.
5377. Breyer, F. ..... Asbestos filters.

9th April, 1890.

5380. St. George, A. F. ..... Gum resins and varnish.
5385. Heys, W. E. ..... Dyeing yarn (*Châtel*).
5387. Fulton, D. ..... Anti-corrosive compound (*Schmid*).
5405. Robbins, J. ..... Water pipes.
5413. Thompson, W. P. ..... Cleaning wool (*Orcal*).
5421. Fennell, G. ..... Springs (*Fennell*).
5422. Malmström, K. K. ..... Percussion fuses.

10th April, 1890.

5471. Bunnett, R. ..... Fog signalling.
5482. Arnott, Olivier, & Seagrave ..... Washing wool.

11th April, 1890.

5511. Moreton, E. ..... Printing rollers.
5515. Justice, P. M. ..... Building material (*Parker & Gates*).
5535. Low, R. ..... Percussion fuses.

12th April, 1890.

5547. Haigh, B. ..... Dyeing.
5552. Dardier, S. V. ..... Percussion fuses.
5579. Cooper & Wigzell ..... Instruments for taking soundings.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form, of such opposition.

Year 1889.

221. Perry.
2412. Fowler & McCaughey.
5989. Graham.
6071. Buckland.
6280. Gronwald & Oehlmann.
6433. Schleuning.
6551. Black.
6598. Samuel Davis, Frank Moore, James Palmer, & Edwin Newton.
7258. Lane.
7427A. Limer. (3rd May, 1889.)
7666. Bamberg.
7711. Grenfell.
7802. Willcox (*Farbenfabriken vormals Friedrich Bayer & Co.*).
7888. Tatham.
7906. Walton.
8089. Holker.
8119. Janssen.
8261. Fawcett.
8372. Case.
8385. Johns.
8649. Gare.
8711. Derbyshire & Entwistle.
8719. Gardner.
8913. Singleton.
8951. Tomkins.
9015. Browne.
9045. Belling.
9142. Brierley (*Baudenbacher*).
9284. Burbank.
9394. Weaving.
9423. Clark.
9454. Love.
9458. Elmer-Honegger.
9479. Bates.
9493. Sellergren.
9503. Rivett.
9546. Billington.
9551. Crompton & Hatton.
9579. Senior.
9599. Cockroft & Farmer.
9612. Johnson (*Von Heyden*).
9632. Parker.
9643. Imray (*Farbwerke vormals Meister, Lucius & Brüning*).
9653. Vero.
9669. Wright.
9684. Hunt.
9702. Colclough.
9784. White.
9803. Bamford.
10007. Daimler.
10244. Barlow.
10354. Cooper.
10801. Pieper.
10918. Linde.
11762. Culpan.
11932. Walters & Smith.
13075. Holbrook.
13977. Dubois.
15764. A. Montague. (8th October, 1889.)
16137. Henckels.
16568. Redgate.
18491. Green.
18820. Staps.
18869. Wathen.
19529. Holt.
20091. Von Possanner-Ehrnthall.
648. Taylor.
5917. Miles.
6034. Nicolls.
6139. Riordan.
6371. Boult (*Eichbaum*).
6518. McEvoy.
6594. Taylor.
6599. Young.
6658. Plowman.
6870. Gardiner.
7083. Taylor & Miller.
7279. Jane.
7443. McCann.
7594. Crowe & Crowe.
7689. Spink.
7748. Robinson.
7816. Helliwell.
7857. Imray (*Farbwerke vormals Meister, Lucius & Brüning*).
7917. Nicholson.
8110. Haddan (*Hahn*).
8150. Gadsden.
8271. Chevalet.
8380. Schaffstaedt.
8561. Conlong.
8692. Kingsbury (*Western Electric Company*).
8715. Dewrance & Wall.
8841. Burghardt.
8931. Hawley & Smith.
8963. Williams.
9018. McDowell & Melsom.
9091. Elliott.
9149. Mason.
9157. King (*Ripley*).
9312. Inkpen.
9403. Barr & Stroud.
9435. Harris, Sheldon, & Baker.
9468. Rickaby.
9480 Wenger.
9494. Miller.
9517. Soennecken.
9548. Cheetham & Sutcliffe.
9573. Dodds & Fothergill.
9595. Melling.
9602. Spence.
9615. Bleasdale.
9642. Imray (*Farbwerke vormals Meister, Lucius & Brüning*).
9648. Coppinger.
9658. Dickson & Cox.
9683. Howden & Hunt.
9685. Hunt & Howden.
9719. Siemens.
9790. Niebour.
9804. Huelser (*Scholz*).
10192. Shortell.
10275. Tyer.
10594. Kershaw.
10824. Brunton & Griffiths.
10994. Plant.
11906. Blakey.
12073. Johnson.
13954. Fisher.
14022 Riedler.
15813. Sinsel.
16110. Rose.
16215. Boult (*Henderson*).
17482. Beckett.
18691. Risk.
18828. James.
19509. Keeler.
19548. Hooper-Rastrick.
20559. Carswell.
20963. Fiske.

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1890.

250. Roche & Roche.
663. Shillito (*Römpler*).
1397. Hinks & Hinks & Son, Ld.
1528. Batchelder.
1599. Kenyon.
1740. Palmer.
1862. Scott & Davis.
1972. Markus.
2704. Cito & Funck.
2822. Crowley. (26th August, 1889.)
3105. Glover.
3381. Barton.
3454. Trask.
3578. Snape.
3591. Paddon.
3607. Beeching.
3611. Schaefer.
3659. Edward Napier Galloway & John Henry Beckwith.
3750. Schonemann.
3781. Haddan (*Blasco*).
3787. Libbey.
3836. Stansbury & Hyatt.
3843. Faust.
3846. Lake (*Husted*).
652. Harby & Vaughan.
1201. Hirons.
1398. Hinks & Hinks & Son, Ld.
1583. Radlauer.
1716. Thompson (*The Office Specialty Manufacturing Co.*).
2645. Spooner.
2757. Holman (*Holman*).
2933. Randnitz.
3058. Binns.
3139. Boult (*Kretzschmar*).
3419. Van Depoele.
3486. Winburn.
3584. Grummt.
3594. Redfern (*Barney*).
3610. Muir.
3647. Beckmann & Henckels.
3673. Nash.
3679. Hulme & Hulme.
3695. Cox.
3771. Steffenhagen.
3782. Pszczolka.
3830. Thompson (*Bourgain*).
3837. Weldon.
3845. Barton & Higgins.
3870. Damer & Damer.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

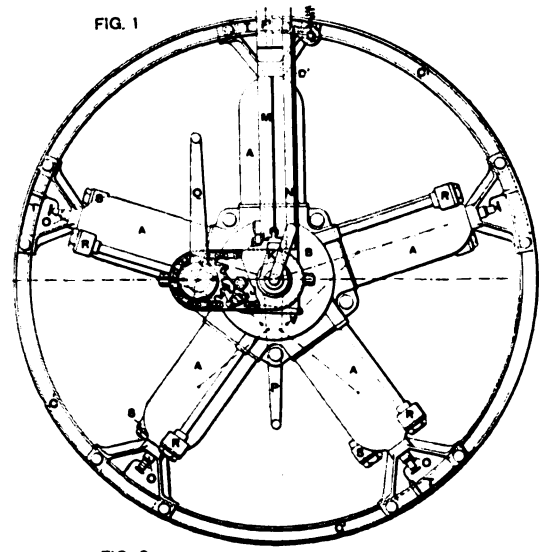
ENGINEERING.

Ships' Propellers.—*H. C. Vogt, Copenhagen, Denmark.*—The two blades of the propeller are each formed with or rigidly connected to a short cylindrical part or axle which is secured in a boss upon the propeller shaft, with its axis at right angles to the axis of the shaft. The blades are capable of turning about the axis of these axles, and thus when the propeller is at work it will only be in continual equilibrium when the greater part of its acting area is aft the produced axis of symmetry through the axle. When the propeller is rotated in the following currents of the ship, the pitch angles of the blades will continually change equally but in the opposite sense, whereby the forces acting on the blades will continually balance each other so as to permit the blades to be broadest near the circumference. Heavy strains are also avoided, such as are usually caused by the pitching of the ship. When the engine is reversed the propeller will of itself turn 180° to be in equilibrium, and makes the blades as effective in driving astern as ahead. Claims: (1) A two-bladed propeller in which the blades are rigidly connected with each other by a blade axle which is able to move in, and enclosed by, the boss like a shaft in a bearing, thus enabling the thrusts on the blades to balance each other in the following currents of the ship, whereby vibrations are avoided without tapering the blades; (2) in a two-bladed propeller of the character described, the employment of a yielding stop or spring for the purpose of making the oscillations of the propeller in the following currents of a ship as elastic as possible with minimum of oscillation to annihilate vibrations; (3) the construction of two-bladed propeller as illustrated in the specification. —No. 7738. May 8th, 1889. 6*d.*

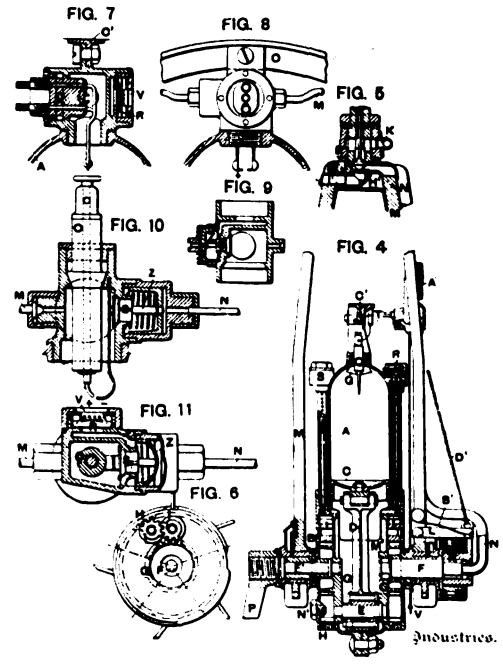
Vacuum Pump.—*E. F. Varaldi, Paris.*—This pump is especially applicable for exhausting bulbs of incandescent electric lamps. On a horizontal axle, which is formed with ports like the plug of a cock, is mounted two tubular arms, more than 30in. in length, and to whose outer ends are jointed vessels having their tops connected by a rod pivoted to them. This rod is mounted on an axle above that on which the arms are mounted, so that it is always parallel to the arms when they are caused to oscillate on their axles, and the vessels at the ends of the arms are thus always maintained in a vertical attitude. The vessels are charged with mercury, and the ports in the plug axle communicate with a vacuum tube, to which are attached the bulbs or other vessels to be exhausted. When the tubular arms are caused to oscillate on the plug axle, the mercury flows down the one arm away from the axle, creating a vacuum, and a port being then open to the vacuum tube air is drawn from the tube into the arm. The mercury in the other arm flows down towards the axle, and the port to the vacuum tube being closed the air previously drawn into this arm finds its way out through the mercury. Thus by oscillating the arms, and so displacing the mercury in them through a height exceeding 30in. at each oscillation, there is formed in each arm alternately a torricellian vacuum next the axle, into which air is drawn from the vacuum tube, and from each arm alternately the air drawn in is expelled. It is preferred to enlarge the cavity of each arm near the axis, so as to have the vacuum formed in considerable space. Claim: A vacuum pump constructed and operated as described.—No. 8687. May 24th, 1889. 6*d.*

Winding Yarn.—*H. H. Lake, London.* (*W. H. Goldsmith & J. H. Wright, Massachusetts, U.S.A.*)—The invention consists in a spool-holder or bobbin-holder which is adapted to be mounted on a winding machine, and is arranged so that it can slide or move towards and away from the mechanism for rotating the spool or bobbin mounted in the holder. This spool-holder is composed of two arms, which are connected with each other by a bar so as to form a frame having substantially a U-shape. Near its upper end one of the arms is furnished with a rod or stud, preferably made adjustable on the arm both up and down and in and out, and the other arm is provided with a rod or spindle loosely mounted in the arm so as to be capable of an in-and-out motion. These two rods constitute the bearings or centres to receive the spool or bobbin and hold it so that it can be rotated on its own axis by suitable mechanism for winding on yarn. The inner ends of the rods are preferably made conical, to accurately centre the spool or bobbin in the holder. A spring is made to act upon the loosely mounted rod or spindle to force it inwardly and into yielding contact with the spool. The device or holder is provided with a trip latch for retaining it in an elevated position, or in such position that the spool or bobbin when mounted in the holder will not be in contact with the winding mechanism, in order that the spools or bobbins may be more quickly and conveniently inserted into and removed from the holder.—No. 8681. May 24th, 1889. 8*d.*

Engine for Terrestial and Aërial Propulsion.—*F. T. Millet, Persan par Beaumont, France.*—The engine is designed for driving vehicles such as private carriages, velocipedes, &c. The cylinders of this engine are mounted upon the driving wheel, so as to constitute the spokes or arms of the wheel. Their connecting rods and crank of their common axle are enclosed in a central lubricating box or hub. The illustrations show the parts of a gas engine constructed according to this invention for driving a

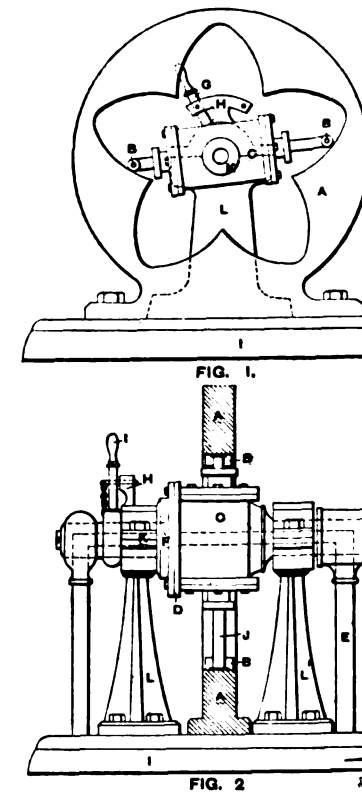


velocipede. Fig. 1 shows the complete engine, Fig. 4 a part vertical section through the driving axle and a cylinder, and the remaining figures show details. The five cylinders A are fixed to the hub B, which is traversed by the cranked axle E F G, one end of which is channelled for the admission of carburetted air. The pistons C of all the cylinders are connected, by rods D, to the same crank pin E. The crank discs G have a concentric ring of teeth in gear with an internal ring H, having double the number of teeth, by means of intermediate pinions I I, as shown in Fig. 6. The rings H have cams on their periphery for working the valves R S. L is a locking lever pivoted to the steering fork M and operated by a cam situated at the upper part thereof, for engaging with the crank arm K (fast on the crank axle) when the engine is required to work the cylinders revolving around



the stationary axle. As the admission pipe N for the carburetted air does not allow of placing the treadle cranks directly upon the wheel axle, they are geared by pitch chains enclosed within an oil-box with the pinion J. At the upper end of each cylinder a contact point is fixed in the porcelain insulator O, and is connected with the external contact fixed on the ebonite insulator T, bolted to the rim C¹ of the wheel. On the left-hand side is a treadle P, by which, and by the treadle Q, muscular power is applied at starting or to assist the engine when necessary. The carburetted air admitted by pipe N to hub B is drawn into the cylinders through the inlet valves R, which are operated at proper times, the gases of combustion being exhausted through the valves S. Upon the hub of the right-hand treadle Q is formed a double-grooved cam X to distribute the ignition electric current. For this purpose a small lever U (see Figs. 2 and 3) is operated by the cam, and through a multiplying lever V and traction rod D causes the pivoted brush carrier Y to distribute the current from the insulated brush Z to the contacts T, upon the rim of the wheel at every alternate revolution of the latter. The engine works as follows:—Motion is first obtained by the use of the treadles; the latch L is then lowered and engages with the crank, causing the pistons and parts to work as the cylinders revolve and so bring the engine into use. The cycle of operations in each cylinder is as follows:—Assuming the piston C (Fig. 4) to be at the top of the cylinder and the crank consequently upwards, the right-hand cam H will be at the point of lifting the admission valve R, and the piston C about to draw in the explosive mixture from the hub B through the channel of the axle F. After the wheel has made half a revolution, the valve R closes and the piston returns towards G¹ and compresses the explosive mixture. On reaching its highest point, the contact point, traversing the insulator O, comes in contact with the piston, and as it recedes from it in the second revolution the contact T is touched by the brush Z, which is brought into position by the cam X, and a spark is thus formed exploding the charge. When the cylinder arrives at its lowest position, the left-hand cam H lifts the valve S, and the exploded charge is expelled through small holes in the pipe leading to the valve. The cycle then recommences. The electric current may be produced by a dynamo driven by the machine, by a battery, or any convenient means. Fourteen claims are made.—No. 5199. March 26th, 1889. 1*s.* 1*d.*

Rotary Engines.—*H. Igel, Newcastle-on-Tyne.*—The engine has one or more cylinders fixed to the shaft so that their axes are at right angles to the axis of the shaft. The piston rod of each cylinder protrudes through both the cylinder's ends, and its piston is secured to the centre of the rod. The ends of the piston rod carry small rollers or bowls which work against the surface of a continuous cam, and cause the cylinders and the shaft to revolve. In the accompanying illustrations are shown an end and side elevation of a single cylinder engine. The cylinder C is mounted by the trunnions or shafts K upon the brackets L L¹ secured to the base plate. Its piston rod J carries the rollers



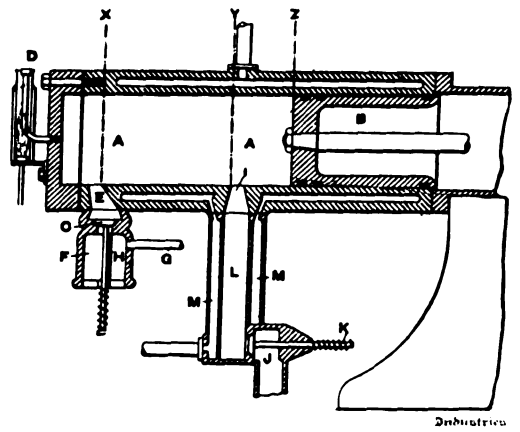
B, which follow the surface of the cam A as the piston makes its strokes. The cam A may have any odd number of projecting surfaces; the number must be odd, so that during the time one end of the piston rod descends the incline of one projection the other end ascends the incline of the other. By this means the cylinder is caused to revolve about the axis of its trunnions, or, on the other hand, if the cylinder be fixed and the cam free, the cam will revolve. The trunnions of the engine are hollow, and the motive fluid supplied through one and exhausted through the other. In the plate D are formed two ports communicating with the ends of the cylinder. This plate fits a circular valve, having as many ports as there are inclines in the cam; one alternate half of these ports communicate with the motive fluid, and the other with the exhaust, so that as the cylinder revolves with the plate D the ends of the cylinder are alternately supplied with motive fluid and exhausted. Claims: (1) In an engine a reciprocating cylinder or cylinders in combination with cams as shown and described, or any modification thereof for the purpose specified; (2) the arrangement for cutting off the motive fluid as shown and described, moved direct or indirect by any revolving part of the engine; (3) a reciprocating rotary engine constructed with all or any of the above combinations of parts.—No. 7937. May 13th, 1889. 8*d.*

Brake Gear for Railways, &c.—*J. Cleminson, London.*—This invention refers to a new method of constructing the brake rigging of railway and other vehicles. The brake block carriers have bosses upon their sides to receive the ends of a tubular strut, which joins the carriers and maintains them at a proper distance apart. A flat strut is placed on the tubular strut at its centre and at right angles to its length. One end of the strut is bored rather smaller than the tube and is heated to be placed in position on the tube. The other end forms the means of connection for the brake levers. To keep the carriers tight against the tubular strut and give rigidity to the whole a tie rod is passed obliquely through the carriers, and through a hole in the flat

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strut, forming with the tube a triangular structure, and having the flat strut connecting the apex with the base (the tube). The tie rod is screwed at its ends, to enable the whole of the parts to be tightened up. Claim: The general combination and arrangement of parts together constituting the improved arrangement of brake beams as described.—No. 8215. May 17th, 1889. 6*d*.

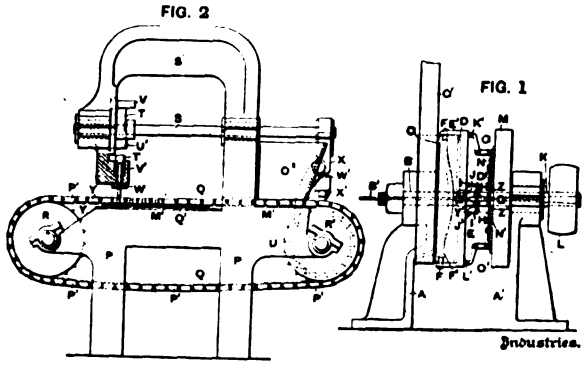
Gas Engines.—*J. Roots, London.*—The engine has a working stroke each revolution, and its valves work automatically. In the illustration, A is the cylinder, B the piston, and D the red-hot tube igniter of the improved engine. To start the engine a small charge is first drawn in and then compressed into the red-hot tube D; the explosion thus occurs, and the piston B makes its working outstroke. When the piston uncovers the exhaust port I the excess of products pass out by the pressure opening the valve J. The piston continues its outstroke and the valve J closes, whilst the exploded charge in the tube T becomes cooled, and in contracting causes more explosive mixture to be drawn in through the valve C. The piston now commences its instroke, forcing more of the products out, until it covers the port I, when



compression of the explosive mixture commences, and at the end of the instroke at the highest point of compression ignition occurs, and the cycle of operations recommences. Claims: (1) The completing of the cycle of suction, compression, explosion, exhaust, in one revolution—*i.e.*, one outstroke and one instroke in the manner described with reference to the illustration; (2) the cooling or condensing chamber L as arranged and combined with the open end cylinder A having two ports only, as set forth; (3) the construction, combined with a condensing chamber as hereinbefore described, whereby the four operations occur on the same side of a piston in a cylinder and in one revolution; (4) placing the automatic exhaust valve at a distance from the exhaust port as and for the purpose described; (5) the partition H in a gas engine admission chamber for preventing the admixture of gas and air before entering the cylinder.—No. 3972. March 6th, 1889. 6*d*.

Boot Machinery.—*W. Ross, London.*—This improved machinery is for the purpose of manufacturing studs, and subsequently inserting them in the soles of boots and shoes. It consists of improved automatic devices for the intermittent feed of the length of wire from which the studs are cut, the cutting up of the wire into studs of even length, their regulated feed to the inserting mechanism, and subsequent insertion in the sole leather. Fig. 1 is an elevation, partly in section, of the devices for feeding up the wire, and cutting it up into studs. Fig. 2 is an elevation of the mechanism for receiving and feeding the studs, and inserting them into the sole leathers. The figures illustrate the invention as consisting of two isolated machines. These may be arranged either side by side, or with the stud-cutting mechanism over the inserting mechanism, as may be convenient.

FIG. 2



Referring to the stud-making machine, B is a hollow mandrel, supporting the driving pulley C and a disc E with flanges E¹. The flanges E¹ are made to slide upon part of C, and carry studs F, which travel in grooves F¹ cut in the pulley C. The mandrel B is stationary, and the disc E connected to it by a feather D¹. In the mandrel B are arranged two milled rollers G¹ G¹, which are rotated by ratchet wheels and pawls. The ratchet wheels and pawls are actuated by a to and fro movement of the disc F, due to the travel of the pins in the groove F¹. The milled rollers grip the wire B¹, and feed it to the knives N N¹. The knives are fitted to a disc M upon the mandrel K, and rotated by the pulley L. Bell crank levers O O¹ slide the knives together as the disc E is moved to the right. The knives are thus operated by the movement of the disc to the right, whilst the wire is fed forward by its movement to the left. Two backward and forward movements of the disc E occurs each revolution of the pulley C. In Fig. 2, M¹ is the table on which the sole Q¹ is placed to be studded. Q is the stud feeder, made in the form of an endless chain. Each link has one small hole to receive one stud, which it takes up as it passes under the hopper O². The driver T is forced down by a hammer U¹, which is raised by the cam T¹ working against the projection V. A ratchet wheel U and pawl drives the carrier Q intermittently. Three claims are made.—No. 3965. March 6th, 1889. 8*d*.

Railway Couplings and Buffers.—*R. M. Mark, Birmingham.*—In this specification is described a combined coupling and buffer. It consists of a hollow projecting block having externally the general form of a buffer. In longitudinal slots in the side of this block are pivoted two strong levers with their fore ends hooked. The rear ends are connected by links to a sliding rod which is pressed forwards by a coiled spring, and so keeps the hooked ends or jaws closed. The opposite block consists of a hollow cylinder sliding upon a second hollow cylinder secured to the carriage. Passing through the centre of both cylinders is a sliding bolt surrounded by a coil spring which tends to push the outer and buffer-shaped cylinder forwards. To the outer or buffer-shaped cylinder is secured a wedge-shape hook which engages with the hooks upon the other block when the two are forced together. To release the hooks one from the other a rack is attached to the sliding rod in the first block, and is operated by hand wheels at the side of the vehicles. By this arrangement the sliding rod is pulled backwards and the jaws opened to release the hook upon the second buffer. Claims: (1) An automatic coupling consisting essentially of two horizontal hook-ended lever jaws on the one end of one vehicle and a sliding spring rod having a double wedge or heart-shaped head on the end of the adjacent carriage or vehicle, the said hook-ended lower jaws being pressed together or closed by a spring and engaged with the double wedge-shaped head for coupling the carriages or vehicles, the said lever jaws and double wedge-shaped head and parts connected with them being constructed, arranged, and working as described; (2) the arrangement and combination of parts described in connection with the hooked and lever jaws for uncoupling the vehicles by hand; (3) the construction and arrangement of the parts of a buffer as described.—No. 8722. May 27th, 1889. 8*d*.

Spinning Machinery.—*T. Watson, Belfast.*—Improvements are here introduced in the quadrants of spinning and twisting frames, whereby an instantaneous reversal of the upward and downward motions of the "builders" is obtained. In the accompanying illustration the figures are respectively front and side elevation and plan of a portion of a spinning frame sufficient to describe the invention. Q is the quadrant capable of turning freely on the stud D or fixed centre of motion at the side of the frame. This quadrant receives an intermittent vibratory motion from the quadrant pinion A¹ which rotates always in the same direction and which has given to it at certain parts of the motion a vertical motion of translation. Free to rotate on the same stud A as that to which the pinion A¹ is keyed, but not to move longi-

FIG. 1

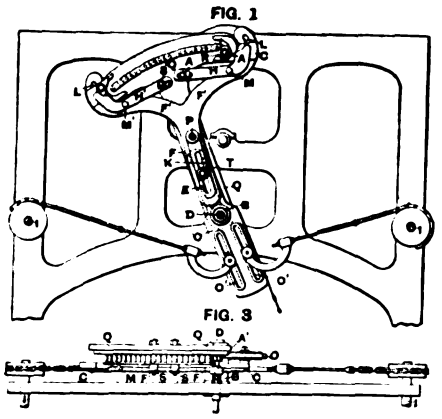


FIG. 2

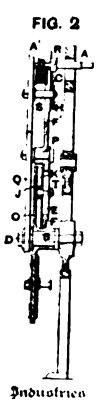


FIG. 3

tudinally, is a roller R. J is a lever having one end double and the other straight, the lever being capable of turning freely on a pin P fixed to the quadrant Q, and therefore moving with it. The arms F¹ of the bifurcated end of the lever J have a cam plate C attached to each of them, and they can each be adjusted in the slot L to suit the different motions desired to be imparted to them by the roller R. The lower arm of the lever J has an adjustable stud T, which carries a collar J free to travel in the slot K of a lever O. The lower end of lever O has connected to it the chains of the "builder" shafts I. By this arrangement of parts the roller R, at the time the pinion A¹ shifts from its upper to its lower position or *vice versâ*, comes into contact with one of the cams C, and, by depressing it, causes the lever O to continue travelling in the same direction until the pinion A¹ has changed its position and the motion is reversed. To hold the lever J in the position they are placed at the end of each motion, the locking levers H H¹ are provided. The levers H H¹ are unlocked at the end of each stroke by the roller R. Six claims are made.—No. 20167. December 14th, 1889. 8*d*.

Tuyeres.—*S. Heartland, London.*—The tuyeres are made with removable nozzles, which fit the body of the tuyeres by means of a male and female joint, so as to render the connection steam-tight. The nozzle is made of chilled cast iron, and it is either bolted, cramped, or cottered to the body of the tuyere. Two claims are made for the method of jointing the parts and connecting them together by bolts, &c.—No. 4943. March 21st, 1889. 6*d*.

Laminated Springs.—*Steel, Peech, & Tozer, Ld., & S. Oakes, Sheffield.*—A machine is here described for fitting the plates of laminated springs. Upon one end of a horizontal metal plate are arranged rollers for "pinching in" the spring plates. In the surface of the plate are holes for the reception of dogs fitted with screws and shoes by which they can be adjusted to suit the different lengths of springs. Between these dogs is arranged an arm which has a reciprocal motion in the plane of the plate's surface. The machinery for driving the rolls and the arm is situated below the surface of the plate. The springs are formed in the following manner: A suitably curved back plate, technically called a "crib," is first formed of the desired curve. A heated spring plate is then placed behind the "crib," and the two passed together through the rolls, accomplishing the "pinching in" operation. The two plates are then placed upon the block, with their ends against the shoes of the dogs, and the arm caused to revolve. A sliding block upon this arm is now pressed against the heated plate and gives it the necessary camber of the hardened back plate or "crib." The hot plate is thus suitably curved and when hardened forms the "crib" for the next plate. Two claims are made.—No. 15914. October 10th, 1889. 8*d*.

Steam and Hot Air Engines.—*E. Field, London.*—The class of engines referred to is that in which steam with air, or products of combustion, are used as the motive fluid, and where the mixture of the gases is effected in the slide valve chamber. Fig. 1 shows a longitudinal section upon the slide valve chamber and cylinder of this improved engine, Fig. 2 a transverse section of the same, and Fig. 3 the arrangement of an engine with the flue of a boiler. A is the cylinder; it is externally heated or steam jacketed. B is a mixing chamber, communicating with the back end of cylinder and with the exhaust. C is the mixing chamber for the front end of the cylinder; D is the exhaust port from B, and J the exhaust port from C; N is the slide

FIG. 2

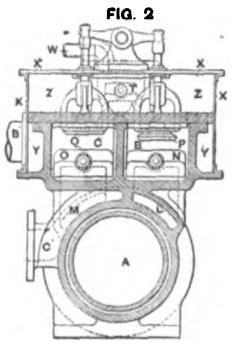
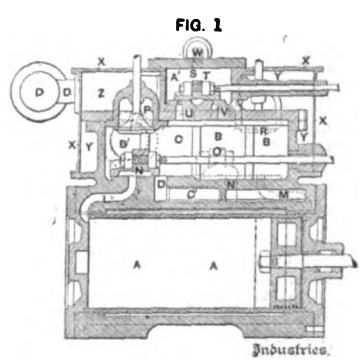
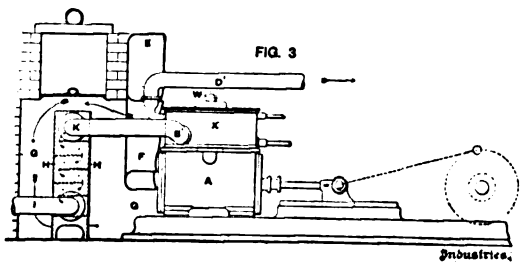


FIG. 1



valve controlling the admission and emission of the mixture to and from the back end of the cylinder; O is a second slide valve for the front end of cylinder. The valves N and O are reciprocated by the same eccentric. P and Q are valves that serve for the exit of mixture alternately from the mixing chambers, and two similar valves (one, R, being shown) serve to admit alternately hot gases to the chambers. These four valves are opened and closed by rocking shafts. T is the steam slide valve, and W the steam inlet. An exterior casing X forms a chamber Y for the reception of the gases previously to their entering the chambers B and C. The operation of the engine is as follows:—The parts being as illustrated, the valve T is disconnected and worked by hand. In starting the steam valve is moved first to the left, opening the port Y and admitting steam to the chamber C. This steam will pass directly through C to the cylinder and drive the piston inwards. The steam valve is then moved to the right and the port U opened. Steam is thus admitted to the chamber B, but passes on through to the back of cylinder, causing the piston to make its outstroke. Speed having been got up in this manner by the use of steam alone, the mixture of the steam with air is then commenced. Assuming the parts to be again as illustrated, the valves N and O are moved to the right, and the back end of the cylinder thus opened to the exhaust. At this moment the valve P is opened for the exit of the mixture remaining in B from the previous charge, and shortly after a charge of hot air is admitted to B by the valve corresponding to R of the other chamber. Whilst these valves are being opened and closed the piston makes its inward stroke. After a charge of air has been taken into the chamber B the port U is momentarily opened and a charge of steam admitted, completing the mixture and giving rise to the desired pressure of the gases. At the end of the inward stroke the port L is opened to the chamber B, and the charge makes the outstroke of the piston whilst a similar preparation of a charge for the instroke occurs in the chamber C. In Fig. 3, E is part of a Cornish boiler whereof F is the fire tube

FIG. 3



and G is the flue. H is a heater located in the flue G, where it is surrounded by hot products of combustion. This heater is composed of a chamber with shelves so disposed that the gases shall be compelled to take a zig-zag upward course in order to ensure their being heated by contact with the heated metal; or a large coil of thin metal might be substituted or any other suitable arrangement be used adapted to impart heat and at the same time to prevent the mixture of the products of combustion with the gases to be heated. With such an arrangement as referred to, air or gases is or are forced by a blower or other suitable means through the pipe I into the heater H, and being heated therein, then passes or pass through the pipe K into the engine at B¹ for use as before explained.—No. 1997. February 4th, 1889. 11*d*.

Sight Feed Lubricators.—*R. J. Threlfall, Gateshead.*—The following advantages are claimed for this lubricator:—(1) Automatic stoppage of the supply when the engine stops; (2) continued supply after steam is shut off, advantageous in locomotives; (3) shuts off the supply when sight feed glass breaks. The lubricator consists of an oil cylinder fitted with a packed piston whose rod projects out of the top end of the cylinder. The piston rod is made hollow to form an air chamber. The cylinder is in communication with a sight feed glass, and the supply of oil is controlled by a cone, plug, or cock, and by a ball valve which rolls upon its seat when the engine is in motion, but when the engine is stationary covers its seat and stops the flow of oil. When filling the cylinder with oil the piston is first pushed down to the

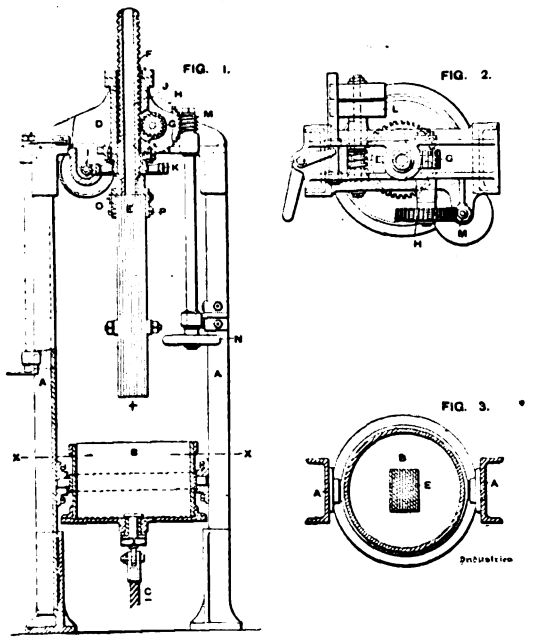
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bottom and the oil poured in at the top. Steam is then admitted to the under part of the piston, forcing it up and exerting a pressure upon the lubricant equivalent to that in the slide valve or cylinder to be lubricated. The air chamber formed by the hollow piston rod is in communication with the top of the cylinder, so that the air is compressed by the oil, and in the case of steam being shut off, the compressed air continues to exert a pressure upon the oil and force it to the parts to be lubricated. Six claims are made.—No. 8847. May 28th, 1889. 8*d.*

BRIQUETTE MACHINERY.—*N. Procter, Leeds; A. Middleton, Ben Rhydding; C. E. Fraser, Leeds; H. M. Carter, Leeds.*—These improvements refer to the part of a briquette machine for feeding in the material. The feeding arrangement and the hot parts of the machine are separated by an intermediate connecting piece of wood or other non-conductor, which prevents the transmission of heat. A plate is also made to pass under the feeder to receive the material prior to its dropping into the machine, and whilst in that position prevents the passage of heat and steam into the feeder. The plate is given an automatic intermittent reciprocating movement, by any convenient means, for the purpose of withdrawing the plate and letting the material fall into the machine. Claims: (1) The employment of the intermediate connecting piece of wood, or other non-conducting material, for preventing the heat passing to the feeding arrangement; (2) the arrangement, construction, and application of a plate operated as described.—No. 11,403. July 16th, 1889. 6*d.*

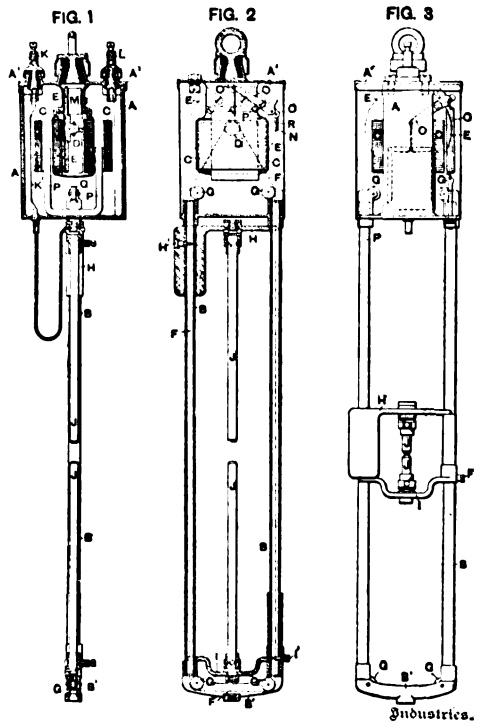
ELECTRICITY.

ELECTROLYSIS.—*M. Killiani, Neuhausen, Switzerland.*—In the electrolysis of a body in a state of fusion, when the heating of the electrolyte is effected by the current alone, the heated region is limited to the portion between the electrodes, unless the current be so intense that the mass between the poles is heated far above its melting point, and gives off heat to the surrounding particles. Such superheating, however, affects injuriously the separation of the elements, since the latter are all the more easily re-combined in the fused electrolyte, in proportion as the temperature is increased. Therefore, in order to secure economy of working, the temperature of the electrolyte must be kept as low as possible. If the current is maintained at a strength favourable for the electrolysis there forms at the surface of the bath a solid crust, preventing the addition of fresh material. To prevent the formation of this crust is the object of this invention. This the inventor does by giving the electrode a rotary motion about its axis. In the illustrations given, Fig. 1 is a vertical section of an elevation, Fig. 2 a plan, and Fig. 3 a horizontal section on the line X X of the machine. The pillars A A carry the receptacle B for the fused substance to be electrolised; the negative current is led into the substance from below by means of the conductor C. The bridge D on the two pillars carries the appliance for holding and moving the positive electrode E. In the head J there is the spindle F of the electrode, its vertical section showing the form of a rack into which the pinion G gears, the latter being worked by the hand wheel N by means of the worm gearing H M. The anode shown at E is inserted into the head O and held therein removably by means of the clamping or binding screws P. The head O is screwed upon or otherwise fastened to the lower end of the cylindrical spindle rack F, which works loosely in the centre of the bridge or crosshead. On the spindle F there is



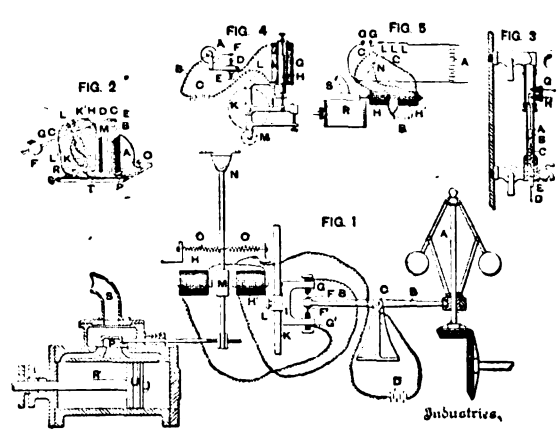
mounted a wormwheel K secured by a feather key in such a manner that the spindle can be moved endwise through the eye of the wheel K. The worm I gears into the worm wheel K and is connected to the shaft of the driving pulley L. By revolving the belt pulley L motion is imparted to the electrode E, and by reason of its angular form stirs the bath and prevents the formation of a crust. Vertical adjustment of the electrode is made by the hand wheel N. Claims: (1) In the electrolysis of bodies capable of fusion the hereinbefore described method of protecting the surface of the electrolyte from solidifying, and of uniformly distributing the solid additions among the molten contents of the bath, the said method consisting in imparting motion to one or both electrodes in a pendulous or circular or eccentrically rotary manner; (2) in an apparatus for the electrolysis of bodies capable of fusion an electrode (or electrodes) moving with a pendulous or circular or eccentrically rotary movement with relation to the bath, and capable of being adjusted in a vertical direction.—No. 6745. April 20th, 1889 8*d.*

ARC LAMPS.—*S. Z. de Ferranti, London.*—The carbons are brought together in this lamp by the action of weight, but are prevented from approaching too near by a clutch arrangement. The action of the clutch is controlled by the movable core of a solenoid, and a magnetic brake controls the speed at which the carbons approach one another. In the accompanying illustrations of the lamp, Fig. 1 is a vertical section, Fig. 2 a side elevation partly in section, and Fig. 3 a side elevation of the lamp with the solenoid core in its lowest position. The mechanism is enclosed in a cylindrical casing A, having the guide rods B attached to its bottom part. The cover of the casing A supports the solenoid coils C and the toothed wheel D, which is secured to the thin iron disc E. The cover also carries an iron plate having a number of parallel projections M, which are in close proximity to the disc E, and constitute the pole pieces of a multiple-pole electromagnet. An endless chain F is geared to the wheel D and passes through the tubular guides B and over the pulleys G. The chain is secured by the pins H^1 I^1 to the top and bottom guides H I. The slide H is insulated from the guides and electrically connected to the terminal K. A conductor from the other terminal L is wound in and out the pole pieces M, then coupled to the coils C, and from these connected to the rods B, upon which the guide I slides. The disc E has ratchet teeth around its periphery which engage with a pawl N carried by the lever O. The lever O is acted upon at one end by the solenoid cores P, and at the other by a coiled spring O^1. The action of the mechanism is as follows: By the extra weight of the top guide there is a tendency of the carbons to approach each other, but by reason of the pawl N they remain stationary. When too little current passes, however, the solenoid core drops and the pawl N is carried upwards; its inclined lower end then comes against a fixed pin R, and the pawl is thereby disengaged from the teeth on



the disc; the carbons then begin to move together. When by the bringing together of the carbons more current is allowed to pass, and the core is consequently drawn upwards into the solenoid, the pawl is carried downwards away from the pin R and again engages with the ratchet teeth on the disc, and if too much current is passing it turns the disc in a direction to separate the carbons. So long as the pawl is engaged the distance between the carbons is controlled by the position of the solenoid core. As the iron pole pieces of the electromagnet M are magnetised alternately north and south, and their extremities are in close contiguity with one side of the iron disc E, a series of closed magnetic circuits are created, which securely hold the disc from rotating so long as current passes, but momentarily release it at each alternation in the current. Five claims are made for the lamp described and a modification.—No. 7275. May 1st, 1889. 8*d.*

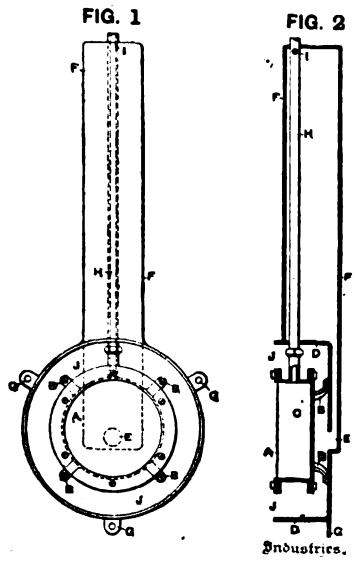
REGULATING APPARATUS.—*W. J. L. Hamilton, Portrush, Antrim.*—The apparatus consists of a delicate and sensitive device which sets in action a small force which in its turn brings into play a greater force for effecting the operation. Fig. 1 shows an apparatus adapted for regulating the speed of a motor. The governor A, in rising and falling, shifts the lever B and makes contact with G or G^1. A current is thus passed in one or the other direction through the magnets H H^1, and moves the pendulum M to the right or left as the case may be. The rod of the valve P is secured to M, so that the former is moved by the motion of the latter and working fluid is admitted to one end of the cylinder R. The piston U is made to control a regulating valve upon the motor, so that the admission of fluid to the cylinder either opens or closes the motor regulating valve. Fig. 2 illustrates a method of keeping a constant potential in electric installation, using a voltmeter as the indicator. In this a solenoid A, which is in connection with the positive and negative mains, controls a contact device similar to that already described. The solenoids H H^1 (Fig. 1) are electrically connected to this device, so that by the motion of the lever C the valve P is operated, and the supply of working fluid regulated to the engine driving the electric generator. In Fig. 3 is shown the appliance adapted to a water gauge to indicate the water level. A float B makes contact with the electric terminals G H. Fig. 4 shows the appliance adapted to a shaft bearing to prevent it becoming overheated. The bearing is water jacketed, and has attached to it a thermometer A. By a rise of temperature in the bearing, and consequently the thermometer, contact is made between F D, and the solenoid G is vitalised. The core H, with the lever I, are thus raised, and partially revolve the wheel K. The wheels K, M, L are in gear, and the two latter connected to cocks controlling the flow of oil and water to the bearing. By the partial revolving of the wheel K the wheels M and L revolve and open their respective cocks. In Fig. 5 the appliance is again shown, combined with selenium cells to automatically extinguish street electric lights when the moon shines. The current from accumulators A passes through selenium cells L and through the coils of a galvanometer by its terminals G G. Its needle N is thereby deflected, and as it strikes



one or other of the terminal contacts C C and closes a circuit, it sends a current from the battery B through one or other of the solenoid coils H H^1, which act on the slide valve of the hydraulic cylinder R. The piston rod works a switch in the main lamp circuit whereby the lamps are lighted or switched off. Eight claims are made.—No. 6027. April 8th, 1889. 8*d.*

MISCELLANEOUS.

WATER TELEPHONES.—*W. Walker, London.*—In apparatus employed for the collection of sound transmitted through water, such as between ships, some difficulty is experienced in properly recording the sounds on account of the instrument being worked by other causes such as the movement of the ship. The inventor remedies this defect by constructing the apparatus so that any pressure caused by the increased density of the water has no effect upon such apparatus. Referring to the illustration, the telephonic receiver C is secured concentrically within the cup D. By a passage E the cup D communicates with a closed tube F. Passing through the tube F is a second tube H having at its upper end an orifice I. One end of the tube H leads to the chamber C, and the other to a pressure gauge on the ship. A is the diaphragm of the receiver. The action of the apparatus is as follows: Assuming the same to be applied to a ship, any alteration that takes place in the position or motion thereof will cause a difference in the external pressure acting upon the diaphragm A, which is counterbalanced internally by the pressure of air in the chamber C and tube H caused by the water rising in the



chamber F in proportion to the depth to which the instrument is immersed. This compensation takes place each time the apparatus is raised or lowered by the motion of the ship in the water, and ensures only the sound waves affecting the diaphragm. The area of the space J through which the water enters to the chamber F being equal to the area of the diaphragm A, an equal pressure acts upon each when the instrument is so placed as to receive the full force of the water through which it is passing, or which is passing it; by this arrangement the equilibrium of the diaphragm is maintained. Three claims are made for the apparatus described and a modification.—No. 5187. March 26th, 1889. 8d.

Copies of the British specifications may be obtained on application to H. READER LACK, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at* ½*d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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IMPROVED ORE CRUSHING MACHINE.

We herewith illustrate a form of ore crushing machine now being made at the Fulton Ironworks, San Francisco. The principal strains fall on double links of wrought iron, as shown in Fig. 1. The cast iron parts are reduced to a symmetrical form, and the crushing faces are built up in sections, or composed alternately of bars of hardened steel and soft iron. This construction produces a self-maintained corrugated face, by reason of the soft metal wearing away faster than the hard steel. The front abutting plate is hinged, and can be thrown down, as shown in Fig. 2, thus permitting free and ready access to the dies. When this plate is closed up, the die is clamped against the ledges on the main frame and requires no other fastening. The machines are driven at 225 to 250 revolutions per minute, and will crush one ton per hour for every two inches of width on the faces—that is, a machine 16in. wide will crush 8 tons per hour when the limit of the throat is 1½in.

THE S.S. "PRINS WILLEM II."

We illustrate on pages 412, 413, and 420 the general arrangement of the engines and boilers of the steamer "Prins Willem II.," built at the "Koninklijke Fabriek van Stoom e. a. Werktuigen," Amsterdam, for the Royal West Indian Mail Service. This steamer is one of the best which has ever been designed and constructed in Holland, and the following description, together with the illustrations, will be of interest, as affording an indication of modern Dutch engineering practice. We intend in a succeeding issue to illustrate the engines of the vessel in greater detail.

The ship is 275ft. long, 36ft. broad, and 21ft. deep, and her displacement at 18ft. draught is 3,000 tons. On the trial trip the engines developed 1,235 i.h.p. at 72 revolutions and gave 13 knots an hour. The engines are of the triple-expansion surface-condensing type, the cylinders being 22in., 24in., and 56in. in diameter, and the stroke 40in. The low-pressure cylinder is placed between the other two. The pistons are fitted with Buckley's piston rings. The slide valves of the high-pressure and of the intermediate cylinders are cylindrical and fitted with springs. The low-pressure valve is a flat, double-ported slide valve. The valve gearing is of the radial type, designed by the late Mr. Robert Wylle. The reversing gear is worked by steam. The weight of the slide valve of the low-pressure cylinder is balanced by steam pressure; the top end of the valve rod being provided with a piston, which slides in a cylinder fitted on the top of the valve. The crank shaft is made of steel 11¼in. in diameter, and has three cranks; there are two bearings, one between each crank. The piston rods and valve rods are made of steel, and the connecting rods of wrought iron. The cylinders are not jacketed.

There is one single-acting air pump, worked by levers from the cross-head pin of the piston rod of the intermediate cylinder. The diameter of the pump is 20in., and the stroke 20in. Kinghorn's valves are used. A manhole is made in the side of the vertical pump barrel so as to command a view of the valves. A double-acting circulating pump is worked in the same way as the air pump, from the cross-head of the high-pressure cylinder. It is fitted with two vertical suction valves and two vertical pressure valves of india-rubber. The diameter of the barrel is 14in., and the stroke is 20in. Two feed pumps and two bilge pumps, with a stroke of 20in., and a plunger with a diameter of 3½in., are worked by the cross-beams of the air and circulating pumps. The condenser is cast to the framing, and is fitted with 801 brass tubes ¾in. outside diameter. The tubes are fixed to the tube plates by wooden rings. The cooling surface is equal to 2,000 square feet.

The bed-plate is made of cast iron, and is cast in one piece with the lower half of the condenser. The foundation in the ship is built up of plates and angle iron on the top of the frames.

There are two single-ended boilers, 10ft. 7¾in. diameter and 13ft. 6in. long. Each boiler has three Purves' ribbed furnaces, 37in. in diameter. The boilers are of steel, and are made of plates 1¼in. thick. The tube plate is ¾in. thick, and the sides of the combustion chamber $\frac{9}{16}$in., both of iron. Each boiler has 300 tubes, including stay tubes. The length of each grate is 6ft., and the length between the tube plates 7ft. The tubes are 3¼in. outside diameter, and are made of iron. The heating surface of each boiler is 1,900 square feet, and the grate surface is 55½ square feet. The working pressure is 160lb. per square inch.

The propeller is made entirely of steel, and of the Griffiths type, with a double pitch in the blades. There are four movable blades. The propeller diameter is 14ft. 8in., and the pitch 17ft. 3in. and 18ft. 3in.

IMPROVED ORE CRUSHING MACHINE.

CONSTRUCTED BY THE FULTON IRONWORKS COMPANY, SAN FRANCISCO.

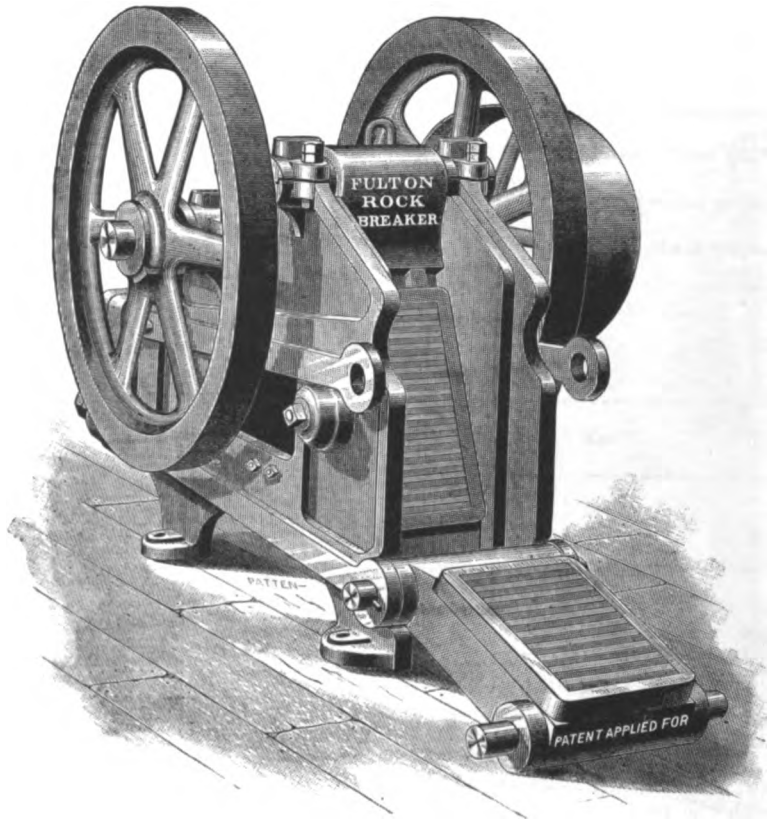


FIG. 1.

NOTES ON ALLOYS.

IV.

SOME additional valuable information on the aluminium alloys is given in a paper by Messrs. Hunt, Langley, and Hall, on "The Properties of Aluminium, with Some Information Relating to the Metal," read at the meeting of the American Institute of Mining Engineers in February last. The authors give the following numbers for 10 per cent. aluminium bronze rolled into plates, viz.:—Elastic limit, 75,000lb. per square inch; tensile strength, 110,000lb. per square inch; reduction of area, from 20 to 40 per cent., and an elongation of 5 to 10 per cent. in 8in. Its specific gravity in castings is about 7·84, and in rolled sheets about 7·89; its modulus of elasticity, 18,000,000lb. In castings, the tensile strength is 70,000lb. to 80,000lb. per square inch, with a reduction of area of about 20 per cent. Compression tests upon bars of ·75in. diameter and 2in. long gave an ultimate compressive strength of 160,000lb. per square inch and a shortening of ·25in. It melts at about 1,700° Fahr., and has a slightly less shrinkage than ordinary brass; it solidifies very rapidly from its molten condition, and hot-baked sand moulds should be used for casting, and the surface of the molten bath should be kept covered with powdered charcoal or with flux, if a slight addition of silicon to the alloy does not matter, in order to prevent oxidation. The metal should also be tapped in an inert atmosphere (smoke) for the same purpose. The authors further point out that the alloy does not corrode in air or water, is very dense, can be worked at a bright red heat as easily as can wrought iron, while all other bronzes are red short at a red heat. As it is malleable at a red heat, and is permanent at this temperature, it is admirably adapted for blast furnace tuyeres. For soldering, zinc and venetian turpentine is recommended, and for brazing, an alloy of equal parts of zinc and copper mixed with three times its weight of flux consisting of equal weights of borax and cryolite.

The analyses of alloys made by the Pittsburgh Reduction Company and the Scovill Manufacturing Company are given in Table I. on the next page. In the table, the column Si (*a*) gives the percentage of graphitoidal silicon, and Si (*b*) that of the non-graphitoidal silicon present. The authors in their paper then refer to the alloys of aluminium and iron, and point out that the addition of aluminium not only makes wrought iron fluid, as in Mitis castings, but at the same time increases the tensile strength and improves the fibre of the

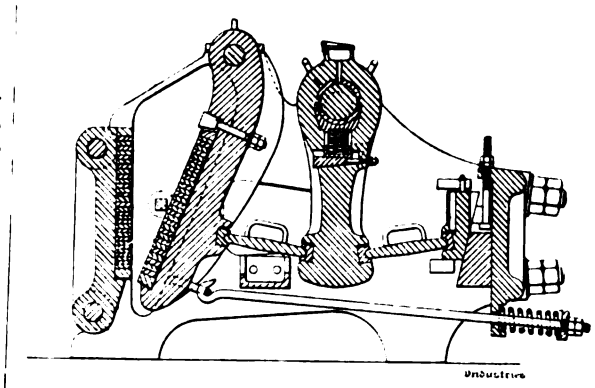


FIG. 2.

metal. With cast iron, as W. J. Keep has shown, the addition of aluminium converts the combined carbon into graphite and closes the texture of the metal. The aluminium can be added as pure metal or in the form of ferro-aluminium in quantities from 0·1 to 2·0 per cent. Aluminium added to steel also turns the combined carbon into graphite, and thus tends to soften the metal. Less than 1 per cent. of aluminium added to a steel rich in carbon increases the tensile strength without decreasing the ductility. It also lowers the melting point and thus increases the fluidity.

Table II., on the next page, summarises the authors' work on the influence of aluminium on various grades of iron and steel.

M. F. Osmond has also recently studied the influence of other foreign elements on the properties of iron and steel, by his thermometrical method, which was first described in the *Comptes-Rendus* for April, 1887. The author then found that when electrolytic iron containing only 0·08 per cent. of carbon was allowed to cool down slowly from the molten state the heat was liberated at different temperatures: the first disengagement called a_3 takes place at 855° C., and in cooling when this temperature is reached the thermometer remains stationary for a very prolonged period; the second disengagement of heat a_2 takes place at 730° C., but it does not appear to be so marked as the first. The transformation of the iron from the allotropic condition known as β to that of α takes place when this first liberation of heat at constant temperature takes place, and the lower temperature corresponds either to

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NOTES ON ALLOYS.

TABLE I.

Kind of Alloy.	Al.	Cu.	Si (*a*).	Si (*b*).	Fe.	Sp. Gr.
10 per cent. bronze casting made December 5th, 1889...	9·20	90·00	0·117	0·370	0·077	7·690
5 per cent. bronze casting made December 5th, 1889 ...	4·70	94·84	0·080	0·320	0·060	8·25
2½ per cent. bronze casting made December 9th, 1889 ...	2·35	97·29	0·05	0·26	0·050	8·61
10 per cent. bronze casting made at Neuhausen	6·32	91·98	0·09	1·09	0·48	8·01

TABLE II.

Tensile Tests of Iron and Steel Containing Aluminium.

Character of Material Tested.	Elastic Limit per Sq. In.	Tensile Strength per Sq. In.	Per Cent. Elongation in 8in.	Per Cent. Reduction of Area.	Character of Fracture.	Analysis. Al.	C.	Mn.	Si.	P.
All iron muck bar rolled, Union Mills of C., P., & Co., Limited	27,300	46,500	28·00	36·08	Fibrous	—	—	—	—	—
Three parts all iron with two parts aluminium muck	26,800	49,000	29·25	40·32	„	—	—	—	—	—
All aluminium muck bar	29,500	55,300	14·00	22·56	„	—	—	—	—	—
Four parts all iron with one part aluminium muck	28,510	49,190	29·50	37·34	„	—	—	—	—	—
Open-hearth steel, with 1–10 of 1 per cent. aluminium, ¾in. thick, plates ...	40,250	58,590	30·10	63·82	Silky cupped	0·04	0·12	0·41	0·02	0·05
Open-hearth steel, with 1–10 of 1 per cent. aluminium, 1in. thick, plates ...	47,950	68,360	25·30	52·10	Silky	0·07	0·16	0·48	0·03	0·03
Open-hearth steel, with 1–10 of 1 per cent. aluminium, 2in. thick, bar steel..	46,260	63,760	26·10	47·90	Silky	0·03	0·16	0·39	0·02	0·05
Open-hearth steel, with 1–10 of 1 per cent. aluminium, 2in. thick, bar steel..	45,980	67,560	29·20	54·80	Silky	0·06	0·15	0·55	0·04	0·05

the end of this change, retarded by the presence of carbon in different parts of the mass, or to another allotropic modification of the metal taking place.

The carbon itself, in passing from the combined to the graphitoidal condition, gives rise to another period of constant temperature called a_1, and which Barrett calls recalescence. Although these points are sufficiently characteristic for any given metal, the temperature halts which they denote vary with the foreign elements present, and M. Osmond has in this present communication investigated the influence of the elements boron, nickel, copper, silicon, arsenic, and tungsten upon the temperature values of a_3, a_2, and a_1.

The alloy containing boron was obtained from Professor Roberts-Austen, and when examined by this method the value for a_3 was found to be lowered to 810°, while that of a_2 remained between 735°–725°. Boron, therefore, acts upon the metal in much the same way as does carbon.

For determining the influence of nickel a nickel steel was made in the laboratory of M. Troost, containing 0·34 per cent. of carbon, 5·97 of nickel and traces of manganese. For a steel without nickel, but containing this amount of carbon, a_3 and a_2 would be practically identical, but completely distinct from a_1. The addition of nickel caused a further lowering of the temperatures of a_3 and a_2 until they coincided with that of a_1, there being only one critical point (660°–640°) for this alloy. This temperature is lower than the normal temperature of recalescence. Dr. Hopkinson has also found by a different method that a large percentage of nickel causes a lowering of the point of recalescence. Nickel in this respect resembles manganese. The action of copper on changing the temperature values of the points a_3 and a_2 was also found to be analagous to carbon, but less energetic, 4 per cent. of copper having about the same effect as 0·25–0·3 per cent. of carbon, while its effect on the point of recalescence is similar to that of nickel and manganese.

The alloys experimented with were prepared by Messrs. Ball & Wingham, of South Kensington. They had the following composition:—

	1	2	3
Copper.....	0·847	4·10	4·44
Carbon.....	0·102	0·183	less than 0·10

The values for a_3 and a_1 were lowered, and in the two specimens with most copper a_3 and a_2 coincide at a temperature 730°–720°, while a_1 is as low as 625°–600°.

For silicon, some steels prepared by Mr. Hadfield contain 0·20–4·40 per cent. of this element and only very small quantities of all other foreign elements. The experiments show that the addition of silicon causes a diminution of the amount of heat disengaged in a_3, and when the amount added is about 2 per cent. this critical point disappears entirely. This disappearance, however, differs from that which takes place with carbon, manganese, nickel, or copper, since the heat does not appear at any lower temperature. In fact, no evidence of any allotropic change in the iron corresponding to the change from β to α is found between 1,400°–500°. In other words, it seems that the addition of silicon to the iron does not induce any change from the α to the β condition, and that, therefore, in subsequent cooling there is no change possible. At the same time, as this critical point disappears, a_2 gradually is lowered from 730°–720° to 710°–700°, while a_1, or the recalescence point, is raised from 660°–650° to 710°–700°, so that the two points a_2 and a_1 coincide.

Arsenic also acts as silicon, a_3 losing its intensity and being raised in position with quantities up to 0·55 per cent. There is no apparent influence on the values for a_2 and a_1.

Tungsten in quantities up to 1·5 per cent. has no influence on the value for a_2, but lowers a_1 considerably, reaching a temperature 510°–530° with the castings which are richest in tungsten.

This method of research undoubtedly gives very interesting theoretical results, but at present we are hardly in a position to show the relationship which obviously must exist between these changes and the amount of chemical and physical union of the various elements in the alloy. The author has done well in selecting alloys whose chemical composition is definitely established, and which have had their physical constants determined, and we shall look forward to the time when the connection between these figures will be generalised into a useful working law.

Two new alloys of mixed composition have recently been described which are likely in the near future to receive important useful applications. The first of these has been patented by Herr Rieth, of Bockenheim, and consists of copper 15 parts, tin 2·34, lead 1·82, and antimony 1 part, and may be looked upon as a bronze to which small quantities of lead and antimony have been added. The inventor states that this alloy practically resists the attacks of most alkaline and acid solutions, and he believes that it can be used with great advantage in the laboratory to replace vessels or fittings of ebonite, vulcanite, or porcelain. The second of these new alloys is called *schmiedbarenguss*, and is a patented mixture of pig and wrought iron to which aluminium bronze and ordinary bronze has been added, with the addition of a flux. The most important characteristic of this material is that it can be manufactured direct in the cupola without annealing, and that therefore its cost of production need not be high. It is stated to produce weldable, malleable, soft steel castings of great ductility and strength, and to have a specific gravity of 7·16. The United States Government has given the following data with regard to its physical properties:—A test bar, ·225in. × ·512in., subjected to a tensile stress of 26,200lb., equal to 200,766lb. per square inch, did not break. With a length of 12in. between the supports, a transverse load of 7,232lb. was necessary to rupture the bar. Twenty-nine test bars that were broken showed a reduction of area of 28–67 per cent.; elongation, 52·1 per cent.; resilience, 37–45 per cent.; compressive strength per square inch, 200,853lb.

We defer our notice of Messrs. Wright and Thompson's paper on ternary alloys for the present.

ALUMINIUM AND ITS USES.

At the present time we are constantly seeing paragraphs in the daily press, and also in *soi-disant* technical journals, describing new processes for extracting aluminium from its ores, and also giving absurdly exaggerated accounts of the usefulness of this metal and its alloys in the industrial and artistic world. There are two ways in which damage can be done to a valuable discovery—viz., by abuse and by over-praise. That aluminium may not eventually have to be saved from its friends is by no means uncertain, and this baleful influence can only with certainty be removed by its advocates strictly honouring the limits of truth.

It may be remembered that Mr. J. H. J. Dagger, F.C.S., F.I.C., read a paper on "Aluminium" before the last meeting of the British Association. This paper was so valuable, and so much interest was aroused by it, that the Cowles Syndicate asked Mr. Dagger to prepare a supplementary account of the properties and functions of this metal. We received a copy of this pamphlet a few days ago, and we consider the information contained in it so reliable, and the method of putting the facts together so excellent, that we give it as follows in full:—

It is now 136 years since Margraff proved that alumina is a metallic oxide, sixty-two years since Wöhler first obtained metallic aluminium, and thirty-six since Deville's historical experiments produced the metal *en masse* for the first time. Modifications of Wöhler's and Deville's methods are still the chief of the processes for producing metallic aluminium, but as these methods involve the use of sodium they can never be the sources of the metal which, according to the enthusiastic journalists and leader-writers, is to be the material of our Atlantic liners, bridges, and locomotives in the coming "Aluminium Age." As far as our knowledge at present will allow us to prophesy, it is certain that the eventual method must be one of direct reduction. The first advance in this direction was the discovery made by Cowles that the use of the intense heat of the electric arc made it possible to reduce aluminium directly from its ores. Unfortunately, up to the present time it has been found that, in the absence of an alloying metal, the liberated aluminium absorbs carbon and is converted into a carbide, and so nothing richer than 80 per cent. aluminium has been obtained. Still there is every hope that at no very distant date it will be possible to overcome this difficulty and to obtain aluminium direct from the furnace.

Before proceeding to give some account of the chief value of aluminium in the arts and industries of to-day, a few words may be said about the physical properties and uses of the pure metal. Much misconception exists as to the purposes and conditions under which it would be possible to use this metal if produced as cheaply and in similar quantity to iron, and comparisons have been made which are certainly misleading. For the sake of more clearly explaining the matter, we give in Table I. the physical data of the two metals side by side. From

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these figures it will readily be seen that, although aluminium is only one-third the weight of iron, it has little more than one-half the tensile strength of the best wrought iron, and only one-third that of mild steel, facts which would tell very materially against its replacing these metals in shipbuilding and for structural purposes. There are, of course, many circumstances in which aluminium might replace iron with advantage, but statements like the following are fallacious and misleading. "An Atlantic liner, built of aluminium, would have one-third the draught, and be propelled with the same engine power at double the speed that it is at present when built of iron; bridges built of this metal would be quite as strong as if built of iron, but would be only one-third the weight."

The chief demand for aluminium is at present—and probably always will be—in connection with its alloys. The use of the metal itself will be chiefly for light machinery, fittings for lighting and water supply, astronomical and scientific instruments, and art metal work generally. With copper, aluminium forms a series of beautiful alloys, varying in colour from bluish-white to red-gold and pale yellow, differing very widely in physical and mechanical properties. Those containing 60 to 70 per cent. aluminium are very brittle, glass-hard, and beautifully crystalline; with 50 per cent. the alloy is quite soft, but under 30 per cent. the hardness returns. The 20 per cent. bronze has a whitish-yellow tint, somewhat resembling bismuth. It is very brittle, and can be pulverised in a mortar. The brittleness of alloys above 11 per cent. prevents their use, but from 11 per cent. down to 1 per cent. they are most valuable. Their physical and mechanical properties render them useful for every variety of metal work, and the high price of aluminium has been the only restriction to their use hitherto. Table II. gives the range of tensile strength and density in castings of these alloys. In resistance to compression, A grade (10 per cent.) equals the best cast steel, its transverse strength or rigidity is about forty times greater than of ordinary brass, and its limit of elasticity equals that of steel of the same tensile strength and elongation. The results given in Table III. were obtained at Waterton Arsenal, U.S.A. One of the most valuable properties of these alloys is the fact that they are forgeable, and can be worked at a bright red heat as easily as wrought iron; all other bronzes are "hot-short." The rolling of sheets, rods, bars, and wire is done at a bright heat; only the finishing is done in the cold. A casting of B grade (which had a tensile resistance of 60,000lb. to 65,000lb. per sq. in.), with 20 per cent. elongation when rolled, showed 83,000lb. tensile resistance, with 30 per cent. elongation. These alloys retain their strength through a high range of temperature, a quality most valuable in a metal. Their resistance to corrosion, which is only a degree short of that possessed by gold and platinum, makes them invaluable to shipbuilders, marine, hydraulic, and sanitary engineers. This quality, combined with their colour, render them far superior to ordinary bronze for art metal work and statuary. The advent of smokeless powder, with its greater corrosive action on ordinary gunmetal and steel, is already causing military engineers to look round for a material to replace these metals in the artillery and small arms of the immediate future, and, in the peculiar combination of properties required, aluminium bronze is unapproachable by any other metal or alloy, and the solution of this question will undoubtedly lead to a great demand for these alloys. The aluminium brasses are made by combining the metal with copper and zinc yielding close-grain homogeneous and remarkably tough alloys. They are made in two grades. (See Tables IV. and V.) These alloys can be forged hot; their special casting properties, high corrosion resistance, and low specific gravity render them most valuable for hydraulic and engineering purposes. A propeller blade can be made of No. 2 brass at least one-third thinner than cast iron. The high elastic limit, surpassing that of alloys used hitherto for this purpose, would greatly lessen the chance of injury to the blades, in the event of contact with wreckage, whales, &c., at present a frequent source of danger and delay. In these days of fast steaming the weakening of blades by pitting and corrosion would be reduced to a minimum if made of aluminium brass.

This is but one of the very many instances which will readily present themselves to the minds of readers who will compare the physical data given above with that obtained from other alloys and metals which it will doubtless supersede as its qualities become more known. Not only is aluminium valuable in its alloys with copper, but it is of service in iron and steel working, giving sound castings, and increasing the tensile strengths. The alloys with zinc, nickel, tin, and manganese are of great interest, but space will not permit of anything beyond a brief note on a few of the properties and applications of a metal which may be truly described as one of the most valuable for the use of the engineer and general craftsman.

ALUMINIUM AND ITS USES.

TABLE I.

	Aluminium.		Iron.			
—	Cast.	Rolled.	Cast.		Wrought.	Steel.
Colour	Bluish.	White.	White.	Grey.		
Density	2·5	2·7	7·5	7·1	7·8	7·7 to 7·2
Tensile strength in tons per sq. in.	12	17	7	9	19 to 27	30 to 38
Melting point	1,300° Fahr.		—		—	—
Average weight per cubic ft. in lbs.	162		450		485	490

TABLE II.

Grade.	Tensile Strength per Sq. In.	Elongation.	Density.
"A" special 11 per cent.	90 to 100,000lb.	0 to 8·0 per cent.	7·23
"A" bronze 10 „	75 „ 90,000 „	4 „ 14 „	7·69
"B" „ 7½ „	55 „ 65,000 „	20 „ 40 „	8·00
"C" „ 5-5½ „	35 „ 45,000 „	30 „ 40 „	8·37
"D" „ 2½ „	30 „ 35,000 „	40 „ 50 „	8·69
"E" „ 1¼ „	25 „ 30,000 „	40 „ 55 „	—

TABLE III.

Compression Tests made at Watertown Arsenal, U.S.A.

Original Length, Inches.	Shortened to Inches.	Original Diameter, Inches.	Increased to Inches.	Ultimate Strength.	Ultimate Strength, lbs. per Sq. In.	Specimens (Casting).
2·00	1·705	0·798	0·865	80,200	160,400	"A" 1 Bronze
2·00	1·525	0·798	0·914	76,800	153,600	"A" 2 „

TABLE IV.

Aluminium Brass.	Tensile Strength in Castings per Sq. In.	Elongation.	Density.
No. 2	30 to 35 tons.	2 to 7 per cent.	8·05
No. 3	26 „ 27 „	14 „ 15 „	8·15

TABLE V.

Transverse Test of No. 2 Aluminium Brass.

Cross Section of Bar in Sq. In.	Length between Supports in Inches.	Breaking Load.	Limit of Elasticity.
1	12	8,064lb. (72cwt.)	6,496lb. (58cwt.)

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ENGINES AND BOILERS OF THE STEAMSHIP "PRINS WILLEM II."

CONSTRUCTED BY THE KONINKLIJKE FABRIEK VAN STOOM E. A. WERKTUIGEN, FOR THE

ROYAL WEST INDIAN MAIL SERVICE.

(*For description see page* 409.)

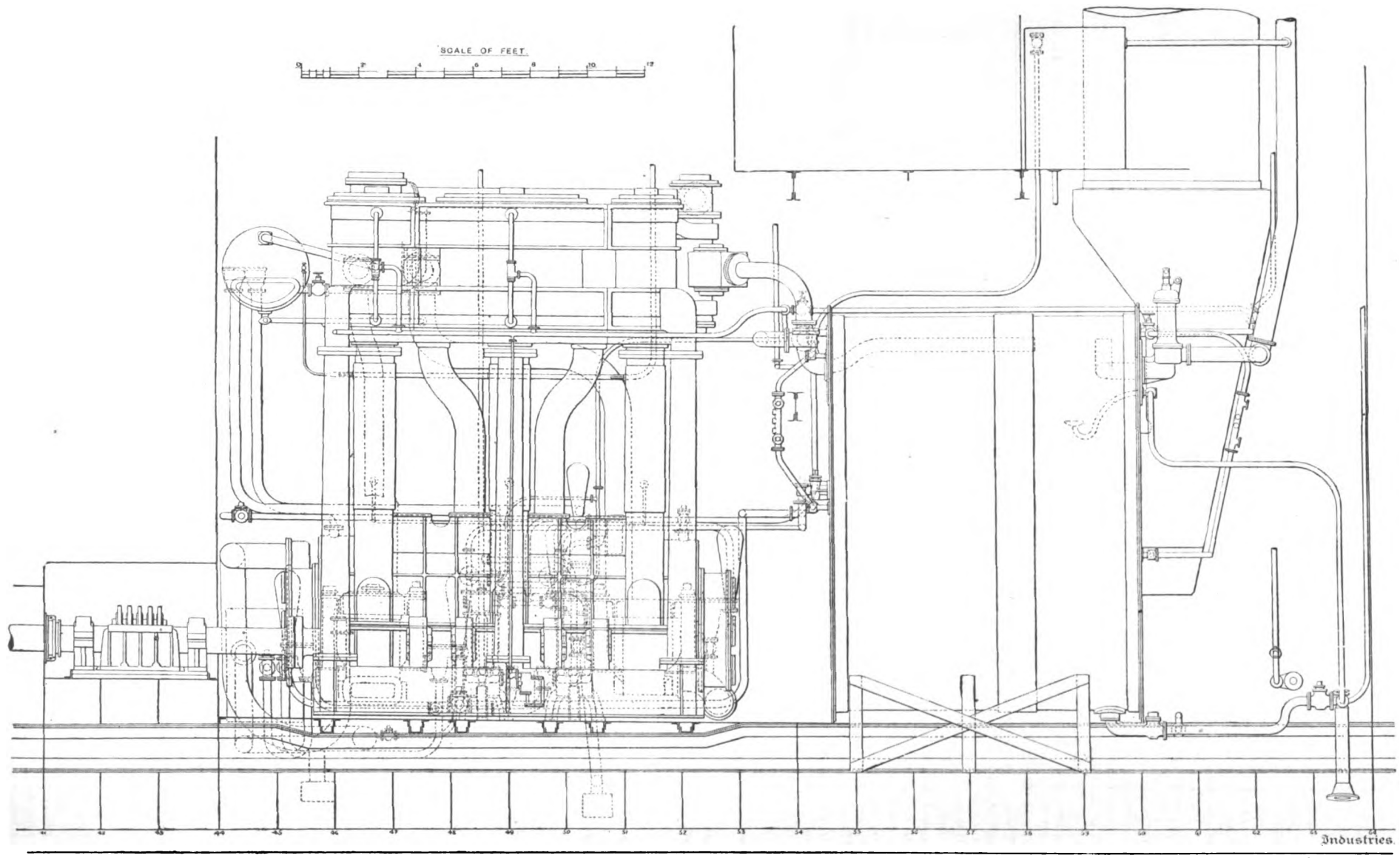


FIG. 1.—LONGITUDINAL SECTION THROUGH ENGINE AND BOILER ROOMS.

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ENGINES AND BOILERS OF THE STEAMSHIP "PRINS WILLEM II."

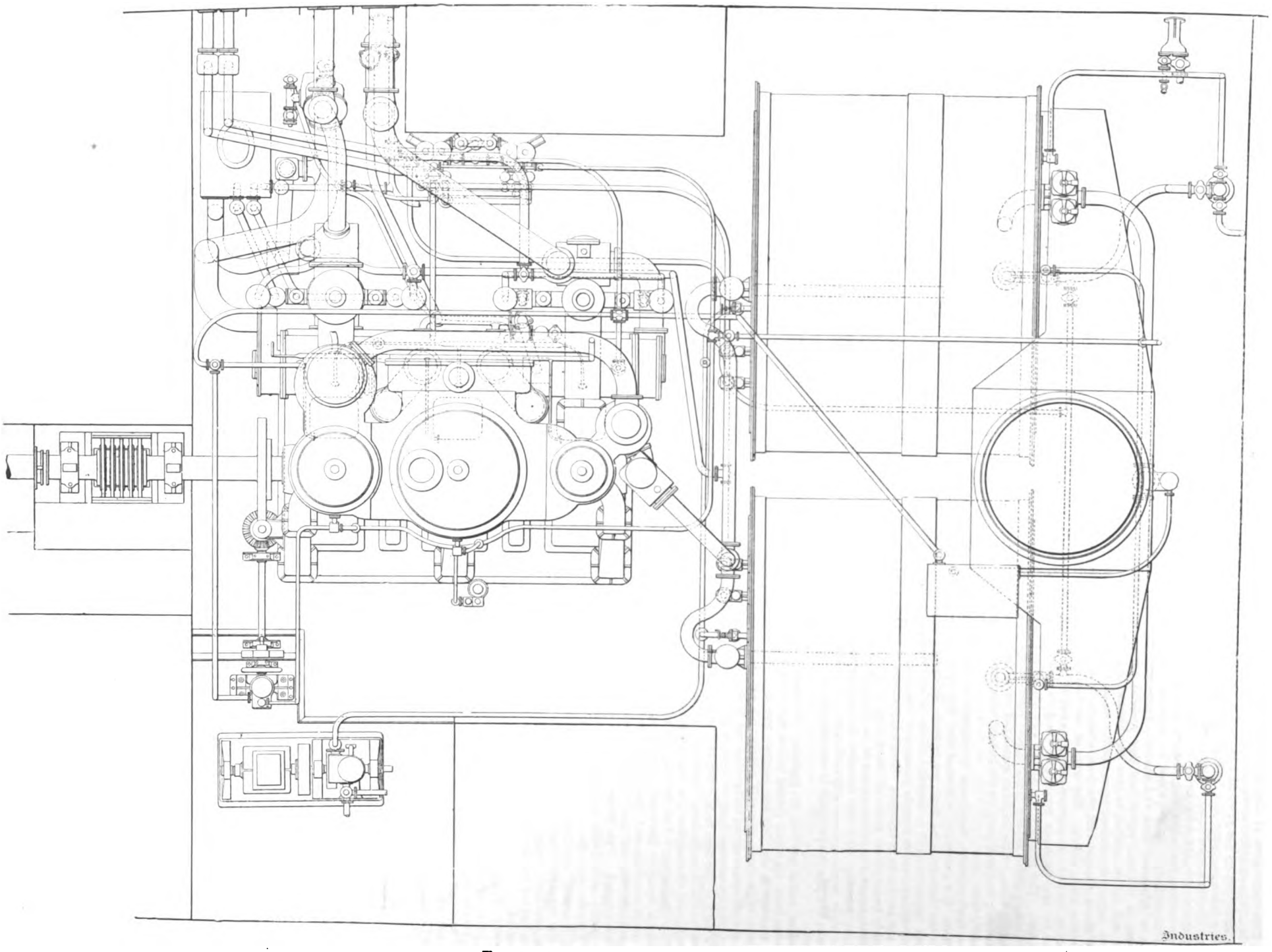


FIG. 2.—GENERAL PLAN OF ENGINE AND BOILER ROOMS.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 29th April, 1890.

Iron.—The iron merchants of the capital, alarmed by the firm attitude of the manufacturers, have met in council and resolved to again put up the price of bars and joists to 160s. a ton. How this agreement is to be kept it would he rash to predict. Business continues slack; but this step on the part of the merchants may bring into the market buyers who were waiting for better terms, since it is sufficient to show that nothing is to be gained by waiting. It must, however, be admitted that the markets of the provinces are losing in life and vigour, and that possibly the manufacturers will be compelled to give way before long. The question is largely dependent upon the course of the coal trade. Without cheaper fuel the iron manufacturers can hardly reduce their prices. The state of the foreign trade relatively to that of the corresponding period of last year is shown by the Customs returns for the first three months of 1890. The imports consisted of—Pig iron, 33,863 (37,687) tons; finished iron, 5,912 (5,637) tons—and steel, 1,812 (2,283) tons. The exports consisted of—Pig, 57,748 (7,410) tons; finished iron, 20,578 (8,689) tons; and steel, 9,644 (7,843) tons.

Coal.—The coal question continues to disturb the industrial situation. For a moment it seemed that the supply had risen to the demand, and that prices were about to give way. But there is still a scarcity of the industrial sorts, and the colliery owners remain masters of the situation. There are no stocks at the pits. Every ton raised is sent away within twenty-four hours of its arrival at bank. In such circumstances lower prices are not to be thought of. Foreign coal is pouring into the country in increasing quantity. As next winter's trade will be begun without a ton of stocks at the pits the prospect is encouraging to the coal producers.

Metals.—The metal market is lifeless. Holders of copper warrants keep up their prices, which are now £6 above those current in the London market, but it is becoming evident that their game is nearly played out. The opinion of consumers seems to be that the average of copper prices in the second half of 1890 will be several pounds below that of the first half. Tin is but little dealt in, and prices continue to decline. Lead is unaltered, but spelter is lower, and the tendency is still downwards.

The Port of Dunkirk.—Year by year the trade of the port of Dunkirk steadily increases. Judging from the records of vessels entering and clearing in the first three months, the current year will compare very favourably with the last in this respect. The growth is especially noticeable in the trade with India and South America. The export of French manufactured goods shows a very encouraging increase, and augurs well for the future of industry in the northern district. When the works now in progress for providing more harbour accommodation are completed, a further impulse will, no doubt, be given to the trade of Dunkirk.

Commercial Treaties.—The Marseilles Chamber of Commerce, in reply to the Government circular, say they strongly deprecate the abolition of commercial treaties as ruinous for the carrying trade. The Marseilles tonnage, which in 1860 was 3,000,000, is now 10,000,000, and this increase the Chamber attributes to free trade.

BERLIN, 28th April, 1890.

Iron.—Within the last few days a clearly marked improvement has taken place in the iron trade of the Upper Silesian district. The efforts to re-establish the convention between the rolled iron manufacturers and the blast furnace owners having proved successful, the tone of the market has become stronger. According to the terms of this convention, which is to last three years, the makers of finished iron and steel are to pay the rates now current for pig so long as bars maintain their present price, and, more or less, according to a sliding scale agreed to as the price of bars varies. It is officially announced on the part of the finished iron and steel makers that they have sufficient work in hand to keep them going full time till the middle of August, and that consequently no fresh orders for delivery before that date can be accepted. The demand for joists is now very brisk. Prices have become firm all round. Foreign pig is less pressed for sale than it was a fortnight ago. The tone of the market generally is strong and buoyant.

Coal.—The effect of high prices in stimulating the production of coal is to be seen in the official records of mining in the Upper Silesian district for the first quarter of the current year. From these we learn that the output of the collieries in that locality amounted to 3,018,290 tons, against 2,501,220 tons in the corresponding quarter of 1889, an increase of more than 20 per cent. The coal market continues active, the demand for industrial use being unabated. Here, in Berlin, smiths' "nuts" are quoted 25s. 6d. to 27s.; blast furnace coke, 38s. to 40s.; and foundry coke, 38s. 6d. to 40s. 6d. a ton delivered.

Metals.—The metal market continues languid. Consumers buy only sufficient to provide for present necessities, and speculators stand aloof. Copper maintains its position with some firmness, but the amount of business done is small. Tin, too, is stronger in appearance; but though last week's prices are maintained, there is no increase of business to justify the improvement. Lead is less in demand and prices have given way slightly. Spelter continues its downward course. The decline is slow, but constant, and, judging from the tone of the market at Breslau, a considerably lower level will be reached before the movement is arrested.

Silver Production.—For a number of years past the production of silver in Germany has steadily increased, but last year showed a falling off relatively to 1888. The total production, which in 1886 amounted to a little under 300 tons, increased to 325 tons in 1887, and to 356 tons in 1888. Last year the quantity was only 341 tons. The shrinkage is attributed to the competition of trans-oceanic countries, which were formerly purchasers of European produce.

Glass Prices.—The German Glass Makers' Association, formed for the purpose of keeping up the price of lamp glass, has been broken up. This step had become necessary in consequence of the depressed state of the trade in that branch. The export trade has suffered severely because America, formerly our best customer, has become a large producer. Large stocks have accumulated at the works. A circular, emanating from forty-four glass bottle makers, has been sent round announcing a rise of 10 per cent. in prices to cover increased cost of fuel and raw materials.

The Imperial Revenue.—The revenue of the German Imperial Exchequer for the financial year 1889-90 exceeded the estimates by 78,239,381 marks, the principal increases being distributed as follows:—Tobacco tax, 196,170 marks; sugar tax, 786,590 marks; salt tax, 118,048 marks; brewing tax, 3,791,397 marks; stamps, 13,929,558 marks; Bourse tax, 11,951,707 marks; and private lottery tax, 1,908,826 marks. The revenue from the manufacture of brandy was 7,686,219 marks, and from the consumption of brandy 18,734,825 marks, below the estimates.

The Transcaspian Railway.—The receipts of the Transcaspian Railway for 1889 show a prosperous state of affairs. The entire cost of working the railway was £241,731, and the total carriage was 350,675 tons. The importation of Asiatic products into Russia has increased 127 per cent. in comparison with 1888, while the importation into Transcaspia, Turkestan, and the Central Asian khanates of sugar, manufactured goods, &c., has increased 94 per cent. It is also stated that in January, 1890, there were imported into Russia 4,078 tons of Central Asiatic cotton, and that the Russian factories will probably receive more than 48,387 tons in the course of the present year.

Women as Railway Servants in Russia.—The employment of women is about to be authorised on the Government railways in Russia. The Transcaucasian Railway Administration, having been invited to indicate the number of women which it believes can be employed, has replied that this number might amount to 25 or 30 per cent. of the total number of the employés.

The Forests of Europe.—The forests of Europe, according to a recent report of one of the State foresters of Prussia, cover the following areas:—Germany, 34,596,000 acres; Russia, 494,228,600 acres; Austria-Hungary, 46,951,700 acres; Sweden, 42,000,000 acres; France, 22,240,000 acres; Spain, 19,769,000; Italy, 9,884,570 acres; and England, 2,471,000 acres.

VIENNA, 28th April, 1890.

The Iron Market.—After a week of stagnation the accustomed activity has come back again to the iron market. The principal attention is being directed to constructional ironwork, for which the request is very great. There is great animation in Hungary. Tinned sheets have such a good sale as has not been the case for many years. Large orders, however, are only few at present, but all the works have so much to do that they do not feel any anxiety. The Prague-Dux and Dux-Bodenbach Railways are intending to give orders for 749 and 123 coal waggons respectively. The Alpine Montan Company will hold a general meeting this week. The balance-sheet shows a profit of 2·2 million florins, of which 1·5 million florins will be paid to the shareholders.

The Coal Market.—Threatening news comes from all the coal districts. The colliers are not willing to work for the wages paid up to the present, and strikes are advised from all sides. Principally in the Ostrau territory, from whence a great part of the Vienna consumption is obtained, the strike is a general one, and more than 5,000 men have ceased to work. The stock at Vienna will soon be consumed, and Prussian and Bohemian coals must be imported. Also in the Silesian and Galician works the labourers are very discontented, and there is a probability of a strike developing. The railways which carry large quantities of coals are completing their accounts for the year, and all show good profits. The Aussig-Teplitz Railway made a profit of more than 2·5 million florins, and pays a dividend of 13 per cent. The Bohemian Western Railway, which last year forwarded a quantity of 772,000 tons of coal and coke, 180,000 tons of iron, and 131,000 tons of ore, made a clear profit of 2·39 million florins, and will pay a dividend of 7½ per cent.

The Iron Gates.—The Hungarian Government are asking for contracts for the removal of the Iron Gates on the Danube. The work will comprise the blowing up of rocks at the rapids amounting in all to 212,000 cubic yards, two breakwaters containing 800,000 cubic yards of masonry and 137,000 cubic yards of paving, and a short ship canal. The works are to be finished in 1895, and bids must be accompanied by a guarantee deposit.

Petroleum Motors for Tramcars.—During the forthcoming Lands and Forests Exhibition in Vienna a tramway will be laid in the centre of the city, to accommodate a new car driven by a petroleum motor on the Daimler system.

DÜSSELDORF, 29th April, 1890.

Iron.—Notwithstanding the improvement which has appeared in the iron markets of Upper Silesia and, in some degree, in Belgium, the iron trade of this district continues languid. At least, there is languor in the markets for pig iron. Buyers restrict their dealings to the smallest possible scale, and as the merchants undersell the manufacturers, the latter receive but few fresh orders. This circumstance, however, is regarded with indifference, inasmuch as the whole of the production of the current year is already sold. The total production of pig in Germany, including Luxemburg, in the month of March amounted to 416,948 tons, against 380,500 tons in the same month of 1889. The total production in the first quarter of the year amounted to 1,153,040 tons, against 1,082,523 tons in the corresponding period of last year. There is still a fairly active current of business in finished iron and steel. Joists and plates are in good demand, and hoops continue to be bought freely, but wire and wire nails are neglected. Founders are not so busy as they were some weeks ago.

Coal.—For the present the coal market remains steady, but buyers are pressing hard for better terms. The demand continues good. It is said, on trustworthy authority, that the railway requirements for this district for the current year will exceed 2,000,000 tons. Last year the contracts amounted to 1,712,000 tons. The output of the Rhenish-Westphalian pits rose last week to 108,000 tons a day as an average. The total production of this locality in the first three months of the year amounted to 9,032,158 tons, against 8,756,225 tons in the corresponding portion of 1889, an increase of 3·1 per cent.

LILLE, 29th April, 1890.

Iron.—Much is being written and said about the firmness of the iron markets in this important district, and the inference invariably drawn is that trade is in a flourishing state. This conclusion is not correct. The firmness is due to the high price of coal, and not at all to an active demand. The truth is that business is languid. The demand falls so far short of the production that the manufacturers have called a meeting to discuss a proposal to imitate their Belgian neighbours, and to work but five days a week. But, after all, it may be doubted whether the firmness talked of really exists. The official quotations remain unchanged but concessions are made in another form.

Textile Manufactures.—Business continues fairly active in the linen goods trade. The demand has fallen off in the course of the last week, as usual at this season; but the amount of business done will compare favourably with that of the corresponding week of last year. A cheerful tone pervades the market. The textile trade of Rouen is disturbed by strikes. A conflict of this nature has occurred at the Union Commerciale de Tissage, an English company, whose mills are situate on the road to Caen. The woollen goods trade at Roubaix is slack compared with what it was a year ago, but the prospect is said to be encouraging.

Flax and Yarns.—The demand for home-grown flax continues brisk, and, as the stocks are being rapidly reduced, prices are very firm, with an upward tendency for the better sorts. Russian is in better demand. Prices are irregular, but on the whole they have not appreciably changed from what they were a week ago. There is not much doing in tows. Jute continues in brisk demand. A considerable amount of business is being done in yarns, sufficient to absorb the whole of the production. Prices are firm. Jute yarns are a little dearer.

Submarine Cable Manufacture.—The Société Générale des Téléphones is about to establish large works at Calais for the manufacture of submarine cables. The management will be entrusted to the firm of Ratier, who possess an important factory of a similar nature at Bezons, where they work solely for the Société des Téléphones. The site of the new works, to the east of the Carnot dock, covers an area of 17,566 square yards, of which some 6,000 will be roofed in. This is the first serious attempt to compete with the English firms, who have hitherto had practically a monopoly of this class of manufacture.

AMSTERDAM, 28th April, 1890.

New Margarine Factory in Holland.—Mr. Simon van der Berch, of Osch, already one of the largest margarine manufacturers of the Netherlands, will further extend his works by building a new factory at Rotterdam.

Navigation upon the Rhine.—The owners of all vessels navigating the Rhine have now to be provided with special licences, issued by the German and Dutch Governments for international use.

The Labour Strikes at Enschede.—The owners of factories at Enschede, suffering under the labour troubles have resolved to combine against the artisans. So long as the strikers do not resume their duties, the work in the factories where no strike exists will be confined to four days a week. All strikers who have not resumed work

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within a week will not be taken on by any of the federated owners for a whole year. Every federated owner who violates these pledges shall forfeit 4,000 guilders. These strong measures appear to have been taken under the impression that the strikers receive help from England.

THE "ZONE" SYSTEM IN HOLLAND.—The State Railways Company will, it is reported, make a trial with the "zone" system upon their own lines. There will be three "zones" established, and both passenger fares and goods freights are to be materially reduced.

OYSTER CULTURE IN HOLLAND.—The prospectus of the Dutch Oyster Culture Company, Limited, has made its appearance. The object is to acquire, amalgamate, and combine certain oyster fisheries, carried on by different private firms on the Zuyder Zee and River Scheldt, under leases which will expire in 1915. The capital of the undertaking is close upon £200,000. In the last seven years the profits, including improvements on the different establishments, are stated to have been more than £100,000. The capital has all been taken up.

COPENHAGEN, 26TH APRIL, 1890.

BOOT AND SHOE MANUFACTORY.—A novel and extensive industry has just been inaugurated at Venersborg, Sweden —viz., a boot and shoe manufactory. The principal building is 90ft. long and 85ft. broad; the machinery is of the most approved style and the whole is lighted by electricity. As a beginning 170 hands are employed, and the daily production is about 700 pairs.

THE TON BREWERY AND MILLING COMPANY.—This company, at Stavanger, Norway, has now been reconstructed with a capital of 400,000kr. It is rather more than a year ago that the old concern suspended payments, although the assets, amounting to 802,000kr., showed a nominal surplus of 245,000kr. The net profits, while it has been worked in liquidation, amount to 42,000kr., but the annual net profits have amounted to as much as 80,000kr. The creditors will be paid in full, and there will, it is said, be a considerable surplus.

THE APATITE DEPOSITS IN SWEDEN.—The vast deposits of apatite in Northern Sweden have of late attracted a very considerable amount of attention, and hopes are entertained that they may prove of great industrial importance. The apatite is especially met with in the Norrbatten district, in the famous Gellivara iron ore mountain. Some five or six miles to the south of the Gellivara mountain is another huge mountain, which is called Gellivara Dundret, and which consists entirely of gabbro. During the year 1888 somewhat extensive examinations were made in this neighbourhood, with the result that deposits of apatite were met with in the gabbro, not only in the Dundret Mountain, but in the neighbouring mountainous districts for a number of miles along the Lulea-Gellivara Railway. This gave rise to some very sensational rumours about the apatite deposits, which, it was stated, had already passed into the hands of English capitalists. This is apparently not the case, but a Government commission was appointed to thoroughly investigate the matter. A report can be expected before long.

ENGINEERING IN SWEDEN.—Most of the larger engineering establishments in Sweden continue to be well employed. Orders for steamers are still coming in, especially from Russia, and those works which have made rolling stock one of their specialties are also doing a large trade. Prominent among the latter is the Kockum Engineering Company, Malmo, which has orders in hand from several railway companies. The Atlas Works, at Stockholm, are also very busy with railway carriages and tramcars for the home market and for export. Five large cars for the Abo Tramway Company, Finland. The construction of the tramcars contains several novel features; the bottom part is made of steel plates, and the springs are also of a new kind. To the town of Tula, Russia, six tramcars have been delivered; these have separate smoking compartments at the ends. For the Stockholm New Tramway Company eight cars are in course of construction. For the State railways a large number of goods carriages are in hand. The Mora-Venern Railway Company has ordered eight and the Gefle-Dalu Railway three bogie carriages, 60ft. long, and having eight wheels. Another firm that is doing remarkably well is the Laval Separator Company, at Stockholm. Their profits during 1889 amounted to close upon 400,000kr. This is not a bad result for a company with a capital of only 1,000,000kr.

MADRID, 28TH APRIL, 1890.

AN IRON ORE LAWSUIT.—A long pending lawsuit about the property of the San Antonio Iron Ore mine has ended in an agreement that the party keeping the mine shall pay £164,000 to the other. The mine is supposed to contain one of the largest deposits near Bilbao of Campanil ore.

SPANISH COGNAC.—One or two of the largest wine merchants of Jerez, in presence of the ungrounded disfavour with which sherry wine of old fame is now regarded in England, have turned their attention to cognac making with their good and strong wines. Their cognac has already acquired a good name, and it is fetching better prices than the finest French qualities.

MATURING OF WINE.—Experiments have been recently published on the action of light in ageing new wines. By exposing layers of the young wine in vessels covered with coloured glass to the direct action of sunlight, the flavour and quality of the wine are said to be considerably improved.

BEETROOT SUGAR IN SPAIN.—No less than ten factories for making beetroot sugar have already been established in the province of Granada, and thirteen more are to be erected in consequence of the success of those already at work. The soil and climate of that part of the country are highly suitable for the cultivation of the beet. The roots grow to exceptional sizes, and give a considerable yield of saccharine matter. These favourable results have only been obtained from one year's experience, and before the cultivation is pronounced a success and extended, the effect on the soil of several years' growth of the beet should be ascertained.

THE POPULATION OF SPAIN.—The Madrid Geographical and Statistical Institute, publishing some of the first results known as to the census taken at the end of 1887, reports that the total population of Spain at that date was 17,550,216, as against 16,634,345 at the census of 1877, this representing an increase of 951,901, or 0·54 per cent. per year; whereas in the period from 1860 to 1877 the increase was at the rate of only 0·35 per cent. per year. The Geographical Institute attributes this slight improvement to the public tranquillity which has prevailed since the close of the Carlist insurrection and to the better hygienic condition of the large towns. In the poorer of the provinces, such at Soria, Teruel, and Almeria, which are badly off for means of communication, the population has either diminished or has remained stationary; but there has been a great increase in the provinces of Huelva and Biscay, where industry has been developed so much lately, though the most densely populated provinces are those of Barcelona, Valencia, Madrid, and Corunna. The returns as to emigration from Spain during the ten years from 1877 to 1887 are not yet prepared, but the preliminary report mentions, as might have been expected, that it has increased very much.

NEW YORK, 19TH APRIL, 1890.

THE IRON AND STEEL TRADE.—The trade is generally very unsettled, and prices are lower in nearly all lines. In pig iron the pressure to realise, on Southern irons especially, has been very great, and prices are about a dollar per ton lower. The three grades can now be bought at $16, $17·50, and $18·50 per ton, and Southern irons bring about a dollar less. The impression is that prices are now about as low as they are likely to be during the present year, and that though some brands are at present bringing considerably more than others they will soon fall to the lower level, and the market will remain stationary for some time. In manufactured iron the prices are correspondingly irregular. A fair amount of business in small lots has been done. The decline in pig iron is of some assistance to manufacturers, but the trade is unsatisfactory and orders are only to cover present needs. Prospects are good for a large summer consumption, and as soon as prices settle down again a very active demand is expected. Bar iron is quoted at 1·9c. per lb., plates at 2·15c., and angles 2·25c., with an advance of from ·15c. to ·25c. for steel. Steel rails are dull, but prices hold their own. Sales of small lots have been made at $34 per ton, but prices are still considered too high for the placing of large orders. In other shapes steel is unsatisfactory. Quotations for billets vary from $30 to $31·50 per ton.

THE COAL TRADE.—The anthracite trade is demoralised The demand for domestic sizes is very light, but manufacturing and steam sizes can be readily sold. The large companies are doing all they can to preserve the prices, but the rates offered by the individual operators have to be accepted or the trade would vanish. As long as the low rates were confined to current orders, the state of things was not so serious, but coal is now being sold for future delivery at the same low rates, and the outlook is, therefore, not a very pleasant one. There is hardly a possibility of any improvement occurring in the situation until the 1st of August, but if the combination holds until that time there will be an active trade for the rest of the year.

CANAL AROUND NIAGARA.—The construction of a ship canal around Niagara Falls by the United States Government was favourably received in the United States House Committee on Railways and Canals. About $10,000 was ordered for the expenses of a Board of Designation, and $1,000,000 to begin the work. The Board will consist of two army engineers, two civil engineers, and one citizen, all appointed by the President. The canal will be along one of the surveyed lines, and its total cost will be $23,000,000. The route will be twenty-three miles long, and the locks 400ft. in length, by 80ft. in width.

THE GRAIN INDUSTRY AT BALTIMORE. Two new elevators are to be built in Baltimore to supply the needs of her growing grain trade. One will have a full working capacity of a million bushels, and it will be supplied with all the latest improvements for elevator work. It will cost $300,000. The other elevator is to be built principally for the storage of oats, and will supply a long-needed want as regards storage and weighing facilities. It will have a capacity of from 250,000 to 300,000 bushels, and will be built at a cost of $150,000.

THE UNITED STATES' TORPEDO BOAT "CUSHING."—The report of the trial board of the "Cushing," built by the Herreshoffs, has been made public. After her trial on the measured mile the boat was taken outside and run around Block Island at a speed of about 16 knots. The boat behaved well with sea abeam and on either quarter. The boat was then loaded with sufficient coal for twelve days and again taken outside. There was considerable sea on but no water was taken aboard. The following is an abstract of the log: Speed, 22·5 knots; steam pressure, 245lb. per sq. in.; pressure in first receiver, 100lb. per sq. in.; in second receiver, 40lb. per sq. in.; in third receiver, 5lb. per sq. in.; vacuum, 24in.; revolutions, 370; revolutions of air and feed pumps, 130; revolutions of after blower, 500; air pressure, 2½in.; revolutions of forward blower, 825; air pressure, 3in.; revolutions of circulating pumps, 360; horse power, 1,720; coal, lbs. per hour, 3,446; coal per horse-power, 2lb. per hour; grate surface in use, 76·6 sq. ft.; coal per sq. ft. of grate per hour, 45lb.

STRIKE IN THE BUILDING TRADES.—About four years ago the first determined effort of the members of the American Federation of Labour was made in Chicago. During that winter, by agitation and organisation, probably 60,000 men were made ready to strike for an eight-hour day on the 1st of May, 1886. The movement seemed irresistible, when the explosion of the Haymarket bomb settled the matter temporarily. Since that time various attempts have been made to lessen the hours of labour, but no great success has been attained. The Confederation of Labour has confined the eight-hour battle for this spring to the building trades. Of these the most powerful—the Bricklayers' Union—has had the eight-hour day for two years, and several smaller unions also have it. The fight was begun in Chicago, on the 7th inst., by the Carpenters' Council, which includes representatives of about 6,000 men. They demand an eight-hour day, an advance of wages from 35 cents to 40 cents per hour, the establishment of an apprentice system, and a permanent arbitration committee to which all disputes shall be referred and whose decision shall be final. The association representing the contractors has refused to recognise the Carpenters' Council. The other building trades are fully organised, and will join the movement on the 1st of May. The trouble will probably be confined to these trades alone, as there is less possibility of filling the places of the strikers, and the federation is in better shape to carry on a winning fight with only a portion of its members on strike.

A HUGE COMPANY.—Negotiations are in progress for the sale of the Chicago Cattle Yards to an English syndicate for $30,000,000. The terms of this contract are as follow:—(1) A cash payment of $15,000,000; (2) bonds in the new company for $10,000,000; (3) the issue of preferred stock to the present stockholders in the sum of $5,000,000. The effect of the sale will be to send princely dividends to Europe, and to that extent it will not be hailed with any tempestuous evidences of approval by the people of Chicago. Thirty-five years ago less than 200,000 food animals of all kinds were slaughtered there annually, while last year 1,763,310 cattle, 87,392 calves, 4,211,867 hogs, and 1,121,154 sheep (7,183,724 animals) were thus disposed of. These figures tell a story of a business the growth of which is without a parallel. The sale of the yards will be the business sensation of the year on the American continent.

PHILADELPHIA, 18TH APRIL, 1890.

CAST STEEL GUNS.—The second cast steel gun, of open-hearth steel, has not been a success, just like that of a year ago. In that test the gun withstood ten service rounds, but showed signs of undue expansion and flaw, the significance of which was disputed. The second test was a repetition of the first, both in the number of rounds and the result. The expansion was doubled, and three serious flaws developed. As the Bessemer steel gun went to pieces at the first round, cast steel guns are for the present out of the question.

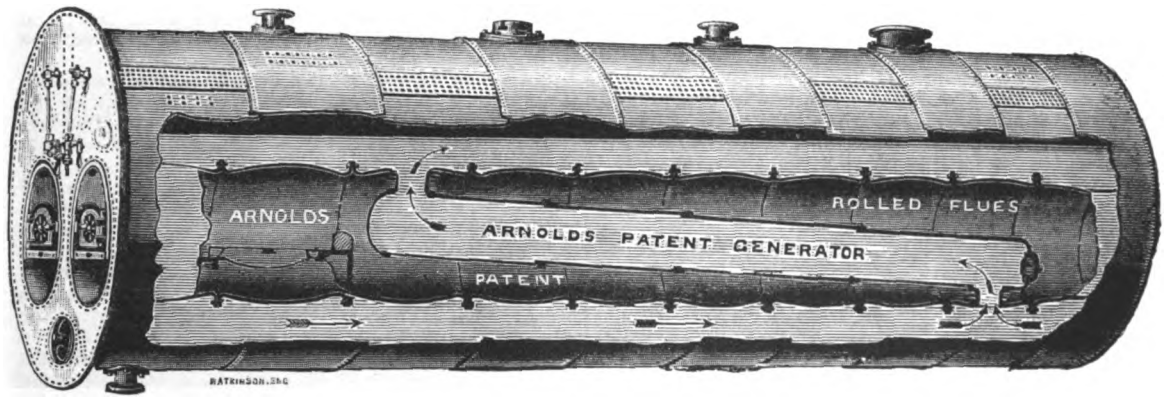
THE "BROWN" WIRE GUN.—The "Brown" segmental wire gun has been very successfully tested on a small scale. The dimensions are: Calibre, 1in.; length, 44in.; diameter at breech, 4in.; at muzzle, 3in.; weight, 70lb. It consists of 24 segments of steel wound with steel wire of $\frac{1}{16}$in. in diameter at a uniform tension of 100lb. At the breech there are 22 layers, and at the muzzle 9. There is no lining tube, the rifling—one turn in 25 calibres—being cut on the inner edges of the segments. The total pressure over the powder chamber is 7,000lb. per sq. in., and the pressure necessary to burst the gun would be about 150,000lb. per sq. in. The success of this gun has satisfied the inventor's friends, and a 5in. gun has been ordered and will be completed in July. The rapidity of construction possible in this design is one of the great advantages claimed for it, and if a 5in. gun, built in three months without even a special plant to do the work, equals in penetration the other guns now used in the navy, it is thought that it may supplant the forged guns, which require about three times as long for completion. The 1in. gun sent a steel projectile through three 1in. plates, developing an initial velocity of 2,570ft. per second, with a chamber pressure of 50,000lb. per sq. in. The wire for winding this gun was made at the Carpenter Steel Works, Reading, Pa., from a special grade of crucible steel costing $1 per lb. It showed a tensile strength of 328,000lb. per sq. in., with 4 per cent. elongation, and 3·32 per cent. reduction of area.

THE OKRA PLANT.—Considerable attention is being directed to the okra plant, an annual of South American origin, which, heretofore, has been known chiefly as an excellent vegetable for soups. It has recently been discovered, however, that this plant has an excellent fibre, and an inventor asserts that he has devised a process for extracting okra fibre at a cost not exceeding 1c. per lb. It is believed that okra fibre, especially if extracted at this price, will largely displace jute, and it is also likely to come into competition with henequen.

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IMPROVED STEAM BOILER.

CONSTRUCTED BY MESSRS. WILLIAM ARNOLD & Co., ENGINEERS, BARNSLEY.



THE LATE PARIS EXHIBITION.

THE official report of the Executive Council of the British Section at the late Paris Exhibition has recently been issued, signed by Sir Polydor de Keyser, President, and Mr. H. Trueman Wood, Commissioner Delegate.

The first step taken by the Council on its election was to form a guarantee fund. Altogether £16,800 was subscribed, but fortunately none of this has been required, for the balance-sheet shows a small surplus. The expenditure up to the 18th of March amounted to about £29,000.

The chief source of revenue has been the money received for space, a charge for which was made at the rate of 5s. per square foot, the only exception to this charge being in the Agricultural Gallery, where there was no flooring, the charge being 2s. 6d. per square foot, and in the Photographic Section, where 2s. 6d. was charged for wall or screen space. One of the largest items of general expense was of necessity that for the decoration of the courts, which was under the honorary superintendence of Mr. Donaldson. The decorations in the Liberal Arts Section and in the Agricultural and Food Galleries were on a less expensive scale. Other heavy items of expenditure were the supplying of the necessary plant and fittings in the Machinery Hall, and the reception of exhibits at the commencement and their despatch at the close of the Exhibition.

The Council think it right to draw attention to the manner in which the space allotted to Great Britain, as to other foreign nations, was divided up. This division placed the exhibits of foreign countries at a great disadvantage as compared with those of France.

A total number of 673 exhibitors occupied space in the Machinery Hall, Industrial Gallery, Liberal Arts, Indian Palace, Food Products, and Agricultural Gallieries, and there were in addition to these, 47 exhibitors in the Social Economy Section, and 429 in the Fine Arts Section—of whom 297 were artists and 132 private lenders—making a grand total of 1,149 British exhibitors.

The awards granted by the French authorities consisted of Grands Prix, gold, silver, and bronze medals, and honourable mentions. The list of awards was given in *Industries* of the 4th and 11th of October, 1889. Throughout the Exhibition the average of awards was 50 per cent. In the British Section, it was 90 per cent., or in the Industrial Section alone, 120 per cent.—*i.e.*, 752 awards amongst 673 exhibitors.

For the accommodation of Indian exhibitors a special building was erected on a space of ground allotted for the purpose by the French Administration. The greater part of the cost of the erection and maintenance of this building was defrayed by the amounts paid by exhibitors for the twenty shops or stalls into which it was divided, and by a contribution from the Indian Tea Districts Association, in return for which the verandah of the building was placed at their disposal, and was turned into a restaurant for the sale of Indian tea. The deficiency, a little over £350, was made up out of the general funds. By the regulations of the Exhibition, the sale of objects of genuine Oriental manufacture was permitted in the Indian Pavilion.

The arrangements for the storage of empty cases have always been a difficulty at International Exhibitions. Following the example of the Royal Commission of 1878, the Executive Council determined to make their own arrangements for this part of the work. Accordingly they rented a piece of waste ground near the Exhibition, and employed Mr. Humphreys to erect on it an iron shed, his estimate for the purpose being lower than those of French contractors for the cheapest possible construction. As the cases were emptied at the commencement of the Exhibition they were removed as rapidly as possible, and stored in such a way as to ensure their being readily and quickly delivered at the close of the Exhibition. The delivery commenced the morning after the Exhibition was closed, November 7th, and was rapidly carried through without difficulty. The exhibitors were charged a fee, varying according to the size of each case, from 2s. 6d. a cubic yard downwards. There were very few complaints of loss or damage, and in these few instances the loss was made good. The work of clearing the galleries commenced on the 7th of November, the morning after the close, and within a fortnight, with the exception of the Industrial Gallery and the Machinery Hall, the British Section was practically cleared of exhibits. The whole of the British Section was cleared out before Christmas, including the Fine Arts, where great care of course had to be taken in the packing of the exhibits.

THE LEEDS EXHIBITION.

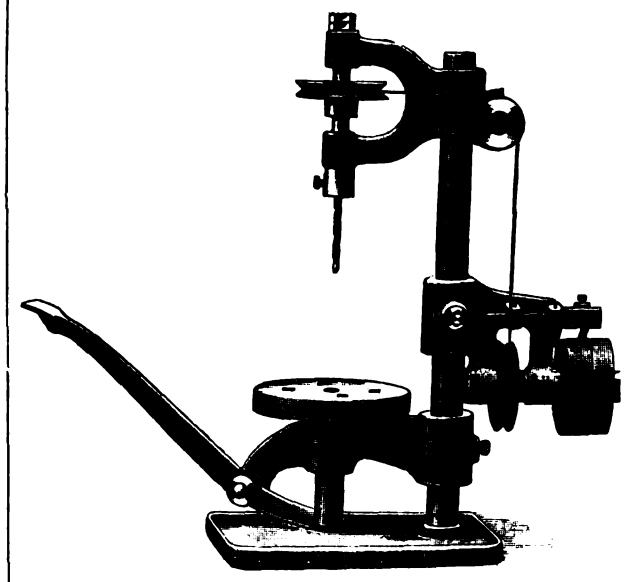
APATHY has given place to interest among the people of Leeds with regard to the International Exhibition which is to be held in that town from the 21st of this month to the end of October. The project did not at first obtain that amount of local support which was anticipated, but within the past few weeks circumstances have occurred which point to the complete success of the undertaking. The greater interest now manifested by Leeds business people in the Exhibition has led Mr. J. Davis, the promoter and manager, to telegraph to his Continental agents not to accept further proposals from intending exhibitors. Should it be found necessary, the management will erect further accommodation for local and national requirements. The venture is in the hands of a syndicate formed of gentlemen in prominent positions, and, though Leeds is not asked to contribute towards the expenditure, it will reap great advantage from the Exhibition.

As previously announced in *Industries*, the Exhibition is to be held at the depôt of the Leeds Rifle Volunteers, which is less than half a mile from the railways running into the town, and within easy reach of several excellent tram and 'bus routes. Five acres of grounds are available for the undertaking. Possession has been taken of the site, and much progress made in the work of preparation for the opening. The Exhibition will deal with matters engineering, mining, industrial, and commercial. The several sections embrace machinery, metallurgy, the production of precious metals, electricity, foods and drinks, architecture, rural industries, manufactures, education, fine arts, chemical industries, decorative art, hygiene, clothing, music, and domestic appliances. A special section is to be devoted to the question of the housing of the poor, with the object of assisting in the development of the best schemes to effect improvement in the condition of the dwellings of the labouring classes. Another specialty will be a "Leeds Court," under the control of a local committee. The centres of industry and places to be represented at the Exhibition include Bradford, Keighley, Pontefract, and other Yorkshire towns, London, Manchester, Liverpool, Birmingham, Newcastle, Bolton, Wolverhampton, Southport, Ferryhill, Blackburn, Wallsend, Keswick, Brighton, and Cornish towns, while many applications have been received from the Continent. During the course of the Exhibition competent jurors will be empowered to award medals and diplomas in those cases where the exhibits are deemed to be of sufficient merit. In the industrial department it is intended to have a series of exhibits illustrating a selected number of trades and handicrafts in operation, while in the engineering section a good display of steamship models is promised.

The Exhibition building will consist of wooden erections, having felt and glass roofs, and forming a series of parallel courts intersected by gangways 6ft. or 7ft. in width. The majority of the contracts connected with the preparation of the Exhibition are in the hands of local tradesmen. The woodwork is being erected by Messrs. Ives & Co., of Shipley. The building is to be coated with the specialty of the Anti-Flamme Company, London, for safety against fire, though there will also be available the hydrants of the Leeds Corporation and the appliances of Messrs. Shand & Mason, and probably those of Messrs. Merryweather & Co. Illumination lamps are to be supplied by Messrs. J. Russell & Co., Leeds; and the decorations, &c., will be fitted by Messrs. Pigott Bros., London. Arrangements are being made with the railway companies for the running of excursion trains and the issuing of cheap tickets. Mr. Davis, who has promoted the Exhibition, was connected with the enterprise at York last year, and had charge of the Anglo-Danish Exhibition at South Kensington in 1888.

PARKINSON'S DRILLING MACHINE.

IN the accompanying illustration we show a small drilling machine now being placed on the market by Mr. J. Parkinson, tool maker, Union Works, Chester Street, Bradford. It is intended for drilling holes up to ¼in. dia-



meter, and will admit work 7in. thick. The table on which the work is held is fed up to the drill by the front lever shown in the illustration, and the drill may be driven either by the cord and power pulleys, as shown, or by treadle. The height of the apparatus is 1ft. 10in. from the base to the top of the drill.

ARNOLD'S STEAM BOILER.

WE illustrate above the latest form of the now well-known steam boiler with rolled flues and circulating water chamber, manufactured by Messrs. William Arnold & Co., Victoria Works, Barnsley. There were two novelties in Messrs. Arnold's boilers, viz., the shape of the segments of the flue and the use of a water chamber within the flue in the place of the ordinary cross tubes. At first the ends of the water chamber were joined direct to the flue, but in the latest form, as illustrated above, the joint is made through the interposition of a flanged ring, so that freer expansion and contraction can be reckoned on. We understand that Messrs. Arnold have put down a large number of installations of this type of boiler, and that they give great satisfaction as regards heating power and economy.

A FRENCH SUBMARINE GUNBOAT.

IN *Industries* for 1st March, 1889 (page 209), we gave a short account of a submarine gunboat built in France, called the "Gymnote," and which had attracted considerable attention in England. We mentioned several experiments which had been made, but since that time considerable modifications have been effected in some of its parts. Recently further experiments have been carried out, from the reports of which we now give a few ex-

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tracts. After the first experiments it was found necessary to modify the accumulator cases, and after patient research, fragile, non-conducting substances being set aside, cases were at length produced which have given entire satisfaction, made of a special kind of guttapercha. After having made a preparatory trip to ascertain that all was working properly on board, and taken some very satisfactory plunges, the boat re-entered the harbour and had her accumulators charged. At noon of the second day she was hermetically sealed by closing the panel giving admission to the interior, which was not to be opened till four hours later.

The "Gymnote" was accompanied by a steam launch, which had instructions to keep out of the way any boats which might come up. On getting to the place selected for the trials everything was put in order for the plunge, and at a given signal it slowly descended, and remained at a depth of 2 metres 50 centimetres below the surface of the water. It was found easy to remain at that depth, with variations of about 20 centimetres. The length of the course was estimated by the number of turns of the screw, and in this way it was known when the limit of deep water was reached. The "Gymnote" then returned to the surface, passed round a mark, and took a plunge in the opposite direction, and made various evolutions to show her powers of steering and of remaining at a given depth. She did not leave on the surface any trace of her passage, and is quite invisible when painted grey, but on the occasion of these trials she was painted white in order that her course might be seen under water. Altogether, the experiments were most successful, and seem to mark a decided advance on anything that had hitherto been attempted.

SHIPBUILDING NOTES.

On the 19th ult. the steamer "Kasara," built by the Ailsa Shipbuilding Company, Troon, for the British India Steam Navigation Company, made her trial trip on the Forth of Clyde. The distance between the Cumbrae and Cloch lighthouses and back again was accomplished at the rate of 14·1 knots per hour, the speed guaranteed being 13¼ knots. The dimensions of the vessel are:—Length, 240ft.; breadth, 34ft.; depth, 25ft. The engines, which are of the triple expansion type, are by Messrs. Dunsmuir & Jackson, Govan. The cylinders are 25in., 40in., and 65in. diameter, and the stroke 42in. The revolutions averaged 88½ per minute, and the power developed was over 2,200 i.h.p. Steam is supplied from two large double-ended boilers working at a pressure of 160lb. per square inch. The fittings include Weir's patent feed-heater evaporator and pumps, Bow McLachlan's patent steam steering gear, &c. The vessel has been supplied with an installation of the electric light by Messrs. William Harvie & Co., Broomielaw, Glasgow.

On the 19th ult. there was launched from the yard of the Tyne Iron Shipbuilding Company, Limited, of Willington-Quay-on-Tyne, a screw steel steamer, which has been built to the order of Messrs. Thomas Stephens & Sons, of London. She is of the following dimensions:—Length, 260ft.; breadth, 36ft. 8in.; depth, 19ft. 3ft. This steamer has water ballast right fore and aft on the cellular system, and is fitted with all modern improvements for the rapid loading and discharging of cargo. The engines, which are to be supplied by the Wallsend Slipway and Engineering Company, Limited, are of the triple expansion type, having cylinders 24in., 34in., and 54in. diameter, by 36in. stroke. On leaving the ways the vessel was named the "Manuka."

On the 19th ult. Messrs. Richardson, Duck & Co. launched from their shipbuilding yard at South Stockton a steel screw steamer of the following dimensions:—Length, 270ft.; breadth, extreme, 37ft.; depth, moulded 19ft. 5in.; and tonnage, gross, about 1,900 tons. The vessel has been built to the order of Messrs. Farrar, Groves, & Co., of London. She has a raised quarter-deck, a long bridge extending to stern, and a double bottom on the cellular principle, extending fore and aft, for water ballast. She will be fitted with four steam winches, steam steering gear, stockless anchors, and all the latest improvements for facilitating loading and discharging cargo. Her engines have been built by Messrs. Blair & Co., Ld. As the vessel was leaving the ways she was christened "Girdleness."

On the 20th ult. Messrs. Laird Brothers, Birkenhead, launched the first of two torpedo gun vessels which they have built to the order of the Government of the Argentine Confederation. This vessel (the "Espora") may be described as being of the "Rattlesnake" type, but has higher speed, lighter draught of water, and several structural improvements embodied in her design. Her dimensions are:—Length over all, 210ft.; beam, 25ft.; depth, 13ft. 6in.; and tonnage, 615 tons. She will be fitted with twin screws driven by two sets of triple-expansion engines having a collective power of 3,250 h.p. The hull is built entirely of steel, with a ram stem, and is divided into upwards of thirty water-tight compartments. The coal bunkers are arranged to afford protection to the machinery, and each set of engines and each pair of boilers are in separate compartments. The armament will consist of Nordenfelt quick-firing guns; two 14-pounders mounted one on each side of the forecastle, one 8-pounder at the after end of the poop, two 3-pounders at fore end of the poop; two Gatling guns; and five torpedo tubes, one in the bow and two on each broadside, fitted for discharging the new 18in. Whitehead torpedo.

Notices of Meetings.

Society of Engineers.—Monday, May 5th, at 7.30 p.m. A paper to be read on "Breakwater Construction," by Mr. F. H. Cheesewright, Assoc.M.Inst.C.E.

Society of Chemical Industry.—Monday, May 5th. Papers to be read: Mr. Watson Smith, "The Dinsmore Process"; Messrs. Cross and Bevan, "Some Considerations in the Chemistry of Bleaching"; Mr. M. L. Griffin, "Moisture in Paper Pulp."

The Institution of Civil Engineers.—Ordinary Meeting, Tuesday, May 6th, at 8 p.m. Paper to be read: "The Screw Propeller," by Mr. Syd. W. Barnaby, M.Inst.C.E.

Iron and Steel Institute.—Annual Meeting, May 7th, 8th, and 9th. Papers to be read: "On a New Form of Siemens Furnace, arranged to recover Waste Gases as well as Waste Heat," by Mr. John Head, London; "On the Robert-Bessemer Process," by Mr. Lynwood Garrison, Philadelphia; "On Some Critical Points in the Iron and Steel Manufacture," by Monsieur F. Osmond, Paris; "On the Carburization of Iron by the Diamond," by Professor C. Roberts-Austen, F.R.S., London; "Notes on the Action of Aluminium on Iron and Steel," by Sir Henry Roscoe, M.P., F.R.S., London; "On Aluminium in Carburetted Iron," by Mr. W. J. Keep, Detroit, U.S.A.; "On the Changes in Iron produced by Thermal Treatment," by Dr. E. J. Ball, London; "On Certain Chemical Phenomena in the Manufacture of Steel," by Mr. W. Galbraith, Willingworth; "On the Estimation of Phosphorus in the Basic Siemens Steel Bath," by Mr. W. Galbraith, Willingworth; "On the Rollet Process for producing Purified Castings," by Monsieur Rollet, Paris.

The Institution of Electrical Engineers.—Thursday, May 8th, at 8 p.m. Discussion on the following paper: "On a Lightning Guard for Telegraph Purposes and on the Protection of Cables from Lightning," by Dr. Oliver Lodge, F.R.S.; and paper to be read, "The Treatment, Regulation, and Control of Electric Light by the Legislature and the Board of Trade," by Major P. Cardew.

Chemical Society.—Thursday, May 8th, at 8 p.m. Extra Meeting. Exhibition of apparatus, &c.

The Junior Engineering Society.—Friday, May 9th, at 7.30 p.m. Paper to be read: "The Slide Valve and Radial Valve Gears," by Mr. W. J. Tennant.

PRICES CURRENT, 30th April, 1890.

Quotations at per ton, unless otherwise specified.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	6 7 6	.....	6 17 6	f.o.t. wks.
„ Angles	6 2 6	.....	6 12 6	„
„ Plates	6 7 6	.....	6 17 6	„
Staffordshire Bars (cheaper makes)	8 10 0	.....	9 0 0	London.
„ Angles	8 10 0	.....	9 0 0	„
Crown Sheets	7 5 0	.....	7 15 0	„
„ Hoops	7 10 0	.....	8 0 0	„
"Siemens-Martin" Steel Boiler Plates			8 17 6	„
„ Ship and Girder			7 17 6	„

Market quiet.

METALS.

Spelter: Ordinary	£22	15	0	to	£23	0	0
Copper: British Cakes and Ingots	55	0	0	„	56	0	0
„ Chili Bars, G.O.B.'s	49	2	6	„	49	10	0
„ Other sorts, G.M.B.'s (equal to Chili Bars)	49	2	6	„	49	10	0
„ Manufactured (strong)	62	0	0	„	.....		
Lead: Common Pig	13	12	6	„	13	15	0
„ English Sheet	14	7	6	„	14	10	0
Tin: Straits	91	15	0	„	92	5	0
„ Australian	92	0	0	„	92	10	0
„ English Ingots	96	15	0	„	.....		

Messrs. Carrick & Brockbank, Manchester, report as follows:—

Copper has been much firmer during the past week, owing to the continued scarcity of Chili bars offering for prompt delivery and the better demand for consumption. Values are consequently higher. On the 23rd quotations for Chili bars were £48 7s. 6d. to £48 15s. cash. Moderate sales took place during the next few days at higher rates, £49 to £49 5s. being paid on the 28th for cash metal. To-day's quotations are £49 2s. 6d. to £49 10s, with quiet business reported. Manufactured has been advanced to £62 sheets, £65 bottoms, and there is more inquiry.

Tin: There has been a rapid rise in tin during the week, but the advance has not been maintained. The rise in silver, and the firmer market in the Straits, caused prices of foreign tin to advance from £90 to £90 10s. cash on the 23rd to £93 10s. to £94 on the 28th, after which values receded, quotations to-day being £91 15s. to £92 5s., with but little business doing.

Lead: Values are a shade easier than last week, with small demand.

Spelter has been rapidly advanced, chiefly by buying on merchant account. The stocks are small, and prices higher abroad than in England, where the low price for spelter is consequent upon the slackness of the galvanisers.

PIG IRON.

Middlesbro' Warrants, No. 3.	44/7½	Buyers,	Cash
Scotch Warrants, m/n	44/8½	„	„
Hematite Warrants, m/n	54/2	„	„
Stocks in Stores: Scotch	Decrease for week	9,647	Tons
Middlesbro'	„ „	3,821	„
Hematite	„ „	4,433	„

	No. 1.		No. 3.	
Coltness	67/6	.....	61/6	f.o.b. Glasgow.
Gartsherrie	63/6	.....	58/-	„ „
Langloan	67/6	.....	61/6	„ „
Summerlee	67/-	.....	61/-	„ „
Glengarnock	67/-	.....	58/-	„ „
G.M.B. ex Store	45/6	.....	45/3	f.o.t. Works.

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton	74/-	65/6

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.

Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

CHEMICALS.

Acid: Carbolic Crystals	lb.	£ 0	s. 0	d. 10	to	£ 0	s. 0	d. 11½
„ „ Liquid	gal.	0	1	2	—	.....		
„ Citric	lb.	0	1	7	—	.....		
„ Oxalic	„	0	0	3½	—	.....		
„ Sulphuric	ton	1	12	0	—	.....		
„ Tartaric	lb.	0	1	4½	—	.....		
Alum: Lump (powder 10/- ex.)	ton	4	17	6	—	.....		
Ammonia: Carbonate	lb.	0	0	3½	—	.....		
„ Muriate (Grey)	ton	22	15	0	—	.....		
„ „ (White)	„	26	10	0	—	.....		
„ Sulphate	„	11	12	6	—	.....		
„ Liquor	lb.	0	0	3½	—	.....		
Antimony	ton	.....			—	.....		
Bleaching Powder	„	5	2	6	—	5	5	0
Bisulphide of Carbon	„	13	10	0	—	.....		
Borax	„	30	0	0	—	.....		
Benzole (90 %)	gal.	0	3	5	—	.....		
„ (50/90 %)	„	0	2	8	—	.....		
Copper Sulphate	ton	25	10	0	—	26	0	0
Copperas	„	2	0	0	—	.....		
Kieserit	„	.....			—	.....		
Lead: Nitrate	„	22	10	0	—	.....		
„ White Sugar	„	24	0	0	—	.....		
„ Brown „	„	19	0	0	—	.....		
Potash: Bichromate	lb.	0	0	4	—	.....		
„ Caustic	ton	22	0	0	—	.....		
„ Carbonate	„	19	10	0	—	.....		
„ Chlorate	lb.	0	0	5	—	.....		
„ Prussiate (Yellow)	„	0	0	9½	—	.....		
„ Sulphate (Basis 90 %)	ton	9	10	0	—	.....		
Precipitate: Red	lb.	0	3	1	—	.....		
„ White	„	0	3	2	—	.....		
Salts: Epsom Bags	ton	3	0	0	—	.....		
Salts: Epsom Casks	„	3	15	0	—	.....		
„ Glauber	„	1	10	0	—	.....		
Sulphur: Sublimed Flowers	„	9	0	0	—	.....		
„ Recovered	„	4	10	0	—	.....		
Soda: Ash	deg.	0	0	1½	—	.....		
„ Caustic (White 70%)	ton	10	0	0	—	10	2	6
„ „ „ 60%	„	9	0	0	—	9	2	6
„ „ (Cream 60%)	„	8	12	6	—	8	15	0
„ Crystals	„	3	0	0	—	3	2	6
„ Bicarbonate	„	6	5	0	—	.....		
„ Hyposulphite	„	6	5	0	—	.....		
Solvent Naphtha	gal.	0	4	0	—	.....		
Tartar, Cream of	cwt.	5	12	6	—	.....		
Zinc Sulphate	ton	7	10	0	—	.....		

OILS.

		£	s.	d.
Cocoanut: Cochin	per ton	28	0	0
„ Ceylon	„	25	0	0
Cottonseed	„	22	10	0
Cod	„	21	0	0
Lard	„	37	0	0
Linseed	„	23	7	6
Palm, Lagos	„	24	10	0
Rapeseed: English	„	32	0	0
Seal: Pale	„	28	0	0
„ Brown	„	22	0	0
Sperm	„	46	0	0
Whale	„	24	0	0
Turpentine	per cwt.	1	8	9
Coal	per gal.			
Petroleum (Refined)	„	0	0	5½
„ Spirit	„	0	0	7

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HOME INDUSTRIES.

LONDON, 1st May, 1890.

The Money Market.—The money market continues fairly easy in default of any great demand and in presence of a plentiful supply. Rates of discount, on the other hand, show a hardening tendency, principally through the drain of gold to the Continent. The Bank refused to sell any more French gold, and, as the French demand has now to be satisfied by the open market, the extent of the drain for that country cannot be exactly gauged. The German demand has been considerable this week. The stock markets have been very active. The announcement of an agreement as to the basis of silver legislation in America has caused a rapid rise in all American securities, as the increase of the currency must enliven trade and bring about a higher level of prices. The advance in the quotations of American securities has been quite sensational, and the revival of speculative activity has spread into all the markets. Securities depending directly on silver have been most prominent, such as Indian rupee paper and Mexican railway stocks, but the advance has been so general that it is impossible to single out individual stocks. The promised inflation of the American currency will certainly promote trade between this country and the States.

Companies.—The following companies have been registered since our last report: Buenos Ayres and Pacific Railway Equipment and Goods Depôt Co., Ld., with a capital of £700; Central African Co., Ld., with a capital of £50,400, to acquire land, mining rights, &c.; Persian Bank Mining Rights Corporation, Ld., with a capital of £1,000,000; Pullenger, Cheverton, & Co., Ld., with a capital of £10,000, to carry on the business of leather dressers, &c.; The Government and General Contract Co., Ld., with a capital of £100,000, to execute public works, &c.; The Pentremaur Colliery Co., Ld., with a capital of £10,000; Hanley & Co., Ld., with a capital of £100,000, to carry on the business of brewers at Oxford; The Burmah Explorations, Ld., with a capital of £200,000; Hartley & Aspinall, Ld., with a capital of £5,000, to acquire a boiler making business; Madagascar Concessions and Exploration Syndicate, Ld., with a capital of £5,000; Geffard Inventions Trust, Ld., with a capital of £6,528, to acquire certain patents; Cam Portland Cement Co., Ld., with a capital of £20,000; Stapleford & Sandiacre Water Co., Ld., with a capital of £20,000; Madagascar (Sumtava and Antalaha) Forests Syndicate, Ld., with a capital of £25,000; Vishnu Gold Co., Ld., with a capital of £200,000; Leedham & Heaton, Ld., with a capital of £25,000, to acquire a tool manufacturing business; Kelsey Patent Adjustable Hat Syndicate, Ld., with a capital of £6,000, to acquire certain patents; The Severn Tweed Co., Ld., with a capital of £150,000, to acquire certain mills; Mundesley-on-Sea Waterworks Co., Ld., with a capital of £3,000; The Knysna Mines, Ld., with a capital of £42,000; The Parker Gold Mines, Ld., with a capital of £150,000; Kingston Engineering Co., Ld., with a capital of £25,000; Imperial Oilcloth Co., Ld., with a capital of £60,000.

Hydraulic Lifts.—Messrs. Archibald Smith & Stevens have received instructions to erect one of their "Reliance" hydraulic lifts at the Badminton Club Chambers. They are also erecting similar lifts at Ashley Mansions, Victoria Street, Westminster; at chambers in Throgmorton Avenue, for Mr. J. Morris; at the Blue Hart Court, for Messrs. Cosh & Co.; at Chesterfield Gardens, for Mr. J. W. Beer; and for Messrs. Carruthers Brothers, of Luton.

Swan United Electric Light Company.—The directors of this company have decided to pay an *ad interim* dividend at the rate of 6 per cent. per annum for the six months ending 31st March, 1890.

Railways.—The gross receipts of the 23 principal railways in the United Kingdom for the week ending April 20 amounted, on 16,159¼ miles, to £1,297,712, and for the corresponding period of 1889, on 16,031 miles, to £1,328,911, an increase of 128¼ miles, or 0·8 per cent., and a decrease of £31,199, or 2·3 per cent., comparison being made with the week which included the Good Friday traffic.

The Iron and Steel Institute.—The Iron and Steel Institute some time ago decided to hold their autumn meeting in the United States at the invitation of the American Institute of Mining Engineers. The meeting will be held in New York on the 1st, 2nd, and 3rd of October, under the presidency of Sir James Kitson, after which an adjournment will be made to Pittsburg, where an international meeting will commence on the 5th of October. The chief bodies represented at this congress will be the American Institute of Mining Engineers, the Iron and Steel Institute, and the Verein Deutscher Eisenhüttenleute. Subsequently the visitors will attend the sittings of the American Institute of Mining Engineers. A large number of excursions have been arranged to most of the places of interest in the United States.

The Institution of Mechanical Engineers.—A distinguished company assembled at the annual dinner of this Institution, which was held last night, at the Criterion Restaurant, Piccadilly, Sir Michael Hicks-Beach being the principal guest. The engineers of the Forth Bridge came in for a lion's share of the compliments.

Prizes for Threshing Machines.—In connection with the Doncaster meeting of the Royal Agricultural Society, a first prize of £100, a second prize of £50, and a third prize of £25 will be offered for the best combined portable threshing and finishing machine, to be worked by steam, and adapted to the preparation of corn for market. The width is not to exceed 4ft. 8ft. inside the frame, and the width of drum must not be more than 4ft. 6in. The points, representing 100 per cent. of perfection, will be valued as under: Clean threshing, 30; clean shaking, 10; cavings free from corn, 5; chaff free from corn, 6; chaff free from cavings, seeds, and dirt, 5; straw unbroken, 5; corn uninjured, 15; cleanness of delivery from machines, 2; perfection of finishing, 5; construction and convenience of working, 6; power in proportion to results, 5; economy of attendance, 4; price, 2.

Electrical Engineering.—The steamship "Ilimoff," recently launched by Messrs. Craig, Taylor, & Co., of Stockton, for Mr. Alfred Suart, of London, has been fitted up with an excellent installation of electric lighting by Messrs. Hayward, Tyler, & Co., hydraulic and electrical engineers, London. This firm has supplied a large number of similar plant to Mr. Suart's steamers. The wiring is carried out on the double-wire system, and the wires are thoroughly cased and protected throughout the ship. Messrs. Hayward, Tyler, & Co. have also supplied all the pumping apparatus and valves for the delivery of petroleum on board these vessels.

MANCHESTER, 1st May, 1890.

The Iron Trade.—The tone of the market is very flat, and little business is offered. It is hardly possible to gauge prices at all, as quotations are only nominally given as a guide to buyers. There is still a disparity between the price of warrants and makers' quotations. A good deal of iron is, however, in the hands of middlemen, who are indisposed to hold it, and prices are, therefore, generally weakening. In bar iron the same tendency is observable, and in some cases makers are anxious for specifications. It is true that they are in many cases well booked with contracts, but the rapid rate of production and the diminution of demand have caused a little anxiety for the present. The price for bars is nominally £7 10s. per ton, but rather lower rates have been taken. Steel plates are not so readily sold at present, as boilermakers, although mostly well off, are not so pressed for business as they were a few months ago.

The Merchandise Marks Bill.—At the quarterly meeting of the Manchester Chamber of Commerce, held on the 28th ult., the proposed amending Bill introduced by Mr. Broadhurst into Parliament was condemned unanimously, with the exception of the clause appointing a public prosecutor. It was pointed out that the Bill, if it became law, would act prejudicially to the merchant who in many cases by prompt payments and advances enables the small manufacturer to establish himself in business.

The Manchester Ship Canal.—Despite the strenuous opposition of various authorities the House of Lords Select Committee has passed the Bill promoted by the Ship Canal Company. The alteration of the tidal openings proposed has been sanctioned, subject to the protective and penal clauses usual in such cases.

The Ribble Bill.—A Committee of the House of Commons has approved of the Bill of the Preston Corporation sanctioning the loan of £220,000 to complete the dock works as recommended by the Board of Trade Commissioners. It is reported that the depth of water at the bar has been considerably deepened, and it is proposed to commence running a regular service of steamers to Glasgow and the Isle of Man.

Type Writing.—The Manchester School Board has recently added type writing to the list of subjects upon which examinations are held. The Technical School Committee also include it in their list of subjects, and the first examination was held on the 28th ult. Ninety candidates came forward and were given sample letters to write. It may be here stated that the evening classes in commercial subjects promoted by the Manchester School Board have been very successful, over 300 students being at present on the books.

A New Bank.—A new bank is about to be established in Manchester by a limited company, under the title of the Lancashire Bank, Limited. The capital is fixed at £2,000,000, and a fair proportion of it is practically subscribed. The reasons for this new step are that the various existing local banks have paid good dividends in the past, and that there will be a great extension of business when the Ship Canal becomes an accomplished fact.

The Linen and Jute Trades.—Since our last week's report was written a somewhat unexpected activity has been noticeable in the wholesale distributing branch of the local dry goods trade, as far as the heavy departments are concerned. This is an unusual occurrence at such a period as the present, as fancy goods are now supposed to be the class of fabrics most suitable for the requirements of the season. Under ordinary circumstances this undoubtedly is so. The weather of late has, however, been so remarkably unseasonable that the ordinary condition of affairs has been reversed, and hence we find that fabrics like linens have had a fair run. As far as agents are concerned, however, there has not been much doing, and orders are difficult to obtain. This is somewhat discouraging, especially in view of the fact that certain classes of goods, such as black and finished hollands, are cheaper to-day than can be remembered for years. There is not much doing for shipment. As far as the South American market is concerned the recent further advance in the gold premium at the Plate tends to disorganise business, which was bad enough before, and with remittances so backward as they are at present new orders are things to be shunned rather than sought for. Yarns for the Lancashire market are in fair demand. In the manufacture of unions considerable quantities of linen and jute yarns are still consumed here.

GLASGOW, 1st May, 1890.

Pig Iron.—The sharp decline in prices has had the effect of bringing to grief one of the oldest houses in the trade. The return to low prices has, it is said, attracted the attention of foreign speculators, and it is reported that there has been considerable buying on account of German bankers in anticipation of an advance at no distant date. It may be, however, that in Germany it is difficult to find investments for capital in industrial enterprises. The report of purchases for abroad in this connection steadied the market in the beginning of the week, and there was a slight reaction upwards.

Utilisation of Waste Shale.—For many years the country immediately to the West of Glasgow has been greatly disfigured by heaps of waste shale, covering many acres. Many experiments have been tried to utilise this material, the mere removal of which, it was stated sometime ago in court, would cost upwards of £40,000. Hitherto the experiments have not been successful; but now, it is said, the problem has been satisfactorily solved. A company is being formed for the purpose of making the waste material into bricks. It is also intended to recover the ammonia which is present in small quantity in the refuse.

Glasgow Harbour Tunnel.—At the first half-yearly meeting of the shareholders of this company, a report was submitted showing that the total expenditure up to 31st January was £14,407 10s. 4d. Of this sum, Parliamentary expenses took £5,979 16s. 8d., and purchase of land and compensation, £8,007. The estimated expenditure during the current half-year was £90,000, and subsequent half-years £75,643 10s. 5d. The work of constructing a tunnel under the harbour was commenced on the south side of the Clyde in January last, and the 80ft. shaft has been sunk to a depth of about 25ft. The work on the north side will be commenced as soon as possession of the ground is obtained at Whitsuntide.

The Boundaries Bill.—This Bill, which is full of importance for Glasgow, both industrially and otherwise, seems likely to pass the preliminary stages before the close of this week. A large number of members of the Glasgow Corporation have been in London in connection with the Bill, but the examination of witnesses on behalf of the promoters was cut short on Monday in consequence of the manifest leaning of several members of the committee. The only point which practically remains to be settled is the question of terms; the ring of burghs outside the city, having enjoyed a low rate of taxation, claim to be exempt from certain of the city taxes for a period of years. The passing of the Bill will make Glasgow a homogeneous whole in point of municipal government, and will, other things being equal, diminish the rate of taxation within the city itself, when the period expires during which the differential rate for the annexed districts is to obtain.

Shipbuilding—A number of steamers which were laid down last autumn on speculation, and which are nearing completion, are being offered in the market at greatly reduced prices. In one case a cargo steamer has been offered at £8 10s. per ton, or 20s. below the quotations given a month ago, by Messrs. Angier Brothers; and in another case 25 per cent. has been taken off the price offered two or three months ago.—An order for a 46ft. steam launch has been secured by Mr. Thomas Orr, Jun., Greenock.—Messrs. James & George Thomson have converted their business into a limited liability company. The capital of £250,000 has already been subscribed and fully paid up. Under the auspices of the Realisation and Debenture Corporation of Scotland, Limited, they now ask for subscriptions to an issue of £150,000 mortgage debenture stock bearing interest at 5 per cent. The security for this debenture stock is the property of the company at Clydebank, valued by Mr. Bryce Douglas, of Barrow, and Mr. Smellie, of Glasgow, at £308,000.

(From our own Correspondents.)

LIVERPOOL, 30th April, 1890.

Technical Education.—Some three or four years ago a large committee was formed with the object of furthering the cause of technical education in Liverpool and the district, and arrangements were made for holding various classes for the practical instruction of the working men in the different parts of the city. The results, however, are not at all satisfactory, and the practical men of the committee are strongly objecting to the *modus operandi* and the consequent results. A large number of the committee appear to be quite satisfied so long as a number of articles such as paper knives, brackets, letter racks, &c., prettily carved in wood, are shown to them as the work of the students. As this kind of training is really not technical education, but more of a recreation, indulged in by both boys and girls, there is no doubt just cause for complaint.

The Liverpool Engineering Society.—After the adjourned discussion of the paper on the "Efficiency of Gas Engines," by Mr. Thos. L. Miller, which takes place at the next meeting, the present session will be closed. At the last meeting, Mr. F. Hudleston, Assoc.M.Inst.C.E., was elected president for the next year. Arrangements are now

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being made for the summer excursion to the Manchester Waterworks in course of construction at Thirlmere, the Forth Bridge, the works of the Liverpool Electric Supply Company, and other places of interest.

SHEFFIELD, 30th April, 1890.

Iron and Steel.—A very quiet tone prevails throughout the whole of this district in the iron trades, although makers still continue to dispose of the whole of their production. One very large firm in this district, who consume 1,000 tons of coal every day in the production of pig iron, are quoting pig f.o.b. this week at 53s. 6d. The steel works continue to be active in all branches. Messrs. Charles Cammell & Co. are engaged upon the production of some extra long marine tunnel shafting for the English Government. The tubular form of shafting is yielding plenty of work. Messrs. Cammells are prepared, if necessary, to bore lengths of 100ft., and to guarantee accuracy.

Coal and Coke.—There is very little change to report at present. Fuel of all kinds is rather quiet, although there is a fair demand for steam-raising fuel. House fire coal still maintains the recent advance; a reduction is, however, shortly expected. Coke continues in fair demand.

Labour.—One of the greatest difficulties manufacturers have to put up with here is the constant demand for an advance in wages from their employés. Never was skilled labour paid better than now.

New Railway.—The contractors for the Beighton and Chesterfield branch of the Manchester, Sheffield, and Lincolnshire Railway are pushing the work forward with great vigour. A considerable portion of the boundary is fenced in.

Leeds Association of Foremen Engineers and Draughtsmen.—At the meeting on Thursday, the 24th inst, it was resolved that the association should meet weekly on Thursday evenings for the perusal of technical papers and for consulting the valuable reference works in the library, the ordinary meeting being held on the last Thursday in the month as usual. The new president, Mr. Alfred Atkinson, then gave his inaugural address, taking as his subject the history of the association from its formation in 1865. He afterwards gave an interesting account of his visit to the anniversary festival of the London Association of Foremen Engineers and Draughtsmen, and also of his visits to the works of Messrs. Maudslay, Son, & Field, to Woolwich Arsenal, and to the Mint.

NORTH STAFFORDSHIRE, 30th April, 1890.

A Birmingham-Liverpool Ship Canal.—Little has been heard for some time of the projected ship canal between Birmingham and Liverpool, but it is now understood that the scheme has been diligently pushed, and that considerable progress has been made in working out the details. A survey has been made by Sir James Brunlees and Mr. McKerrow, in co-operation with Mr. Edwin Clark. Among other alterations in the plans suggested by Sir J. Brunlees and Mr. McKerrow, the width is to be increased to 72ft. This will give a capacity sufficient to accommodate seagoing vessels of 300 tons burden, or barges of 400 tons. Instead of locks, the continental system of hydraulic lifts will be largely used. The estimated cost of the canal is between £2,500,000 and £3,000,000. The route is from Birmingham, through the Black Country, to Wolverhampton; thence, in a line almost due north, to Stoke-on-Trent, through the heart of the Potteries, and then, in a north-westerly direction, to Kidsgrove, Wheelock, and Winsford, where the canal will meet the Weaver at a place called the Top Flashes. The distance from Birmingham to this point is sixty-one miles.

An Improved Packing.—Mr. W. J. Mayger, of Burton-on-Trent, is introducing into this country an improved square packing for piston rods and valve stems. The packing consists of successive layers of cotton duck firmly cemented together by an elastic lubricating compound, and its mode of manufacture is such that the edges of the cotton fabric are brought into contact with the rods. Thus the friction is entirely on the ends of the threads, and, consequently, the wear is very slow. Some of this packing has already been supplied to the London and North-Western and the Midland Railways.

LEICESTER, 30th April, 1890.

Wool Spinning and Yarn Trades.—There is on the whole an improvement in the local wool market. Since last report a very fair amount of business has been done, and prices are firmer and more settled. The local spinners do not buy as freely as those elsewhere, and seem to have less confidence in the present quotations. Skin-wools sell very freely and at full rates. As the consumption is increasing a very fair turnover is being made. Spinners are getting busier, but there is no pressure. Cashmere yarns are slow in demand and under the average.

Hosiery Trade.—There is a gradual though slow improvement in this industry. The influx of orders increases and more workpeople are employed. The improvement is felt in almost all branches, and there are some good orders on offer, but prices are not very settled. Buying as a rule is very steady, and the wholesale houses seem loth to speculate.

Boot and Shoe Trade.—Though there is a slackening in the orders to hand there is sufficient business on the manufacturers' books to keep all hands fully employed. Scarcity of labour is the principal want, and to meet the demands many houses are running overtime. There is no doubt that the present activity in the trade will last till Whitsuntide. Leather merchants are doing a good steady business, but users buy very closely and the market offers no inducement to speculative buying.

Colour Printing.—Mr. Thomas Taylor, engineer and machinist, Leicester, is introducing an appliance called the "Radiant," for printing in several colours from a single forme at one impression. It is intended to be fitted to the inventor's "Favourite" platen printing machine, but it can be fitted equally well to any platen printing machine which has an ink duct as long as the diameter of the distributing disc. No new operations are introduced by its use, and no reduction is required in the working speed.

SWANSEA, 30th April, 1890.

Coal in South Wales.—For some weeks past boring operations have been carried out on the burrows about two miles east of the Prince of Wales Dock, Swansea, and coal has been struck at a depth of 80ft. An extensive area of land has been secured from the Earl of Jersey, and it is confidently anticipated that some twenty-six seams of coal will be eventually tapped, including all the well-known Aberdare measures. In addition to the land area, the workings will be extended out into the Channel. The available quantity of coal is estimated at sixty to seventy million tons.

Tinplates.—The Old Lodge Tinplate Works have commenced operations, and five mills have been re-started at Abercarne. The edict of the Tinplate Workmen's Association, that the first week in May should be observed as a stop week, is not likely to meet with unanimous obedience so long as the stocks continue to be reduced at the rate of 23,000 boxes per week. American advices are reassuring, and the recent reductions in the price of bars are enabling makers to better meet the views of buyers.

Labour Disputes.—The employés of the Taff Vale Railway Company, in seeking to fix the maximum hours of duty to ten per day except for shunters in busy yards, and signalmen at important boxes, whose maximum should be only eight hours, would appear to be studying as much the safety of the public as their own convenience.—The strike at the Cardiff works of the Tharsis Copper Company still continues, and a settlement has not been brought nearer by the introduction of new hands from Bridgwater who have left work.—Some 500 men and boys at Tredegar struck work against a charge of 6d. each weekly for their conveyance between Tredegar and the Pochin collieries, two and a half miles distant.

BARROW-IN-FURNESS, 30th April, 1890.

Hematite Iron.—The depression is more pronounced in the hematite pig iron trade this week, as although arrangements have been made to blow out several furnaces there is no improvement in prices, which are steady at 53s. 6d. per ton for warrants. Stocks of the latter have been further reduced during the week to the extent of 5,578 tons, and from the beginning of the year they have been decreased 38,050 tons. There are 47 furnaces in blast and 32 standing idle.

Steel.—There is next to no trade doing in steel, either in Bessemer or Siemens-Martin. Although large orders are still held the outlook is anything but assuring, and prices show a gradual depression. Heavy rails are at £5 per ton, ship plates at £7 10s., and angles at £6 15s. per ton. Tinplate bars are down to £5 5s. per ton. There is a movement amongst those makers who are not working on the sliding scale to effect a reduction in the wages of steel workers, in order to meet the altered condition of the market.

Shipbuilding.—Orders for shipping are not coming to hand from either home or foreign sources, but it is probable that local builders will be favoured with some large contracts which can be secured when the value of building material has been further reduced. In the meantime builders and engineers are very busy in every department.

Shipments.—During the past week shipments have been on a large scale. The total exports of iron and steel from West Coast ports were 27,201 tons, compared with 20,636 tons in the corresponding week of last year. The shipments this year to date have been 345,741 tons, compared with 354,930 tons in the corresponding period of last year, a decrease of 9,189 tons.

MIDDLESBROUGH, 30th April, 1890.

Pig Iron.—Since last report the tendency has been downward, with sudden fluctuations. Yesterday the market was firmer, however, and is now much the same as it was a week ago. Merchants ask 45s. 6d. to 46s. per ton for makers' No. 3 G.M.B. prompt f.o.b. delivery. Cleveland No. 3 warrants are 45s. cash, buyers offering 44s. 9d. per ton. The makers' price is 50s., but merchants shipping iron prefer to draw upon warrants. Grey forge is to be had at 46d. 6d. West Coast hematite is quoted at 54s. 10d. cash; East Coast hematite is quoted at 65s. to 70s., but with West Coast so cheap there is practically nothing doing in them.

Shipments of Pig Iron.—The shipments are improving as the season advances. Compared with last month they are better, but not so with the same month last year. Up to the 28th inst. the month's shipments are 66,689 tons, as against 53,006 tons to the 28th of last month. The shipments are disappointing when compared with those of last year, which for the month of April up to the 28th amounted to 92,918 tons.

Manufactured Iron and Steel.—Manufactured iron and steel are as dull as they were last week, and prices are drooping. The North Eastern Steel Company have stopped for the first time since they started for want of specifications. Of new orders there are none, and even inquiries have ceased to be made.

Wages.—Notwithstanding the sinister aspect of business, demands are being made for advances in wages. The Anderston Foundry men demand 15 per cent. on the top of a similar advance a short time ago, and the stevedores who are engaged in loading pig iron and unloading iron ore at the wharves demand 12½ per cent. advance. In a falling market neither demand is likely to be conceded.

NEWCASTLE, 30th April, 1890.

The Coal Trade. The demand for gas and steam coals is fairly active, but for household coal there is very little inquiry, and consumers may now count on getting their supplies at somewhat lower rates than they have been paying lately.

The Timber Trade.—There is still a lack of animation in the timber trade, but the season for importations is commencing, and the present state of dulness at the docks and wharves will soon be changed to one of considerable activity. In the meantime, the saw mills are very busy, and likely to continue so for some time.

Marble Works.—Messrs. Emley & Sons' marble work Gateshead, are very fully employed just now, the orders in hand being mostly from local builders whose requirements have, for some time past, been rather heavy.

Shipbuilding.—The evidences of slackening trade in the shipbuilding industry are daily becoming more strongly manifested, and there is now scarcely a building yard on the river which has not one or more empty berths. Sir W. G. Armstrong, Mitchell, & Co. have three berths vacant at their Low Walker yard, and Messrs. Hawthorn, Leslie, & Co. have four. At Messrs. Schlesinger, Davis, & Co.'s establishment, however, matters are much worse, as in that case only one berth out of seven is occupied, and the vessel on the stocks is nearly completed. Messrs. Wigham Richardson & Co. have still a large reserve of work besides the vessels in progress, and their establishment is likely to be kept busy up to the end of the year. The Palmer's Shipbuilding & Iron Company have ten vessels on the stocks at their Howden and Jarrow yards, and they are now busily preparing to lay down two line-of-battle ships at the latter establishment. Messrs. Readhead & Sons, of Tyne Dock, have their berths well filled; but the Edwards Shipbuilding Company have only two vessels on the stocks, four of their berths being vacant. The prices of steel and iron material having fallen to the extent of about 30s. per ton since the opening of the year, builders are now able to offer lower quotations for tonnage; but notwithstanding this incentive to speculation, new orders are scarce, and are likely to continue so until an all-round lessening in the cost of production enables builders to bring their prices more within the range of customers' requirements.

BELFAST, 30th April, 1890.

Shipbuilding and Engineering.—Business in all the yards both in Belfast and Derry is very good. A large number of ships are on the stocks, and although no new orders are reported, there is enough work in hands to ensure constant employment during the summer months. The boiler makers are fairly busy, and several large land boilers are in hand.

The Belfast Drainage Scheme.—The drawings and specifications for the pumping engines for the new Belfast main drainage scheme have been prepared, and are at present before the Council. The main engines will be two in number, and will be exact duplicates of each other. They will be of the compound horizontal condensing type, having cylinders 10in. and 18in. in diameter, by 3ft. stroke. The surface condensers will be so arranged that the sewage in the discharge pipe shall act as the cooling medium. The piston rods will be carried through the back ends of the cylinders, and will actuate the pumps by means of bell crank levers. The pumps themselves will be of the plunger type, the barrels being unbored. The engines will run ordinarily at 24 revolutions per minute, but will be capable of working up to 30 revolutions when required. In addition to the main engines, there will be a centrifugal pump, for use after a heavy rainfall. This pump will be driven by a separate compound condensing engine, coupled direct to the driving shaft of the pump, and will run at 150 revolutions. The estimated cost will be about £14,000, and the annual working expenditure, £800.

The Linen Trade.—Business in the linen trade still continues slack, and an improvement is much to be desired. Sales of yarn have not been large, but prices still remain firm. The stocks of handloom goods are poor; in fact, this industry is almost at a standstill. The supply of home-grown flax is nearly run out, and the foreign markets are not yet opened.

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ENGINES AND BOILERS OF THE S.S. "PRINS WILLEM II."

CONSTRUCTED BY THE KONINKLIJKE FABRIEK VAN STOOM E. A. WERKTUIGEN, AMSTERDAM.

(*For description see page* 409.)

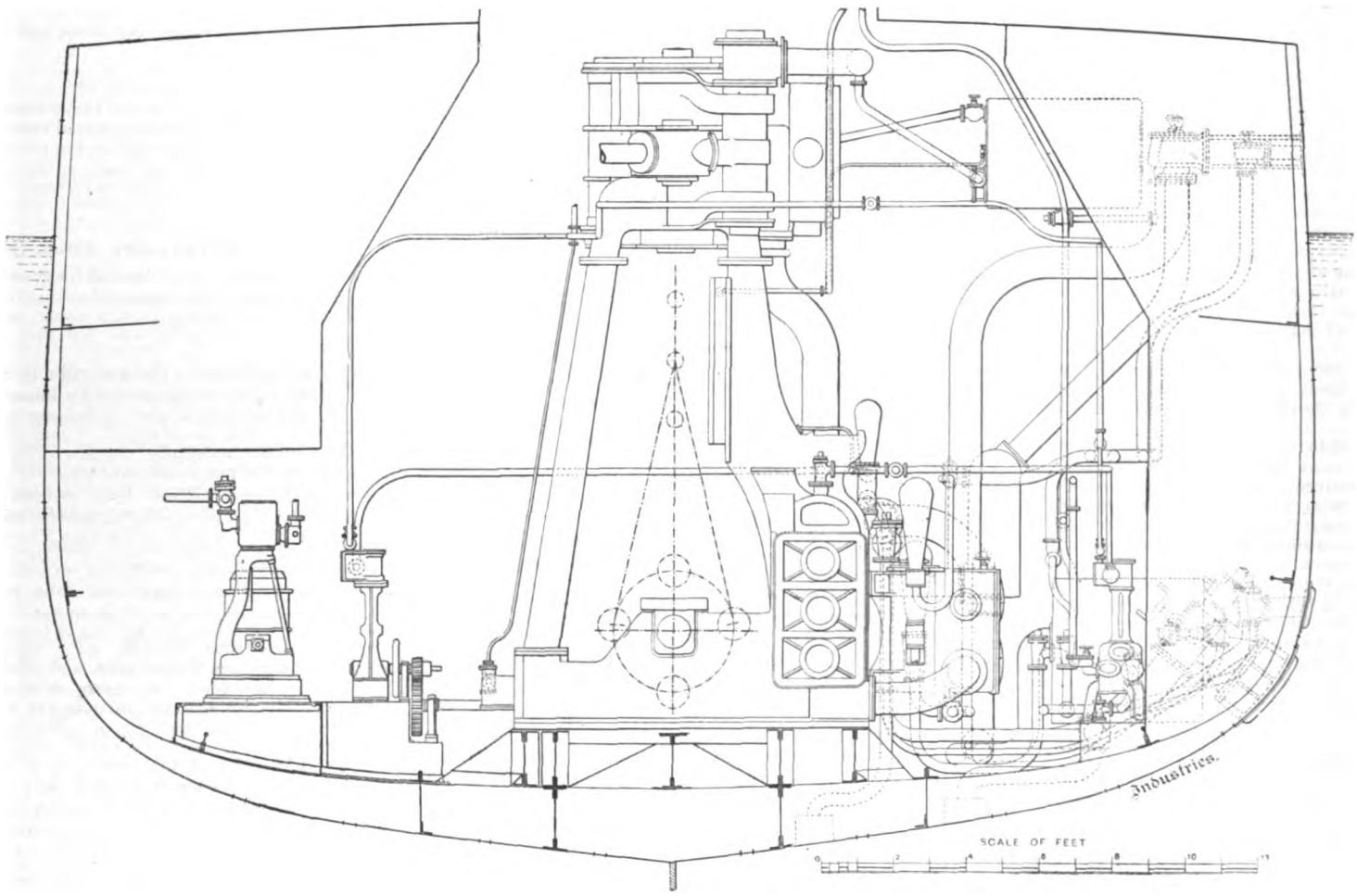


FIG. 3.—TRANSVERSE SECTION THROUGH ENGINE ROOM.

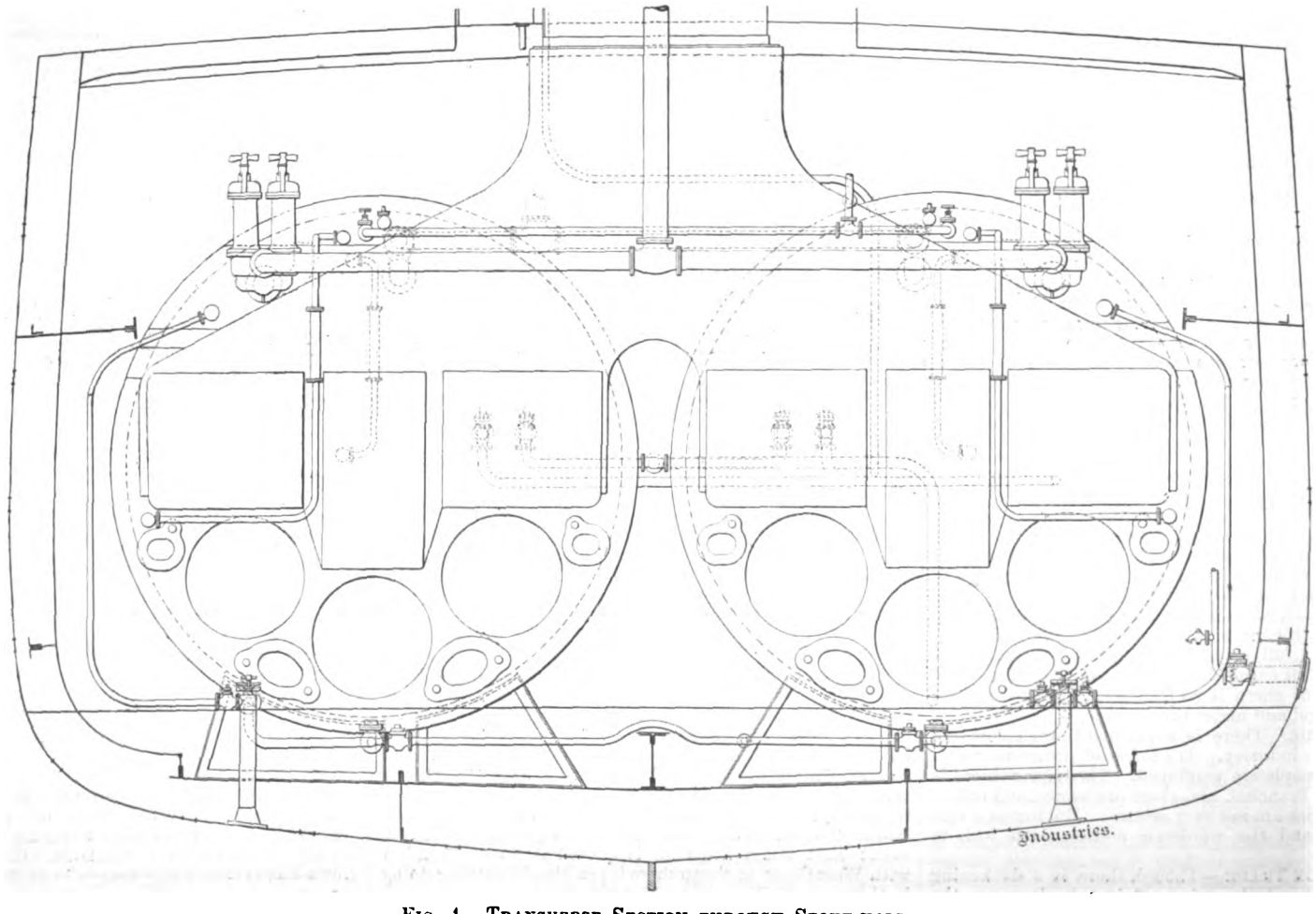


FIG. 4.—TRANSVERSE SECTION THROUGH STOKE-HOLD.

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As we go to press early with certain of our advertisement pages, all Alterations to Standing Advertisements should reach the Publisher not later than 2 o'clock on Wednesday afternoon in each week.

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93, *Hope-street, Glasgow.*

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

Contents.

	PAGE
Improved Ore Crushing Machine (*Illus.*)	409
The S.S. "Prins Willem II." (*Illus.*)	409
Notes on Alloys—IV.	409
Aluminium and its Uses	410
Foreign Industries (Corres.)	414-415
The Late Paris Exhibition	416
The Leeds Exhibition	416
Parkinson's Drilling Machine (*Illus.*)	416
Arnold's Steam Boiler (*Illus.*)	416
A French Submarine Gunboat	416
Shipbuilding Notes	417
Notices of Meetings	417
Prices Current	417
Home Industries (Corres.)	418-419
The Horse-Power of Marine Engines	421
The Proposed Great Tower in London	422
The Report on the Naval and Military Departments	422
Lloyd's Committee on Shipbuilding	423
The Federated Institution of Mining Engineers	423
The Edinburgh Exhibition	423
Letters to the Editor:—	
The Breakdown of the "City of Paris"	423
Compressed Air Tramcars	424
Steatite as a Pigment for Anti-Corrosive Paints	424
An Improved Submarine Grapnel (*Illus.*)	424
Reviews	424
Compound High-Speed Engine (*Illus.*)	425
The German Testing Station at Charlottenburg near Berlin	425
Yeadon & Adgie's Gas Retorts (*Illus.*)	426
The Quality of Roofing Slates	426
Notes	428
"Industries" Patent Record:—	
Applications and Acceptances	429-430
Illustrated Abridgments	430-432

To Correspondents.

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Industries:

FRIDAY, 2ND MAY, 1890.

THE HORSE-POWER OF MARINE ENGINES.

AT the end of the session of 1888, the Council of the North East Coast Institution of Engineers and Shipbuilders issued a Report on what they called the Normal Indicated Horse-power of Marine Engines, and sent it to the various Engineering Institutions for discussion. We gave a *résumé* of the Report shortly after its publication (see *Industries*, Vol. IV., page 642), and at the same time invited the opinion of our readers regarding it, but little or no interest seems to have been raised in the matter. Various incidental expressions of opinions have been given, but it cannot be said to have been fully discussed. In October, 1888, it was taken up by the Institution of Engineers and Shipbuilders in Scotland, but the general results of the discussion could not be considered favourable. Mr. Dyer, who introduced the subject, pointed out that in every department of scientific investigation the tendency has been towards the displacement of all merely nominal or qualitative measurements by exact quantitative measurements; and he was of opinion that until fairly convenient means were devised for measuring the brake horse-power, it would be better to be content with the power as given by the indicator. Dr. Kirk, the President of the Institution, was strongly against the proposal contained in the Report of the Council of the North East Coast Institution. He asked: "For what purpose was it desired to have a formula to ascertain the nominal horse-power of an engine? Was it for a commercial purpose? In all his experience he had never known the machines sold by nominal horse-power. Was it to be a substitute for the present rational method of computation in calculating the power of an engine? He thought that in the coming days of technical education, and even before those days, in the days of more general education, it would be simply deplorable to use a formula which, at the very best, put in an artificial state the practice of the present time. Now that practice was continually changing, and the ordinary rational formula, which covered all the calculations at present in use for discovering the horse-power of marine engines, could cover all those changes. And what more could a formula do? Perhaps it might be said that it would be useful in estimating the cost of engines. Then, he would say, the man who so used such a formula would soon be in the Bankruptcy Court." Dr. Kirk then went on to say that, although in some respects the proposed formula was an improvement over the old ones, "he thought a formula of the kind under discussion was of no use. The only thing which could be said in favour of nominal horse-power being computed was that it was in use for registration, and the Merchant Shipping Act required that every vessel with engines over 100 horse-power was bound to carry at least one first and one second class certificated engineer. They could not expect that the Parliament which passed that measure was composed of experts, and so the measure was passed by men who knew nothing at all about the question of determining the horse-power of an engine, for which no rule was wanted. He thought that nominal horse-power was fast passing into disuse, and was dying a natural death."

After such an authoritative opinion it might have been thought that the question was settled, but the recent paper by Mr. Weighton, read before the North East Coast Institution, has again brought it to the front. It is well known that Mr. Weighton took an active part in framing the rule, and it is a pity that his paper was not read along with it instead of nearly two years afterwards. He says that in many cases the scope and intention of the rule has been totally misunderstood, and he thinks that this was largely due to the fact that the Report appeared in a very condensed form. His paper was read at the request of the Council, in the hope that, by entering at greater length than was possible or desirable within the confines of a report into an exposition of the principles upon which the rule is based, such misapprehensions would be corrected and future ones obviated. Mr. Weighton still believes that, if properly understood, the rule will prove of great value, not only to shipowners, underwriters, and non-technical men generally, but that it may also be found of very considerable value in the practice of marine engineers themselves. We must admit that Mr. Weighton shows great ability in his paper, but we must also confess that we think his ingenuity might have been expended on a more useful purpose. He begins by inquiring if there is any need for a rule to take the place of the now obsolete horse-power? and, if there is a need, what is it intended to represent, and for what is it to be used? To the first of these questions he replies that there is a need—a very great need—to be able to estimate the comparative values of different engines and boilers, and different combinations of engines and boilers; and he points out that marine machinery may be said to have two kinds of value—(1) value to the owner, and (2) cost to the builder—and that these two values are not synonymous, and do not necessarily run parallel with each other for all sizes of even one type of machinery. He explains that it is the first kind of value with which the paper is chiefly concerned, although the relation of the second to the first is touched upon briefly. He then goes on to show that what is required is a rule which expresses, in convenient mechanical units or terms, the value to the shipowner, and states that from this point of view the rule must *not* represent the actual i.h.p. which will be, or is expected to be, developed in every case. It *may* give the same result as the actual i.h.p. in many cases, but it is not necessary that it should do so; in fact, it would not serve the purpose intended if it did do so in all cases; and Mr. Weighton complains that it is chiefly in this respect that the rule has been misunderstood. He says that it has been assumed by many that the intention was to produce a formula which would give the actually developed horse-power in all cases, and because it failed to do so when applied to particular cases, it has by some been condemned as worthless, and he is very much pained to find it said that the ordinary means of arriving at the powers of engines by the indicator was on the whole more correct and preferable in every way. To remove, what he considers, such deplorable misunderstandings as to the aim and meaning of the rule under discussion, he deals with this particular phase of the matter at some length. This, however, was surely unnecessary, at least to anyone possessing any knowledge of the subject, for nobody would have imagined that the i.h.p., or even the brake horse-power, was in itself a sufficient measure of the efficiency of one engine as compared with another, at least from the shipowner's point of view. As

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Mr. Weighton points out, "to compare the values of two engines by comparing their actual i.h.p. is—in the absence of identical working conditions—like comparing the values of the numerators of two fractions without first reducing them to a common denominator. Any given size of engines can be made to indicate vastly increased power by simply running them at a greater number of revolutions, or by increasing the period of admission of steam in the high-pressure cylinder, or by both of these means combined; any given size of boiler may be worked very much beyond its normal power by forcing the fires. But this increase of power is obtained at the cost of increased wear and tear and increased fuel consumption, unless, indeed, it be possible to introduce some compensatory arrangements or devices in the higher power engines and boilers." He adds that, "apart from the question of the possibility of introducing such arrangements, it is distinctly to be borne in mind that no elements beyond size of engines and boilers, and working pressures, can possibly be included as factors in any general rule," and he illustrates his remarks by some arithmetical examples.

We must confess, however, that, notwithstanding all his ingenuity, Mr. Weighton has in our opinion failed to make out his case. We fully admit that the proposed rule is a great improvement on any of the old ones, because its data are more in accordance with modern practice, and also because it takes the boiler into account; but, notwithstanding all this, we think that, in the absence of the brake power, the indicated power is the most useful and most correct measure, alike to owners and builders. An expression which contained all the variables affecting the efficiency of a steamship, or even a marine engine, from the owner's point of view would be a very complicated affair, and when Mr. Weighton puts forward one, as he does, he only tends to give a wrong opinion, and lead to satisfaction with results which are capable of great improvement. The efficiency of the engines includes that of the boilers, the steam, and the mechanism, but each of these again have many factors depending on design, materials, arrangement, workmanship, pressure, speed, and many other things, and, among others, the skill and attention of the engineers and the stokers, and the efficiency from the owner's point of view extends over the whole life of the ship or engines. It is almost as absurd to measure this efficiency from a number of indicator cards extending over a year or more, as it is to do so from a single one. But these immeasurable factors are, in reality, the "personal equations" of the builders, and on them depend to a large extent their commercial success, for no shipowners would return to them with orders when they found that their work, while giving a high efficiency on the trial trips, very soon cost a great deal for repairs or renewals. It seems to us, therefore, that the common sense of the matter is simply this. The i.h.p. is the nearest approach to the actual power which we can conveniently obtain, and when a ship is wanted the naval architect should say to the engineer what number of i.h.p. he requires. The owner should further stipulate that the conditions under which the engines are to work are normal, that the materials and workmanship are good, and the design simple, and allowing of repairs. For the rest he must trust to the skill of the engineer and those who are advising him, and this cannot be measured by any factor in an equation, for it requires to be supplemented by careful working and skilful management to produce real economy. We think this matter should be settled once for all, and as some of our readers may differ from our conclusions we shall be glad to publish their opinions.

THE PROPOSED GREAT TOWER IN LONDON.

The promoters of the Great Tower for London announced some time ago that they would offer prizes of 500 guineas and 250 guineas for the best and the second best design and estimate for a tower of not less than 1,200ft. in height. The specification indicated a preference for steel, but left the question of material an open one. Should steel be employed, it was stipulated that the structure should be designed to withstand a maximum wind pressure of 56lb. per square foot, the stress on the steel being stated at a maximum of 7½ tons per square inch. The ultimate stability of the whole should be assured under an assumed pressure of double the above amount. The questions of the number of storeys and the type of lifts were left open. The following are the jurors:—Sir Frederick Bramwell, Sir Benjamin Baker, Sir Edward Harland, M.P., Professor Alex. B. W. Kennedy, Mr. Charles Liddell, Mr. J. F. Moulton, M.A., Q.C., Mr. Thomas Verity, F.R.I.B.A., and Mr. E. H. Carbutt, chairman. The promoters requested that the plans should be accompanied by a general elevation $\frac{1}{240}$th of the actual size of the proposed erection. Eighty-six designs in all have been sent in for competition. Of these, however, only sixty-eight fall within the scope of the specification. All of the designs, are now on exhibition to the public free of charge in the Hall of the Drapers' Company, Throgmorton Street, London, E.C. It would be premature to pronounce any opinion upon the merits of the designs, as the jurors have not yet delivered their award. The designs exhibit considerable range of style. The Eiffel Tower design, more or less modified, appears in several of them. Some are apparently suggested by the conventional pictures of the Tower of Babel, others are ecclesiastical towers whose proportions have simply been expanded, others are magnified screws, while some are glass furnaces of monstrous size. The lure of £500 has brought into the net not a few curiosities. There is the Chinese lantern design, the design on half a sheet of note paper, the factory chimney design, the gigantic mast design, the candelabrum design. More than one of the designers aim at a tower of 2,000ft. in height. One of these proposes that the base of his tower shall occupy sixty-four acres, or about twenty times the area of the Albert Hall. The competitive drawings have come from many quarters. Though the names of all of the competitors are not given, Jamaica, Canada, Constantinople, Hamburg, New York, Philadelphia, Paris, and Naples are represented. It is expected that the award of the jury will be made in a few days.

THE REPORT ON THE NAVAL AND MILITARY DEPARTMENTS.

The Report of the Royal Commissioners on the Civil and Professional Administration of the Naval and Military Departments, and the relation of those Departments to each other and to the Treasury, which has been so long expected, was recently issued, and although it contains many important proposals, and exposes many absurdities in the present methods of doing business, it does not seem to have attracted much attention, either on the part of the public or of the members of the Services concerned. We can easily understand why this should be, for the public, as a rule, only takes an interest in such matters when there is either a great panic or a grave scandal. As to the members of the Services, the *Times* recently remarked that "if the long-suffering taxpayers of this country are going to wait until a report of this kind is actively taken up by the persons whose failures it exposes, they will wait a very long time. The wasteful muddle of administration with which the country is burdened suits the existing administrators perfectly, otherwise it would not exist. They only want things to be left as they are, and they are wise enough in their generation to know that the less they discuss the Report, the better their chance of getting it quietly shelved. It is for the House of Commons and the country to see that the Report shall not be shelved." We think so too, and, therefore, we propose to give some of its most important points. We may say that the Report and its appendices are well worthy of careful study by all interested in the Navy and the Army, as they explain fully the present system of administration, without an understanding of which it is impossible fully to follow the recommendations of the Commissioners. They found, on entering on the inquiry entrusted to them, that a great mass of information bearing upon it had already been collected by Commissioners and Committees which had previously investigated the administration of the Navy and Army. Summaries of much of this is given, together with statements descriptive of the systems of administration prevailing in some foreign countries, which were drawn up by the Naval and Military Intelligence Departments. Not content with this, however, the Commissioners formulated certain questions to past and present Ministers and professional officers, who from experience were best able to form a just judgment on the various points submitted to them. The questions thus issued grouped themselves under two principal heads:—(*a*) Measures required to ensure closer administrative harmony between the naval and the military services; (*b*) matters of internal departmental administration, and the responsibility of departmental chiefs and their immediate subordinates.

The replies to these questions showed that a great divergence of opinion exists on some points, and serve to illustrate the difficulties of the task with which the Commissioners were called to deal. They state that much of the evidence on which their report is founded was given on the understanding that it would not be made public, and they consider that the publication of much of it would be most inexpedient. This may be so, but it places the public at a great disadvantage in judging of the evidence. The subject matter of the Report has been arranged under the following heads: (A) The measures required to ensure full and sufficient administrative harmony between the two Departments; (B) the internal administration of the Admiralty; (C) the internal administration of the War Office; (D) the relation of the Treasury to both Departments of State, and matters of financial control generally. We propose to make a few remarks, in the meantime, on the first two of those divisions. On the first of these it must be admitted that the arrangements have hitherto neither been reasonable nor business-like. The two Departments of the Army and Navy have, or ought to have, one duty and one combined work—viz., primarily the defence of the United Kingdom, its Colonies and dependencies, and the protection of its commerce, supplies of food, and other necessaries; and secondly, the organisation of the naval and military strength of the Empire with the view to the conduct of any hostile operations against foreign Powers in which the policy of the country may cause it to be engaged. What struck the Committee, and what must strike anyone who looks at the matter, is that, while in action, and even in the preparation for war, the two great fighting Departments must be largely dependent on each other, little or no attempt has ever been made to establish settled and regular inter-communication or relations between them, or to secure that the establishments of one Service should be determined with any reference to the requirements of the other, and that no combined plan of operations for the defence of the Empire in any given contingency has ever been worked out or decided upon by the two Departments. The naval authorities contend that it is essential to the efficiency of the fleet, and the success of naval operations, that absolute freedom of action shall be left to the naval commanders in time of war, and that this freedom of action would be impaired by any regulations or understanding involving the retention of certain ships at certain stations in order to aid in their military defence. On the other hand, the military authorities consider that it is essential to the completeness and efficiency of their preparations that they should be informed what amount of assistance they can definitely reckon upon from the Navy. The Committee mention several suggestions which have been made for bringing the Admiralty and the War Office into closer relation to each other. The first was that a Minister of Defence should be created, who would be the supreme and responsible head of both services, the immediate control of each service being entrusted to a professional officer. Another suggestion was that each Department should be entrusted to the supreme and responsible control of a professional head, the necessary link between the two services being provided by the appointment of a civilian Minister of high rank, whose principal duty would be to settle with the heads of each service the amount of annual expenditure required, to audit their accounts, and to form a channel of communication between them on all subjects of mutual importance. To both of those proposals the Committtee saw very grave objections, and they think that means might be devised for bringing about more regular and constant communications between the Admiralty and the War Office, and could be arranged by certain departmental changes, which might provide for very constant communication and consultation between two highly responsible naval and military officers on all questions where common action and preparation on the part of the two Departments are required. The Committee also suggest that there might be some advantage in the formation of a Naval and Military Council, which should probably be presided over by the Prime Minister, and consist of the Parliamentary heads of the two Services and their principal professional advisers, and they note that it would be essential to the usefulness of such a council and to the interests of the country that the proceedings and decisions should be duly recorded, as instances have occurred in which Cabinet decisions have been differently understood by the two Departments, and have become practically a dead letter.

The Committee do not propose any very sweeping internal changes. They recommend that the duties of the different members of the Board of Admiralty be more exactly defined and responsibility brought more directly home to them; and, in order that this may be done, they suggest that it would be an advantage if each

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member of the Board were required to prepare annual reports of the condition and working of the branches of the Service placed unper his immediate control. These reports would form a useful foundation for the Memorandum which is now presented to Parliament with the annual Estimates by the First Lord, to the continuance of which in a complete form, as a record of past proceedings, the Committee attach considerable importance. They recommend that the First Naval Lord should be relieved from all duties except those for which he is specially qualified—such as, for instance, advising on the distribution of the fleet in time of peace or war; the relative strength of our own and foreign navies; the duties required of the Navy in the protection of our commerce and possessions; the number, class, and type of ships of war to be maintained or provided; the regulation with the War Department of all questions in which joint action or a definite understanding is required; and many other questions more than sufficient to occupy all his time. Further, in order to preserve the continuity which must at present be mainly maintained by the Civil officers of the Admiralty, the Committee are of opinion that the Naval Lords should be appointed for a definite period, subject to the right of the First Lord to select new Naval Lords when he considers a change desirable. The Committee state that Her Majesty's Navy is administered by civilians to a far greater extent than is the case with the navies of other Powers, and they recommend that the professional staff of the Admiralty be strengthened, and that naval officers be appointed to do some of the work now done by civilians. They think also that it would be an advantage if a naval officer were appointed as Permanent Secretary, provided that an officer can be found possessing the special qualifications for the post. The Committee's recommendations as to the administration of the Admiralty are summed up as follow:—1. Full recognition of the complete and individual responsibility to Parliament and the country of the Cabinet Minister at the head of the Department. 2. Constitution of the office of the First Naval Lord as that of Chief Adviser of the First Lord in all great questions of naval policy. 3. Clear definition of the administrative duties of each of the remaining Lords, and direct responsibility of each of them to the First Lord for his own duties. 4. The Board to be regarded as a Standing Council for Naval Affairs, but the existence of such council in no way to diminish the responsibility of the First Lord. There are several dissentients to some of the findings of the Committee.

LLOYD'S COMMITTEE ON SHIPBUILDING.

In a recent issue we referred to the advantage to be derived by Lloyd's Register from the proposed addition of technical members on the Committee. Our contention was that shipbuilding interests have not always been in accord with the laws emanating from that Society, and the system under which work was carried on, if a vessel were classed, as the majority are, in the Register. We expressed the opinion that the Committee would be considerably the gainers by giving outside scientific members some direction instead of relying wholly on the permanent staff, and that with such innovation it might be expected that many anomalies that had existed would be removed in the future arrangements of this body. Our remarks went even farther than this, and tended to show that virtually the paid servants of the Society were independent of any control whatever. They possessed the key of the whole situation by their professional knowledge, and were able to assume in consequence a sway that was not desirable.

Outside pressure was brought to bear, and the Committee eventually found it would be to the improvement of their own deliberations, as well as better for their officers, if extra-technical aid were introduced. They decided to reform themselves, in fact, and it is greatly to the credit of this old-established body that, the decision having once been taken, some vigour has been shown in carrying it into effect. Having advanced some distance on the road, however, it will come somewhat as a surprise that, in the forward movement set up at White Lion Court, serious revelations should have been brought to light respecting the engineering department. The charge is against Mr. Parker, and is that he has been pecuniarily influenced in his reports upon the fittings of ships. The result of the investigations of a sectional committee has been unfavourable to him, and suspension has followed. If there have been "considerations" paid by those who have benefited, it means that inferior articles have thus obtained undue notoriety, to the detriment of the mercantile marine generally. That shipping stands pre-eminent in England above that of any other country goes to prove in a great measure that no general action of this kind has been allowed to exist; but that there is a blemish at all connected with any of the Society's transactions is a serious matter, and shows that the resolution to admit professional men on the Committee was a very necessary one, and was adopted none too soon.

It is almost needless to say that the office which governs the constructive departments of all our shipbuilding yards wields an immense power. If, therefore, any section of it is not above suspicion, every report sent out partakes more or less of the same character. That the unhealthy spot has been discovered is satisfac- in so far as the public are partly assured that it is the only one. We may therefore presume that, under the new *régime* that has set in, greater strides than ever will be made. As we mentioned in our former remarks on the subject, success will be best attained by the Society confining itself to its own legitimate sphere of usefulness. It was established for certain purposes, and, with the vast proportions of the present shipping trade, it might reasonably be supposed that its surveyors always had their hands full in attending to the registration and classifying of ships.

THE FEDERATED INSTITUTION OF MINING ENGINEERS.

The second meeting of the Federated Institution of Mining Engineers was held in London, at the Institution of Civil Engineers, on Wednesday, the 30th ult. A paper on "Coal in Kent" was read by Mr. W. Topley, F.R.S., of H.M. Geological Survey. In this he briefly sketched the history of the question, showing that coal had frequently been found in the Wealden districts of Kent, Surrey, and Sussex. This coal was, however, a brown coal or lignite of the Wealden age, quite different from the carboniferous coal measures. He then passed in review the geological investigations as to the supposed underground range of the palæozoic rocks, with which coal measures are associated, from the North of France to the West of England, and described the various deep borings that have been made during the last thirty-five years in the South-east of England. All but two were in search of water. The two borings made especially for underground exploration were the Sub-Wealden boring (1874–77), and the search for coal at Dover, recently successfully completed. These bore holes have afforded valuable information as to the range and depth of the palæozoic rocks, proving that these rocks lie nearer to the surface than was expected, and that the overlying secondary rocks are thinner. The older rocks (Silurian) of the palæozoic series occur to the north of London at Ware, Devonian rocks further south; whilst red rocks of uncertain age have been found at Kentish Town, Crossness, Richmond, and Streatham. It was inferred that the coal measures would occur to the south of London, probably near the North Downs or under the northern part of the Wealden area. A comparison of the coalfields of the West of England with those of the North of France and Belgium indicates that in the south-east of England the coal would be found in detached basins, each separated from its neighbour on the east and west by older rocks. The coal, too, would be much disturbed and faulted, as is the case in the Bristol coalfield and in the North of France. In the latter district the development of the coalfields has been extraordinarily rapid, a result that is partly due to the fact that the French mining laws are very favourable to mining enterprise and to mineral researches. Now that public opinion is plainly directed to the subject, systematic exploration will doubtless be made in the south-east of England, and a great source of wealth for the district opened up. In conclusion, the author noted certain localities where explorations might well be carried out in the first instance—places where geologically low beds are brought to the surface being especially suitable. At Chatham Dockyard a boring is already 965ft. deep, and this could be carried much deeper at a comparatively small cost.

The discussion that followed the reading of Mr. Topley's paper was well sustained. A letter from Mr. G. C. Greenwell was read by the secretary, Professor Lebour, in which the probable state of things in the south-east of England was deduced from a comparison of the Somersetshire and North of France coalfields. Professor Hughes, of Cambridge, in his usual eloquent style, gave an exposition of the theory of faults. Mr. Bauerman, the Examiner in Mining to the Science and Art Department, contributed valuable details of the structure of the French coalfields, derived from information he had collected at the Paris Exhibition. Mr. Emerson Bainbridge thought that the results of the Chatham, the Sub-Wealden, and the Dover bore-holes indicated that further exploration would show that it was improbable that coal existed to any great extent. Mr. W. Whitaker, F.R.S., who had recently contributed a paper on the same subject to the Society of Arts, spoke at considerable length, and expressed very sanguine views. He urged the importance of continuing the Chatham bore-hole, and was of opinion that if coal is found in the south-east of England it will be at distinctly workable depths—say, 800ft. to 1,300ft. Water, if met with, would be a possible source of profit, and is not likely to occur in sufficient quantity to seriously interfere with the working.

At the conclusion of the meeting Mr. A. Smith, M.Inst.C.E., exhibited and described a patent adjustable automatic fire alarm and heat indicator brought out by a Birmingham company. The appliance is somewhat similar in construction to an aneroid barometer, and consists of sensitive diaphragms for electrically giving an alarm when the temperature of a building in which it is placed rises to that indicated by the adjustable index finger, which has a range of from 32° Fahr. to 200° Fahr. if required. It was thought that this instrument might be of considerable value to mining engineers, as affording an indication of increased heat due to imperfect ventilation. It might also be placed in the centre of coal heaps, so as to indicate overheating due to spontaneous combustion.

THE EDINBURGH EXHIBITION.

The Exhibition which was opened yesterday by T.R.H. the Duke and Duchess of Edinburgh is *the* Exhibition of the year. The indifference with which it was regarded when it was first proposed soon passed away, owing to the energy of the Executive and of Mr. Lee Bapty, and the result has been that a large number of important firms have taken an enthusiastic interest in the Exhibition, and made it a most successful show of electrical and other machinery.

On Wednesday evening the members of the press were entertained by the Executive to dinner, and were allowed a private view of the Exhibition. The exhibits individually will afford material for further detailed description; but it may be said that they represent as a whole the high-water mark of applied electrical science. It might go without saying that the halls and grounds are brilliantly lighted, arcs, sunbeams, and small incandescent lamps being used in profusion. The opening on Thursday was attended by the ceremonials usual on such occasions. After the formal proceedings were over the Royal party made a tour of the buildings and a general examination. In our issue of the 25th ult. we gave a general view of the Exhibition, and shall follow this up by detailed descriptions and illustrations of the most interesting of the exhibits.

Letters to the Editor.

THE BREAKDOWN OF THE "CITY OF PARIS."

To the Editor of "Industries."

Sir,—The particulars of the breakdown of the "City of Paris" naturally make engineers ask if the modern triumphs of shipyard construction are quite what they are supposed to be. Certain it is that but for the strength and subdivision of the hull, which saved the vessel in the emergency, the ship must certainly have foundered.

There can be no longer any doubt that the breaking of the propeller shaft was what happened first. In the anxiety to have the propeller as far aft as possible, to get solid water in which to turn, and at the same time to present as few obstacles as possible along the ship's run, it seems there was no support given to the shaft from the stern tube down to the boss held up by the usual brackets just forward of the propeller itself. This was for a length of between 50ft. and 60ft. At one end the shaft was 20in. diameter, and at the other 15in.; there would, therefore, probably be about 20 tons weight to carry outside the ship. This would be borne by the boss alluded to. The liners of this boss have worn down about 8in., proving what happened. Either, then, the original design of this detail must have been faulty in some particular, or, what is more probable, the bearing surface was not large enough for such a weight. However this may be, the shaft in dropping this depth broke off next to where it was held up forward, that is, outside the stern tube. Such a result was certain to follow from the first defect, as it is clear there would be a bending moment tending to fracture of over 500 foot-tons. That such an accident is novel may be accounted for in two ways. First, there are very few twin screw vessels built at all, and fewer still of this size and power. Conditions that apply to small types are of no avail when the dimensions become increased. Is it not just possible then that this is where the mistake has crept in? Instead of taking a big problem, like this undoubtedly is, as a new one, deductions were made from previous examples with the subsequent evil consequences. It is safe only to draw conclusions from what has gone before, when there is ample material to hand on which to work. There can be no doubt that a temporary blow has been struck against twin screws on ships, and the opponents of the system will be professionally jubilant for a time. It may be taken for granted, however, that boats under a certain tonnage are safe when built in this way. It is when the powers and weights are excessive, as in the large liners, that a new set of circumstances come into play

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BENEST'S SUBMARINE GRAPNELS.

Fig. 1.

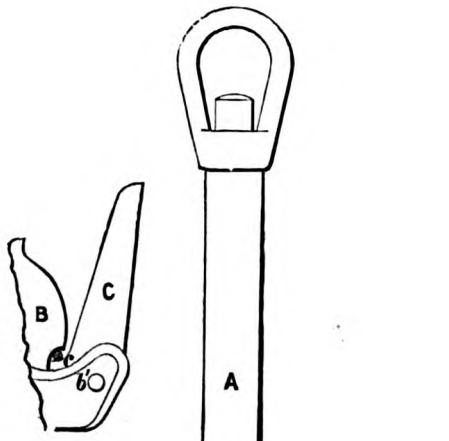


Fig. 2.

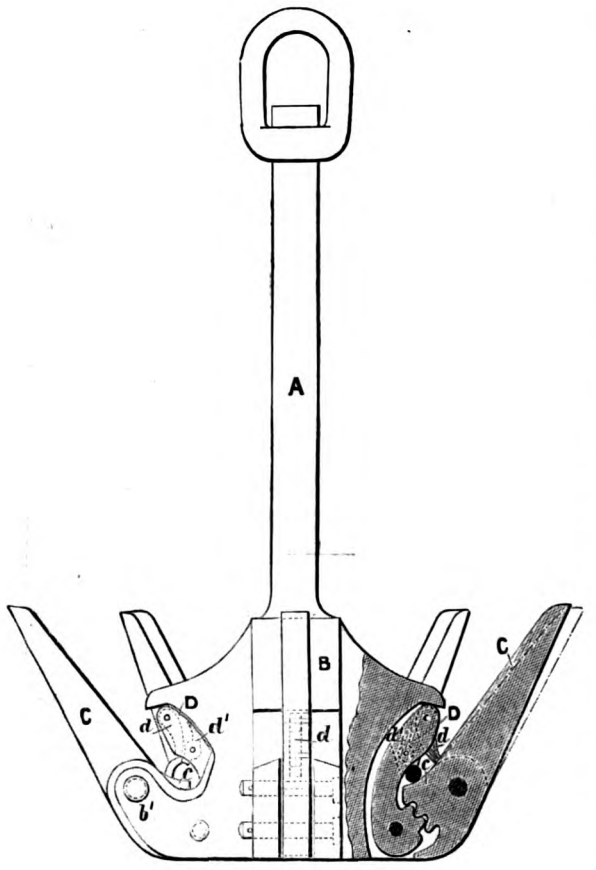


Fig. 3.

altogether, and it is not rash to predict that the design of the after parts in the shafts of these double-screw leviathans will be somewhat modified in future. Detailed suggestions would be out of place without drawings, but they will occur to every engineer.

When attention is paid to the engine-room, where the effects of the racing of the shaft, small though it may have been, were felt immediately, the peculiar feature is that only the low-pressure engine gave way. The high and intermediate engines remain intact. As all three engines drive the one shaft, the racing should affect them alike. The obvious difference is in the diameters of the cylinders, which are 45in., 74in., and 113in.—that is, 9½ft. for the largest. Now any sudden strain on the low-pressure piston requires to be specially provided for. As in the boiler one safety valve is not depended upon, so in a structure of these dimensions, even if a good governor be fitted to the engines, it is unwise to look to a small relief valve for full security. It is not known what the size of the valve in the present instance may be, but clearly it was inadequate for what was required of it. Probably it will be found that as the engine increased in area, if the valve did likewise, it was in an arithmetical rather than a geometrical ratio—in short, allowance was not made for any catastrophe such as the one that has occurred. It is a costly experiment to demonstrate that when we get to these very large engines dangerous ground is being trod upon, and that what are minor matters in a small engine become magnified to considerable importance under other conditions; but if a purpose has been served in this way, perhaps consolation may be derived from the fact that the engineers who were in charge of the machinery have withstood the ordeal and escaped with their lives.

Yours, &c.,

Marine Engineer.

London, 28th April, 1890.

COMPRESSED AIR TRAMCARS.

To the Editor of "Industries."

Sir,—We should have thought our letter in your issue of the 11th inst. was sufficiently plain to require no further explanation from us. The statement of your correspondent, "Car," was that our system required "a new roadway," which we denied. By "a new roadway" for a tram system we should imagine that anyone would understand the taking up and relaying of the rails in some different manner. Thus, the cable system requires a new roadway; so also do the electrical systems with underground cables, and the storage system also, in cases where the gauge is different.

On our system the existing roadway is in no way altered or interfered with, beyond the few feet occupied by the valve boxes at intervals of from a quarter of a mile to a mile or so apart, according to the gradients. We cannot understand how anyone could consider the laying of an air pipe, which seldom exceeds 4in. diameter, under the foothpath as "a new roadway." Even the laying of a gas or water main does not involve "a new roadway."

We have laid some hundreds of miles of air mains in the streets of towns in connection with the Shone drainage system, and we know "the distinction between pulling up the centre of a street and pulling up the sides" or footpaths, which your correspondent would soon find out if he had the work to do, especially if he had paved streets to deal with.

The Electric Traction Company's contract to run cars at 4½d. per mile has been persistently dinned into the ears of the public in a manner which would lead them to believe that that is the actual cost. The papers have lately been teeming with paragraphs about the great success of the electrical traction system, with the view of "educating" the public up to the point of subscribing largely for shares in electric traction companies. Those who are behind the scenes in regard to electric traction in America are aware that it cannot hold out much longer in that country; hence the strenuous efforts that are now being made to get up a "boom" in this country before the anticipated *exposé* in America, and to smother and hush up as much as possible the utter collapse of the electrical system in Brussels.

We have only to add that the conditions of working vary so greatly on different lines that it is altogether misleading to take the average cost of working several lines on our system, including one colonial line, and compare that with the charge on a London line which is merely contracted for by the Electric Traction Company.

The question is, Would it pay the Tramway Company in London to work its own electric traction any better than it did the Brussels Tramway Company, who worked their line long enough to learn something about the cost of maintenance and renewal of plant which the short trial on the Barking line was not sufficient to test?

Yours, &c.,

Hughes & Lancaster.

City Road, Chester, 24th April, 1890.

STEATITE AS A PIGMENT FOR ANTI-CORROSIVE PAINTS.

To the Editor of "Industries."

Sir,—In your issue of the 11th inst., which absence from England has prevented my seeing sooner, you reported some remarks made by me on the paper read by Mr. F. Goodall at the recent meeting of the Institution of Naval Architects on "Steatite as a Pigment for Anti-Corrosive Paint." The short notice in question, however, does not quite convey the real object of my remarks, and I should, therefore, feel extremely obliged if you would kindly grant me space to explain more clearly what I stated.

With regard to steatite itself, I merely pointed out that the Maritime and General Improvement Company, of which I am the chairman, has been employing it successfully in ships' coatings for about twelve years; but that it was found only to combine well with naphtha and not with oil. My reference to gas factories was in no way in relation to the above subject; I only incidentally called the attention of the members of the Institution to the extremely interesting sight then to be seen at the Mansion House Station, where the iron girders were being coated with a kind of cheap black varnish obtained from the gas factories and mixed with naphtha, the original coating of oxide paint mixed with boiled oil having proved an utter failure, as far as the preservation of the girders was concerned. Quoting from one of the addresses of Mr. J. Head, delivered as President of the Institution of Mechanical Engineers, I maintained that corrosion resulted solely from the oxygen contained in the oil—an opinion which is every day more and more confirmed by experience. The stations at the Temple, Charing Cross, &c., which were coated a long time back with the black varnish above referred to, present a striking contrast to those where oil paint is employed.

Yours, &c.,

Charles Fairholme.

18, St. Dunstan's Hill, London, E.C.,
30th April, 1890.

AN IMPROVED SUBMARINE GRAPNEL.

The disadvantage of an ordinary submarine grapnel is that it does not grip the cable or other body to be raised. The consequence is that the cable can easily slip off the flukes, especially if it is a loose end that is being raised. In order to remedy this defect, and to make the grapnel more sure in its operations, Mr. Henry Benest, of the India Rubber, Gutta Percha, and Telegraph Works, Silvertown, London, has devised the apparatus which we illustrate above. The essential feature of the invention is the conversion of the flukes into automatic gripping jaws.

In Fig. 2 we show a grapnel, in which one of the jaws is fixed and the other movable, Fig. 1 being a view of one of the flukes in the gripping position. The stem A of the grapnel carries at its lower end a boss B. The ribs *b* of the boss form inclined shoulders, which constitute the fixed gripping jaws. Below these ribs the boss extends laterally and forms five forks, which serve as supporting arms for the pivoted flukes C. These flukes form the pivoted gripping jaws; they take the shape of a bell-crank lever, their rear ends extending inwards beyond the centre of motion of the fluke, and, when depressed, causing the upper part of the fluke to advance towards the fixed gripping surfaces. The upper surface *c* of the tail end of the fluke is intended to receive the cable. As the cable slides over the flukes it will press upon the surface *c* of the tail end of the fluke, and by so pressing it will tip the fluke into the position of Fig. 1; by this means the cable will be automatically gripped between the fluke C and the boss B of the grapnel. On hauling in the grapnel the bite on the cable will be not only maintained but increased, and thus the tendency of the cable to slip, even though a loose end only is caught, will be removed.

In some cases, however, where the hauling in is irregular, the grapnel may drop suddenly and lose hold of the cable. To avoid this Mr. Benest has devised the form shown in Fig. 3. In this arrangement, instead of the fixed gripping surfaces forming part of the boss, there is a second movable jaw D, which, like the fluke C, is pivoted within the supporting arms b^1 extending horizontally from the boss B. The jaws D are connected with their flukes C by interlocking teeth, which ensure the simultaneous approach of the jaws C and D. Each jaw D is slotted longitudinally to receive a locking pawl *d* and a tumbler d^1. These pieces *d d* are pivotally connected to the jaw D, and the end of the pawl, when in its locking position, enters a nick in the gripping face of the fluke C. The tumbler is so formed that, when not in action, its lower end will project somewhat from the gripping face of the jaw D, as shown on the left hand side of Fig. 3. This is for the purpose of enabling the cable, as it slides in between the gripping surfaces, to tip the tumbler D^1, and thus bring the locking pawl *d* into position, as shown at the right hand side of Fig. 3. In order that the cable, whilst being hooked, may not be caught by and lodge upon the top of the jaw piece D, the boss is formed with a web which projects so as to cover the jaw piece. It will be seen that the cable when caught by the grapnel, and brought within the grip of the jaws C D, will be entirely prevented from escaping.

Reviews.

Electric Transmission of Energy. By Gisbert Kapp. Second Edition. London: Whittaker & Co. 1890.

Whatever Mr. Kapp writes cannot fail to be of value to the electrical industry, and considering the strides which have been made since the date of the first edition, he is to be congratulated that in revising this work for the present issue he has not found it necessary to eliminate as antiquated, from the descriptive portions, more than the account of the experiments of Marcel Deprez and one or two dynamos. On the other hand, it is to be regretted that more care has not been expended on the theoretical portions, which cannot be expected, in a book of this size, to form a complete introduction to the subject. Several pages might have been spared from those

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devoted to absolute measurements and to the theory of magnetism, in exchange for a few paragraphs on those quantities which are commonly designated by the symbols **B H I** and μ. On page 61 we find the somewhat loose statement, "Roughly speaking, we may take it that air offers to the lines of force about 800 times the resistance of iron," and this is not qualified by any remarks about the varying permeability, until after reading some forty pages, when it is only alluded to in the course of the discussion of magnetic resistance. There are a few mistakes of more practical importance, such as the statement that a compound dynamo will run at constant speed as a motor on a constant potential circuit if the series coils demagnetise. It would really run much too fast, unless Professor Ayrton is right in saying that the armature current strengthens the field in a motor.

The method of constant current regulation given on page 170 is particularly ingenious. Mr. Kapp still adheres to inch lines, and perhaps he is wise in doing so. He also goes with the times in using the idea of magnetic resistance. His magnetic resistance of 1,440 for air and copper must be wrong; it should be 1,880, or a trifle over, as copper is diamagnetic. If it were so magnetisable as that, a piece would stick strongly to a field pole. Some six pages of rather involved calculations are devoted to the discussion of the effect of a leak due to imperfect insulation on the efficiency of a dynamo and a motor, and it is suggested that the assumption generally made in text-books, that the insulation of the line is perfect, is to be discouraged. But a few pages later an example is worked out in which leaks are neglected. Bearing in mind that in such a case as the one cited, viz., two miles of copper wire, presumably on poles, 6·2 ohms, 14·5 amperes, 900 volts, the Board of Trade will not allow a leakage of more than one twenty-fifth of an ampere, 36 watts would be lost out of 22,500. A loss of 2,500 watts is put down to mechanical and magnetic friction of the dynamo.

Although we have dwelt somewhat fully on these faults, they detract but little from the value of this eminently useful and practical book, which can be recommended to all engineers who have to do with the subject, and to such students as can find time to read books other than those written to suit the syllabus of some examination.

HANDBOOK OF QUANTITATIVE ANALYSIS. By John Mills and Barker North. London: CHAPMAN & HALL. 1889.

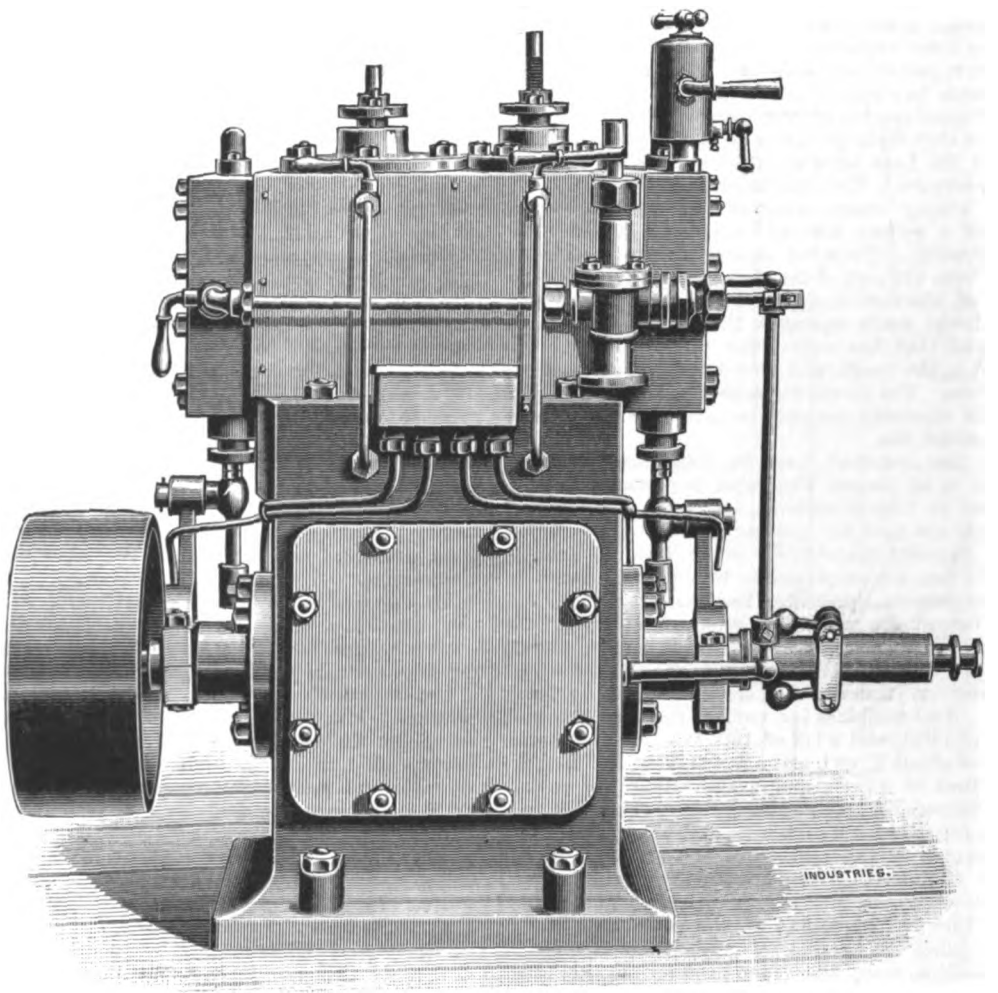
We recently had occasion to praise the recent work of the same authors, entitled "Introductory Lessons in Quantitative Analysis," but from a perusal of this larger book we must conclude that Messrs. Mills and North would have done well in waiting before attempting any fresh publication. Such subjects as practical quantitative chemistry cannot be crammed by the student in the way the authors seem to imagine, and we should be very sorry to present ourselves for examination before the examiners of the Institute of Chemistry relying on the present volume as our only guide. The authors have added to their former book matter on the analysis of alloys, minerals and ores, commercial products, assaying of silver and gold, water, gas, and organic analysis in a very poor fashion, but obviously in order that the subjects mentioned in the Science and Art, University of London, and Institute of Chemistry respective schedules may be included in their book. We do not believe in books written on this plan, and feel confident that any student who relies on such teaching will not find his knowledge of much practical use to him in after life. The authors themselves apparently have only had experience of the first of these three examining bodies, and seem to forget that the conditions of success at the examinations of the other institutions are different.

COMPOUND HIGH-SPEED ENGINE.

WE illustrate above a high-speed compound engine recently constructed by Mr. A. W. Richardson, "The Electric Light and Engineering Works," Stretford Road, Manchester. This engine has been specially designed for dynamo driving, direct or otherwise, but it is equally suitable for any other purpose where great power in small space is required. It has been constructed to run at high speeds continuously with safety and economy, and without excessive wear. The cranks run in oil, and have wipers to prevent the oil from working out of the bearings. The wearing surfaces are very large, and are adjustable. No exhaust steam enters the crank box. These engines are made single or double acting, and when made double acting the piston glands have metallic packing. The cranks are effectively balanced, every part is fitted with efficient means of lubrication, and all parts are easy of access.

COMPOUND HIGH SPEED ENGINE.

CONSTRUCTED BY MR. A. W. RICHARDSON, ENGINEER, MANCHESTER.



THE GERMAN TESTING STATION AT CHARLOTTENBURG, NEAR BERLIN.

SOME articles have been written lately respecting the various fuel testing stations which have been established in Germany and elsewhere, and urging their adoption in England. With the penetration and scientific insight that distinguishes them, the Germans were among the first to perceive that the introduction of steam and machinery had revolutionised industry, and that it was, therefore, essential that the working conditions of a boiler, for instance, should be as perfect as possible. The relations between the steam and the combustible generating it having been determined, it has for many years been within the power of every coal consumer in Germany to have his fuel consumption tested at a small cost, and its heating value ascertained. And of late a fresh step has been taken. The Germans have succeeded in arranging for daily tests, on a large scale and by accurate scientific methods, on the strength and quality of iron, wood, steel, paper, oil, &c.—in short, of all materials used in machinery and construction.

About six years ago a testing station was established at Charlottenburg, under the auspices of the Prussian Government. The institution has been organised on a strictly scientific and commercial basis. A series of instruments have been devised, chiefly by the officials who conduct the tests, for carrying the trials out as perfectly as possible; and a fixed scale of charges has been drawn up. Any manufacturer, wishing to have a product of his mill or factory tested, is supplied with a tariff of prices, a list of the different methods by which the article specified can be tested, and precise instructions regarding the proper size of the samples to be sent in. Although the establishment is still in its infancy, it will be seen at a glance how important a place it may hereafter occupy in commercial industry. All disputed questions between buyer and seller as to strength or quality of goods delivered can be settled at once, and the interests of both equally protected by an appeal to the authorities at Charlottenburg. A still more critical function is there performed, by testing with scientific precision the strength of materials employed in bridges, buildings, &c.

The institution is under the superintendence of Herr Martens, a distinguished engineer. It is connected with the Technical and Mechanical High School at Charlottenburg, and has an engineering workshop attached to it, which forms an indispensable adjunct to the work undertaken, and a training school for the students. The substances tested are divided into four sections, viz.:—

I. Metals, wood, ropes, driving straps, chains, and al materials used in construction.
II. Lubricating oils.
III. Paper of all kinds.
IV. Gauging and testing machines.

I. As may be supposed, the work done in the first division is the most important. The usual method of determining the strength of metal is to test sample bars of a given size, but the actual parts of any structure can also be experimented upon. The station possesses the appliances necessary to determine the resistance to tension, pressure, percussion, bending, twisting, and buckling; also the tensile strength of leather straps and cords, sheet iron and corrugated plates. Wire is tested for its bending and twisting capacity, oil for its lubricating properties, and paper for strength and quality of material. Iron and other metals are also tested by weights falling vertically, and by an ingenious arrangement, to be described hereafter, these experiments can be carried out at a distance from the testing station. The tests applied are of two kinds:—1st, single experiments upon the tensile and ductile strength of the material; 2nd, repeated trials continued for a long time, and intended more especially to test for power of prolonged resistance. The metal bars generally used are from 1½in. in diameter and upwards. An ordinary simple test comprises: Determination of the limit of elasticity, breaking weight, the elongation of the metal, and diminution of area after fracture. Sleepers, girders, and iron columns are tested for resistance to sudden pressure, and the limits of elasticity obtained. Samples of iron for carriage and locomotive axles are tested, duly loaded and while revolving. The hardness of sheet iron and buckled plates, the strength of telegraph wires, and the tensile strength of wood, driving straps, steel, iron, and hempen ropes are also carefully proved and tested. To all these operations a regular tariff of prices is attached.

A complete trial of cast iron comprises the following processes:—(*a*) Three separate tests of the resistance

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of the metal to bending. The size of the bars experimented on must be 3ft. 7in. × 1¼in. × 1¼in. (*b*) Tension and torsion tests, without determining the limit of elasticity, upon some of the bars already tested for bending. (*c*) Six pressure tests, made upon cubes 1¼in. side, cut from bars already tested.

In even the smallest experiments it is desirable to test not less than five bars of a certain prescribed size, as the average quality of the metal cannot be determined from fewer experiments. If special strength and solidity are required more elaborate trials are necessary. By these tests two important points are ascertained:—(1) The original quality of the materials used, and (2) the changes they undergo in the process of manufacture. The size of the bars experimented upon is a matter of much importance. The instruments for carrying out the tests are of course adapted for working upon material of a certain size, and are with difficulty adjusted differently. Tools for separating the portion to be tested from the rest of the metal are provided in the workshop of the station. It is so necessary that this portion should really represent the average quality of the material that the authorities prefer to have the metal sent in the rough, and to cut the test pieces from it themselves. The proper experiments for determining the limit of elasticity can only be carried out with bars of the standard size.

Testing the materials used in construction and in machinery is at present the most important function undertaken at Charlottenburg, and a large number of instruments are used for this purpose. Four machines, having a capacity respectively of 98 tons, 49 tons, 39 tons, and 1 ton, are employed to test the resistance of metals to tension, pressure, bending, breaking, &c. The two largest are worked by an automatic hydraulic accumulator, and are regulated by levers, screws, moving weights, and springs. Wire up to one-third of an inch in diameter is tested in a small machine specially designed. Two machines for vertical pressure, one with a weight of 110lb. and a fall of 14ft. 9in., the other with a weight of about 12 cwt. and a fall of 32ft., are used for sleepers, tires of wheels, and axles. Measuring instruments, a furnace for testing the elasticity of red-hot iron, crucibles for alloys and cast iron, and a forge complete the appliances in this section of the station. Eleven machines of different types are used for repeated and long protracted experiments. In each of them from four to eight bars can be tested at the same time, and in other machines the bending of loaded bars is repeated continuously so many times per minute. Ropes, cords, driving straps, and wood can also be tested in almost all these machines, and it is intended shortly to add appliances for percussion.

II. These, although the most important, are by no means the only experiments undertaken by the institution. Oil for lubricating machines is analysed and tested under ordinary working conditions. Nothing, perhaps, is more essential to the proper driving of machinery than to determine the quality of the materials used to prevent friction. The chemical laboratory, which forms one of the chief departments of the station, here becomes of value. The oil is subjected to twelve tests. The most important are the determination of the specific gravity and visible properties of the oil, as colour, transparency, iridescence, taste, and smell; its power of liquefaction at a temperature varying from 68° Fahr. to 302° Fahr.—for this the mean of ten experiments is taken. The coefficient of friction for a given speed and pressure is also ascertained, as well as the point at which the oil congeals and burns. The boiling point, the residuum after boiling, the quantity of acid contained, and the chemical analysis of the oil form part of the investigation. These experiments are easily and accurately carried out with various appliances, some of them automatic. Where a new vein of oil is struck, and it is desirable before working it to know the quality of the oil, the value of this systematic and scientific testing can scarcely be overrated.

III. Paper may be, and is, frequently subjected to the same exhaustive tests. All paper supplied to the Prussian Government must be tested and properly certificated before it is accepted; the value of other paper is ascertained at the wish of the buyer or seller. For these experiments the paper is divided into two sections, comprising (I.) strength of texture, and (II.) quality of material used. Each section is subdivided respectively into six and four classes, and every kind of official paper must pass a certain standard prescribed by Government. In Section I. the strength of the paper is tested according to a theoretical quantity called the "tearing weight." The weight required to break the paper is first ascertained, and then reckoned in so many thousand feet of paper of the same width. Thus the tearing weight of a first-class paper will generally be about 5,466 yards of paper. The paper is also tested for its elasticity, resistance to creasing and crumpling, material of which it is composed, and especially for any admixture of mechanical wood-pulp, which is rigidly excluded from the composition of all good paper. The tests usually applied to a paper are: Determination of its tearing weight and elasticity, of its resistance to friction and crumpling, quantity of ash left after combustion, chemical examination to detect wood-pulp if present, microscopical examination of the fibres and other materials in the paper, and chemical analysis of the colouring matter, acids, chloride, &c., in the paper and sizing. The shape and quantity of paper to be sent in is fixed by the authorities, though it is not so strongly insisted on as in the case of metals.

IV. A fourth branch of the institution, which has not yet assumed large proportions, is that of testing the instruments and appliances used to prove the strength of metal. These machines are either completely tested in all their parts, or the accuracy of certain important sections, as weights, scales of measurement, levers, &c., are carefully verified. Attached to this branch of the establishment is a department for enabling manufacturers to make practical use of those methods of testing which have here been reduced to a science. Small copper cylinders 2in. in height and ¾in. in diameter are sent, if desired, with a copy of the testing certificate. The cylinders are subjected to the same heavy vertically-falling weight as the metal to be tested. Their power of resistance to pressure being accurately known, the effect produced on them is calculated, and the resisting strength of the iron deduced from it. This forms a simple and convenient method of testing iron. It obviates the difficulty and expense of conveying heavy blocks of metal to the testing station, while at the same time it ensures the same scientific accuracy as in the experiments there undertaken.

Another useful branch of the institution is devoted to photography. Views are taken of exploded boilers, broken bridges, and other iron structures, and of large pieces of wrecked machinery, and afford a valuable record of the condition of the iron at the actual moment of fracture. Many of these interesting photographs were shown at the section allotted to the Charlottenburg Testing Station in the Berlin Exhibition of 1889. A valuable and instructive collection of objects was also exhibited, comprising fragments of iron from exploded boilers, the exact point in a girder where it had given way, the piece of defective metal which had caused the collapse of a building, together with models or photographs of the various apparatus and appliances used in the testing operations of the station.

YEADON & ADGIE'S GAS RETORTS.

From the earliest days of gas manufacture the great desideratum has been a mechanical method of charging and discharging the retorts. In the first place, the employment of a machine would reduce the amount of wages paid to hand labour, and would place the industry beyond the influence of strikes. Again, no time would be lost between the charges, nor could any gas escape while the retort was being filled and emptied. Further, the operation of distillation would be conducted more rapidly, for each particle of coal would stay for a shorter time within the retort, and during the whole time it was there it would be subjected to the heat of the furnace instead of lying stationary for a certain period buried among its neighbours. It has been known for some time that the greater the rapidity with which the distillation is effected the greater is the quantity and illuminating power of the gas given off. Until recently, perhaps, Brunton's and Scott's retorts were the only successful embodiments of these principles, but of late years many forms of apparatus have been introduced with greater or less success.

A new machine is now being introduced by Messrs. Yeadon & Co., engineers, Leeds, which promises to leave all its predecessors behind, for, in addition to its possessing all the usual advantages of a mechanically charged retort, there are a number of remarkable points in its design. Their retort differs from all previous ones by being arranged to revolve instead of being fixed, and by being able to deal with the very smallest coal, even breeze. We will now proceed to give a description of the plant, but before doing so we may remark that several leading gas companies in England have already recognised its advantages, and have decided to adopt it at their works.

In the illustrations on the opposite page, Fig. 1 is an elevation of the feeding end of the retort, Fig. 2 is a side elevation, Fig. 3 is an elevation of the discharging end, and Fig. 4 is a longitudinal section through the centre. The body of the retort A is made of fireclay, and of cylindrical conical shape; it revolves inside the furnace B, and rests at each end in the metal sockets C C^1, to which it is secured by bolts. These sockets are made to revolve smoothly on bearing rollers D D, which revolve in the metal boxes E E^1. The retorts are suspended, with no brickwork underneath them, and thus, in revolving, the heat of the furnace comes in direct contact with the whole of the fireclay body. The interior of the retort has a number of continuous blades Y Y, extending nearly the whole length. The object of these blades is threefold—viz. (1) to work the coal through the retort; (2) to raise the coal constantly from the bottom of the retort to a point nearer the top, and then to allow it to fall over; and (3) to strengthen the shell of the retort so as to make it better able to carry the weight of the coal. These blades are made of a tapering form, deepest at the front or feeding end, where the coal requires to be broken up most, and gradually tapering to nothing about the point, thus preventing the coke from being unnecessarily broken after the gases have been liberated. The retorts are conical and widest at the discharging end. At each end there is a fixed end-plate in a recess, in which the ends of the retort revolve. A steam chamber at the back of these recesses keeps the necessary packing rings up to the retort ends, and makes a gas-tight joint. The front end-plate F has a hopper G, into which the coal is fed from the conveyer V (Figs. 1 and 2) after being delivered there by the elevators W. At the bottom of the hopper G there is a cylinder H, of smaller diameter than the retort, and this cylinder is fitted with internal shaft I, on which adjustable blades are fixed. The speed of this internal shaft is regulated by the change chain wheels K and K^1. As the cylinder is always kept full of coal, any escape of gas or ingress of air is prevented. The cylinder delivers the coal into the interior of the retort. On arriving here it falls on the bottom, and is caught by the blades, which operate on the coal as described before. The annular ring in the interior of the retort prevents the coal from working back into the recess L. This constant turning over of the coal promotes rapid distillation. The back end-plate S, like the front one, is fitted with grooved recess, packing rings, and steam chamber. A scraper X guides the coke into the discharging outlet pipe U, which is fitted with two discharging valves. By means of these valves and a swing door, the hot coke can be delivered right into the furnace B, or into a water cistern, or into an endless conveyer. The retorts are driven at each end by spur wheels M M^1, fixed on the metal sockets. This arrangement avoids any torsional strain on the body of the retort. These wheels receive their motion from the pinions N N^1 on the shaft O, which again is connected by the bevel wheels P P^1 to the main driving shaft R. The gases which are the result of the distillation escape up the ascension pipe T, which is purposely arranged at the hottest end of the retort, in order to prevent choking.

THE QUALITY OF ROOFING SLATES.

H. Brunner, in a communication to the *Schweizerische Wochenschrift für Pharmacie*, has recently showed how useful information on the quality of tiles can be obtained from their physical and chemical properties. In the first place, he points out that the colour of a roofing tile does not afford any safe indication of its durability, but that uniformity in the direction of the surface markings, which should be parallel to the length, is a desirable quality. A good slate should also be hard and not easily indented with the nail. He finds that the hardness varies between 2 and 3·5 in slates from various localities. The mechanical properties, such as its freedom from splitting into thin plates on sawing or hitting, should also be first noticed. The determination of the specific weight gives no useful information. Good slates give a clear ring when struck, while inferior qualities have a dull sound. From a microscopical examination of a thin section it is easy to recognise the presence of calcium carbonate, iron pyrites, and marcasite in the slate. A large amount of any of these is deleterious, and especially the last, as, from the readiness with which it undergoes oxidation, slates containing this sulphide of iron soon become friable and worthless. The porosity of slates can be readily determined by imbibition of water. A piece 12cm. long and 6cm. wide being stood in a beaker which is filled with water to the depth of 1cm., the beaker is then closed with a glass plate, and after standing for twenty-four hours the height to which the water has ascended in the slate above the water level is noted. Good qualities allow the water to rise only a few millimetres, while porous slates and those liable to split give a much greater height. The chemical analysis is of great importance, as it supplements the microscopical examination and gives the percentage amount of calcium and magnesium carbonates and iron sulphides present, all of which have an important influence on the weathering properties of the slate.

Fresenius many years ago pointed out that the presence of iron pyrites and other sulphides in slates influence their quality, and described in his *Zeitschrift*

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YEADON & ADGIE'S REVOLVING GAS RETORT.

CONSTRUCTED BY MESSRS. YEADON & CO., ENGINEERS, LEEDS.

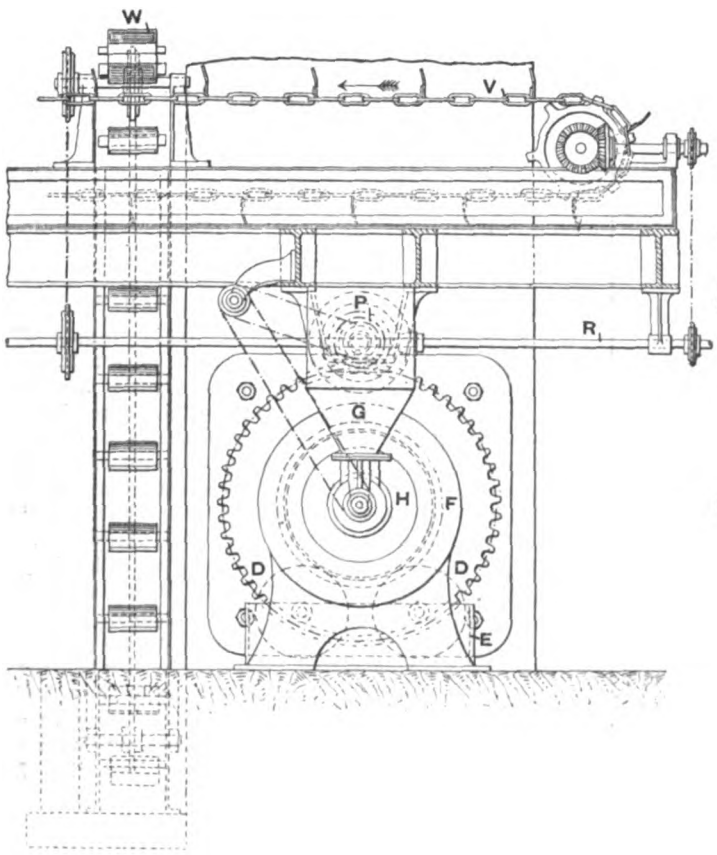


FIG. 1.—ELEVATION OF FEEDING END.

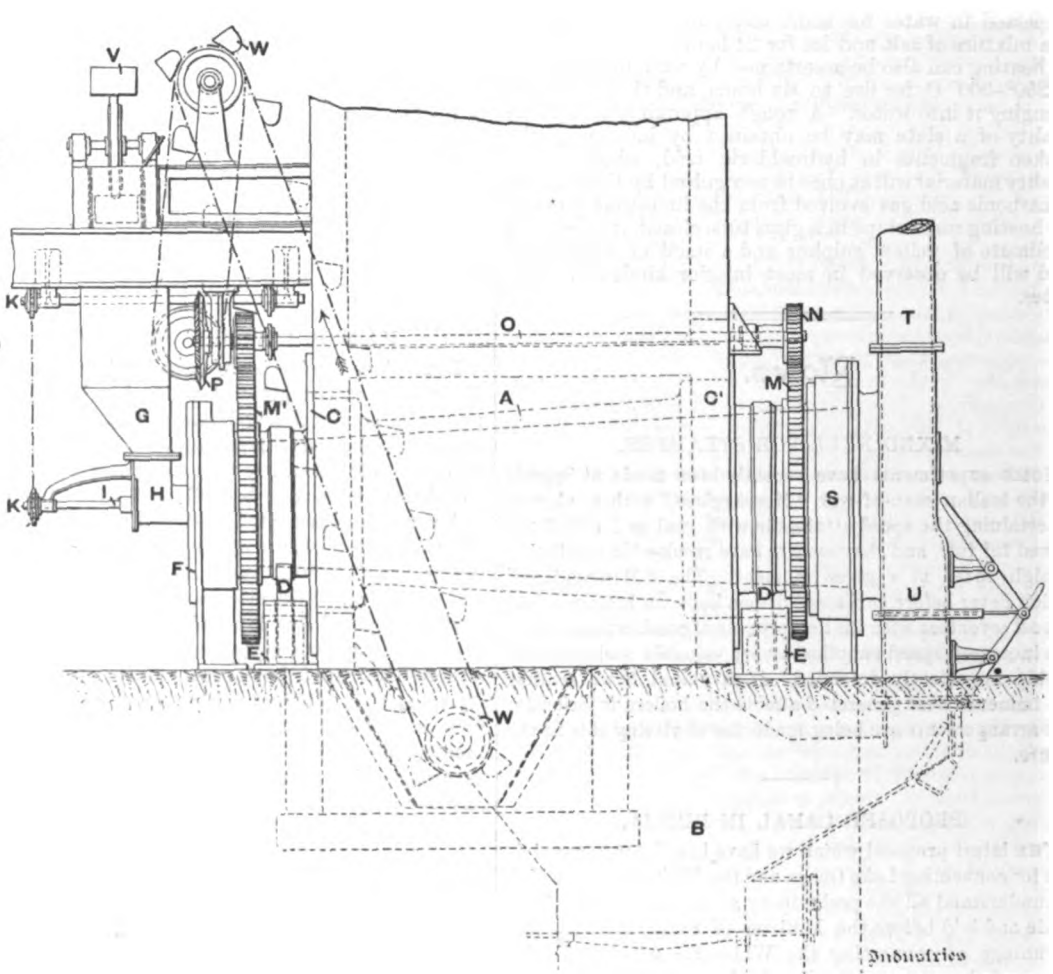


FIG. 2.—SIDE ELEVATION.

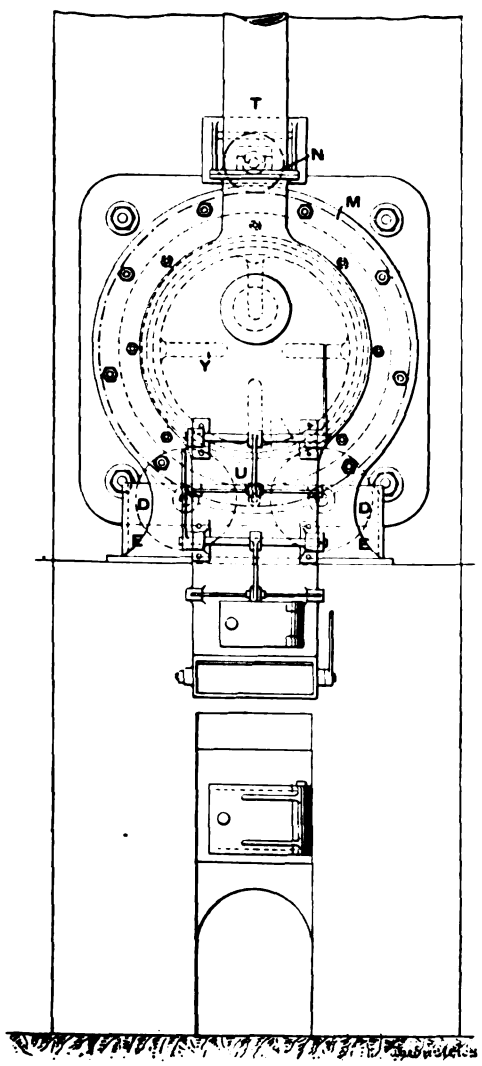


FIG. 3.—ELEVATION OF DISCHARGING END.

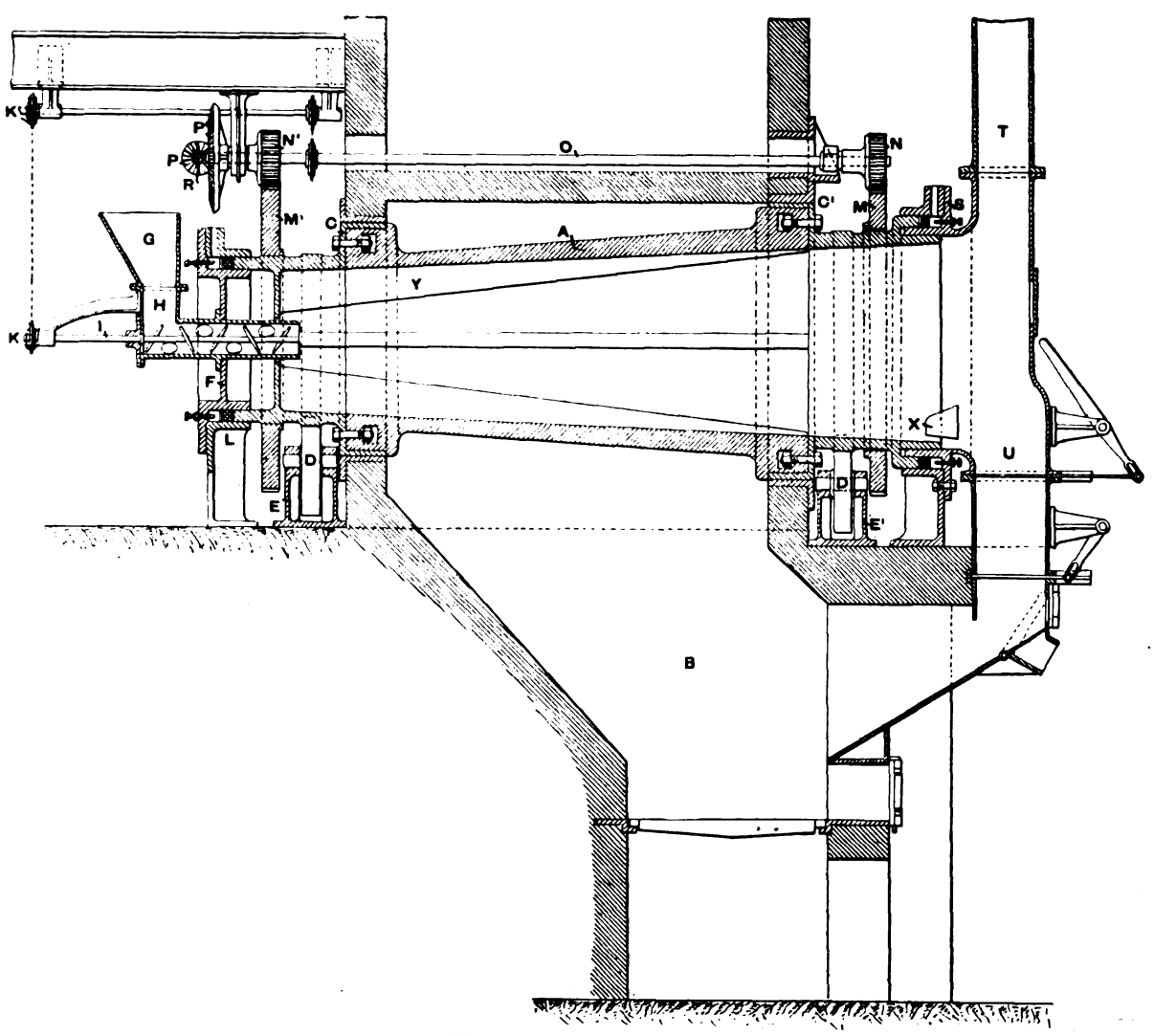


FIG. 4.—LONGITUDINAL SECTION.

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für Analytische Chemie (VII.,72) the experimental results obtained by a chemical examination of several different kinds, and which are fully supported by this investigation of Brunner. The behaviour of slates towards sudden changes of temperature has also been the subject of direct experimental examination, Brunner suggesting that the quality in this respect may be estimated by first saturating the slate in water by allowing it to remain immersed in water for some days, and then placing it in a mixture of salt and ice for 24 hours. Its behaviour on heating can also be ascertained by warming a sample to 250°–300° C. for five to six hours, and then suddenly plunging it into water. A rough approximation of the quality of a slate may be obtained by immersing the broken fragments in hydrochloric acid, when a bad quality material will at once be recognised by the amount of carbonic acid gas evolved from the limestone present. By heating some chips in a glass tube closed at one end, a sublimate of yellow sulphur and a smell of sulphurous acid will be observed in most inferior kinds of roofing slates.

Notes.

MIXED FUEL FOR STEAMERS.

Some experiments have recently been made at Spezzia on the Italian man-of-war "Messaggiero," with a view to ascertaining the speed attainable with coal and petroleum mixed for fuel, and they seem to have resulted in producing a high speed at a given moment. The "Messaggiero," which never before surpassed fifteen knots an hour, reached almost seventeen with the new process of combustion, so that the increased speed supplies a very valuable assistance to a ship imperfectly defended. It is stated, however, that the immense heat generated affects the boilers injuriously, but arrangements are being made for obviating this in the future.

PROPOSED CANAL IN RUSSIA.

The latest proposal which we have heard for a canal is one for connecting Lake Onega and the White Sea, for which we understand all the preliminary arrangements have been made and laid before the Minister of Public Works. The advantage of connecting the White Sea with St. Petersburg and the centre of the Empire by means of a waterway has long been recognised both by the Government and in commercial circles. A port is to be constructed on the White Sea, and, according to present proposals, the canal will be 145 miles long, of which, however, only about one-half will have to be artificially constructed, and it will be wide enough and deep enough to admit vessels drawing 10ft. of water. It is expected that when the scheme has been carried out it will greatly help to develop Russian trade.

SEA FISHERIES OF THE UNITED KINGDOM.

According to the annual report of the Board of Trade on the sea fisheries, which has just been issued, the quantity of fish landed on the coast of England and Wales in 1889, exclusive of shellfish, amounted to 6,465,000 cwt. The value was £3,862,000, which, with the addition of £307,000 for the shellfish, gave a total value of £4,169,000. These figures have been about practically the same for several years past. The corresponding figures for Scotland show a total quantity of 5,416,000 cwt., exclusive of shellfish, valued at £1,431,000, while the total value, including shellfish, was £1,494,000. The aggregate result for the United Kingdom was a total of 12,678,000 cwt., exclusive of shellfish, valued at £5,608,000. Adding to this the value of the shellfish, amounting to £386,000, there was a grand total of £5,994,000 as the return of the sea fisheries of the United Kingdom, as valued at the place of landing, in the year 1889.

WEST OF SCOTLAND ENGINE KEEPERS' ASSOCIATION.

When we hear of proposals for the Government examination of engine attendants it is satisfactory to find a voluntary association which, for the district in which it is situated, appears to be doing very good work. The West of Scotland Engine Keepers' Association recently held its third annual meeting in Glasgow, at which the secretary was able to report very satisfactory progress. He stated that the object of the association was not to advocate legislative interference in the management of engines and boilers, nor for sinister purposes against steam users, but to cheerfully lend their best assistance to the development of sound instruction in the management of engines and boilers, enabling them to look forward with greater certainty to a considerable diminution, if not a prevention, of those calamitous explosions which so frequently plunge whole families into mourning by unexpected and instantaneous death. The association, which was formed three years ago, has now a roll of two hundred members, all of whom have passed the Board of Examiners. This Board is composed of professional engineers, who assign first and second class certificates on proof of testimonials of good character and a knowledge of elementary principles. It is further satisfactory to find that numbers of important steam users are recognising the aims of the association, and have shown a desire to employ its members in preference to others, as it was found that their good conduct and superior knowledge entitled them to confidence, and were at once a guarantee of public safety and of prosperity to the public.

HARBOUR WORKS AT YOKOHAMA.

Ever since foreign intercourse has been carried on with Japan, one of the greatest wants has been found to be proper harbour accommodation at Yokohama. The Bay of Yedo (Tokio) covers a large area, but it is so shallow that all ocean-going steamers have to discharge their cargo at Yokohama and send it by rail to Tokio. The harbour at Yokohama is unprotected, and has no appliances for the shipping and discharge of cargo, and everything has to be done by small boats, a system which is both troublesome and expensive. Very many schemes have been from time to time proposed, but it is only recently that definite plans have been made out and agreed to, and at present there is a representative of the Japanese Government in this country engaged in making contracts for the materials to be used in the construction. The works will include two breakwaters nearly two miles in length, together with beacons, dredgers, and all other requirements of first-class harbour works.

FRENCH RAILWAYS IN AFRICA.

We recently mentioned the French proposals for a Trans-Sahara Railway. This is only a small part of what is being done to promote French interests in Africa. A French company is now being formed for the purpose of constructing a railway from the coast to the Congo, and thus developing that region; and as the sanction of the Government has been obtained, the work will be actively pushed on. In Tunis considerable speculative activity is being shown, and a bank under French auspices has been formed for the purpose of assisting industrial enterprises, and railways have already been extended in several directions. Several French travellers have penetrated into various parts of Africa, and have strengthened old stations or established new ones for the purpose of extending French commerce. The effect of these various efforts has been to bring a considerable amount of trade and commerce to France.

THE CULTIVATION OF PISTACHIO NUTS AT ALEPPO.

The last *Kew Bulletin* contains a report from the Consul at Aleppo on the method of cultivating the pistachio tree prevailing there. It is produced only from the seed, which is steeped in water for two days and then planted in the nurseries and watered at least twice a week for two years, when it is grafted from a good fruit-producing tree. After another year it is transplanted to the pistachio gardens, where it is again watered for a year, or until the roots are well fixed. It is then left to nature, no more water being given. The gardens are ploughed up twice a year—in spring and winter—and the spade is used round each tree as with the olive. The tree does not naturally reproduce itself, although when the ground is exceptionally moist the seed sometimes, though rarely, fructifies itself. Two years after being grafted it begins to produce fruit. The distinction between the male and female trees is not understood, but those producing fruit of good quality are supposed to be female. It is not until the tree is seven years of age that it begins to give a good crop. Like the olive, the pistachio has alternate years of good and bad crops, and ordinarily good trees bear for sixty to eighty years. Excessive frost sometimes dries up the trees, and then they are cut down and uprooted, as shoots never appear. The tree is 12ft. to 15ft. high, and thrives best in a whitish chalky soil which retains moisture. In this and many other respects it resembles the olive.

TRAFFIC OF THE SUEZ CANAL.

In a recent issue (*Industries*, 14th March, 1890) we published a table showing the traffic through the Suez Canal during the past three years. The following table, which has been prepared by Messrs. F. W. Allen & Co., Buchanan Street, Glasgow, shows the percentage of steamers and tonnage belonging to the six leading maritime nations, and from which it will be seen that that belonging to Britain tends to increase:—

	1887.		1888.		1889.	
	Stmrs.	T'nage.	Stmrs.	T'nage.	Stmrs.	T'nage.
British	74·28%	76·52%	76·31%	78·65%	76·23%	78·91%
French	5·90	6·51	5·44	5·83	4·91	5·33
German	5·07	3·72	4·74	3·58	5·66	4·27
Netherland	3·92	3·75	3·52	3·28	4·26	3·87
Italian	4·40	4·28	4·24	4·03	3·01	2·76
Austro-Hungarian	2·61	2·39	1·69	1·85	1·58	1·72

BASIC SLAG AS AN ARTIFICIAL MANURE.

We have several times pointed out the importance of basic slag as an artificial manure, and have suggested that more attention should be paid to its qualities in this country, where they do not seem to be so highly appreciated as on the Continent. From the annual reports of the Sussex Association for the Improvement of Agriculture, and the Agricultural Research Association, we gather most emphatic support of the value of basic slag as an artificial manure. The experiments show that the phosphate in basic slag is clearly of a nature that can be assimilated by the plant, and that the power of the plant to make use of insoluble mineral phosphate is not, therefore, limited to the forms of it found in nature, termed coprolite, but extends to this artificial or manufactured form, and further that the prejudicial effect which was apprehended from the action of iron in basic slag has not been experienced. These conclusions are very satisfactory, and show that a very important bye-manufacture can always be connected with that of basic steel.

THE EMERY MINES OF GREECE.

The French Consul at Syra, in a recent report on the emery mines of Naxos, supplies some interesting information about the emery which is found in Greece. Naxos emery is universally known, and has a high reputation; it is the hardest and finest in the world. The ferruginous elements which it contains are so covered that the magnet exerts no appreciable action on it. Its composition is 80 parts aluminium, 3 parts silica, 4 iron, and 1 part not separated. According to the classification adopted by savants and, among others, by Mr. Tennant, the plain and red Naxos emery, which contains neither gold nor silver, comes from copper mines. It is therefore superior to that met with in iron mines, and which is of a blackish colour. By reason of its exceptional qualities it answers best to the needs of the arts and industries. In England and America it is used to polish gold, to cut and polish glass, marble, and the hardest stones. In some countries even it is combined with gold to increase the hardness of that metal. The consumption of this emery, both in America and Europe, is estimated to be nearly 20,000 tons.

THE SILK TRADE OF JAPAN.

The silk industry of Japan promises to become the most important in the country. We learn from a recent issue of the *Japan Weekly Mail* that new plantations are being laid out, new filatures and re-reeling establishments being started, new firms and companies beginning business, and constant improvements being made which are making the Japanese product more popular with manufacturers in Europe and America. Not only is the exportation of the raw silk being largely increased, but the goods woven in the Japanese looms are finding their way to Europe and America, where the beautiful fabrics of artistic Japan are greatly appreciated. In 1889 the value of the raw silk exported was $26,332,900, as against $25,899,700 in 1888. The export of waste silk was valued at $2,509,500, against $2,794,700 in 1888. The trade in manufactured silks grows year by year. Large factories, with new and improved machinery for warping, winding, weaving, and dyeing are being constantly erected, and the industry is fast developing. The United States is at present the best customer for these goods, but England, France, Germany, Canada, and Australia are rapidly entering the field as competitors in the purchase of these fabrics. At the present rate of progress the value of woven silks will soon exceed the value of tea annually shipped from Japan.

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Patent Record.

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

14th April, 1890.

5603. Proctor, J. ..... Mechanical stokers.
5606. Marsden, H. M. ..... Manufacture of nails.
5607. Weight, W. H. ..... Machine for heeling boots.
5616. Fraser, W. ..... Furnace bars.
5618. Wishart, T. G. ..... Governor for steam engines.
5625. Sutcliffe, J. ..... Looms.
5627. Rome, J. C. ..... Metallic flooring for bridges.
5633. Stratton, J. M. ..... Steam generators.
5641. Howard, H. (of the Firm of Lloyd & Lloyd) ... Iron and steel tubes.
5643. Newton, H. E. ..... Rotary engine (*Jones & Green*).
5648. Bessonoff, S. ..... Regulating supply of feed water.

15th April, 1890.

5654. Allison, H. J. ..... Heating apparatus (*Edgar*).
5658. Wattie, W. ..... Turning and drilling machines.
5659. Marble & Simons ..... Forging metals.
5661. Rogers & Paramor ..... Revolving boilers.
5663. McKenzie & McKenzie Self-detaching gear for boats.
5665. Malmstrom, K. K. ..... Quick-firing guns.
5669. Palmer, J. H. ..... Car starter.
5675. Brearley, A. ..... Mules.
5676. Van Fleet & Graff ... Typewriter.
5680. Weber & Mayer ..... Wood screw machines.
5684. Henderson, C. ..... Sheet metal boats.
5685. Kidman, J. ..... Furnace doors.
5690. Beetlestone, R. ..... Doors of lift wells.
5692. Smallman, J. W. ..... Revolvers.
5697. Seabury, S. ..... Breechloading cannon.
5698. Newton, H. E. ..... Sewing machines (*National Machine Company*).
5702. Hansen, G. E. ..... Boiler tubes.
5704. Butman, T. R. ..... Flue scraping rods.
5706. Hall, Whittaker, & Fallows ..... Jacquard apparatus cards.
5709. Longmore & Watson ... Spinning machines.
5710. Löfström, L. ..... Typewriting machines.
5711-2. Longmore & Watson Spinning machines.
5713. Brickley, W. H. ..... Sewing machines.
5714. Mewburn, J. C. ..... Looms (*Campion*).
5717. Godfrey, A. ..... Boring tools.
5720. Kneen, W. ..... Utilisation of pressure for the obtainment of motive power.
5724. Lake, H. H. ..... Locking nuts (*Knapp*).
5725. Bowen, J. H. ..... Mechanical movements.
5729. Weiss, F. J. ..... Governors for steam engines.
5731. Imray, O. ..... Coupling metallic pipes (*Hogan Engineering Company*).
5732. Imray, O. ..... Partitioned pipe (*Hogan Engineering Company*).
5733. Imray, O. ..... Promoting circulation in boilers (*Hogan Engineering Company*).
5734. Imray, O. ..... Boiler furnaces (*Hogan Engineering Company*).

16th April, 1890.

5739. Cresswell, C. ..... Sewing machines.
5741. Chadburn & Findlay ... Ships' boats.
5743. Starkey, T. ..... Machinery for bending hay forks.
5749. Whalley, C. ..... Looms.
5755. Heath, G. ..... Firearms.
5766. Ellams, G. ..... Steam boilers (*Ellams*).
5774. Mellor & Mellor ..... Knitting machines.
5778-9. Roberts, G. C. ..... Reversal gears.
5784. Marley, H. ..... Winding machinery for textile materials.
5785. Lake, H. H. ..... Apparatus for heating and cooling fluids (*Joennson & Berg*).
5786. O'Donnell, F. H. ..... Lifeboats.
5787. Dunbar, A. ..... Machinery for manufacture of casks.
5789. Mayor, P. H. ..... Cylinders and pistons. (21st October, 1889.)
5795. Cooke, E. W. ..... Roller bearings.
5799. Reid, J. ..... Governor for steam engines.
5801. Corrigall, W. E. ..... Mounting ordnance.

17th April, 1890.

5808. Pritchard, Snape, & Sherratt ..... Lubrication of axles.
5811. Simpson, J. ..... Pipe-welding apparatus. (18th October, 1889.)
5813. Mynsbrugge & Mynsbrugge ..... Typewriting machines.
5814. McGrady, H. ..... Typewriters (*Crandall*).
5826. Aylmer, P. ..... Hoists.
5828. Womack, C. ..... Machines for extracting carbonised burr from woollen cloth.
5829. Ewen & Mitton, Jun. ... Machines for drying sand.
5834. Smith, J. R. ..... Pipe wrenches.
5840. Strathern, A. G. ..... Reversing and steam brake engines.
5844. Leachman, W. B. ..... Boiler furnaces.
5848. Wardle, W. W. ..... Apparatus for moistening air.
5851. Reid, J. ..... Self-lubricating valve spindle.
5853. Beechey, C. G. ..... Gas governors.
5854. Capel & Ladd ..... Apparatus for weighing and baling peat.
5855. Osenbrück, J. A. ..... Utilising exhaust steam.
5857. Boyle, R. K. ..... Utilising the force of railway trains whilst stopping.
5865. Hutchens, W. ..... Mitreing machine.

18th April, 1890.

5869. Wright, G. ..... Looms.
5872. Dale & Dale ..... Heel-paring machines.
5877. Duncan & Latta ..... Apparatus for making corks.
5878. Wild, J. ..... Valve gear.
5879. Riley, J. H. ..... Machinery for folding fabrics.
5881. Marsden, H. M. ..... Circular saws.
5887. Golding, W. ..... Spinning machinery.
5891. Kerr, J. ..... Evaporating salt water.
5894. Boult, A. J. ..... Converters (*Bookwalter*).
5897. Brown, A. G. ..... Steam generators.
5899. Robinson, T. N. ..... Wood planing and moulding machines.
5904. Lange, O. ..... Signalling on railways.
5908. Turnbull, Stockdale, & Carr ..... Calico printing machines.
5915. Bonne, C. R. ..... Preventing loss of water in water-pipes in case of bursting (*Herrnberg & Zipperling*).
5917. Mackie, S. A. ..... Washing machines.
5918. Ellis, E. ..... Boats.
5921. Thomas, H. M. ..... Sheep shearing machines (*Blanks, Lefebure, & Bird*).
5922. Oriolle, P., Fils ..... Steam boilers.
5926. Pitt, S. ..... Machine for covering electrical conductors with lead (*Atherton*).
5929. Carbonnier & Molié ... Spinning machines.
5930. Perry, F. J. ..... Embroidery machines.
5933. Dheyne, De Nydprück, & De la Hault ..... Gas engines.
5934. Nisbet, W. R. ..... Detaching ships' boats.

19th April, 1890.

5941. Adnams, F. J. ..... Raising sunken vessels.
5942. Holden, H. C. L. ..... Firing ordnance.
5943. Moore, A. S. ..... Casting cylindrical vessels.
5949. Leverkus, K. ..... Horse-power gauges.
5950. Freeman, J. G. ..... Grinding machine.
5952. Darroch, J. ..... Condensing engines.
5962. Maynard, R. ..... Elevators.
5963. Thomson, W. ..... Axles.
5966. Pullman & Smith ..... Machinery for finishing skins.
5969. Baldwin, B. J., Jun. ... Bending sheet metal. (18th November, 1889.)
5972. Otto, N. A. ..... Gas engines.
5985. Edwards, B. J. ..... Speed regulating pulley.

ELECTRICITY.

14th April, 1890.

5640. Watson, C. ..... Electric safety fuses.
5645. Odell, J. B. ..... Electric railway apparatus.

15th April, 1890.

5678. Kalb, J. ..... Electric regulators.
5716. Manville & Madgen ... Producing currents.
5728. Lake, H. H. ..... Regulating dynamos (*Foote*).

16th April, 1890.

5748. Jamieson, A. ..... Galvanometers.
5750. Crompton, R. E. B. ..... Dynamos and motors (*Fritsche*).
5764. Thompson, W. P. ..... Electrical inter-communication (*Berne & Taylor*).

17th April, 1890.

5804. Pollak, C. ..... Electric miners' safety lamps.
5810. Rawson, F. L. ..... Galvanic battery (*Hartmann & Braun*).
5836. Radcliffe, J. ..... Regulating dynamos and motors.

18th April, 1890.

5910. Jarman, A. J. ..... Insulating conductors.
5916. Bonne, C. R. ..... Electric alarm (*Mix & Genest*).
5920. Schoop, P. ..... Accumulators.
5925. Kellogg, M. G. ..... Telephony.
5938. Boettcher, K. E. ..... Secondary element.

CHEMISTRY.

14th April, 1890.

5608. Letcher, J. ..... Recovering tin from slag.
5620. Bowden & Hern ..... Soap.
5638. Teague, T. ..... Extraction of tin from slag.

15th April, 1890.

5721. Hall, J. ..... Colouring matters.
5722. Willcox, B. ..... Diquinoline derivatives (*Farbenfabriken vormals Friedrich Bayer & Co.*).
5723. Willcox, B. ..... Phenacetine derivatives (*Farbenfabriken vormals Friedrich Bayer & Co.*).
5736. Imray, J. ..... Colouring matters from azoxyamines (*La Société Anonyme des Matières Colorantes et Produits Chimiques de St. Denis, Poirrier, & Rosenstiehl*).
5737. Imray, J. ..... Colouring matters from fluoresceine (*La Société Anonymes des Matières Colorantes et Produits Chimiques de St. Denis*).

16th April, 1890.

5777. Imray, O. ..... Colouring matters (*Farbwerke vormals Meister, Lucius & Brüning*).
5780. Imray, O. ..... Colouring matters (*Farbwerke vormals Meister, Lucius & Brüning*).

18th April, 1890.

5937. Loe, W. C. ..... Recovery of metals.

19th April, 1890.

5971. Dewar & Redwood ..... Distillation of oils.

MISCELLANEOUS.

14th April, 1890.

5605. Livesey, J. F. ..... Shuttles.

15th April, 1890.

5719. Taylor, W. R. ..... Manufacture of cement.
5730. Lake, H. H. ..... Insulating compound (*Knudson*).

16th April, 1890.

5762. Rocke & Prosser ..... Shuttles.
5775. Veasey & Brough ..... Packing for stuffing boxes.
5776. Gottschalk, R. ..... Fire escape.
5790. Patton, H. B. ..... Fire escape.
5793-4. Puskas & Schlenker Submarine blasting.

17th April, 1890.

5815. Raudnitz, S. ..... Substitute for glass.
5816. Hall & Kay ..... Sliver cans.
5823. Perry, J. ..... Signalling.
5827. Rigby, A. B. ..... Concrete blocks.
5833. Tall, G. ..... Refining cotton oil.
5838. Pielsticker, C. M. ..... Mineral oils.
5847. Wood, C. ..... Manufacturer of fibrous material from slag.

18th April, 1890.

5886. Thompson & Thompson Shuttles.
5898. Howat, A. ..... Miners' safety lamps.
5927. Lloyd, E. W. ..... Sights for ordnance.

19th April, 1890.

5948. Moffitt, G. ..... Time fuse for shells.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form, of such opposition.

Year 1889.

843. Selwyn.
5219. Nouailhac-Pioch.
6519. Thompson (*Mahr*).
6590. Thompson (*Brown*).
6861. Price.
7073. Lake (*Leonhardt & Co.*).
7347. Thomas.
7416. Mills (*Fiske*).
7496. Newcomb.
7657. Clark & Maxwell.
7883. Cuttriss.
7983. Griffiths.
8107. Schevelin & Mindovsky.
8427. Baumgartner.
8624. Weston.
8706. Holdcroft.
8760. Drummond.
8779. Alsberge.
8828. Lutticke.
8864. Werdenberg.
8948. Highfield.
8949. Du Four.
8981. Atkinson & Hooper.
9014. Ashwell.
9085. Fisher.
9096. Jackson & Sinclair.
9130. Cowburn.
9225. Turner.
9241. Swinton.
9275. Bidtel.
9427. Johnson (*Badische Anilin & Soda Fabrik*).
9512. Hawksley.
9613. Royle.
9680. Greenway.
9713. Lorrain (*La Société d'Exploitation des Cables Electriques Systeme Berthoud, Borel et Cie.*).
9783. Neilson & Black.
9789. Hawkins.
9798. Purvey.
9826. Sharp.
9850. Brown & Johnston.
9866. Maude.
9883. Wootton.
9897. Franklin.
9906. Burn.
9918. Hoese.
4484. Mordey.
6483. Percy.
6520. Thompson (*Gunther & Hoppe*).
7042. Rivers.
7193. Paul.
7364. Tracy, Catty, & Dobson.
7621. Townsend.
7761. Erard & Round
7954. Foster.
7993. Allison (*Robertson*).
8202. Turnock.
8258. Sheppard.
8547. Lecoultre - Piguet. (4th December, 1888.)
8740. Thompson (*Schumacher & Tschiffeli*).
8781. Smith & Stephenson.
8838. Cotton.
8928. Mackay (*Barter & Muter*).
8961. Hanff.
9004. Butler & Rickard.
9041. Morison.
9089. Jones.
9104. Emanuel, Wood, & Crump.
9227. Butler.
9268. Boult (*Féret*).
9305. Johns.
9431. Barnaby.
9473. Allchin.
9566. Pierrard & Pierrard.
9666. Nunan.
9705. Leffler-Arnim.
9730. Thompson (*Caillard & Caillard*).
9760. Katz.
9771. Renshaw.
9772. Yagn.
9788. Sinclair (*Lyndall*).
9794. Johnson.
9820. Hancock.
9836. Heys (*Vandermeirssche*).
9851. Bastow.
9878. Garroway.
9889. Sunderland, Sunderland, & Sunderland.
9917. Nicholson.
9937. Cleminson.

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9945. Hanson.
9957. Hacking.
9986. Stewart, Charlton, & Casey.
10015. Turner.
10044. Reeve & Ratcliffe.
10088. The Broseley Tilleries Company, Ld., & Crump.
10100. Daugy.
10132. Brown.
10194. Barker.
10198. Vincent-Péchoux.
10273. McEnerney & Demorest.
10331. Clarke.
10348. Hill.
10576. Aubout.
10927. Hinklein & Hauss.
11128. Batchelor.
11243. Buston.
11609. Thompson (*Heinrichs & Schuster*).
12170. James Turner & Samuel James Sewell.
13930. Rudall.
15408. Challis.
16373. Faull.
17185. Boult (*Eichbaum*).
17578. Winn.
17817. De Pass (*Demagnin & Bourdier*).
18916. Barker (*Oliver*).
19440. Dorman.
20068. Marx.
20342. Wright & Gillott.
9954. Lewis.
9961. Dixon & Dack.
9993. Sherman.
10003. Hunter.
10021. Jones.
10073. Gurteen, Jun., Gurteen, Gurteen, & Unwin.
10097. Harvey.
10120. Wormald.
10164. Crookes & Ricarde-Seaver.
10232. Elliot & Creed.
10310. Satchwell.
10330. Cleeve.
10344. Cook.
10504. Crawford.
10592. Oldershaw.
10933. Von Dolivo-Dobrowolski & Allgemeine Electricitäts-Gesellschaft.
12130. Brocklehurst.
12279. Lees.
12996. Lomas.
13755. Walker & Stephenson.
14048. Avery.
15839. Browne (*Prowattain*).
16544. Bonne (*Hofele*).
17493. Trainor.
17720. Hill.
18286. Pridham.
18709. Jones.
19110. Clarkson (*Fisher*).
19847. Elsom.
20223. Taussig.
20372. Hickman.
20675. Sautenard.

1890.

37. Smee.
430. Des Rosiers.
818. Strain.
1077. Thornycroft.
1754. Höper.
1988. Johnstone.
2303. Coker, Mitchell, & Fosdick.
2470. Gay.
2665. Britten & Biddlecombe.
2902. Ingraham.
3072. Korn.
3229. Leak & Aynsley.
3306. Ekelund.
3455. Lake (*Ewing*).
3483. Burdon.
3668. Foulds.
3789. Watts-Hughes & Viney.
3944. Jerome & Stevens.
4019. Nightingale.
4022. Thompson (*Heinrichs & Schuster*).
4084. Stehle.
4109. Brown.
4133. Roberts & Belden.
4148. Pol & Künzel.
4190. Allison (*Munger & Munger*).
4199. Mills (*Rau Novelty Company*).
4262. Thomson.
4314. Schreiner & Salz.
128. Bang & Ruffin.
653. Smith.
1037. Bowles.
1247. Fairgrieve.
1901. Brown.
2139. Bellot.
2308. Beck (*Schaal*).
2398. Aston.
2640. Blanken.
2750. Newcome.
2871. Berne & Taylor.
3018. Howard & Geddes.
3095. Leigh (*Williams*).
3293. Carette.
3400. Allison (*Githens*).
3459. Ames.
3537. Salberg.
3686. Lee.
3840. Currie.
4018. Gadewoltz.
4021. Boult (*Sievert*).
4048. Clegg.
4077. Mathewson.
4088. Cahill.
4124. Bell & Nicholls.
4144. Morrell.
4186. Kennedy.
4192. Coons & Coons.
4193. Schorno.
4237. Wells.
4244. Galloway & Beckwith.
4276. Preston.
4819. Pryce.

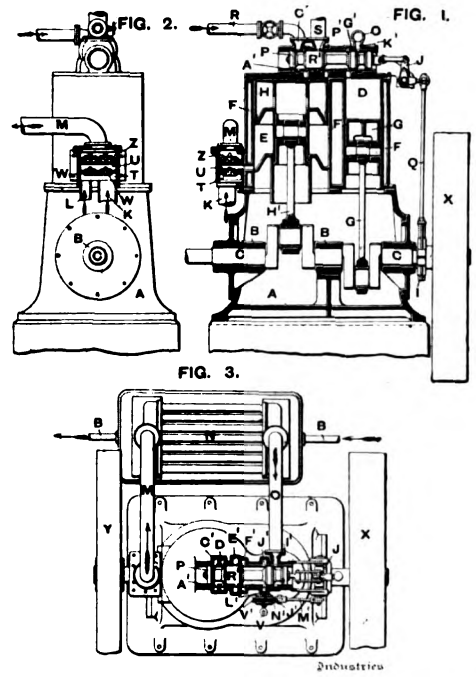
ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

Milling Machines.—*G. Collett, Ashton-under-Lyne, and J. Hollingworth, Dobcross, Yorkshire.*—In the usual form of this class of machine tool the cutter spindle is carried at one end by a headstock, and at the other by a fixed radial arm cast to the headstock. To obviate the impediment of the radial arm in cutting certain forms and shapes of work, the inventors make the arm so that it can be revolved or oscillated, and its position altered to suit the work. The radial arm and headstock are cast separately, and the headstock has a flange with an annular groove formed in it. A flange corresponding to that on the headstock is formed on the radial arm, and T-headed bolts, sliding the groove of the former, pass through holes in the latter, and so provide the means of clamping the arm in any position. Claims: In milling machines for cutting metals the use of an adjustable radial arm such as that herein described and shown for the purpose set forth.—No. 7236. May 1st, 1889. 6*d*.

Moulds for Bricks.—*J. G. Parker, London.*—Instead of making the pressure mould of a brick machine with solid sides and bottoms, the inventor makes the lower parts of the sides and the bottom perforated. A body of grit sand or gravel is placed in the mould of sufficient height to cover the perforation in the sides. Above this body of grit is placed a perforated or porous slab of the internal dimensions of the mould and resting upon the body of grit. Over this slab is spread a piece of fine calico. The object of thus preparing the mould is to provide passages for the escape of moisture from the clay as the brick is being formed in the upper part of the mould. The brick is delivered from the mould in the usual manner. Claim: The method described of making moulds with perforated sides or bottoms to be filled with granulated filtering material in the manner described.—No. 4881. March 20th, 1890. 6*d*.

Gas Engines.—*H. H. Lake, London.* (*J. C. Beckfield & A. Schmid, Pennsylvania, U.S.A.*).—The principal object of this invention is to ensure the more uniform expenditure of the driving power in gas engines. The three illustrations show respectively a sectional front elevation, a side elevation, and plan of an engine constructed according to the invention. The engine has two cylinders D and E of different diameters; the larger, E, is termed the power cylinder, and the smaller, D, the explosive cylinder. Communication is made between the two cylinders, between the cylinder D and a series of pipes N, and between the cylinders and pipes R and S by the valve R¹. The engine is first started by the admittance of steam to the cylinders. The steam is supplied through R, and exhausted through S. When speed



has been obtained, gas and air is passed to the engine through K, and is drawn into the lower part of the cylinder E. Upon the descent of the piston H, the explosive mixture is compressed and discharged through the valve U and pipe M to storage pipes N, which are surrounded by water. From the storage pipes the mixture is drawn into the cylinder D, and when the piston G is at the bottom end of its stroke, and the piston H at its top end, communication is made between the cylinders, and the charge is exploded. The piston H is thus driven down again, compressing a fresh supply of gas and air, and the piston G ascends ready to take in a fresh explosive charge. Nine claims are made.—No. 2647. February 18th, 1890. 8*d*.

Signalling Apparatus.—*J. Fletcher, London.*—This apparatus is designed for the purpose of indicating the position of the helm of any vessel to one approaching it. A large lamp with circular front made of opal glass is fitted with a diaphram or circular piece of metal so arranged that it will travel across the larger front by the action of the helm. The disc of metal is smaller than the semi-transparent front of the lamp, and therefore when the helm is amidship a circular white ring is visible. When the helm is moved over to port or starboard side a half moon is shown either to the right or left, as the case may be. The metal disc may also be connected to engines of a steamer to show whether the engine is going astern by lifting the disc to the top, or going ahead by lowering it. By the semi-transparent nature of the front of the lamp the device may be seen in the day and at night. Claims: (1) Apparatus for signalling in which a disc or other shaped screen is, on the helm being moved, caused to traverse across an illuminated space; (2) apparatus for signalling as described.—No. 6923. April 25th, 1889. 6*d*.

Steam Engine Governors.—*J. W. Brown & W. W. Sutcliffe, New Orleans, U.S.A.*—This governor is arranged on the steam supply pipe of the engine. It consists of a turbine, situated in the steam pipe, and rotated by the passage of the steam to the engine. To the axle of this turbine are fitted centrifugal governor balls, whose sliding collar is connected to a valve regulating the supply of steam to the engine. Thus, as the rate at which the steam flows to the engine varies, the turbine varies directly in speed, the centrifugal balls rise or fall and the regulating valve is opened or shut. Seven claims are made.—No. 2691. February 19th, 1890. 8*d*.

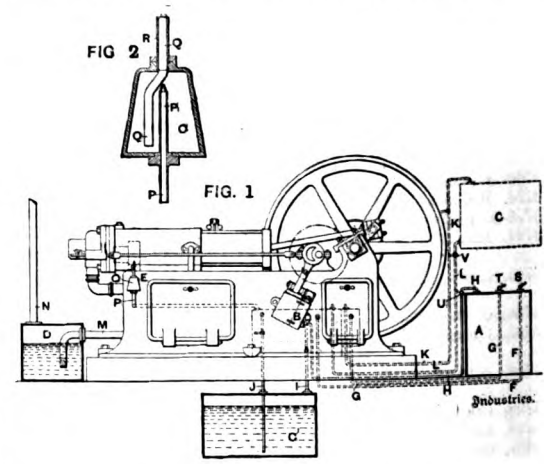
Manufacture of Clear Ice.—*W. L. Wise, London.* (*Escher, Wyss, & Co., Zurich, Switzerland*).—A rotating motion is given to the water to be frozen by external means. The freezing cell is surrounded by the freezing mixture, and it is fitted so as to turn on a vertical, horizontal, or slanting axis. The revolving motion is made continuous in one direction or reciprocal. This motion of the cell in the freezing mixture induces an active friction between the walls of the cell and the liquid to be frozen within the cell. The friction is so great that the liquid is quite freed from air during the operation of freezing, and freezes into a transparent crystal-like block. Three claims are made.—No. 5592. April 2nd, 1889. 8*d*.

Cushioning Parts of Machinery.—*A. Gibb, London.*—In applying this invention to cylinders filled with liquid to form a resistance to the movement of a piston from end to end of the cylinder, a second cylinder is arranged upon the side of the first to receive the liquid as it is discharged by the piston in the first. The second or receiving cylinder has two pistons situated at each of its ends, and they are pressed apart by two coiled springs supported upon a rod concentric with the axis of the cylinder and between the pistons. The liquid, as it is discharged from the first cylinder, passes into the receiving cylinder between one of its ends and one piston against the resistance of the springs between the pistons. The force of the springs and the suction of the piston in the first cylinder returns the liquid from the receiving cylinder to the first as its piston makes a return stroke. Claim: That by the present arrangement only one receiving accumulating cylinder is used instead of two, thereby effecting a saving of half the number of springs and tension rods, besides having the springs enclosed and the whole taking up less room.—No. 5151. March 26, 1889. 6*d*.

Water-Heating Apparatus.—*T. Bradford, Salford.*—This apparatus is constructed somewhat in the manner of a feed-water injector. The object of the invention is to make use of steam for the purpose of heating water supplied to public baths and steam laundries. The appliance is attached to the water supply pipe, and consists of a cylindrical chamber having three openings, one at each end of the chamber opposite to each other, and the third at the centre of the side of the chamber at right angles to a line drawn through the others. The water is supplied through the opening upon the side of the chamber, and steam at one of the end openings; the resulting hot water from the mixture of the two is discharged at the other end opening. The steam entrance terminates in a steam nozzle within the chamber, and the discharge opening is made smaller than the water inlet. By this construction the steam mingles with the water as it passes through the device. Claim: The improved apparatus as described for heating water by means of a jet of steam introduced into the supply pipe between the cold supply and the hot outlet.—No. 8392. May 20th, 1889. 6*d*.

Steam Boilers.—*J. F. A. Schnarrendorf, Hamburg, Germany.*—The invention is especially applicable to high-pressure boilers. Its objects are to increase the calorific effect of the burning gases and to facilitate the cleaning of all those parts liable to be fouled by the products of combustion. To withstand a high pressure the boiler is made of spherical form, the shell being composed of two semispherical parts. The fire-boxes—four in number—are arranged in the lower part of the boiler symmetrical about its vertical axis. At the junction of the pipes is attached the uptake, which is here a vertical tube. The lower part of the tube forming the uptake constitutes with the four large radiating tubes the fire-box of the boiler; the lower part of the vertical tube is divided from the upper by a damper. From the vertical tube a number of small tubes radiate to the boiler shell. The products of combustion, as they leave the fire-box, pass by these small tubes to an annular smoke-box upon the outside of the boiler shell, and then back again through similar tubes to the uptake above the damper, when they ascend and are discharged. Claims: (1) A boiler which is spherical or concoidal in form, and provided in its lower part with a number of fire-boxes developed at their junction on the upper surface of the latter into a socket connected to a fire-box plate which is adapted to receive the inner ends of boiler tubes radiating towards an annular chamber or smoke-box; (2) in combination with a boiler, the shell of which is spherical or concoidal in form, and provided in its lower part with a number of fire-boxes developed at their junction on the upper surface of the latter into a socket connected to a fire-box plate, which is adapted to receive the inner ends of boiler tubes radiating towards an annular chamber or smoke-box, a damper within the fire-box, and adjustable in any desired position.—No. 13711. August 30th, 1889. 6*d*.

Hydrocarbon Engines.—*W. D. & S. Priestman, Hull.*—This invention relates to motor engines operated by the combustion of inflammable vapour, such as petroleum or other liquid hydrocarbon mixed with air, and consists of improved means for heating the vapour-chamber preparatively to starting the engine, means for replenishing the supply of oil in the petroleum reservoir whilst the engine is running, means for purifying the exhaust gases previously to their discharge into the atmosphere,



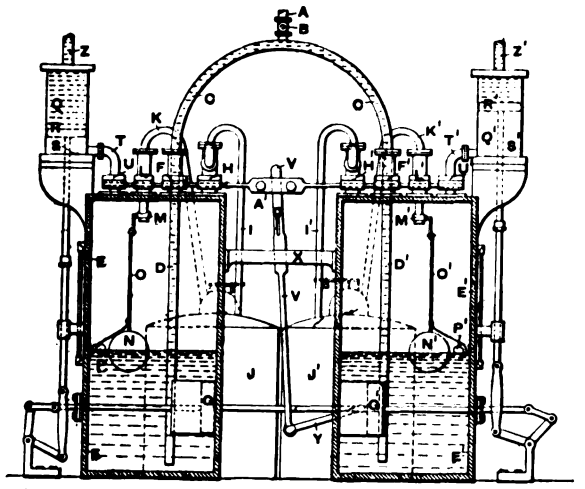
and means applicable for use in connection with firing the working charge when the ignition thereof is effected by means of a flame. In the illustrations Fig. 1 represents a side elevation of an engine embodying the improvements, and Fig. 2 a section upon the ignition lamp. Instead of employing an air-pump actuated by hand for creating sufficient pressure in the petroleum and compressed air reservoir to operate the vapour lamp before the engine is started, the inventors employ a storage vessel A, which is supplied with air from the reservoir through the pipe F or by means of a subsidiary pump B whilst the engine is in motion. When the engine is restarted it is thus only necessary to turn the cock T, and form communication between the vessel A and the petroleum reservoir, to supply the lamp with air and oil. To replenish the supply of oil in the petroleum reservoir whilst the engine is running the reservoir is connected by an air-pipe K with a closed storage tank C. The tank C is placed at a height about the reservoir to equalise the pressure in the two. By opening the cock V the oil flows by gravitation to the reservoir. The exhaust gases are purified previously to being discharged into the air by leading the exhaust pipe N to a cistern D containing water. The pipe is so arranged that the gases before

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escaping pass through the water and the heavier products are thereby condensed and arrested. The lamp employed for igniting the charge is a petroleum lamp E provided with an oil tank O and supplied with air from the petroleum reservoir through the pipe P. Q is the lamp-wick. Six claims are made.—No. 6682. April 18th, 1889. 8*d*.

JOURNAL LUBRICATORS.—*J. T. Kirby, London.*—This lubricator works by capillary action. Under the shaft to be lubricated is a flat-bottomed vessel containing the lubricant. In the vessel is a wick-holder made of a thin sheet of metal bent into the shape of a U. The upper ends of this U-shaped holder is bent to fit the shafting, and they have cut in them serrated edges, which are bent inwards, and hold up the wicks against the sides of the shaft. The wicks consist of sheets of asbestos or woollen felt. One edge of the wicks dips into the lubricant, whilst the upper edge is held against the sides of the shaft. Six claims are made. —No. 1218. January 23rd, 1890. 6*d*.

COMPRESSED AIR GENERATORS.—*A. J. Boult, London. (L. Bontemps & P. Bontet, Paris.)*—The energy utilised for the purpose of compressing the air is that due to a constant column of water. The machine is of duplex form, and the pressure of the column of water transferred from one compressing chamber to the other alternately. The illustration shows a sectional elevation of the machine. E E¹ are the compressing chambers; J J¹ the reservoirs for compressed air; Q Q¹ air cylinders for supplying air to the compressors; G G¹ pistons for compressing the air; A the pipe sustaining the column of water, and having branch pipes C leading to each compressing chamber; U, F, H, and U¹, F¹, H¹ are valves controlling respectively the supply of air and water to the compressing chambers, and the escape of air from the compressing chambers to the reservoirs: the valves are actuated by the tappets and rods A¹ V. The machine works in the following manner: The various parts being in the positions illustrated, air will be passing from the cylinder Q to the chamber E whilst water enters from the pipe A, and by the pressure due to its

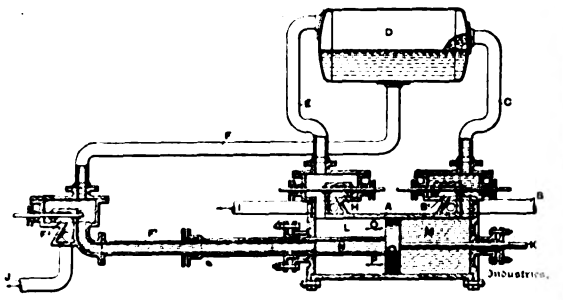


height forces the piston G to the right. The motion of G is transmitted to G¹, and the latter thereby compresses the air in E¹, and causes it to escape to the reservoir J¹, whose valve H¹ is open. At the same time the piston R descends and passes air into the chamber E, whilst the piston R¹ ascends and draws a supply of air into its cylinder through the flap valve S¹. The tappet arrangement is also operated by the motion of the piston G, and as it approaches the end of its stroke shifts the valves so that those previously open are shut. An action now commences upon the right side of the machine similar to that upon the left side. When the water exceeds a certain height a float arrangement N and N¹ opens a valve and discharges the water from the chambers E E¹. Eight claims are made.—No. 1893. February 2nd, 1889. 8*d*.

LOOMS.—*G. Thomson & J. Hampshire, Huddersfield.*—The object of this invention is to diminish the shock caused by the momentum of the shuttle of a power loom at each end of its traverse or pick, and is chiefly applicable to under pick looms. The two picking arms are connected by straps which are looped upon the arms and connected by wire provided with one or more screw couplings for adjustment. The wire or rod is strained sufficiently to cause the picking arms when at rest to be drawn a slight distance towards the centre line of the loom in order that when either of the pickers is struck by the shuttle a small space is left in which the picker springs back. The leather loops by which the check wires are attached to the picking arms are on one side of the loom secured to the picking arm above its pivot and upon the other side below its pivot. By this arrangement the lower part of the picking arm moves outwards when the shuttle is struck, and draws the non-striking picking arm inwards a short distance; in this position the non-striking picker receives the shock of the shuttle. Claims: (1) For the purpose of checking or diminishing the force of the blow given by the shuttles of power looms at each end of their traverse or pick a connecting wire or rod provided with screw couplings for adjustment, each wire being attached to a picking arm by means of a strap and loop of leather upon one side of the loom above the fulcrum upon which the picking arm is hinged, and the same wire is connected to the picking arm upon the other side of the loom below the fulcrum; (2) in a check motion for the shuttles of looms the combination of the check-wire or rod, the screw couplings, and the straps and loops of leather, with the picking arms and the springs for returning the arms into their striking position; (3) the general arrangement of the parts comprising the check motion as described.—No. 3149. February 27th, 1890. 6*d*.

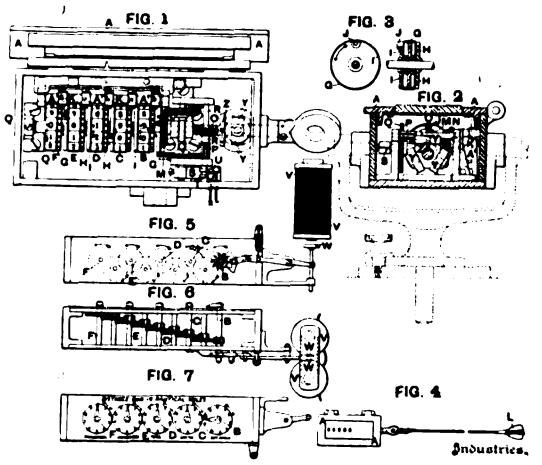
STEEL.—*M. F. Coomes & A. W. Hyde, Louisville, U.S.A.*—The object is to effect a rapid carburisation of malleable cast iron or of low carbon steel by the use of certain carbon compounds which are readily decomposed by contact with heated metal. Suitable carbo-hydrates for the process are sugars, syrups of any kind, molasses, treacle, and honey. As an equivalent and substitute for the above any of the organic acids which result from the oxidation of glycols may be employed. Any of these substances are dissolved in water or milk, forming a bath into which the metal to be carburised is placed at a white heat. The metal parts with its heat, which decomposes the carbo-hydrate, setting free the carbon, which is absorbed and chemically united with the metal. Four claims are made.—No. 2981. February 25th, 1890. 4*d*.

ALTERING THE PROPORTION OF MIXED GASES.—*S. Fox & E. Blass, Leeds.*—The proportion of the gases is altered by compressing the mixture in the presence of a suitable absorbent, such as water, and thus eliminating quantities of the respective gases. A longitudinal sectional side elevation of the apparatus



used for this purpose is shown in the illustration; it works in the following manner:—The piston O, when moving in the direction of the arrow P, draws in through the pipe B and valve B¹ a charge of the gas and water. On the return stroke of the piston this charge is delivered under pressure through the pipe C to the reservoir D. The water, with the gases it has absorbed, are drawn from the reservoir D through the pipes and valve F F¹ and F² into the hollow prolongation N of the piston O as the latter makes its stroke to the right. Upon the return of the piston to the left, the water and contents are forced out through the pipe F¹ and valve F² to the delivery pipe J. The gases in the altered or purified state are removed from the reservoir through the pipe E and valve H, and discharged through I by the action of the piston in the back of the cylinder L. Claims: (1) The altering the proportions of gaseous mixtures by compressing them intimately mixed with water substantially as herein set forth; (2) the apparatus or its equivalent substantially as described and illustrated for the purpose specified.—No. 6129. April 10th 1889. 6*d*.

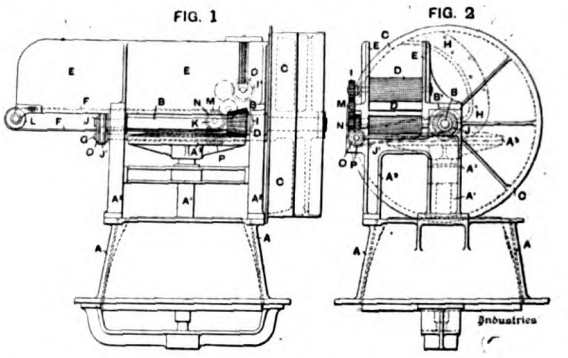
LOG OR CURRENT METER.—*D. McGregor, Jun., Glasgow.*—This log or meter is an improved instrument for recording the distance a vessel travels through the water, or it may be used for ascertaining the speed of currents of water or other like purposes. The movement or wheelwork is contained in a strong metal case which by suitable fittings accommodates itself to and neutralises any motion due to the rolling or pitching of the vessel. The illustrations show Fig. 1a plan of the meter with case open, Fig. 2 a sectional end elevation, Fig. 3 views of a recording drum; Fig 4 shows a plan of the meter on a reduced scale; Figs. 5, 6, and 7 show an indicator with dials and pointers provided with electrical means for communicating the state of the meter on the bridge of the vessel or other parts. Referring to Figs. 1, 2, 3, and 4, the lid A is provided with apertures through which one figure upon each drum is alone visible at a time. Five recording drums are shown; the first B makes one revolution in one mile; the second C one revolution in ten miles; the third D one in a



hundred miles; and so with E and F, increasing by multiples of ten, ten being the number of divisions on each drum. Each drum G (Fig. 3) has secured to it a driving toothed wheel H and a disc I having a single-toothed recess J. The drums are supported upon a shaft in the centre of the box, and the toothed wheels and discs are made to gear with double-toothed pinions K loose upon a counter-shaft A¹. At each revolution of a disc H the recess J engages with a tooth of a pinion K and turns the pinion sufficiently to rotate the toothed wheel I on an adjacent recording drum a distance of one recording figure. The first disc is revolved by means of a rotator L (Fig. 4) whose motion is transmitted to the disc through the bevel gearing M and N. Upon a transverse shaft R is a worm wheel O, which, with the pinions P and Q, revolve a projection S, and by the spring contacts T U connect up an electric circuit containing the electro-magnet V. The magnets V actuate by the armature W, the levers X and Y, and the wheel Z, the indicating mechanism shown in Figs. 5, 6, and 7 which is placed on the bridge or other parts of the ship. Claims: (1) A recording log, for indicating the speed and distance of a ship's motion or the velocity of a water current comprising the combination of a speed counter having a series of indicating edge numbered drums or wheels directly connected to wheel gearing which receive motion from a revolving spindle attached to a tow rope and propeller or motor rotated by the motion of the vessel or current, substantially as described in reference to and shown in Figs. 1 to 4 of the accompanying drawings; (2) in combination with the mechanism of the above-claimed recording log, an electrical make and break contact mechanism actuating speed and distance indicating dials or drums substantially as described in reference to and shown in Figs. 5, 6, and 7 of the accompanying drawings.—No. 6137. April 10th, 1889. 8*d*.

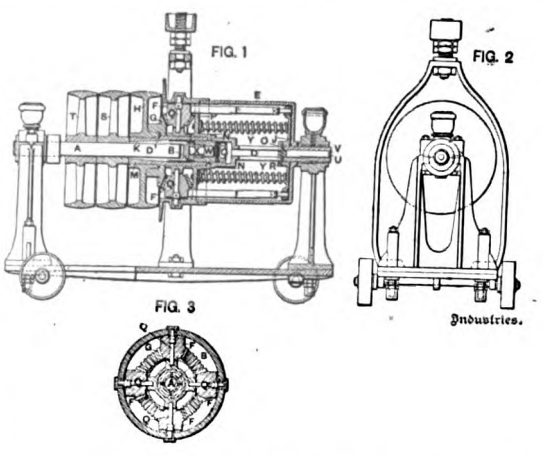
SHIPS' GANGWAYS.—*C. Townson, Montreal, Canada.*—The steps of this gangway or companion ladder are so constructed that they always assume a horizontal position. The hand rails are also automatically adjusted so that they are convenient for the hand notwithstanding the variation of the inclination of the frame. The steps are pivoted at the centre of each end to the side frame of the ladder, and upon their rear edge to two sliding rods. One end of the ladder and the sliding rods are secured to a platform, either of a trolley form when the ladder is to be transported, or to a horizontal extension of the ship's deck when it is permanently fixed to the ship. The ladder is hinged to this platform, so that it can be raised. When the ladder is raised the sliding rods hold the steps in a horizontal position. The upright standards of the rails are pivoted to the side frames of the ladder and the lower or upper part of the rails attached to the horizontal platform, so that the rails always remain parallel to the frame of the ladder. Three claims are made.—No. 3237. February 28th, 1890. 6*d*.

BARK MILLS.—*E. V. Brown, Exeter.*—In this bark mill the bark is cut transversely to the length of fibre, and, dropping from the cutting knives, is received between the grinding surfaces of the mill, where it is reduced to a condition suitable for the tanner. Fig. 1 is a side and Fig. 2 a front elevation of the machine. The driving pulley C is cup-shaped in cross section, and has fitted to its hollow sides the cutting blades H, similar to those used in chaff-cutting machines. To the shaft B of the pulley C is keyed the bevel wheel B¹, which gears into a crown wheel A³. The wheel A³ transmits rotary motion to the conical runner of the



mill. The bark is fed to the machine by laying it in the trough-like casting E. It is then advanced towards the corrugated rolls D by an endless apron F. The rolls D seize it and deliver it to the knives. The rolls D and apron F are driven off the counter-shaft G by the worm P and wheels M N I and I¹. The counter-shaft is driven off the main shaft by an endless chain J¹. The bark as it leaves the knives falls to the conical bark mill A of ordinary construction. Claim: The arrangement of cutting and grinding mechanism described constituting the improved compound bark mill.—No. 7724. May 8th, 1889. 8*d*.

DYNAMOMETERS.—*A. Ackermann, Grellingen, Switzerland.*—A rotating dynamometer is here described, for transmitting and indicating power between the driving shaft and the machine, whose power it is desired to measure. It consists of a drum E carrying bevel pinions F arranged radially within it. The pinions F gear with a bevel wheel G fixed to the loose pulley H, and they are connected by bands I to a disc J movable upon the mandrel D. A resistance to the motion of the plate is caused by spiral springs Y, and the plate is connected to a rod in the interior of the mandrel D. The power transmitted by the dynamometer to the machine is measured by the winding of the bands



on the bevel pinions and the displacement of the plate J. A graduated scale is introduced into the hollow mandrel, and indicates in horse-power the work performed by the displacement of a rod connected to the plate. The pulleys T and S are those used to drive the dynamometer, whilst the pulley H is that used to transmit motion to the machine whose consumption of power is to be tested. In the enlarged part of the hollow mandrel is arranged a coupling device for bringing the machine into work as required. Three claims are made.—No. 8318. May 18th, 1889. October 20th, 1888. 8*d*.

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Bottle Washing Mechanism.—*G. Burges, Jun., Sheffield.*—The machine consists of an intermittently rotating bottle-carrier having recesses in which the bottles are soaked and automatically brushed, and of mechanism for brushing the bottles internally and externally, and finally delivering them on to a table by the side of the machine. In the illustrations Fig. 1 is a side elevation, Fig. 2 a back elevation, and Fig. 3 a front elevation of the machine. The bottle-carrier A is a drum-like casting, having cylindrical chambers B for the bottle. The carrier is supported by tubular journals in a water tank C. A ratchet wheel D is secured to the side of the carrier A, the number of teeth corresponding to the number of rows of bottle chambers B, so that by rotating the carrier the distance of one tooth a fresh row of bottles are brought under action. The mechanism for driving the carrier by the ratchet wheel consists of the parts E, F, G, H, I, J, K, and L, operating the pawl M, and causing it to advance a

FIG. 1

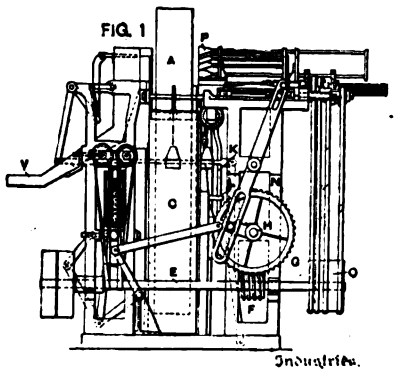


FIG. 2

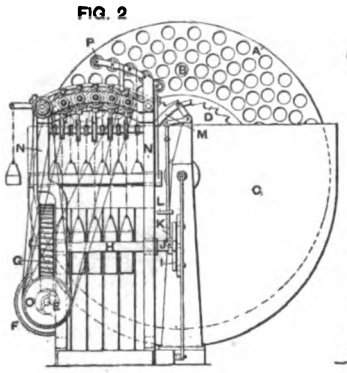
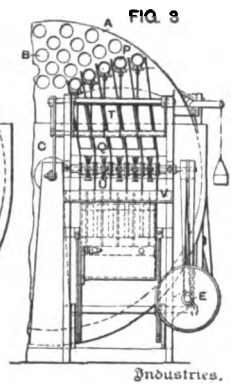


FIG. 3



tooth each revolution of the crank plate I. At the back of the machine is a frame N which carries a series of rotating brushes corresponding to the holes in the carrier. The brushes are rotated by bands upon the pulley O, and they are intermittently advanced in the direction of their lengths for brushing the interior of the bottles in one row of holes when the carrier is at rest, and are retired prior to the next movement of the carrier. Above the brushing mechanism is arranged an equal number of bottle-ejectors P, which are advanced in the manner of the brushes and eject the previously washed bottles. The bottles as they are ejected from the carrier are conducted mouth downwards through the channels Q to the externally brushing brushes, and then to the rinsing pipes. Each of the channels Q is provided with a shutter T, which are simultaneously opened to pass the bottles to the brushes, and also to simultaneously press the bottles, previously brushed and rinsed, over into the front continuation U of the channels Q down which they slide to the delivery table V. Nine claims are made.—No. 19801. December 9th, 1889. 8*d.*

Hydraulic Presses.—*C. A. Piat, Paris.*—According to this invention the actions and reactions take place in the interior of the press, and the press is suspended from the extremity of a swing arm instead of a jib or ordinary crane; it can thus be readily manipulated and can be used in connection with several platforms or tables. Or the press may, with the same object, be

FIG. 1

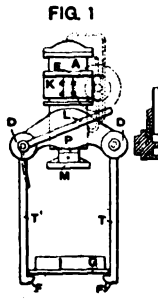


FIG. 3

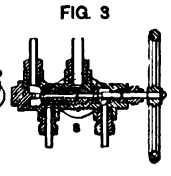
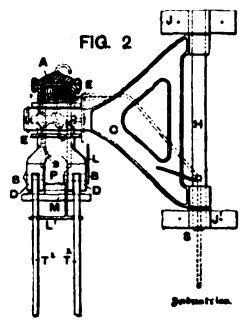


FIG. 2



carried by rails. The support, whether swing arm or rails, has only to withstand the mere weight of the apparatus, and is not affected by the internal strains which may be developed, as is the case in ordinary presses where the action takes place between a bed-piece or support and a head-piece. In the accompanying illustrations Figs. 1 and 2 are respectively side and end elevations of the apparatus. A is a hydraulic cylinder supported by a shoulder E upon the collar K of a pivoted frame C. In this cylinder works a piston P carrying a compressing plate M. The ascent and descent of this piston are effected by means of water under pressure distributed by distributing apparatus which may be of the kind described in the specification of a former patent, No. 7026 of 1886, and of which a longitudinal axial action is shown in Fig. 3. The hydraulic distributor is shown in position by the dotted lines. The lower end of the cylinder is formed with a cross-head which carries the hooks T T^1 T^2. These hooks engage with the underside of a table G, upon which the material is placed to be pressed. A hand lever L enables the operator to throw out the two hooks T^1 T^2 from under the table, to facilitate the removal and placing in position of the table. The vertical axis or pillar H, which supports the frame C and turns or travels therewith, is provided with a stuffing box at one end for the reception of the pipe supplying the pressure water. The exhaust pipe may in like manner pass out through the same end or through the other end, or it may freely eject the exhaust water whilst following the motion of the apparatus. Claims: (1) Tie-bars such as T T^1 each provided with a hook such as F and freely suspended from an axis such as B passing through a lug such as D on the cylinder A, in combination with an operating lever such as L and a press table G; (2) the cylinder A with collars E E in combination with a frame C, having a collar K fitting loosely between the collars E E, the said frame turning with the axis H, which has a stuffing box S, through which passes the pipe that supplies the pressure water to the distributor S of the press; (3) the combination of the piston P, the hydraulic distributor S, and the collar K surrounding the cylinder A, the whole so arranged as to permit of the rotary movement of the apparatus in conjunction with the up and down movement of the piston.—No. 16686. October 22nd, 1889. 8*d.*

ELECTRICITY.

Dynamos and Motors.—*James Swinburne, Wimbledon.*—This invention refers to direct and to alternating current dynamos and motors. A sort of subsidiary armature core, consisting of a ring of wires or discs, is placed inside the connections to the commutator, so that the commutator connections are on its outer surface, or in grooves milled out of the discs. A little field magnet is arranged so that the connections come under it so as to have the necessary electromotive force induced at the right time or place. An alternating current motor is designed so that at any instant its back electromotive force is just less than the electromotive force on its terminals by enough to cause the armature current needed to give the power. At no load such a motor should give a back electromotive force which at any instant is almost exactly equal to the terminal electromotive force. At full load the field is weakened enough to let the necessary current pass, so that the motor does not need to lag much and weaken its field by the reaction of its armature current. In the case of a motor, the exciting circuits are so arranged that at no load the field excitation gives a back electromotive force approximately equal to the electromotive force in the mains. If it has very nearly the same back electromotive force the motor at no load becomes cophasedly synchronised and takes just enough current to drive it and give power for excitation. When load is put on the motor begins to lag. The armature current then reacts on the fields and weakens them; this weakens the field excitation, as the exciting coils are influenced by the same field magnets, and the field can thus be weakened enough without much lag. The exciting armature circuits are coupled up to a commutator, as in an ordinary closed or open armature circuit direct current machine. The field excitation is then affected by the main armature current's reaction on the field magnets. The field excitation may be lessened more directly at full load by passing the main current of the motor round the field magnets after commutation. All these methods depend

FIG. 1.

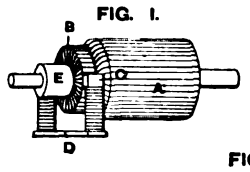


FIG. 2.

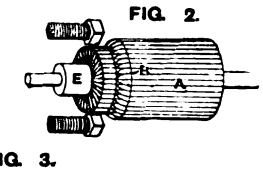
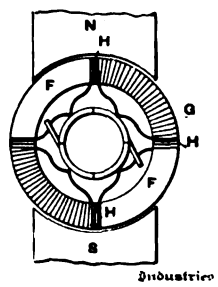


FIG. 3.



for their final adjustment on the lagging of the motor as the load increases, but instead of being considerable the lag is small, because the current turns round the field magnets are fewer at full load than at light loads. To start an alternating motor, the inventor uses one of the methods already mentioned by him in earlier patent specifications—namely, starting by connecting batteries with the direct current exciter; starting by turning the alternating current into the exciter, which has, preferably in this case, laminated magnets; or starting by connecting the armature and field magnets of the motor with the alternating current. Fig. 1 is a diagram of a reversing armature and magnet attached to an armature and commutator. A is the armature of the dynamo or motor and E the commutator. B is the reversing armature core, in the periphery of which the commutator connections are embedded, and C is one pole of the reversing magnet. A yoke D is shown, but in practice the vertical parts of the magnet are mounted on the bed-plate. Fig. 3 is a diagram showing the commutator sections and connections of alternating current motors. F is a ring armature. For the sake of simplicity a two-pole machine is taken, though in practice it is better to have six or more, so that the speed is not too great. G are the active coils or main coils of the machine. They are connected to collecting rings as usual, which are not shown in the diagrams. H are the exciting coils of the armature. In Fig. 3 the exciting coils are connected up as in a Gramme ring. Claims: A generator or motor for direct currents, having—(1) A reversing armature core with the commutator connections embedded in it; (2) a reversing armature with the commutator connections thin where they pass through the reversing field; (3) a reversing armature core with each commutator connection passing over the outside only once, substantially as set forth (4) reversing magnets adjustable as to position substantially as described. A synchronising alternating current motor—(5) in which the current turns on the field magnets are decreased when the load increases; (6) excited from its own armature; (7) a self-exciting alternating generator or motor with two or more exciting coils on the armature giving currents differing in phase, substantially as and for the purposes set forth.—No. 3424. February 26th, 1889. 8*d.*

Electrical Firing Apparatus.—*R. Morris, Blackheath, London.*—The firing is effected by a blow from a spring striker on a percussion cap. There is attached to the breech of the weapon a tube containing a spring striker, which can be drawn back by a handle at the breech end of the tube. When the striker is drawn fully back, compressing the spring, a sear in the form of a stud, sliding in a hole of the tube transversely to the striker, is caused by a spring to engage in a recess of the striker and hold it back in a cocked position. The sear is connected with certain freedom of motion to the armature of an electromagnet which is fixed on the side of the tube. One end of the armature is hinged to one end of the core of the electromagnet, and the other end of the armature is held by a spring at some distance from the other end of the core. An arm projecting from the armature has a pin entering a circularly slotted hole in the sear. The coil of the electromagnet is connected by two insulated wires to a battery through a contact key which may be at a distance. On depressing this key a current passes through the coil of the electromagnet, and the armature is attracted. During the first part of the movement of the armature its pin moves freely in the slot of the sear, but at the last part of its movement this pin, meeting the end of the slot of the sear, pulls the sear outward, releasing the striker, which is thereupon forced forward by its spring, and, striking the cap, explodes the charge. Claim: Electric firing apparatus for ordnance, consisting of a tube attached to the breech of the gun, having within it a sliding spring striker, in combination with an electromagnet, armature lever, and transversely sliding sear constructed and operating as described.—No. 7780. May 9th, 1889. 6*d.*

CHEMISTRY.

Extraction of Gold.—*J. H. Pollok, Glasgow.*—This invention consists in the continuous application of hydraulic pressure to a rotating vessel, in which the process of chlorination is being conducted, by means of a pipe leading from an accumulator, pump, ejector, or other water-forcing device to the cylinder. The pipe passes through the centre of rotation of one end of the cylinder, to which it is attached and kept tight by a suitable packing box. In operating, the ore is first crushed, concentrated, roasted, or otherwise prepared, and is then placed in the cylinder with the necessary reagents. The air is next removed from the cylinder, and the water supply turned on. When the cylinder is completely filled with ore, reagents, and water, it is closed and revolved. The water maintains a constant pressure in the cylinder during chlorination. When the chlorination is completed the valve on the hydraulic press supply pipe is closed, and the excess of chlorine blown off by a valve provided for the purpose. The contents are next discharged from the cylinder to a filter, when the solution of gold is drawn off and the gold precipitated. Claim: The application, as described, of continuous hydraulic pressure to the revolving cylinder wherein the wet method of extracting gold by chlorine, bromine, or iodine is conducted by means of a pipe passing through the centre of rotation of one end of the cylinder, and connected to the said end of a suitable packing box so as not to interfere with the revolving of the cylinder.—No. 5578. April 2nd, 1889.

MISCELLANEOUS.

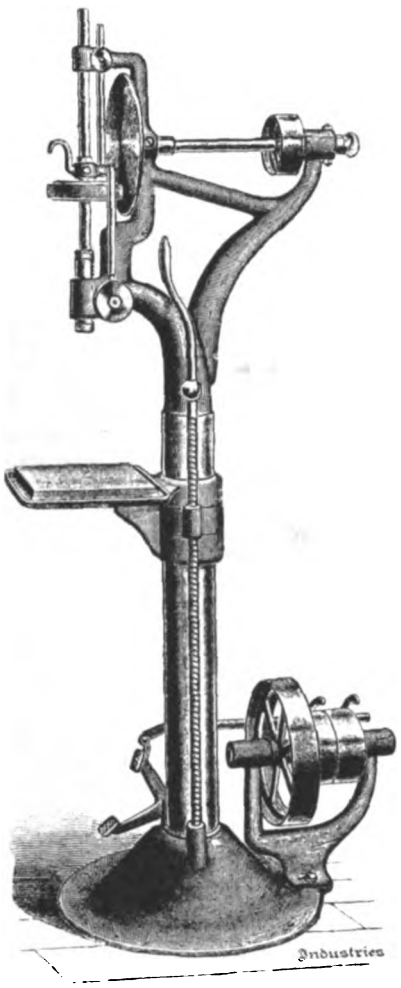
Speaking Tubes.—*G. King, London.* (*H. A. Cutmore, Melbourne.*)—The mouth-piece of this speaking tube is of the ordinary construction, but it is used only as a transmitter. In the tube, close behind the mouth-piece, is a cock of usual form, which closes normally the end of the tube. The cock is made hollow, and its interior communicates with a branch pipe, which answers the purpose of a receiver. The branch pipe is secured to the plug of the cock, and by its weight the pipe normally hangs downwards and closes the cock. When the branch pipe is raised, however, in a horizontal position to the ear of the operator the cock is opened, and communication formed between the speaking pipe and branch tube and between the pipe and its transmitter or mouth-piece. Behind the cock is situated, on the upper part of the tube, a compressible bulb, having communication with the tube, and provided with a signalling whistle or call. To use the tube, the operator first attracts the attention of the recipient by pressing the flexible bulb. This action blows the whistle in the bulb at the other end, and conversation can then be carried on by raising the branch pipes to the operators' ears. Claims: (1) In a speaking tube the combination with a cock plug of a hollow branch or arm, communicating with the interior of the plug, and carrying an ear-piece and a mouth-piece; (2) in a speaking tube the combination with a stop-cock or equivalent device, adapted to close or unclose the tube of a signalling device; (3) in a speaking tube the combination with a stop-cock adapted to close or unclose the tube of an ear or mouth piece connected with the interior, and movable with plug of said cock, and a mouth or ear piece upon said piece; (4) in a speaking tube a cock with a parallel plug and stops, adapted to allow of the plug being inserted into the barrel from either side; (5) the combination with a speaking tube of a cock or equivalent for closing or unclosing the tube, and operated by an arm or tube which carries the mouth or ear piece; (6) the combination and arrangement of parts described; (7) in a speaking tube the combination with means for stopping the tube of a call-whistle or equivalent.—No. 4787. March 18th, 1889. 8*d.*

Copies of the British specifications may be obtained on application to H. Reader Lack, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every 10d. or fraction of 10d. Remittances exceeding one shilling must be made by Post Office Order.*

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SENSITIVE DRILLING MACHINE.

The drilling machine here illustrated is specially adapted for delicate and accurate work, where exact adjustment and rapid and effective operation are essential. The machine is made by the W. F. & John Barnes Company, of Rockford, Illinois, U.S.A. All the adjustments of power and speed can be made without removing the belts or stopping the machine. By means of the hand



screw shown, the table can readily be moved and fixed at any required height. The principal dimensions are: Extreme height from the base to the drill spindle, 46in.; the greatest space between the table and spindle, 36in.; diameters of column and spindle, $3\frac{1}{2}$in. and $\frac{3}{4}$in. respectively; vertical motion of spindle, $3\frac{1}{2}$in. The machine weighs 170lb., and is capable of running at any speed up to 1,600 revolutions per minute.

THE S.S. "PRINS WILLEM II."

On pages 436 and 437 we illustrate the engines of the steamship "Prins Willem II.," the general arrangement of whose engines and boilers we illustrated in last week's issue. We need not repeat the description of the engines which we then gave, but we give as follows their leading dimensions and particulars:—Diameter of cylinders, 22in., 34in., and 56in.; stroke, 40in.; initial steam pressure, 160lb. per sq. in.; indicated horse-power, 1,235, at 72 revolutions per minute.

THE INSTITUTION OF MECHANICAL ENGINEERS.

The spring meeting of this Institution was held on Thursday and Friday, the 1st and 2nd inst., at the Institution of Civil Engineers, Great George Street, Westminster, Mr. Joseph Tomlinson, President, in the chair. After it had been announced that the Prince of Wales had been elected an honorary life member of the Institution in recognition of the interest he has always taken in mechanical progress, the President delivered his inaugural address, which we publish herewith in full. There is no man living, with the exception, perhaps, of Mr. Edward Woods, who has had such a long experience in railway work as the President, and the reminiscences which formed the substance of his address are therefore of special interest.

PRESIDENT'S ADDRESS.

As I have been a railway man nearly all my working life, I think the best subject I could choose would be "Railway Locomotion" of the past and present. My recollection and practice lead me back to the early days of the locomotive engine, though not to the very earliest. My first knowledge of them as a boy dates back to the year 1837. My father being at the time passenger superintendent of the Stockton and Darlington Railway, it was nothing extraordinary that, with my predilection for mechanics, my desire to go to the old Shildon Works should be gratified. Timothy Hackworth, the then locomotive superintendent and also the contractor for the working of the railway, was pleased to agree that I should have the "run of the shops"; and thus I began my working life.

The locomotive engines in use in the early days of the Stockton and Darlington Railway differed widely in every respect from those of to-day. Nearly all, I daresay, have seen old "Locomotion," now on the pedestal in front of the North Road Station at Darlington. This engine was one of three which were first placed on the railway. Two only survived to the time I first knew it. It is now as it was delivered to the railway; but the boiler *is not* as I knew it at first. When first put to work it would not make steam; and the fire tube had to be taken out and replaced by a return tube, similar to what is now, or was until lately, used in the boilers of north-country tug boats. When this had been done its load was composed of 16 waggons, weighing empty about 27 cwt. each, or about 22 tons for the train. This was its load from Middlesbrough up the hill to Shildon; and down the hill from Shildon to Middlesbrough it took the same number of waggons loaded, each carrying 53 cwt. of coal, or about 64 tons for the train. The weight of engine and two tenders loaded with coal and water was about 15 tons. There is unfortunately no record of the consumption of coal for this early period; but I think I may say, from having helped to put the coal on the tender, that 16 cwt. to 17 cwt. were consumed in 48 miles, or about 40lb. per engine-mile, the principal part of which was consumed on the up-hill journey. This engine had two cylinders of 10in. diameter and 24in. stroke, half of each being inside the boiler. It had a cross-head to each cylinder, and thus four connecting-rods and two coupling-rods. It had four wheels of 4ft. diameter coupled. There were only two eccentrics, which had to be changed in position for back and forward gear, and the engine had to be started by hand-gearing. There was no brake on either engine or tenders. The steam pressure was from 30lb. to 35lb. Necessarily the engine had no springs; and the axles ran in cast-iron plummer-blocks. The pistons were packed with a spun-yarn gasket plaited square, which was tightened by a piece of box-wood and a hammer whenever required; this was done by the driver and fireman themselves.

The next type of engine was the "Royal George," with six wheels coupled, 4ft. diameter. Like its predecessors, and many types besides, it had vertical cylinders, of about 11in. diameter, 18in. stroke, and steam pressure about 40lb. The boiler was of the return-flue type, the fire-door and chimney being at the same end. It had two four-wheeled tenders, with ordinary chilled-face waggon-wheels keyed on their axles with wooden and iron wedges. One tender, working first up-hill, carried the water in one or two large barrels; the other tender carried coal with which the firing was done. Like the first engine, this also had only two eccentrics. The leading axle, to which were connected the cylinders, had no springs; but there were springs to the two other pair of wheels. The engine was carried, like its predecessor, in cast-iron plummer-blocks. The heating surface would be about 120 square feet, not counting the underside of the grate. The load up the hill from Middlesbrough to Shildon was 24 waggons empty, or about 33 tons; and down the hill the same number of waggons loaded, or 96 tons. The speed both up and down was about seven to eight miles an hour.

The next type was, like the earlier engines, made with vertical cylinders, but with a new class of boiler. It had a boiler partly of tubes and partly a flue, similar to what is now used for small engines, half the boiler having a flue, and then the tubes carried on to the end into a smoke-box. This brought the chimney to the same end as the cylinders. These engines, of which I think there were six, were, as far as I remember, not favourites, and the load had still to be limited to twenty-four waggons. Instead of the ordinary wheels of cast iron, it had wheels made with a cast-iron boss and wood spokes. The tires were of iron, and of the same size—namely, 4ft.

The next type was also a departure from the old type in many respects. The boiler was greatly improved, and went by the name of the "Napier" boiler; it had one straight flue for containing the grate, about 9ft. long; at the end was a combustion chamber, from which about a hundred tubes came back by the sides of the main flue to the chimney. The engine, too, was very much modified. The cylinders were still vertical, but worked on to an independent shaft fitted with cranks, and from thence the power was carried to the wheels by three coupling-rods on each side. The cylinders were about 14in. diameter and 16in. stroke. The steam pressure had also increased to 60lb., and the load was increased to thirty-two waggons, or 44 tons up hill and 128 tons down. This engine had no slide bars, the piston-rod being guided by a parallel motion. The principal defect was that, owing to keeping the centre of gravity low, very short connecting-rods had to be used, not more than three lengths of the crank. Nevertheless, this class of engine was always used to run the passenger trains when any accident or shortness of power rendered it necessary. This engine also had two tenders and only two eccentrics.

The next type of engine was made with inclined cylinders of somewhat larger diameter and stroke, but with the same size wheels. This enabled springs to be used, and many engines of this class were added subsequently. The boiler was longer, though of the same type. This engine took the increased load of 32 waggons. Like the earlier engines this had two tenders, one for water and the other for coal, but no brake.

The wheels of all the classes I have described were of cast iron, and were made in two parts—namely, the boss, which was keyed on the axle, and outside a cast-iron ring to take the tire. This ring was secured to the boss by oak filling-pieces; and after being wedged tight with steel wedges, the wood was covered by a cap inside and out, and a small bolt was put through to prevent the wedges from coming out. This style of wheel was used nearly to the year 1850, and on some old engines after that date.

I have hitherto spoken only of mineral and goods engines; I now come to the class of passenger engines in use at the time I was a lad. Several of the early engines were somewhat similar to the engines of the Liverpool and Manchester Railway, on four wheels; one pair of drivers, with 11in. to 12in. cylinders by 16in. to 18in. stroke, and about 4ft. 6in. to 5ft. wheels; but there was one engine, built, I believe, by Kitching, of Darlington, which has been seen by very few of the engineers now living. It was called the "Swift," and was of small power, about 10in. cylinders by 18in. stroke, with 4ft. wheels coupled, and steam about 50lb. The cylinders were vertical between the two pairs of coupled drivers, and worked on to an independent shaft. When I knew it, the trains between Middlesbrough and Stockton were worked with it. It seemed to me to have been the model from which Mr. Crampton took the idea for his engines of the "Lablache" class, which were put by him in later years on the Great Northern, the South Eastern, and the London, Chatham, and Dover Railways, though he used a crank-shaft and large wheels and greater power; but the idea of the designer of the "Swift" had doubtless been to take the shocks of working away from the power-shaft.

I have now also to describe another engine for passenger train work, designed by the late Timothy Hackworth, and the only one of its class ever made for England, though a somewhat larger one was made and sent to Russia. This engine, the "Arrow," was the first made at Shildon, with what may now be taken as a locomotive boiler—that is, with a fire-box and tubes. The peculiarities of its construction were that it had cylinders of 17in. diameter by 9in. stroke, and 5ft. driving wheels. It was a six-wheeled engine, with single drivers. It was supplied with a cross shaft, on which were hung two solid cast-iron wheels. On each end of this shaft a lever was attached, by which the driver and fireman could pull down the solid or friction wheels between the periphery of the driving and trailing wheels, thus temporarily connecting by friction the large drivers and the small trailing wheels; in other words, converting a single engine into a coupled one, when needed by greasy rails. The engine, as will be clearly understood, was a bad starter, and never did any good service. Many years after it was built I happened to be in the North, and inquiring about my old friends I was informed that the "Arrow" was still at work, but that the short crank had been taken out, and a 9in. put in, and this had been done while still keeping the same cylinders. It was effected by putting in a lever, the top end of which was fixed on the boiler bottom; the piston-rod took hold of the middle of its length, and from the bottom end the small end of the connecting-rod was worked. I need hardly say that such a scheme did not emanate from the brain of Timothy Hackworth, but was, as I heard, the idea of a draper in Darlington.

All the engines up to and including the "Swift," which was built in 1836 or thereabouts, had only two eccentrics, which of course necessitated hand-working to start in either direction. This of itself required a practised hand to do, and would bother nearly every engine-man of to-day. There was no brake of any kind on engine or tenders, and the only way of controlling the trains down the banks was to put the engine out of gear, or for the fireman to drop off the engine, and let down as many waggon brakes as he thought necessary; and when they had to be taken off, he had to repeat the operation of getting off and lifting them, he himself then getting on the last waggon of which the brake had been down, and walking along the top of the coals back to his engine.

In my early days the engines were worked by contract by the driver, who found coal, oil, and every requisite, and was paid by ton of coal moved. The driver had two men in his pay, one a "driver-fireman" and the other a "fireman." The steam was got up on Sunday night by the fireman; and the driver and he ran the first train on Monday morning from Shildon to Middlesbrough, the then port of shipment. On the return to Shildon in about eight or nine hours, the fireman went home, and the driver with his "driver-fireman" ran the second trip; and on the completion of the second trip the "driver" went home, and the "driver-fireman" took charge as driver, and the "fireman" who had been resting resumed duty as fireman, and this system was followed day after day. The other duties of these men was somewhat as follows:—On the return after a trip the engine was taken to the coal depôt, and coaled with a shovel by the men themselves ready for the next trip. If traffic was plentiful the stay was short, and after a meal the engine was off again. There was no time-table. After going about a mile from Shildon all the waggons had to be oiled, as there were no grease boxes; the engine was slowed down on the level to about three or four miles an hour, and the two men got down, one on each side, with his oil-can and a hazel stick about three feet long, at the end of which a piece of oakum was tied; and with this the underside of each journal running in a cast-iron plummer-block was carefully oiled. After all were done, they got on the top of the last loaded waggon and walked back to the engine, and away they went. This was repeated after about twelve miles, when going in both directions. There was no guard and no brake-van, and so all depended on themselves. As there was no van, it was necessary in the day-time to put a board up on the last waggon, so as to be sure they had not lost any of the train. At night a large pan of fire was affixed to the front of the tender and to the last waggon for the same purpose; and it was the duty of the fireman to keep both alight. There were no signals and no pointsmen, each man taking care of himself and his train, and keeping out of the way of the few passenger trains run.

No passenger trains were run on Sundays, except between Darlington and Stockton once each way, which were worked by a horse. The carriage was on four wheels without springs, and was made to carry six inside and fourteen outside, including the coachman. It was like an old ordinary road stage coach with two front ends. The ordinary passenger trains on week-days had one first-class with three bodies, which could carry eighteen passengers; and one second-class, also with three bodies, which could carry twenty-four passengers; these two were attached at Darlington to the train which came from Shildon, and were put off at the junction at Stockton. The engine coming from Shildon brought a composite carriage with one first-class and two second-class bodies, or twenty-two seats, which was run on to Middlesbrough. The speed, including stoppages, averaged, say, 16 miles per hour for the whole journey of 24 miles.

One engine not already described, which was also put on the old line, was the first goods engine with a crank-shaft, a fire-box proper, and a tubular boiler. It was built by Kitching, of Darlington, about 1838, and was called the "Queen." It had four

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wheels only, with cylinders below the level of the axles and inclined upwards, 13in. diameter and 18in. stroke, and outside frames. All the wheels were coupled, and were of wrought iron. This engine was very similar to engines made about 1839 and 1840, and put on many other railways; it was used for years, but with a pair of small wheels added behind.

The "Clarence" Railway, which is now a part of the present "North Eastern," had mineral engines at starting very similar to those I have described. This line ran from Coxhoe to Port Clarence, with a branch to the old line, and was a rival to it; and hence any coal from Shildon to Simpasture, the junction, had to be worked by horses, as it had no running powers, and the Stockton and Darlington would not supply engines. Four waggons were drawn by one horse, and there was attached to the end what was called a "dandy cart," into which the horse was trained to put himself when the loaded waggons would run by gravity. The first outside cylinder engine ever made with horizontal cylinders was put on this Clarence line, and was built by Hackworth and Downing on Shildon bank top. This Hackworth was a brother of Timothy, and afterwards started with Mr. Fossick the works at Stockton now known as "Blair's." The engine had the usual return-flue type of boiler, with six wheels coupled, and cylinders of 13in. or 14in. diameter and 20in. or 22in. stroke. Up to this time all the mineral engines were innocent of framing as it is now understood; all the parts for doing the work of drawing and carrying were attached to the boiler, and hence all were as light as could be made.

About the time I first began to work a stir was being made in the matter of railways, and several were almost simultaneously opened in England. All the various locomotive superintendents of that day having had the advantage of studying the three parent lines—the Stockton and Darlington, the Clarence, and the Liverpool and Manchester—it was not strange that many variations should be introduced, which it would be impossible to describe in detail in such an address as this. Sufficient to say that some, like Bury, adopted four-wheeled engines with inside cylinders; some, like Alexander Allan, John V. Gooch, and Francis Trevithick, adopted outside cylinders; some had small drivers, and some had large; but all of them adopted, like Allan, single drivers for passenger trains, and for many years all adopted four wheels coupled for goods.

We have now arrived at 1841 to 1842, when railways had assumed proportions never dreamt of by the early pioneers and engineers, and the work was done by different types of engines, according to the ideas of the different men who had the control. The revolution in size of engine was begun with the "battle of the gauges," in 1845, with great diversity of design, and against all sorts of difficulties, chiefly those arising from want of endurance of material in rails and tires, and was carried on at all costs till the age of Sir Henry Bessemer, followed by Sir William Siemens. The relief came by the success realised in making durable, strong, and reliable material.

I now purpose to show by a few examples how in a locomotive engine, as in other things, history has repeated itself. The first example I will give is the bogie. Every modern engineer, I think, would say that this part of an engine, in its most simple form, was first adopted by Mr. Daniel Gooch in the engines built about the year 1848 for the South Devon Railway, as detailed in Mr. D. K. Clark's volume on "Railway Machinery." That is not so, however; for the earliest bogie, in this country at least, was on an engine built by Carmichael, of Dundee, in 1833, for the Dundee and Newtyle Railway. The old engine was found by Mr. Alexander Allan when he was locomotive superintendent of the Scottish Central Railway about 1855, and before it was broken up it was photographed.

Next we come to the radial axle-box as used by Mr. Webb, Mr. Worsdell, and others. This was invented without doubt by the late Mr. William Bridges Adams, and was applied by Mr. Cross, on the St. Helen's Railway, in an exactly similar way to what Mr. Webb and others are now doing. The engine was called the "White Raven," and was on eight wheels, like Mr. Webb's, the two end pairs of small wheels being free to move radially. I need not say it was by no means so perfect as it has been made at Crewe and copied by others. The fact of the modern engine having inside bearings has greatly facilitated improvement and the making of a compact and useful design.

The position of the frames has passed through many changes, beginning with inside and then to outside, and then backwards and forwards from one plan to the other; until at last it has become almost universal that they should be inside, although in his last design of single engine Mr. S. W. Johnson has once more come to the outside and inside frame combined, as was for so long generally adopted. This double frame has undoubtedly the merit of enabling less weight to be carried by each square inch of bearing surface of the journals.

In 1851 Mr. McConnell put on the London and North Western Railway a class of engine called "Bloomers," which is without doubt exactly similar in general design to those made by Mr. Stroudley and known as the "Grosvenor" class, the only difference being that the latter designer was not hampered as Mr. McConnell had been by the necessity for keeping down the weight. Some of these engines are still, after thirty years, doing useful duty on the North Western Railway.

The battle of the gauges brought to the front various types of engines. Every engine builder and locomotive superintendent made the greatest possible efforts to *do something*, and sometimes with conspicuous success. In 1851 Mr. D. Gooch produced his "Lord of the Isles"; and this class of engine may be regarded as one of the most successful, for it continues to this day in its original form down to the minutest detail, and now working all the broad-gauge expresses between London and Bristol. New boilers these engines have had, and a higher pressure of steam has been the only change. The express is run now, though of much greater weight than in 1846, at *precisely* the same speed—namely, 53¼ miles per hour between London and Swindon. Stephenson & Co. also came to the fore with long boiler type and outside cylinders; the drivers of the single engine being placed in front of the fire-box, and two pairs of carrying wheels leading. Mr. Crampton, too, added his contribution in the shape of the "London" and "Liverpool," both of them with the driving wheels behind the fire-box and the carrying wheels in *front*, and with outside cylinders placed about midway along the barrel of the boiler. This class of engine was largely used on the Western of France and the Northern of France, and some survive to-day. Mr. Francis Trevithick produced at Crewe the "Cornwall," with 8ft. single drivers, 18in. cylinders, and 24in. stroke. To keep the centre of gravity down the boiler was placed wholly under the driving axle, which plan necessitated that the axle of the trailing wheels should pass through the fire-box. It was not a good engine for steam, and about 1863 was supplied with a new boiler above the driving axle; and it is thus working at the present time. Mr. John Viret Gooch, too, had a special engine made for the London and South Western line, with outside cylinders and 7ft. drivers, which did useful work for years; but he was tied in weight by the lightness of the road. Sharp Stewart & Co. constructed engines of large power for those days, which went by the name of "Jenny Sharp." They had 16in. by 22in. cylinders, with 5ft. 6in. single drivers, and inside and outside frames, and were very successful engines. They were from the design of the late Mr. Charles Beyer. E. B. Wilson & Co., of Leeds, produced an engine which was called "Jenny Lind." Of this class many scores were built; they had 15in. by 20in. cylinders with 6ft. driving wheels. The drivers had inside bearings only, and the leading and trailing were 4ft. wheels with outside bearings. They were largely used in the north, and as far south as Rugby on the Midland. These engines were principally designed by the late Mr. James Fenton

The railway itself has undergone in the course of years a considerable alteration and improvement; but the change cannot be called so radical as in the engine. The rails of which the pioneer railway was made were of wrought iron, in about 15ft. lengths, and about 35lb. per lineal yard, carried on very small cast-iron chairs, which were secured either to stone blocks or to light sleepers of larch timber, many of them of half-round section. The rails were of fish-bellied type, and the ends were a sort of half lap, about 2in. long. They were secured in the chairs with a cast-iron ball, of about 1in. diameter, held in by a wrought-iron key about ¾in. square, which was bent to prevent its coming out. In a few years a parallel rail with a small bulb bottom was rolled. This soon gave way to a double-headed rail, which held its own for many years. The form called the bridge rail was then brought out, similar to the rail used on the Great Western for the broad gauge; and this, increased in weight, is still used. About thirty-five years ago a rail, which was to dispense to a great extent with sleepers, was designed by Mr. W. H. Barlow, but the road was hard and not lasting, and was soon discarded. Some of the Welsh railways, notably the Newport and Abergavenny, were laid with it, as was also the Birmingham and Derby. About the same time the Vignoles rail was produced, and a great deal of road was laid with it; but after some years it was practically given up in England, except for light branches and for contractors' use. Foreign nations and America took it up, however, and it is now almost the only rail used. By the perseverance of Mr. C. P. Sandberg, who came over here as the inspecting engineer of the Swedish and Norwegian Governments, it was re-designed in detail, until it has now reached a weight of 105lb. a yard. We in England have gone on increasing the weight of the rail to meet the greater weight of engine, and have added sleepers in proportion until 2ft. 6in. to 2ft. 8in. is now the distance from centre to centre; but some of our foreign neighbours, notably the Germans, are still a long way behind us, notwithstanding they have equalled us in the weight to be carried on a pair of wheels.

Wrought iron and steel are gradually replacing the old cast-iron arches throughout our country. The earliest wrought-iron bridges of long span were certainly not handsome, though strong: notably the Menai, the Chepstow, the Saltash, &c. But the latest and the greatest ever made in the world, across the Firth of Forth, by Sir John Fowler and Sir Benjamin Baker, is not only enormous in size, but, now it is finished, looks a graceful structure. The bridge of Mr. Barlow, to replace the ill-fated bridge across the Tay, is also a beautiful piece of mechanical engineering. The fall of the old bridge and its consequences point a moral to all future engineers, and it is this:—Do not let others ever cause you to deviate from true principles, or allow them to persuade you to let mere money be the guide as to strength in your work. If Sir Thomas Bouch had not been influenced by such means he would not have built the bridge he *did*, and his bridge would be across the Tay to-day, and he, in all probability, might have lived till now. While on the subject of bridges, I cannot help the remark that Brunel's bridge across the Thames at Maidenhead has always been admired by me as the most graceful I ever saw. The high-level bridge of Mr. T. E. Harrison, at Newcastle, must not be omitted from this record, for at the time it was erected it was ahead of everything, and still stands as good as ever.

The report of the Research Committee on Marine Engine Trials (Professor Kennedy, Chairman) on the "Trials of Three Steamers, 'Fusi Yama,' 'Colchester,' and 'Tartar,'" was then read. The "Fusi Yama" is an ordinary trading vessel, and her compound-expansion unjacketed engines do not present any points of interest. The "Colchester's" engines are of the compound twin-screw type, and were quite new at the time of the trial. The "Tartar" is an excellent modern cargo vessel fitted with high-class triple-expansion engines. During the trial there was hardly any cargo on board, and the engines were working considerably below full power. The results obtained from the "Tartar" caused a large amount of trouble to the Research Committee, and they probably consider that she well deserved her name. It will be noticed on looking at the table of results that the amount of feed-water evaporated per lb. of fuel was extraordinarily large. From an analysis of the chimney gases, and from temperature observations, it was found that this figure was too high, and Professor Kennedy therefore concluded that a large amount of water mixed with the steam had passed through the cylinders. The table of results is given on the opposite page, in which, it will be seen, the results of the former "Meteor" trial are included.

In the discussion which followed the reading of this report, Mr. E. H. Carbutt drew attention to a sentence in the report, in which it stated that during the trials the steam of the main boilers was used exclusively for supplying the engines, and that all the steam necessary for working the circulating pump, &c., was obtained from an adjacent donkey boiler. In his opinion, the circulation of the water in the condenser should be effected by steam from the main boiler, and not from another source. Otherwise the committee had done their work excellently, and their facts and figures were remarkably complete. The meeting was then adjourned until the following evening.

On the resumption of the proceedings on Friday, the 2nd inst., Professor Kennedy said he would like to give the results of a trial of a Thames steam tug which he had made a short time ago at the request of the owners. The tug was propelled by a screw, which was driven by a compound engine. The following table gives the leading particulars:—

Diameter of cylinders	19in. and 35in.
Boiler pressure	76lb.
Revolutions per minute	107
Indicated horse-power	222lb.
Consumption of coal per horse-power per hour	3·3lb.
Ditto in carbon value	2·7lb.
Consumption of feed-water per horse-power per hour	22lb.
Efficiency of boiler	60 per cent.

Mr. P. W. Willans said that the arranging of the results of the trial of several vessels side by side was an additional feature of interest in the present paper. As regards the extraordinary efficiency of the boiler of the "Tartar," it was his opinion that a great deal of the water was never converted into steam at all, but passed over as watery vapour. It was, however, astonishing that there had been no evidences of such an occurrence in the engines themselves. In a vertical engine there was greater tendency to condensation below the piston than above, and he wished that Professor Kennedy had shown indicator diagrams of the performances below the piston, and not mixed with those of the upper end. He then detailed some experiments which he had made with regard to the condensation of steam on the under side of the piston in vertical engines. In one particular engine the average steam pressure as indicated used at times to drop 25 per cent., and this he found was due to the accumulation of water at the bottom of the cylinder. In order to obviate this, he cut a circular groove round the inside of the lower cover near its circumference, and arranged a copper steam pipe in this groove. Directly water began to accumulate he blew a current of high-pressure steam through the copper pipe, and the water was then dispersed by conversion into steam. He further ascertained that there was no great tendency towards condensation in the steam itself, but directly some was turned into water then the condensation continued. This was discovered by passing a current of cold water through the copper pipe above mentioned, while the steam was quite free from moisture and there was no accumulation of water; quite five minutes elapsed before any change took place, but after once beginning, the condensation continued rapidly. Mr. Willans concluded by suggesting that, in future trials, calorimeter tests of the steam should be made.

Mr. Henry Davey wondered why the compound engines of the "Fusi Yama" were not jacketed, for, in his opinion, the addition of jackets would increase the efficiency quite 12½ per cent. He said that he would be glad of some further facts bearing on the effect of piston speed on the efficiency of the engine. In comparing the triple-expansion engines of the "Meteor" with a similar land engine that he was well acquainted with, he found that the efficiencies were precisely equal, although the piston speed of the former was 490ft. per minute and that of the latter 140ft. per minute. Mr. Davey then entered into the vexed question of engine efficiency, and remarked that a standard method of reckoning efficiency was greatly needed. In his opinion it was neither fair to engineers nor to the engines themselves to say that the efficiency was the ratio of heat actually utilised to the amount of heat in the fuel reckoned from absolute zero. One could not expect to obtain any more heat work out of a body after its temperature had fallen to the temperature of the surrounding atmosphere, and he thought, therefore, that the ordinary temperature of the air should be considered the datum line from which to calculate efficiencies. Mr. Davey also said that the fact of marine engines being less efficient than land engines was to be accounted for by the use of simple forms of slide valve and valve gear still adopted in marine engines.

Mr. Schoenheyder said that the publication of the report of the committee had been delayed for an unpardonable length of time. In days of continual improvement like the present the data of the performances of a particular engine were useless if they were published after the engine was obsolete. The method pursued by the committee of combining a hundred or more diagrams into a mean diagram was very unsatisfactory, and every one of those hundred should be given separately if any good purpose was to be served. In his opinion the Institution gained no benefit by these trials, and the only persons who were any better off were the owners and

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designers of the vessels, for they had obtained a complete test of the machinery, and all for nothing.

Mr. Lavington E. Fletcher asked the committee if they would in future tests and tabulation of results give the "piston constant," in addition to the dimensions, speeds, and pressures, for with these items of information the capacity of the engine could be arrived at with the greatest ease.

Mr. Frederick Edwards said that it was under his supervision that the engines of the "Fusi Yama" had been overhauled and repaired before the trial. New piston springs were added, and these had not had time to settle down into working order at the time the trial was conducted. Since then an improvement had taken place, and the engines were afterwards capable of working with an increased horse-power. He also took part in all the three trials, and he said that during the trial of the "Tartar" there was absolutely no sign of the presence of water in the steam, nor was there any record of priming in the ship's log-book. Since the trial of the "Tartar" complete diagrams of the work done by the circulating and feed pumps had been taken, and the results thus obtained would be added to the report. The pressure in the feed pump was extremely high, and represented a large amount of work.

Mr. J. F. L. Crosland said that marine engines had hitherto been supposed to work at very high efficiencies with a consumption ranging from 1¼lb. to 2lb. of coal per i.h.p. per hour; this bubble was now burst by the facts tabulated in this report.

Mr. Stromeyer said that the method of weighing coals on board ship by means of a spring balance was a bad one on account of the oscillations caused by the motions of the ship; whenever he had to do any such thing he always used a steelyard. The committee should have measured the temperature and quantity of the discharge water, and also the amount of air present in the boiler. There were also many data concerning the performance of the fuel in the combustion chamber, tubes, and uptake which might have been given, for then the total loss of work in the boiler could be apportioned and the various causes of loss ascertained more exactly.

Mr. G. R. Bodmer pointed out that, according to the results contained in the report, the loss of heat by initial condensation was least in the least economical engine.

Mr. C. J. Wilson, who had throughout the trials made the analyses of the chimney gases, &c., then gave an account of the method pursued by him in conducting his tests. Extraordinary precautions were taken, and every possible source of error was watched most carefully. For instance, in choosing the samples of coal for analyses, a large amount of coal was crushed to a fine powder and thoroughly mixed; then two samples were taken out, and each analysed. If the two analyses did not agree exactly further tests were made until practically absolute accuracy was obtained.

Mr. Phillips thought that the presence of water in the steam of the "Tartar" was to be accounted for by the fact that the vessel was propelled without a cargo, and that the power exerted by boilers and engines was much below what they were designed for.

Mr. C. E. Cowper expressed the desire that engineers would settle on standard methods of calculating efficiencies, and of combining the diagrams of two and three cylinder engines.

Mr. David Joy said that it would afford more information if the hundred or so diagrams taken were not combined into a mean diagram but were given separately; for it was highly desirable that they should be able to see the best diagram and the worst diagram, and that the variation in the diagrams should be noted.

Mr. Watkins said that boilers and engines should work to their highest limit if a satisfactory efficiency is desired, and, therefore, in his opinion it would have been better to use only one boiler when driving the cargoless "Tartar."

Mr. Hudson desired to have more information as to the condensers used on board these vessels. If the rate of discharge and the temperature of the effluent water had been given, some idea could have been obtained as to the transmission of heat through the tubes. Condensers were almost always designed by rule of thumb, and if the committee could carry out a series of accurate observations as to their behaviour, it would be possible to design condensers in future on more scientific principles.

Mr. Young said that a method of ascertaining the amount of priming had occurred to him. If the feed-water and the water in the hot well were analysed, then the difference in the analyses would account for the amount of water which had passed through the engines If the feed-water used were absolutely pure, then some substance might be put into it which would not distil over along with the steam; the different constitutions of the feed-water and the water in the hot well would, after a time, indicate the occurrence of priming.

Mr. Robinson wished that the air pressure, if any, in the ashpits had been given, for then it could be ascertained whether there had been any forced draught or not.

Mr. W. Worby Beaumont quoted a passage in the report on the "Tartar" trial, to the effect that the jacket of the high-pressure cylinder was not used, but that during the trial a leak was discovered in the cock through which the steam could be admitted to this jacket. This leak allowed steam to enter the jacket, and this steam had a pressure varying from 0lb. to 50lb. per square inch. In the speaker's opinion, the presence of this steam was quite sufficient to cause a condensation of steam in the cylinder.

The President, in closing the discussion, disagreed with the views of Mr. Watkins as regards the advisability of using only one boiler when propelling the cargoless "Tartar," for the greater the heating surface the better in comparison with the work to be done. As regards the use of triple and quadruple expansion engines generally, he mentioned that the necessity of having an equal load on each crank seemed to be overlooked by most marine engineers. The effect of such a want of equality on a locomotive would be to throw it off the line and almost make it turn a somersault, and arguing by inference a large amount of power must be wasted in a marine engine in counteracting and withstanding these strains. If a reducing valve or some other throttling device were placed in the receivers between the cylinders, the work of each cylinder could be equalised, and the objectionable strains avoided. In concluding, he expressed his gratification at the highly useful results obtained by the committee, and congratulated Professor Kennedy on the remarkably businesslike manner in which the trials had been conducted.

MARINE ENGINE TRIALS.

Comparative Results of the Trials of Four Steamers, "Meteor," "Fusi Yama," "Colchester," and "Tartar."

		Meteor.	Fusi Yama.	Colchester.	Tartar.
1	Name of Vessel				
2	Date of trial	24th June, 1888.	14 & 15 Nov., 1888.	9 Nov., 1889.	27 Nov., 1889.
3	Duration of trial ..... hours	17·15	13·95	10·88	10·08
4	Type of engines	triple	compound	twin compound	triple
5	Cylinder diameter, high-pressure ..... inches	29·37	27·35	(two) 30	26·03
6	,, ,, intermediate ..... inches	44·03	—	—	42·03
7	,, ,, low pressure ..... inches	70·12	50·3	(two) 57	68·95
8	Stroke, length ..... inches	47·94	33	36	42
9	Boilers, number of main boilers	2	1	2	2
10	,, single-ended or double-ended	double	single	double	double
11	Furnaces, total number	12	3	12	8
12	Heating surface, total ..... square feet	6,648	2,257	5,820	5,226
13	,, ,, tubes ..... square feet	5,760	1,689	4,770	4,366
14	Grate area ..... square feet	208	52	220	161
15	Total heating surface to grate area ..... ratio	32·0	43·4	86·5	32·5
16	Tube surface to grate area ..... ratio	27·7	32·5	21·7	27·1
17	Grate area to flue area through tubes ..... ratio	—	4·05	5·51	4·50
18	,, area through funnel ..... ratio	5·04	3·21	4·77	4·19
19	Mean boiler-pressure above atmosphere ..... lbs. per sq. inch	145·2	56·84	80·5	143·6
20	,, admission pressure high-pr. cyl. above atmos. ..... lbs. per sq. inch	134·4	50·3	64·3 / 59·4	121·4
21	,, effective ,, high-pr. cyl. ..... lbs. per sq. inch	58·46	30·74	45·65 / 42·07	36·89
22	,, ,, ,, inter ,, ... lbs. per sq. inch	19·50	—	—	20·07
23	,, ,, ,, low-pr. ,, ... lbs. per sq. inch	12·38	10·87	13·42 / 12·42	7·18
24	,, ,, ,, total reduced to low-pr. cyl. ..... lbs. per sq. inch	29·9	19·9	24·8	19·8
25	,, exhaust ,, low-pr. cyl. below atmos. ..... lbs. per sq. inch	11·6	10·9	10·6 / 10·5	10·5
26	,, vacuum in condenser below atmos. ..... lbs. per sq. inch	12·17	12·48	12·49	12·9
27	Revolutions per minute, mean ..... revs.	71·78	55·59	86·0 / 87·1	70·0
28	Indicated horse-power, mean total ..... i.h.p.	1,994	371·3	1,022·5 / 957·2	1,087·4
29	Coal burnt per minute ..... lbs.	66·75	16·45	95·7	32·0
30	,, per hour ..... lbs.	4,005	987	5,742	1,920
31	,, per sq. ft. of grate per hour ..... lbs.	19·25	18·98	26·1	11·93
32	,, per sq. ft. of total heating surface per hour ..... lbs.	0·602	0·437	0·987	0·367
33	,, per indicated horse-power per hour ..... lbs.	2·01	2·66	2·90	1·77
34	Carbon-value of 1lb. of coal as used ..... lbs.	0·878	0·878	0·913	1·031
35	,, equivalent per i.h.p. per hour ..... lbs.	1·76	2·33	2·65	1·82
36	Feed-water per minute ..... lbs.	497·7	131	717	359·4
37	,, per hour ..... lbs.	29,860	7,860	43,020	21,564
38	,, per sq. ft. of total heating surface per hour ..... lbs.	4·49	3·48	7·39	4·13
39	,, per lb. of coal ..... lbs.	7·46	7·96	7·49	[11·23]
40	,, per lb. of coal from and at 212° F. ..... lbs.	8·21	8·87	8·53	[13·06]
41	,, per lb. of carbon value from and at 212° F. ..... lbs.	9·62	10·10	9·34	[12·67]
42	,, per indicated horse-power per hour ..... lbs.	14·98	21·17	21·73	[19·83]
43	Calorific-value of 1lb. of coal as used ..... Th. U.	12,770	12,760	13,280	14,995
44	Percentage of line 43 taken up by feed-water	62·0	67·2	62·0	—
45	,, ,, carried away by furnace gases	21·9	23·5	28·0	22·1
46	,, ,, lost by imperfect combustion	3·6	0·0	1·3	0·0
47	,, ,, expended in evaporating moisture in coal	1·2	0·9	0·4	0·0
48	,, ,, unaccounted for	11·3	8·4	8·3	—
49	Heat taken up by feed-water per minute ..... Th. U.	528,600	141,100	788,700	[403,600]
50	,, turned into work per minute ..... Th. U.	85,240	15,870	84,630	46,490
51	,, taken up by feed-water per i.h.p. per minute ..... Th. U.	265·6	380	398·4	[371·2]
52	Efficiency of boiler (line 44) ..... per cent.	62·0	67·2	62·0	—
53	,, of engine (line 50 ÷ line 49) ..... per cent.	16·1	11·2	10·7	[11·5]
54	,, of engine and boiler combined (line 52 × line 53) ..... per cent.	10·0	7·6	6·6	9·7
55	Mean velocity of steam through water-surface in boilers per minute feet	—	6·28	8·6	3·43
56	Space occupied by boilers per i.h.p. ..... cubic feet	2·72	4·53	2·52	4·33
57	Weight of engines, boilers, &c., with water, per i.h.p. ..... tons	0·20	0·27	0·20	0·27
58	Clearance surface, high-pressure cylinder ..... square feet	—	—	22·6 / 22·6	—
59	,, ,, intermediate ..... square feet	—	—	—	—
60	,, ,, low-pressure ..... square feet	—	—	56·9 / 56·9	—
61	Speed of vessel, mean, during trial ..... knots.	14·6	—	14·4	—

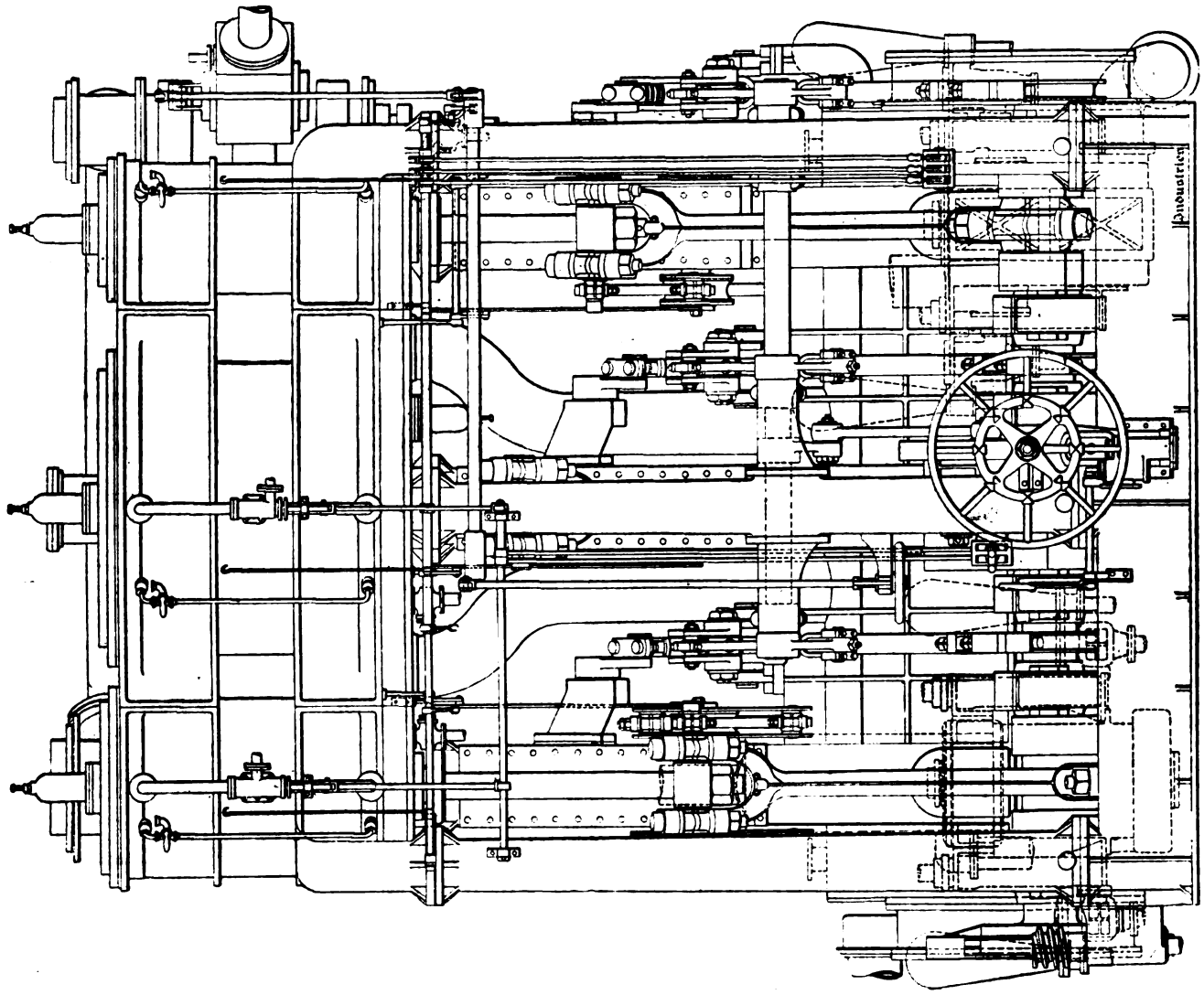
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ENGINES OF THE S.S. "PRINS WILLEM II."

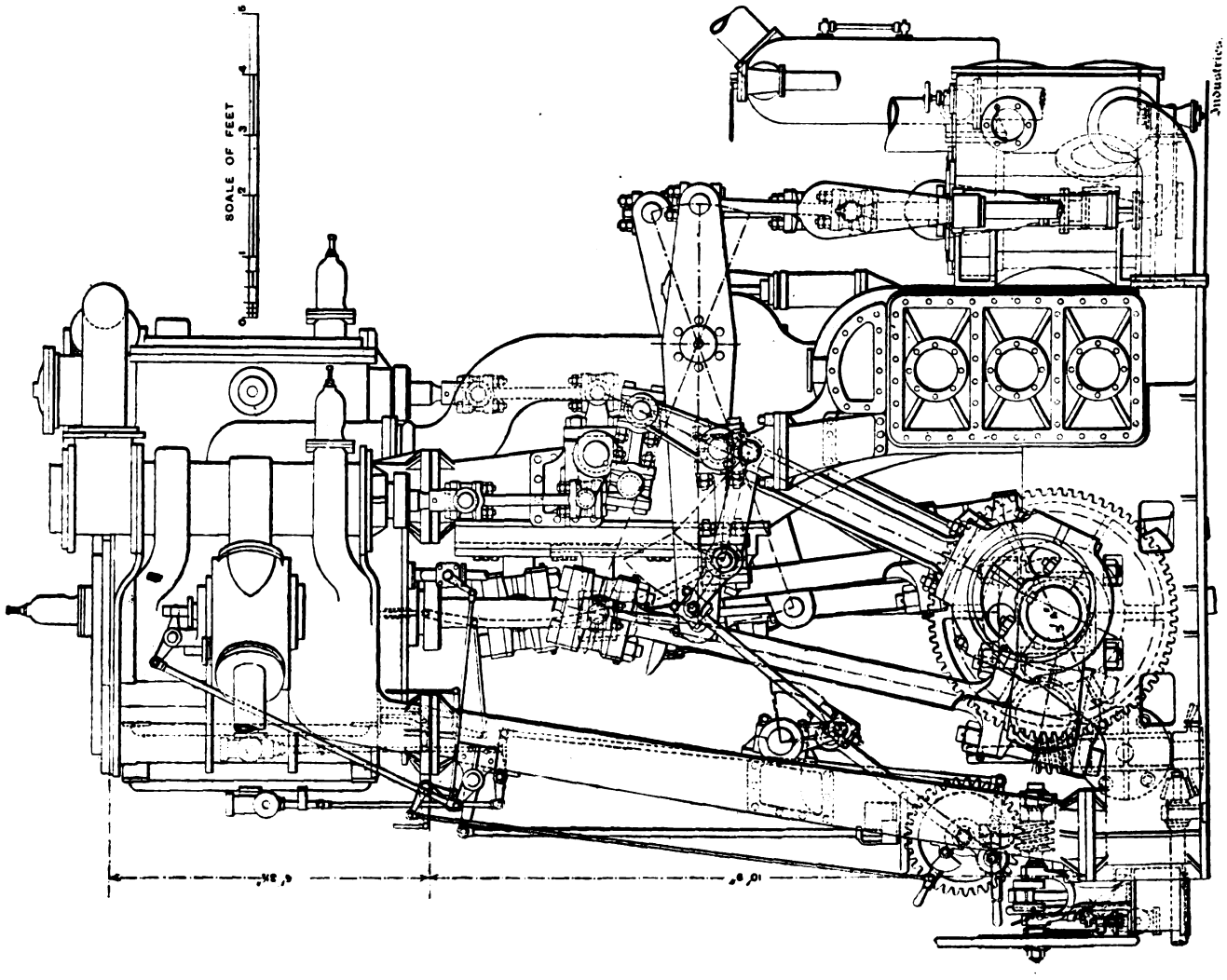
CONSTRUCTED BY THE KONINKLIJKE FABRIEK VAN STOOM E. A. WERKTUIGEN, FOR THE

ROYAL WEST INDIAN MAIL SERVICE.

(*For description see page 433.*)



FRONT ELEVATION.



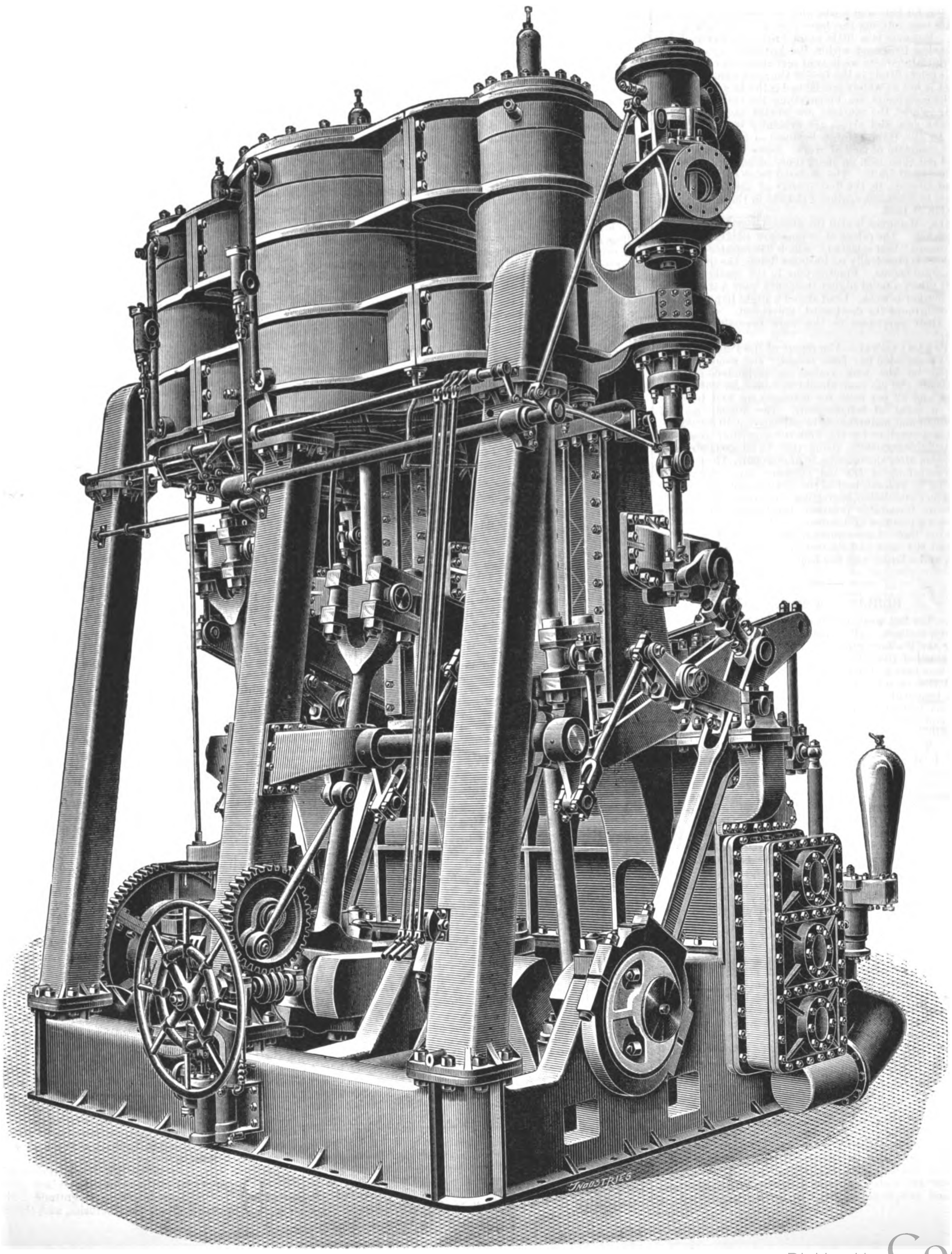
END ELEVATION.

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ENGINES OF THE STEAMSHIP "PRINS WILLEM II."

CONSTRUCTED BY THE KONINKLIJKE FABRIEK VAN STOOM E. A. WERKTUIGEN, AMSTERDAM.

(*For description see page* 433.)



GENERAL VIEW.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 6th May, 1890.

Iron.—The great drop in prices in Germany has had a weakening effect on the French markets for iron. Here in Paris the merchants who a week ago talked loudly of 160s. a ton for bars and joists, and no concessions on that price, are now offering the former at 152s. and the latter at 156s. Business is a little more brisk, the demand for joists having increased within the last few days. From the provincial markets we hear of manufacturers maintaining their prices firmly in the face of the slackening demand. But what is not so widely proclaimed is the fact that everywhere the merchants are underselling the manufacturers. Correctly judged, the markets are weaker than they were a fortnight ago, and prices are evidently tending downward. In the Haute Marne business is slackening, and founders complain of lack of work. Some have been compelled to put their men on short time. There is still some life in the export trade. The declared value of the exports of iron of all sorts in the first quarter of the current year amounted to £350,560, against £110,880 in the corresponding portion of 1889.

Metals.—Languor is still the characteristic note of the metal market. The prices of copper are nominally maintained, except "best selected," which has receded a point; but as there is practically no business doing, the quotations have no significance. Fluctuations in the market for tin have left prices a point higher than they were a week ago; but the market is weak. Lead shows a slight improvement. Spelter continues its downward movement. Consumers restrict their purchases to the bare necessities of the moment.

The Panama Canal.—The report of the Panama Canal Inquiry Commission has been issued. The completion of the canal on the lock system is estimated to cost 485,000,000fr.; 20 per cent. should be added for unforeseen expenses, and 29 per cent. for management and interest, making a total of 900,000,000fr. The annual cost of management and maintenance is estimated at 10,000,000fr., and the net receipts for the first three or four years are estimated at 38,000,000fr., rising then to 50,000,000fr., and twelve years after the opening to 61,000,000fr. The material and preparations of the old company are reckoned as amounting to, at least, half of the 900,000,000fr. still necessary. The Commission, regretting that they cannot hold out a more favourable prospect, think the best solution would be a guarantee of interest by the maritime States. In 1879 the time of construction was reckoned at twelve years, and the cost at 1,000,000,000fr., but ten years have elapsed, and a larger sum has been already spent.

BERLIN, 5th May, 1890.

Iron.—The last week has been a period of perturbation in the iron markets. The announcement of reductions in prices in the Western provinces far beyond what was expected startled the whole industrial world, and, so far as the markets here and in the Breslau district are concerned, checked the current of business in iron. Consumers of Silesian iron will now wait the effect upon prices of the reductions in the Rhenish-Westphalian district. For some time to come, therefore, we may expect buyers to restrict their dealings to the bare necessities of the moment.

Coal.—The situation has greatly changed for coal within the last fortnight. The reaction has evidently set in, and we may expect considerably lower prices by the end of the first half-year. The markets of Upper Silesia, so active of late, have lost much of their animation. A sudden calm has overspread them, and a weak tendency of prices has manifested itself. The reason is that consumers have now filled their stores, and can afford to wait the course of events, and as the recent tendering for locomotive coal showed an altered state of things in the coal trade, they abstain from further dealings till the prospect has cleared itself somewhat The matter is felt to be one of immense importance to German industry in general.

Coal Production in 1890.—The official statistics of coal production in the Prussian territory in the first quarter of the current year have just appeared. As they are specially interesting in the present circumstances of European trade, I make the following extracts to show, first, the state of the coal industry in Germany, and second, its distribution over the country. The total production in the first three months amounted to 16,522,864 tons, against 15,756,913 tons in the corresponding portion of 1889, the number of hands employed being 228,065, against 210,195 last year. These quantities were derived from the various mining districts in the following proportions, the figures within parenthesis being those for 1889: Breslau, 5,276,918 (4,778,639) tons; Halle, 5,727 (5,959) tons; Clausthal, 153,500 (115,736) tons; Dortmund, 9,032,150 (8,756,225) tons; and Bonn, 2,054,561 (2,100,354) tons. The production of lignite in the same periods amounted to 3,798,424 (3,388,797) tons, the number of hands employed being 26,664 (24,715). Of these quantities the mining district of Breslau produced 140,593 (132,416) tons; that of Halle, 3,428,182 (3,061,160) tons; that of Clausthal, 68,443 (47,840) tons; and that of Bonn, 161,206 (147,381) tons.

Telegraph and Telephone Extension.—The telegraph and telephone construction industries will have a busy year in this country. For the extension of these lines of communication a sum of nearly eight million marks (£400,000) has been provided by the Government, to be spent in the course of the present fiscal year. The scheme includes the conversion of some important aërial into subterranean lines for greater security in case of war.

Railway Inventions.—The German Railway Managers' Association has decided to give prizes of the value of 30,000 marks, every four years, for important inventions and improvements interesting to railways. For inventions and improvements in the structural and mechanical departments the first prize is 7,500 marks, and there are second and third prizes of the respective value of 3,000 and 1,500 marks. Prizes of a like value are to be given for inventions and improvements in the rolling stock, and also in the management and working of railways and the collection of railway statistics. Finally, a prize of 3,000 marks, and two of 1,500 marks, are to be awarded for noteworthy books on railways.

German Railways.—The revenue of the German railways in the working year from the 1st of April, 1889, to the 31st March, 1890, advanced 100,000,000 marks, as compared with the preceding year. The increase was chiefly owing to the activity of trade. Its importance will be better appreciated when it is learned that the increase in the six great French railways in the Exhibition year was only a little more than 78,000,000fr., of which 65,000,000fr. may be put down as due to the Paris Exhibition. The hundred million marks (or 125,000,000fr.) increase in the German railway traffic, due to no extraordinary circumstance, may be regarded as a very brilliant sign of industrial development.

Packing for Stuffing Boxes.—A new metallic packing for stuffing boxes, made of plaited bronze wire, is being manufactured by Mr. G. Pickhardt, Bonn. It possesses the advantage of having complete steam and water tightness at the highest steam pressure; it does not become hard or burn; does not cut into the piston rod; and is unusually cheap. With a sharp chisel a piece is cut off the plait long enough to go completely round the rod and to allow of the ends being firmly riveted when the ring is fitted in. Before being cut the ends should be wound with wire, so that the plait may not come uncoiled. The number of rings thus formed is determined by the length of the stuffing box. Between the metal packing and the stuffing box cover, a ring of hemp, tallowed twine, or india-rubber, is fitted in, to permit of the longitudinal expansion of the metal packing in the stuffing box.

VIENNA, 5th May, 1890.

The Iron Market.—For a short time the strikes in the collieries had a depressing influence, and during the first days of last week there was no business done. Now that regular labour has recommenced, and the largest establishments are at work, the customary animation in the market has returned. Prices are unchanged, and there is a firm tendency. The Alpine Montan Company has declared a dividend of 7½ per cent., and the profit of last year's working amounted to 2,109,000fl.

The Coal Market.—There is no change to note in the coal market. The strikes in the Ostrau district have terminated, and, as the demand is very brisk, the old animation has returned. Judging from the results of some joint stock companies, the business done this year has been better than ever before. The Brüxer Kohlenbergbau-Gesellschaft is paying a dividend of 7 per cent. Until 1885 no dividend was paid, and since that time it has steadily increased from 2 to 3, 4, 5, and 6½ per cent. The Trifail Coal Company is paying 8½ per cent. As a result of the animated coal traffic the waggon companies obtained large orders, and the report for 1889 of one of them shows that the profit amounts to 232,000fl., a dividend of 8⅝ per cent. being paid.

BRUSSELS, 6th May, 1890.

The Iron Market.—The iron market is calm. The raw materials are far too dear for satisfactory business, and prices are practically ruled by those of foreign iron. It is no use to reduce the prices any further, and if the prices of the iron syndicate are not accepted business will have to be refused. The rolling mills have not sufficient orders to keep them going continually. There is no great demand for sheets, and the prices of girders are low. The steel works are, however, much better off for work, and they seem to experience no great difficulty in obtaining orders at satisfactory prices. Several blast furnaces have been blown out, and some of the puddling furnaces also. The price of merchant bars is 18fr., and that of sheets 22fr.

The Coal Market.—In most of the branches of the coal trade there is plenty of firmness, but the prices of coke although high, show some signs of weakness. It is thought that coal prices are now about as high as they can be, and there is not so much confidence among sellers as regards the future course of the trade. Any new increase in the prices would stop the consumption to a considerable extent, as the industries in which coal is a raw material are even now almost paralysed by its high price. Coke is now quoted at 32fr. instead of 35fr., this reduction being caused by German competition.

The Glass Trade.—The state of the window glass trade is far from satisfactory. Orders are by no means sufficient to carry off the large production, and the prices have been consequently lowered to a disastrous extent in order that some of the surplus stock may be got rid of. It is impossible for the present state of things to last long, for it is utterly contrary to all common sense. In face of the poor demand, the number of glass furnaces are being increased, and probably many makers will come near their ruin shortly.

Electrical Engineering.—The electric tramway, which was started as an experiment in Brussels a short time ago, has been discontinued. The cars were propelled by accumulators, but the road was hilly and the route so objectionable, that the discontinuance of the system does not reflect any discredit on electric propulsion.

DÜSSELDORF, 6th May, 1890.

Iron.—Last week has been a period of considerable excitement in the iron markets. It was expected that the several syndicates would, at their next meeting, make some reduction in the minimum prices, but no one expected so large a drop as that which was announced a few days ago. The Rhenish-Westphalian Pig Iron Association reduced forge pig 12s., foundry 11s., Bessemer 11s., and Thomas pig 10s. a ton. Next the Rhenish-Westphalian Bar Iron Association announced a reduction of 20s. a ton for bars; and, to heighten the surprise, the West Germany Plate Iron Association followed promptly with a reduction of 20s. a ton for boiler plates and 35s. a ton for common plates. What the effect on the trade will be remains to be seen. For the moment business is very quiet. The following are the prices now current, compared with those paid a fortnight ago:—Rhenish-Westphalian best forge, 78s. (90s.); foundry No. 1, 82s. (93s.); Bessemer pig, 82s. (93s.); Thomas pig, 68s. (78s.) a ton. Bars, 180s. (200s.); boiler plates, 240s. (260s.); and common plates, 200s. (235s.) a ton. The South Germany Rolled Iron Association has been prolonged for three years. The coke syndicate has also been prolonged for three years, a circumstance that has tended to steady the iron markets.

Westphalian Coal at Hamburg.—The trade in Westphalian coal with Hamburg and its neighbourhood was not marked by greater activity in the month of April than in the previous month. It compares favourably, however, with that of April of last year, the total consignments being 67,150 tons, against 62,000 tons in the corresponding period of 1889. English coal is now being offered at slightly lower rates. It is expected that the prices of Westphalian coal will be considerably reduced before the end of the current month.

Roburite.—At the general meeting of the Actiengesellschaft Chemische Fabriken (formerly Weiler & Co.), held the other day at Cologne, it was resolved to increase the capital by 125,000 marks, for the purpose of buying up the Rhenish-Westphalia Roburite Company at Witten. The latter company will receive half the net profits in 1890. The purchasers take over the book debts for the sum of 44,456 marks. The manager of the roburite works stated that the business done last year was 50 per cent. greater than that of 1888, and that, according to present appearances, 1890 will show the same increase on 1889.

LILLE, 6th May, 1890.

Iron.—Judging from the general aspect of the iron market prices have a hardening tendency. Manufacturers refuse to sell bars or joists below 156s., and even talk of demanding 160s. before long, but as the middlemen are offering the same classes of iron at 154s. and less, it must be inferred that the real tendency of the market is downward. This is the opinion of consumers, who delay the placing of fresh orders till the latest possible date. The obvious truth is that business is languid, and that production is in excess of consumption. As soon as the contracts in hand have been worked off this fact will make itself felt. Hence we may infer that prices are giving way.

Textile Manufactures.—The trade in linen goods continues to shrink as usual at this time of the year, but the business done is fully up to the average. The May Day holiday and the strikes that have followed have now brought business to a standstill. The same remark applies to the woollen trade of Roubaix, where for the moment the utmost confusion prevails. A letter from Calais describes the tulle industry as lifeless, and the immediate prospect as gloomy. The disappointment has been bitter, for a year ago there were indications of returning prosperity, and hope rose high.

Flax and Yarns.—The flax market continues animated, if we except the last two or three days, in which trade has been influenced adversely by the labour disturbances which have occurred in this locality. For home-grown there is a brisk demand at full prices. Russian has been a little less inquired for. Prices are, however, very firm. There is an average market for tows; the better sorts being in brisker demand. Yarns are freely dealt in, and prices are firmly maintained. Jute spinners have no difficulty in getting rid of their produce.

Labour Disturbances.—To show the character of the labour disturbances which have brought the woollen industry of the Roubaix-Tourcoing district to a standstill, their origin and development may be described. A band of some 200 May Day holiday-keepers, who had kept up their carousing till the early hours of the morning near the Belgian frontier, were returning to Roubaix at the hour when their more sober comrades were going to their work. As a kind of practical joke, they compelled the latter to join them, and as they approached the town the numbers grew till the procession assumed an imposing magnitude The result was to stop work at all the factories, and, the Socialists

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having turned the opportunity to the best account, a general strike was brought about. There are now about 100,000 out, and it is said that of these some 95,000 are kept out against their will by the remaining 5,000 riotous Socialists. A movement originating in such a manner has but little industrial significance.

AMSTERDAM, 5th May, 1890.

Railways.—The opposition to the Government proposals for the State acquisition of the Dutch-Rhenish Railway Company increases. The Ministerial Bill will probably be lost. At an extraordinary meeting of the shareholders, which sanctioned the proposed extension of time in the contract between the Government and the company, the Chairman said the latter had not been at all anxious to sell its properties to the former, but they had been compelled to do so. The company would gladly resume its existence under a new concession. The new cheap goods tariff between Holland and Germany, in competition with Belgium, was put in force on the 1st inst.

Dutch Railway in the Transvaal.—It is expected that the first section of the Dutch railway in the Transvaal (75 kilometres) will be completed and opened in the course of this year. The same company—the Dutch South African Railway Company—is building the steam tramway between Johannesburg and Boksburg, a distance of 50 kilometres, with the two extensions between the points named.

Mails to the Dutch East Indies.—The negotiations between the Government and the directors of the Nederland Steam Navigation Company, anent a more rapid and frequent conveyance of mails to and from Holland and Insuland, are nearly complete. The perfection of the new postal contract will necessitate the acquisition of more powerful steamers than the company at present possesses. From the report of the directors of the Rotterdam "Lloyd," which likewise has a mail service with the Dutch East Indies, it appears that the company performed twenty-two journeys in 1889, yielding a net profit of 815,000 guilders, and leaving an available balance of 380,000 guilders, after providing for reserve and writing off for depreciation. This enables the directors to distribute a dividend of 9½ per cent. on the share capital. In order to strengthen the fleet two new-type steamers are upon the stocks at the "Scheldt" shipbuilding yard, Flushing. One will be ready for service by the end of this year and the other by May next year.

COPENHAGEN, 3rd May, 1890.

Tramways at Christiania.—The Christiania Tramway Company has declared a dividend for last year of 7 per cent. At the general meeting the other day important extensions were discussed, entailing an outlay of some 250,000kr., and the board was authorised to negotiate with the Corporation with a view of making the necessary arrangements.

The New Gasworks at Stockholm.—The works at the new gasworks, which the Corporation of Stockholm has decided upon building, are already fully designed. The complete plan comprises four gas revervoirs, of which one, with the requisite buildings, is in course of erection. The buildings are of considerable dimensions; the coal-house will be 135 metres long and the retort-house 110 metres.

Petroleum at Copenhagen.—The Danish Petroleum Company at Copenhagen is extending its business. Last year a reception reservoir was constructed at Triborg, to the north of Copenhagen; and now another is approaching completion on the Refshale Island, in the Copenhagen harbour. The tanks, of which there are two, are protected by a wall of concrete and clay; there is room enough for a third tank, which will be added when required. From the tanks large pipes go to the quay where the vessels will discharge. A large tank steamer has been built for the company at Burmeister & Wain's shipbuilding yard, Copenhagen.

Engineering Societies in Sweden.—There are only two engineering societies in Sweden and these are about to be united. The older one—the Society of Engineers—was constituted about thirty years ago by practising engineers, in Stockholm, and the other—the Technological Society—was originally an association of fellows of the technical high school in Stockholm, but recently was transformed into a general society of technical engineers. The younger one is the most active of the two, and the meetings of the elder society have of late attracted very little attention.

Electrical Engineering in Sweden.—The Electrical Company, Ld., in Stockholm, the only dynamo manufacturing concern of any note in Sweden, recently held its meeting. The company was formed in 1883 to build dynamos of the Wenström type. Each year has shown an increase in the business, and last year the business amounted to about 330,000kr.; 38 dynamos were sold, giving a total of 501 electrical horse-power, and the installation of 4,234 incandescent lamps of 16 candles and 16 arc lamps had been completed. From the commencement the company has supplied 155 dynamos of 1,880 electrical horse-power, 17,400 incandescent lamps of 16 candles, and 35 arc lamps. A dividend of 5 per cent. was declared.

Swedish State Telegraphs.—The telegraphs have always been separate from the postal department, and have been under a special administration. At several times the question has been raised as to how to unite these allied departments under the same control, though until recently nothing positive has been done to realise this object. Some time ago the Government appointed a commission to investigate the matter and to propose means for its solution, and this time there is every reason to believe that within a short period this union will be an accomplished fact.

Telephones in Sweden.—Last year the first of the telephone trunk lines, that between Stockholm and Gothenburg, was opened to the public, and at present several others are under construction; for instance, one between Stockholm and Malmo, and one between Malmo and Gothenburg. These trunk lines are all metallic circuits without connection to the earth, and consist of hard-drawn copper wire. Between Stockholm and Gothenburg there are double telephone wires fixed on the same poles as the telegraph wires. One line is continuous between Stockholm and Gothenburg, and the other is connected at three or four cities with switchboards for the convenience of the public in those cities.

MADRID, 5th May, 1890.

Secondary Railways.—The Secondary Railway Bill pending at the Cortes has been altered slightly by the appointed Commission. In the first place, the interest guaranteed by the estate is to be 6 per cent. instead of the 5 per cent. per annum proposed, and, secondly, all materials and plant are to be Spanish, and if any foreign material is imported it will have to pay full duty. If the alteration of the Bill is carried through there will be no question as to the absolute necessity of establishing some very large and perfect works in Spain for making locomotives and carriages. Some influential parties in Bilbao are already contemplating the starting of such works in combination with English firms.

Spanish Quicksilver.—As is usual, the Almaden Quicksilver Works stopped the distillation of the ores on the 1st of May, and the hot months of the year will be devoted to repairs and putting things in order for the commencement of the season in October. This is principally done for the sake of general health, but also because most of the workmen find occupation in the harvest season of the year. The production of the mine during the past season has been rather under that of the previous one, on account of some mismanagement in the Madrid offices. Besides the Almaden mine, we have in regular production the quicksilver mine in Asturias, belonging to the Porvenir Company, which is continually increasing the output. Last year they obtained 1,955 flasks, Almaden giving about 52,500. However, the circumstances are so different that, whilst the average yield of Almaden is 6½ per cent., the yield of the Porvenir Company was only 1·07 per cent. So whilst the cost of each flask at the estate mine is about £1 12s., at Porvenir it is no less than £3 12s.

The Central Cuba Railways.—Tenders for the concession of this important system of railways were received by the Colonial Minister on the 26th ult. Two offers were made. Mr. Ivo Bosch, a Spanish banker at Paris, offers, on behalf of the Banco de Madrid, to take up the concession, with an interest of 8 per cent. to be guaranteed on a sum of £4,840,000. He, moreover, offers to the Government 55 per cent. of the net profits beyond the 8 per cent. The other proposal is from an English company, called the British and Foreign Constructive Company, Limited. The capital they propose is £4,893,000, and they offer the Government 75 per cent. of the net earnings exceeding 8 per cent. The other details of the conditions offered are very similar, but the fact that the Spanish tender engages to use Spanish materials for plant and railway rolling stock as far as possible makes it very likely that the final decision will be in its favour.

NEW YORK, 26th April, 1890.

The Iron and Steel Market.—There is a steadier feeling in the iron trade, and although there has been no improvement in prices, and in some cases even lower quotations are reported, it is considered in the trade that the worst is over, and as soon as prices settle on the present basis the market will soon begin to improve. Prices of pig iron are at a standstill. Small lots of standard quality have sold at $18 to $18·50 per ton for No. 1 foundry, $17 to $17·50 for No. 2, and $16 for grey forge, and these are likely to be fair average prices throughout the summer. The cost of production is very heavy. Ores are high and coke is dear, and there is no likelihood of their becoming cheaper. The outlook is not particularly good, therefore, for producers, but consumers have a chance of renewing contracts at low rates, with a probability that prices will increase somewhat as the season advances. The demand for finished iron is better than it has been for some weeks, but prices are a little lower. Prices have now fallen back to what they were eight months ago. The decline in pig iron, old material, and various kinds of steel has been such that wrought iron has declined in proportion. Mills are getting nearer to the end of their orders, and there is considerable competition for any new business offered. Prices for small lots are from 1·85c. to 1·9c. per lb. for best refined bars, 2·10c. for plates, and 2·20c. to 2·25c. for angles. The demand for steel rails is not very heavy, and while the usual quotation is $34 per ton at the mill, only small lots are taken at that rate. What demand there is is mostly from Western Roads, and Western prices are something lower proportionally than at Eastern mills. Billets remain nominally at $31 per ton, but on desirable orders ·50c. to $1 per ton less could easily be obtained.

The Coal Trade.—There has been more activity in the anthracite trade during the past week than for some time. The opening of canal and lake navigation, and particularly the settlement of the question of tolls for the summer, have been the means of improving the trade. A great many dealers had been withholding their orders in hopes that the tolls would be reduced, and they placed them as soon as the question was settled. Prices are about the same, but they are rather steadier. If the present restriction of output is maintained, the trade of the latter part of the year will be fairly prosperous.

Gas for New York.—The Gas Commissioners met at the Mayor's office the other day, and resolved to postpone indefinitely the consideration of the tenders of the electric lighting companies for lighting the streets. It was learned that these companies had divided up the city, and each had confined its tender to the district allotted to it, thus preventing competition. The bid of the Equitable Gas Company for furnishing over 3,000 lamps with gas at $12 a year for each lamp was accepted. The Standard Company put in no bid, as its franchise does not allow it to charge over $12·50 per lamp. It was resolved to take steps to compel the company to furnish the Commission with a record of its mains, and to light such lamps on their lines as are not already contracted for with the other company. The Commissioner of Public Works said that last year the average paid for twelve months' service of each arc light used for street lighting was $24, and this year the tenders for lighting the streets by electricity have increased to an average of from $39 to $42 per lamp.

Fast Train Running.—A fast run on the New York Central and Hudson River Railroad occurred between Albany and Poughkeepsie, N.Y., on the 12th inst. The train was composed of an engine, a Michigan Central baggage car, one buffet car, one dining car, two passenger cars, one drawing-room car, and two sleeping cars. On the way over the bridge at Albany the cylinder head of the engine was blown out, and delayed the train at East Albany a little over 40 minutes, till another engine could be procured. At 5.34 p.m. the train started again. It ran from East Albany to Hudson (28 miles) in 30 minutes, arriving there at 6.5 p.m., and left at 6.10 p.m. It passed Tivoli (49 miles) at 6.29 p.m., Barrytown, at 6.33 p.m., Rhinebeck (54 miles), 6.40 p.m., and reached Poughkeepsie at 6.55 p.m., thus making the 70 miles with 8 cars in 1 hour 20 minutes, having run from Rhinebeck to Poughkeepsie (16 miles) in 15 minutes.

The Hudson River Tunnel.—The new shield is now being erected on the west side at a point 2,050ft. from the shore end. This shield is complete up to the top-girder, and will be in working order shortly. On the east side the condition is not so favourable. The late attempt to pump the tunnel out developed several very large leaks in the caisson next to the shaft; the shaft itself was badly shaken, and the timbers had separated so as to cause extensive leaks. These leaks have now been plugged in the shaft; but those in the roof of the caisson are more troublesome, as this is under the wharf. Divers are now at work trying to plug them up from below. It is hardly necessary to state that the late stories of "rats with oakum tied to their tails" being chased into the cracks in an attempt to plug them, are the results of the imagination on the part of the daily papers.

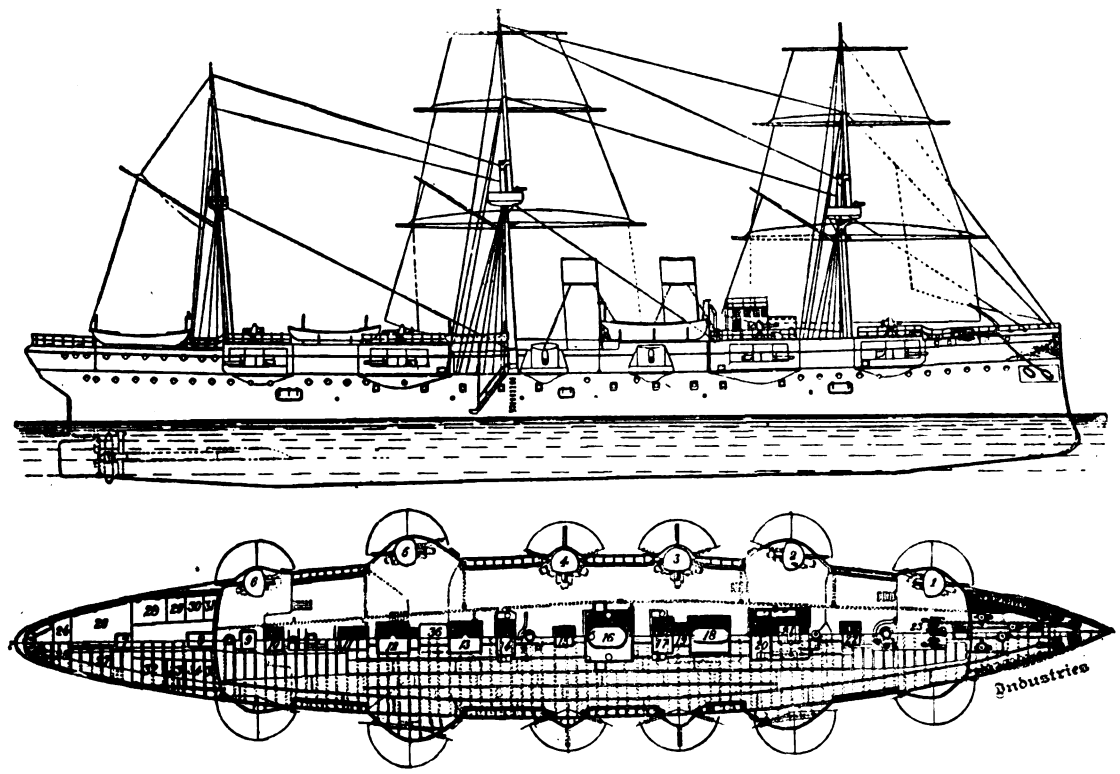
PHILADELPHIA, 25th April, 1890.

The Output of Iron and Steel in Allegheny.—The amount of finished iron and steel turned out in Allegheny, County Pennsylvania, in the first three months of this year was 455,000 tons. Of this a little more than 150,000 tons was iron from muck bar, of which probably 10,000 tons was bought from outside firms and finished there. The output of steel rails at Carnegie's Edgar Thompson Works was about 75,000 tons, which is more than was ever before made in the history of the plant. About 60,000 tons were made at the Allegheny Bessemer Steel Works, Du Quesne, making 135,000 tons of rails in the Pittsburg district. While a small portion of pig iron has been shipped from the south, there have been no foreign metal shipments so far this year. Nearly every ton bought was from furnaces in Pennsylvania and Ohio. Of this volume of iron and steel, which will be far over 500,000 tons at the end of April, there is not 500 tons in stock.

Philadelphian Carpet Trade.—The proposals of the new tariff to increase the duty on carpet wools has caused something of a consternation among the carpet men. During the year 1889 it is estimated that there were 8,000 looms in operation in this city, employing 17,000 operatives, and turning out upwards of 70,000,000 yards of carpet, valued at from $33,000,000 to $40,000,000, per year. The trade is in a flourishing condition, there being 180 distinct carpet mills in the city. Within the past ten years the industry has increased 60 per cent., and it is feared that the proposed increased duty on wools will raise the cost of carpets, which now average about 60c. per yard, to something over 80c., that the demand will become much smaller, and the trade lose much of its increase. The manufacturers were slow in waking up to the situation, but they are determined to continue their agitation, when it comes up for debate, against the adoption of the clause of the Bill affecting their interests.

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THE UNITED STATES CRUISER "NEWARK."



THE UNITED STATES CRUISER "NEWARK."

On the 19th of March the 4,000 ton United States steel cruiser "Newark" was launched from Messrs. William Cramp & Sons' yard, Philadelphia. Especial interest attaches to the "Newark," from the fact that she is essentially an American ship in design, material, and construction, whereas several of the other new cruisers have been largely built after plans furnished by European engineers, and are, to some extent, copies of existing vessels in the English Navy, although with material modifications. The "Newark" is a twin-screw unarmoured vessel, having a poop and forecastle deck, with an open gun deck between. She is built of mild steel throughout, and has a steel deck extending her whole length, below which are the engines, boilers, shell-room, torpedo spaces, and steering gear. The engines and boilers are further protected by coal bunkers, which serve as extra armour as well as fuel stores. The engines are designed, with natural draught, to indicate 6,000 h.p., and with forced draught 8,500 h.p., and to give a maximum speed of 18 knots per hour. The following are the principal dimensions of the vessel:—

Length over all	328ft.
Length on the load water line	310ft.
Moulded breadth	49ft.
Extreme breadth	49·14ft.
Depth (knee plates to spar deck)	31·80ft.
Mean draught of water	18·825ft.
Displacement in tons to load water line	4,082·98ft.
Tons per inch at load water line	24·96ft.
Area of load water plane	10,484 sq. ft.
Area of immersed mid-ship section	807·23 sq. ft.

The "Newark" has a double bottom for 127ft., covering the space occupied by the engines and boilers, the depth between the inner and outer skin plating being about 39in., and this space being divided into 12 water-tight compartments by means of solid floors and a vertical keel. The engine and boiler space is divided into 17 water-tight compartments, while the space between the engine and berth decks is divided into 72 water-tight compartments. On the berth deck are 7 water-tight compartments, and all the openings from this deck to the engine and boiler rooms are protected by cofferdams, while the scuttles, hatches, and store-rooms are water-tight. Below the gun deck, when all the water-tight doors are closed, there are 147 distinct compartments, and there are 85 such compartments when the doors are all open.

The protective deck, for 168ft. of its length, rises to 15in. above the load water line, while forward it slopes to 4ft. 6in. below the water line, to strengthen the stem, and abaft it slopes to 3ft. below the water line. The horizontal portion of this deck is about 2in. thick, which is increased to 3½in. over the steering gear, while the sides are about 3in. thick, the angle of inclination being designed to prevent a projectile from striking a straight blow upon it. Armour shutters and scuttles of the same thickness as the deck are fitted at all hatchways and openings, and these are also inclined to deflect projectiles. The coal armour belt is about 9ft. thick amidship, and 7ft. forward and aft.

The main battery of the "Newark" consists of ten 6in. breechloading rifles, each using a 100lb. shell with a powder charge of 50lb., the projectile being designed to pierce 13in. of iron at its muzzle velocity. The guns are mounted on central pivot carriages, with circular shields fitted to each to protect the gunners from the fire of machine guns. The two forward guns, one on each side, are trained from 70° abaft the beam to 95° forward, giving a cross fire of 5° degrees at 111ft. forward of the stem. The two after guns have nearly the same range of fire, and all of the battery on one side can be concentrated on an object not more than 30ft. away.

The secondary battery consists of four six-pounders, four Hotchkiss revolving cannon, and two short Gatlings, while there will be other Gatlings in the fore and aft tops. The vessel will also have six torpedo-launching tubes worked from the berth deck.

The boilers and machinery of the "Newark" are ready to be put in. The power is to be furnished by two triple expansion engines with cylinders of 34in., 48in., and 76in. diameter and 40in. stroke. There are four boilers, each 13ft. 6in. in diameter and 19ft. 6in. long, designed for a steam pressure of 160lb. per sq. in., and with a grate surface of 540 sq. ft. Sail is to be used only as an auxiliary for cruising purposes, but a spread of 11,932ft. of canvas is provided for. The incandescent system of electric lighting is to be adopted throughout the vessel, and electric search lights will also be supplied. The ventilation will be effected by the exhaust system. It will probably be autumn before this vessel will be furnished with her machinery and fittings and be ready for trial. She is intended for use as a flagship, and the space under her poop will be made into quarters for the admiral and captain. She will have a crew of about 300 men. For the above description and illustration we are indebted to our contemporary *The Scientific American*.

THE EDINBURGH EXHIBITION.

The International Exhibition of Electrical Engineering, General Inventions, and Industries, Edinburgh, 1890, or, as it must more shortly be called, the Edinburgh Exhibition, was opened by H.R.H. the Duke of Edinburgh, on Thursday, the 1st inst. After the formal opening, the Royal party were entertained to luncheon, and subsequently were conducted to the Grand Hall, where a programme of music was executed. Finally, the party made a tour of the principal courts. The weather was splendid for early spring in Scotland, the buildings were crowded, and altogether it was generally felt that the opening was most auspicious. Notwithstanding the recent succession of Exhibitions, there is much to attract the technical as well as the general visitor. It is altogether a miscellaneous exhibition, bright, varied, and attractive, with handsome buildings and an ample variety of amusements. Our Exhibition executive committees have in their eyes rather the amusement and entertainment of the crowds who go to be amused than the edification of the few who go to be instructed. There are many reasons for siding with fun instead of culture, and for apparently truckling to the tastes of the vulgar instead of adopting the standard that the educated mind aspires to; but as this question borders on the ethical, we need not pursue it here.

It must be said that there is nothing whatever to illustrate the progress of electrical science in America, and so far, at least, no illustration of (we quote the prospectus) "the mechanical arts exemplified in the completion of the Forth Bridge." There is not even a hydraulic riveter, nor a suggestion of the methods by which the bridge was constructed, unless the wooden cantilever bridge over which the covered way is carried may have some remote connection therewith. The Executive might, at least, have procured some large scale drawings of the erection, in order that the crowds which are expected to visit Edinburgh to view the bridge and the Exhibition may have some intelligent idea of how it was built.

The site, luckily secured by the Executive free of charge from the Caledonian Railway Company and the Edinburgh Merchant Company, is fifty acres in extent, with an available additicnal area of forty acres, and is admirably adapted for exhibition purposes. It is bounded by two lines of railway and by a canal, and is intersected by the Edinburgh Suburban Railway. It is two miles from the heart of the city, and is readily accessible by rail or tramway. Trains from Glasgow and elsewhere are run direct to the Exhibition stations, of which there are no fewer than three. The main building (for elevation of which see *Industries*, of the 25th ult.) is 700ft. long by 300ft. wide. The vestibule and concert hall form a transept, on one side of which is the space for foreign exhibits, and on the other side that for British manufactures. The style of the front is French Renaisssance, with suggestions from Byzantine; but the simplicity of both exterior and interior, and the almost total absence of meretricious ornamentation, too often seen at recent exhibitions, is a laudable departure from the usual method of carrying out these styles. A covered way, resting on a cantilever wooden bridge, connects the main building with the Machinery Hall. This hall is 680ft. in length, 150ft. in breadth, and is 40ft. high. The girder roof is trussed and braced, the span being 80ft. In the centre of the Machinery Hall is the main electrical plant, to be hereafter fully described, and illustrated on page 444. The space is ample, and the plant is seen to better advantage than has been the case at any previous exhibition. The engineering and electrical department is under the charge of Mr. W. A. Bryson, whose similar work at the former Edinburgh Exhibition, and at the Manchester and Glasgow Exhibitions, has given him extensive experience of large electrical installations. Behind the Machinery Hall there is the Railway Court, the French electrical annexe, both to be hereafter described, and the boiler-house. In the latter there is a battery of five boilers made by Messrs. Galloway, of Manchester. The combined capacity of the battery is 1,400 horse-power. The recreation ground is lighted by twenty-four arc lamps suspended on poles 25ft high. The track is one-third of a mile long. The cost of the Exhibition buildings has been £50,000, the preliminary expenses bringing up the total cost of the Exhibition to date to £70,000.

The Electrical Exhibits.—In such an Exhibition the electrical section is naturally the first to demand detailed description. It goes without saying that there is much here that has been seen before. Nevertheless there is perennial interest attaching to a well-finished dynamo and to a well-designed switchboard, commonplace and everyday matters though they be. The electrical plant for the supply of light for the grounds and for the greater part of the interior of the buildings is contained within a railed-off space in the centre of the Machinery Hall. The plan of this space is illustrated on page 444.

The largest installation is by the Anglo-American Brush Electrical Corporation. The plant set down by this firm consists of fifteen dynamos. Of these, thirteen are No. 8 machines, old type, each supplying current to thirty-five lamps, and two are No. 7 machines, each supplying light to fifteen lamps. There are two lengths of countershafting, and six machines run on each length, there being one spare machine. The shafting runs at a speed of 320 revolutions per minute. The motive power for the twelve No. 8 dynamos first mentioned is obtained from a magnificent set of engines by Messrs. Robey & Co., of

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Lincoln. These will form the subject of a separate notice under the head of prime movers. The total number of lamps in the Brush installation is 366, 71 being in the grounds and 295 in the buildings. Each lamp is 2,000 candle-power. Rope gearing is used for the main drives, and the endless cotton belting for working the dynamos was made by the Lancashire Patent Belting and Hose Co., Manchester. The shafting was made by Messrs. Brown Brothers, Rosebank Works, Edinburgh. The pulleys on the countershaft are by Messrs. Howellson & Walker, of York. Staffa's solid lubricant is used on the dynamo bearings, with obvious advantage in point of cleanliness, and with, it is reported, satisfactory results as regards lubrication.

The grounds are lighted by lamps in groups of three, upon bracketed masts, forty-five in number, each 65ft. high. In the recreation grounds there are twenty-four lamps, suspended from brackets on 25ft. poles. The feeding-wires are placed inside the masts. The globes in the outside installation are clear, and those within the buildings are of obscured glass. The switchboard is of simple and effective design, loop switch handles being used, so that any machine can be connected to any circuit in the installation.

Next to the installation of the Brush Electrical Engineering Company the most extensive is that of Messrs. King, Brown, & Co., Edinburgh. Though the plant to be put down by this firm is not yet completely in place, we may give the leading particulars of it. The concert hall is supplied with light from eighty-one super-incandescent lamps, and the dining-rooms with twenty-five lamps of the same type. These lamps are supplied by the Woodside Electric Company, and are of 200 candle-power and upwards. They are worked with an e.m.f. of 100 volts. Each lamp is provided with a safety fuse. The length of wire used in this installation is $8\frac{1}{2}$ miles. In addition to this portion of the public lighting of the Exhibition, Messrs. King, Brown, & Co. supply current for some 800 or 900 16 candle-power lamps on exhibitors' stands, and also supply current for the motor which drives the model of the engines of the "Princesse Henriette," exhibited by Messrs. Denny & Co., of Dumbarton. The four dynamos employed are of the type shown by Messrs. King, Brown, & Co. at previous exhibitions, and actuated by engines of the Westinghouse type, designed and made by Messrs. Alley & Maclellan, of Glasgow. The engines are two in number, and are respectively 125 h.p. and 80 h.p. One of these engines is of novel design, being an adaptation of the triple-expansion principle to this class of engine. This interesting engine will form the subject of a subsequent notice. In the meantime a single Brush dynamo is employed as a temporary expedient. Subsequently, Messrs. King, Brown, & Co. will put down one of their own dynamos. In addition, the same firm has a separate exhibit, consisting of two slow-speed ship dynamos constructed to Admiralty specification. Only one of these is as yet in position. It is a single-magnet machine with a ribbon-wound drum armature insulated with silk. The speed is 300 revolutions per minute. It supplies 120 amperes at 100 volts. The engine is coupled direct to the shaft and is bolted to the same bed-plate as the dynamo. The cylinder being below the armature shaft and bolted direct to the bed-plate makes an exceedingly compact arrangement. A system of centrifugal lubrication has been employed. The second dynamo is a four-pole machine, with an armature of similar type to the above, and a compound engine arranged in the same manner as its fellow. The capacity of the second dynamo, with 120lb. steam pressure, is 700 16 candle-power incandescent lamps, and the speed is 320 revolutions per minute. Both of these dynamos have been designed with a special view to meet the Admiralty requirements for low temperature, and the armatures, besides having large conductivity, have ample surface ventilation.

Messrs. Woodhouse & Rawson supply light for the band-stand in the grounds. The current is obtained from an Elwell-Parker 100-unit alternator, with engine combined. Messrs. Ernest Scott & Co.'s exhibit consists of three engines and dynamos. First, a 15-unit compound-wound dynamo, 150 amperes, 105 volts, at 950 revolutions. Second, a compound-wound machine, coupled direct to a vertical high-speed engine, making a self-contained plant, suitable for ship lighting: capacity, 100 lights 16 candle-power. Third, a 10-unit alternator, "Tyne" pattern, by Mr. W. C. Mountain, 1,000 volts, and 1,200 revolutions. All three sets of plant are employed in lighting nearly the whole of the outbuildings, including refreshment bars, Venetian glass factory, kiosks, Cadbury's cocoa-house, &c. The motor driving Mr. Webb's model engine in the railway annexe is supplied with current from this plant, as also the lamps in all the carriages and saloons exhibited by the railway companies. This firm exhibit, among miscellaneous electrical exhibits, a quick release spring switch, and show in action on all their machines the gauze brush, which is now coming extensively into use. The engines used are respectively 5, 7, and 9 n.h.p.

Notices of Meetings.

SOCIETY OF ARTS.—Tuesday, May 13th, at 8 p.m. Paper to be read: "The Use of Alloys in Art Metal Work," by Professor W. C. Roberts-Austen, F.R.S. Wednesday, May 14th, at 8 p.m. Paper to be read: "Professor Elihu Thomson's Electro-Magnetic Induction Experiments," by Dr. J. A. Fleming, M.A.

CHEMICAL SOCIETY.—Thursday, May 15th, at 8 p.m. Papers to be read: "On Diethylphosphorous Acid," by Professor Thorpe, F.R.S., and Mr. Barker North; "The Ten Isomeric Dichloronaphthalenes" and "The Action of Chlorine on Naphthalene and Naphthalene Derivatives," by Professor Armstrong and Mr. W. P. Wynne; "A Third Naphthaquinone," by Professor Meldola and Mr. Frank Hughes.

NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Monday, May 12th, at 7.30 p.m. Adjourned discussion on Mr. Bergström's paper on "The Structural Strength, &c., of Cargo Steamers of Different Types;" discussion on Mr. Boyd's paper on "The Weight of Machinery in the Mercantile Marine."

THE INSTITUTION OF CIVIL ENGINEERS.—Ordinary Meeting, Tuesday, May 13th, at 8 p.m. Paper to be further discussed: "The Screw Propeller," by Mr. Syd. W. Barnaby, M.Inst.C.E. Paper to be read (time permitting): "The Keswick Water-Power Electric Light Station," by Messrs. W. P. J. Fawcus and E. W. Cowan, Assoc.M.Inst.C.E.

THE PHYSICAL SOCIETY.—May 16th. (1) "On Haygens' Gearing in Illustration of Electric Induction," by Lord Rayleigh; (2) "Dr. R. König's Researches on the Physical Basis of Music," by Mr. S. P. Thompson.

THE ROYAL INSTITUTION.—Friday, May 16th, at 9 p.m. Professor Raphael Meldola, F.R.S., on "The Photographic Image."

PRICES CURRENT, 7TH MAY, 1890.

Quotations at per ton, unless otherwise specified.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	6 7 6	.....	6 17 6	f.o.t. wks.
„ Angles	6 2 6	.....	6 12 6	„
„ Plates	6 5 0	.....	6 15 0	„
Staffordshire Bars (cheaper makes)	8 0 0	.....	8 10 0	London.
„ Angles	8 0 0	.....	8 10 0	„
Crown Sheets	7 10 0	.....	8 0 0	„
„ Hoops	7 0 0	.....	7 10 0	„
"Siemens-Martin" Steel Boiler Plates			8 15 0	„
„ Ship and Girder			7 15 0	„

Market quiet

PIG IRON.

Middlesbro' Warrants, No. 3.	43/3	Cash
Scotch Warrants, m/n	44/6	„
Hematite Warrants, m/n	53/7½	„

Stocks in Stores	Scotch	Dec. for week ending 2nd May	11,291	Tons
	Middlesbro'	Inc. „	722	„
	Hematite	Dec. „ 3rd May	8,579	„

	No. 1.		No. 3.	
Coltness	67/6	.....	61/-	f.o.b. Glasgow.
Gartsherrie	62/6	.....	58/-	„ „
Langloan	57/-	.....	55/-	„ „
Summerlee	47/6	.....	47/-	„ „
Glengarnock	65/-	.....	57/6	„ „

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	71/6	61/6

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

METALS.

Spelter:	Ordinary	£22	15	0	to £23	0	0
Copper:	British Cakes and Ingots	55	0	0	„ 56	0	0
„	Chili Bars, G.O.B.'s	49	12	6	„ 50	0	0
„	Other sorts, G.M.B.'s (equal to Chili Bars)	49	12	6	„ 50	0	0
„	Manufactured (strong)	62	0	0	„		
Lead:	Common Pig	13	12	6	„ 13	15	0
„	English Sheet	14	7	6	„ 14	10	0
Tin:	Straits	92	0	0	„ 92	7	6
„	Australian	92	0	0	„ 92	10	0
„	English Ingots	96	10	0	„		

Messrs. Carrick & Brockbank, Manchester, report as follows:—

COPPER: The improved tone of the copper market mentioned in our last has been well maintained during the past week. This is due principally to the limited quantity of spot G.M.B. bars available, and the improved demand for different descriptions of refined copper. The old stocks continue to be firmly held off the market, and the labour troubles in Chili are restricting production there and increasing the costs. During April stocks decreased about 1,800 tons, the total visible supply being returned May 1st, as 90,200 tons, against 92,000 April 1st. From figures before us, the stock in England of bars, furnace material, &c., appears to be 42,000 tons, which is considered about the ordinary regular average, the surplus being in French hands, and practically off the market. The rise in silver has improved the Indian demand, especially for yellow metal. Some good locomotive copper orders have also been placed. Chili bars have ranged, during the week, from £49 to £50 cash, to-day's quotations being £49 12s. 6d. to £50 cash. Manufactured is quoted £62 sheets, £65 bottoms, with more inquiry.

TIN: Values have fluctuated considerably during the week. The market during the past few days has shown a stronger tone, with fair demand for sharp cash foreign, and prices are about 5s. higher on the week.

LEAD: Reports received from various sources point to an early improvement in lead. There is a better demand and more inquiry, with indications that higher prices will rule shortly.

SPELTER is steadily advancing, owing to the Continental demand and the small stocks. It is likely to be much dearer.

CHEMICALS.

			£	s.	d.		£	s.	d.
Acid:	Carbolic Crystals	lb.	0	0	9	to	0	0	10½
„	„ Liquid	gal.	0	1	2	—		.....	
„	Citric	lb.	0	1	7	--		.....	
„	Oxalic	„	0	0	4	---		.....	
„	Sulphuric	ton	1	12	0	—		.....	
„	Tartaric	lb.	0	1	4½	—		.....	
Alum:	Lump (powder 10/- ex.)	ton	4	17	6	—		.....	
Ammonia:	Carbonate	lb.	0	0	3½	—		.....	
„	Muriate (Grey)	ton	22	15	0	—		.....	
„	„ (White)	„	26	10	0	—		.....	
„	Sulphate	„	11	7	6	—		.....	
„	Liquor	lb.	0	0	3¾	—		.....	
Antimony		ton		.....		—		.....	
Bleaching Powder		„	5	0	0	—		.....	
Bisulphide of Carbon		„	13	10	0	—		.....	
Borax		„	30	0	0	—		.....	
Benzole (90 %)		gal.	0	3	6	—		.....	
„ (50/90 %)		„	0	2	8	—		.....	
Copper Sulphate		ton	24	10	0	—	25	0	0
Copperas		„	2	0	0	—		.....	
Kieserit		„		.....		—		.....	
Lead:	Nitrate	„	22	10	0	—		.....	
„	White Sugar	„	24	0	0	—		.....	
„	Brown „	„	19	0	0	—		.....	
Potash:	Bichromate	lb.	0	0	4	—		.....	
„	Caustic	ton	22	0	0	—		.....	
„	Carbonate	„	19	10	0	—		.....	
„	Chlorate	lb.	0	0	5	—		.....	
„	Prussiate (Yellow)	„	0	0	9½	—		.....	
„	Sulphate (Basis 90 %)	ton	9	10	0	—		.....	
Precipitate:	Red	lb.	0	3	1	—		.....	
„	White	„	0	3	2	—		.....	
Salts:	Epsom { Bags	ton	3	0	0	—		.....	
	{ Casks	„	3	15	0	—		.....	
„	Glauber	„	1	10	0	—		.....	
Sulphur:	Sublimed Flowers	„	9	0	0	—		.....	
„	Recovered	„	4	10	0	—		.....	
Soda:	Ash	deg.	0	0	1½	—		.....	
„	Caustic (White 70%)	ton	8	17	6	—		.....	
„	„ { „ 60%)	„	8	0	0	—		.....	
„	„ (Cream 60%)	„	7	15	0	—		.....	
„	Crystals	„	3	0	0	—	3	2	6
„	Bicarbonate	„	6	5	0	—		.....	
„	Hyposulphite	„	6	5	0	—		.....	
Solvent Naphtha		gal.	0	4	0	—		.....	
Tartar, Cream of		cwt.	5	12	6	—		.....	
Zinc Sulphate		ton	7	10	0	—		.....	

Messrs. S. W. Royse & Co., Manchester, report as follows:—

CHEMICALS.—There is quite a want of animation about this branch of commerce. Caustic soda, after a slight spurt, is again lower. Bleaching powder is quiet, but prices are unchanged. There is a moderate inquiry for soda ash for early delivery, and also for soda crystals. Carbolic acids continue to droop. Picric acid also is slow of sale. Creosote, however, is in good demand, and benzoles rather firmer. Sulphate of ammonia very flat, and carbonate of ammonia is also somewhat lower. Sulphate of copper is active for May–June delivery.

OILS.

			£	s.	d.
Cocoanut:	Cochin	per tun	28	15	0
„	Ceylon	„	25	10	0
Cottonseed		„	22	5	0
Cod		„	20	0	0
Lard		„	36	10	0
Linseed		„	23	15	0
Palm, Lagos		„	24	15	0
Rapeseed:	English	„	32	0	0
Seal:	Pale	„	28	0	0
„	Brown	„	22	0	0
Sperm		„	45	0	0
Whale		„	24	0	0
Turpentine		per cwt.	1	9	3
Coal		per gal.			
Petroleum (Refined)		„	0	0	5½
„	Spirit	„	0	0	7

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HOME INDUSTRIES.

LONDON, 8th May, 1890.

THE MONEY MARKET.—Though money has been in good supply at easy rates a good deal of uncertainty has prevailed in the discount market. Continental rates of exchange continue very low, and gold is steadily leaving the outside market for Paris and Berlin. In consequence discount rates are inclined to harden. The stock markets have been active this week, the principal movements taking place in American railway securities. The Silver Bill is confidently expected to pass, and stocks have not reached the point which the expansion of the United States currency is thought to enable them to attain. Canadian railways have moved in sympathy with Americans, as well as in consideration of their hopeful prospects. The securities of the Mexican Railway have been rather irregular in spite of the increased exchange value of the dollar. Home railways have improved through the recovery in pig iron, and the tone of this market is firm. A good deal of movement has taken place in the passenger stocks; an important legal decision affecting the relations of the South Eastern and the London Chatham and Dover has given a fillip to these securities. The Underground Railway stocks have been adversely influenced by the success of the Bill for the construction of a central subway through London. Foreign stocks have been firm, notably Egyptians, and a favourable turn in the conversion negotiations have benefited them. Argentine securities have improved greatly on a sustained decline in the premium on gold at Buenos Ayres. Copper shares have been in favour at higher prices, and South African gold shares have been receiving a little attention again. In the miscellaneous market there has been little movement save in telegraph cable shares, which have improved, and in telephones, which have declined. The nitrate group has fluctuated irregularly.

COMPANIES.—The following companies have been registered since our last report: Richard Whittaker & Sons, Ld., with a capital of £100,000, to carry on the business of brewers; St. Asaph Iron, Lead, and Baryta Co., Ld., with a capital of £30,000; Hollybrook Brick Co., Ld., with a capital of £20,000; J. H. Hopkins & Sons, Ld., with a capital of £100,000, to carry on the business of tinplate and ironplate workers; The Gospel Oak Iron Co., Ld., with a capital of £150,000; North Wales United Mines, Ld., with a capital of £25,000; Atkinson's, Ld., with a capital of £140,000, to carry on the business of brewers, &c.; The Diamond Patent Fuel Co., Ld., with a capital of £460,000; The Electric Welding Co., Ld., with a capital of £460,000; The Castle Hill Coal Co., Ld., with a capital of £25,000, to carry on the business of coalmasters, &c., in New Zealand.

RAILWAY TRAFFIC.—The gross receipts of the 23 principal railways in the United Kingdom for the week ending the 27th of April, amounted, on 16,159¼ miles, to £1,332,587, and for the corresponding period of 1889, on 16,031 miles, to £1,336,093, an increase of 128¼ miles, or 0·8 per cent., and a decrease of £3,506, or 0·2 per cent. The week last year with which comparison is made included part of the Easter season.

THE SILK EXHIBITION.—The first Exhibition of the Silk Association of Great Britain and Ireland was opened on Tuesday, at 7, St. James's Square, S.W., the residence of Lord Egerton of Tatton.

THE INSTITUTION OF CIVIL ENGINEERS.—The annual dinner of the students of this Institution was held at the Holborn Restaurant on Friday evening last. There was a large attendance of students and guests. Sir John Coode, President of the Institution, was in the chair, and was supported by Mr. Berkley, Mr. Hayter, Mr. Giles, M.P., Mr. Preece, Sir Bradford Leslie, Professor Unwin, Mr. Spagnoletti, &c.

ELECTRIC LIGHTING.—The town of Fareham, Hampshire, is to have a public electric lighting station, which is to be opened on the 1st September. The installation is to be carried out by Messrs. Laing, Wharton, & Down, who will lay down one Thomson-Houston alternating dynamo for 1,000 incandescent lamps, and a 30-arc light machine. The actual street lighting consists of 20 arcs and 100 glow lamps, the reserve output being for private lights. The engine will be supplied by Messrs. Ruston, Proctor, and Co.

THE POLYTECHNIC.—The early morning classes in commercial subjects, which were commenced on the 21st ult., at the Polytechnic, Regent Street, have been very successful. In the arithmetic class 90 students entered; French, 168; shorthand, 115; book-keeping, 105; German, 74; typewriting, 16. Many of the students attend from long distances, and arrive at 7 o'clock. At the conclusion of their class they are enabled to get a good breakfast at a very cheap rate. The classes were started with the view of organising a thorough course of instruction in connection with the scheme proposed by the London Chamber of Commerce, and the successful results attained will encourage the committee to start classes in other important commercial subjects.

THE ROYAL MILITARY EXHIBITION.—Yesterday the Prince of Wales opened the Royal Military Exhibition. The site selected is in the grounds of Chelsea Hospital, and the main buildings, which are constructed of corrugated iron, form a large quadrilateral erection of irregular sides. In the centre are some well-laid-out grounds, with a band stand, while in the outer part are various attractions which can be summarised as sundries. The exhibits were mostly complete, and the electric lighting was all in order. The lighting contract has been undertaken by Messrs. Davey, Paxman, & Co., of Colchester, who have engaged Messrs. Laing, Wharton, & Down to supply the dynamos and accessories. The plant consists of four continuous-current Thomson-Houston dynamos able to supply current to thirty-five lamps of 10 amperes. Three dynamos will be in use, with one for reserve. These run at 850 revolutions. There are two alternators of the standard Thomson-Houston type running at 835 revolutions, with an output of 1,000 volts and 35 amperes. Special transformers allow of the pressure being reduced to 50 or 100 volts, as may be desired. There are five arc circuits and three alternating circuits. All the lighting of the grounds and most of the interior lighting is by arc lamps, of which there are a hundred. The glow lamps are used for the offices, refreshment rooms, and other subsidiary buildings, and vary in power. There are, for instance, 200, 100, 50, and 10 candle-power lamps, the total being equivalent to about 1,000 16 candle-power lamps. In the grounds the arc lamps are fixed to wrought-iron posts 32ft. high, the bases being of cast iron 6ft. 6in. in length. Motive power is supplied by two 40 nominal h.p. undertype engines of Messrs. Davey, Paxman, & Co.'s make.

RAILWAY ACCIDENTS.—The number of persons killed on railways in the United Kingdom during the year 1889 was 1,076, as against 905 in 1888; while the injured were 4,836 in number, against 3,826 in the year before. That is, the fatal injuries increased by 171, and others by 1,010. A great part of this vast increase is to be accounted for under one head. Fatal injuries to passengers arising from accidents to trains, rolling stock, permanent way, &c., had been reduced to 11 in 1888, and other injuries to 594. In 1889 the list of killed is eightfold, and of injured nearly twice as great. The numbers thus reached—88 killed, and 1,016 injured—are far above the average of recent years. The cause of a great part of the increase is not far to seek. The disastrous accident on the Great Northern Railway of Ireland (June 12th) caused the deaths of 78, and injuries to 200 passengers, many of whom, it will be remembered, were children. Passengers killed and injured from other causes remained almost stationary in numbers—95 and 813 respectively. The injuries to servants were also much above the year 1888, when the killed were 396 and injured 2,193. Last year these numbers rose to 435 and 2,769. Trespassers again (in which class are included suicides) shared in the general increase; the killed were 351 (56 more), and the injured 122 (six more). All accidents being taken together that occurred on railway premises, the total during the year 1889 amounted to 1,139 killed and 10,981 injured.

MANCHESTER, 8th May, 1890.

THE MUTUAL TELEPHONE COMPANY.—A company bearing this title is being formed, with a capital of £100,000, of which £45,000 is at present being issued. The dividend to be paid is limited to 6 per cent., after which all net profits are to be returned to the renters. The company proposes to commence work on the expiration of the Bell patents at the end of this year.

MANCHESTER BANKING.—As an instance of the rapidity with which banking has increased in Manchester, the following figures relating to the first three months in each of the years named may be given. During that period in 1879, the Manchester Clearing House dealt with £20,783,875, while this year the amount was £43,649,308, or more than double that of 1879. This shows the great strides made by Manchester as a financial centre, a fact which is also evidenced by the advance in the price of the shares of local banks.

SHRINKAGE OF COTTON YARNS.—The Manchester Chamber of Commerce recently met in conference with the Glasgow Chamber at Carlisle, to determine upon a basis of allowance for the shrinkage of cotton yarns during dyeing. Under the Indian Merchandise Marks Act of last year this has become a matter of importance to exporters. It was agreed to ask the Indian Government to sanction the importation of yarns with a reasonable allowance for shrinkage, but it was decided that the extreme allowance made should not exceed 2½ per cent. from the standard length of 840 yards per hank.

THE ENGINEERING TRADES.—There is a rather better tone existing among engineers in this district. Things are a little more cheerful, although the amount of new work is not great. There are signs of improvement, however, for the steadying of the prices of raw materials is having a good effect. Boiler makers are well employed, although there is not the pressure in this department that existed a short time since. Tool makers are generally well off, and there does not seem to be any lack of new business. In the railway department especially, orders for tools are being given freely. Spinning machinists are busy. The whole of the plant for the Elm Spinning Company, consisting of 70,000 spindles and preparation machines, is being made by Messrs. John M. Hetherington & Sons, of Manchester, who have recently greatly improved their mule. Ring spinning machine makers are also busy, and a new spindle of the "elastic" or "top" type is being put upon the market by Messrs. T. Coulthard & Co., of Preston. Loom makers are fairly busy, although plain looms are not so much in request.

IMPROVED RING BOBBINS.—An improved ring spinning bobbin is being introduced, the novelty of which consists in its being all made of wood, without the ordinary brass or steel hoop at the lower end. To strengthen the bobbin at that point a semicircular bead is formed just above the nose, fitting into the cup on the spindle. These bobbins have been severely tested, and we have seen several of them after the tests which have resisted compressive strains quite as well as the brass-hooped type. The cost being much lower than that of the latter, the new form has much to recommend it.

GLASGOW, 8th May, 1890.

PIG IRON.—In sympathy with the generally buoyant character of the stock markets, stimulated probably by the passing of the Silver Currency Bill, the pig iron market has been firm, with a large business doing at advancing prices, but the Cleveland makers' returns for the month of April being considered disappointing a reaction set in, and the market opened on Tuesday morning at a fall of about 1s. from the closing prices of the previous Friday.

FORTH BRIDGE.—The first through passenger train passed over the Forth Bridge on Monday. The train was a special excursion train from Aberdeen to Edinburgh *viâ* the Forth and Tay Bridges. The bridges on the Burntisland section will not, however, be ready for some time, so that the full use of the bridge will not be available till the summer has well progressed.

SHIPBUILDING AND ENGINEERING.—The local shipbuilding and engineering works now complain of a blank outlook. One of the leading Greenock shipbuilding yards launched its last ship this week, and other yards are working off the orders they have on hand very rapidly. Wages have been reduced at several of the steel works, and further reductions are not improbable. Notices have indeed been already given by several firms.

ENGINEERING.—The new pumping machinery which the Bonhill local authority had decided to provide for their pumping station at Balloch is now completely fitted up. Messrs. Joseph Evans & Sons, Wolverhampton, erected the machinery, which consists of one of their horizontal direct-acting compound surface-condensing duplex type, with two high-pressure cylinders, each 15in. diameter; also two low-pressure cylinders, each 24in. diameter and 3ft. stroke. The engines are guaranteed to deliver 60,000 gallons of water through a 12in. pipe, 2,500 yards long, to the reservoir at Alexandria, 170ft. high.

LABOUR.—The shipbuilders in Greenock have decided to grant an advance of a farthing per hour in response to a request of the joiners for a halfpenny. The workmen have agreed to accept the offer.

GOLD EXTRACTION.—An important improvement in the method of roasting refractory ores has been made by the Pollok Patent Gold Extracting Company. The machine is the invention of Mr. Alley, of Messrs. Alley & McLellan, who is of one the directors of the company. The roasting apparatus consists of a hollow cylinder, where the ore is heated while the cylinder revolves. The ore passes from the crushing mill into the roaster, and is subjected to heat, and is discharged from it ready to be introduced into the chlorinators. In connection with this company Mr. Pollok is about to proceed to the Transvaal, where works are to be erected by the company. The same company intend also to establish works at Taltal, Chili.

ELECTRICAL ENGINEERING.—Messrs. Mavor & Coulson have contracted with the British India Navigation Company for the lighting of the offices of the company at Calcutta. About 300 incandescent lamps will constitute the installation.

GLASGOW BILLS.—The Boundaries Bill has been thrown out. It will come up again in a new form. The Caledonian Vale of Leven Railway Bill has been thrown out. The Clyde Navigation Bill, which provides, amongst other things, for the diversion of Govan Road round the new Cessnock Dock, has passed the Committee stage, the preamble having been proved. The Railway Amalgamation Bills are still before the Committee. The preamble of the Subway Bill has been passed.

(From our own Correspondents.)

LIVERPOOL, 7th May, 1890.

THE SALT INDUSTRY.—There has been a considerable increase in the export of salt from Liverpool to the different foreign countries during the last month, amounting to 59,537 tons, against 48,536 tons during April last year. The shipments during the first five or six months last year were equal to the average, and as the shipments during the first three months of this year are in excess of those of last year the results are very reassuring.

NEW WELSH COAST STEAMBOAT SERVICE.—Considerable dissatisfaction has been felt for many years at the slow and inconvenient service of steamers running between Liverpool, Llandudno, and Carnarvon; and at the recent meeting of the shareholders of the Welsh Coast Steamboat Company it was proposed to purchase the fine steamer "Cobra," and run it in conjunction with the present boats, and so improve the service. Upon a vote being taken, 897 shareholders voted in favour of the proposal and 591 against it. Although there was a substantial majority in favour of the purchase, by the constitution of the company the majority was not sufficient to carry the proposal. Several of the leading directors of the company intend to resign their position, and are now pushing forward the new company. Arrangements have been made for the purchase of the "Cobra," and it will shortly be put upon the station.

DOCK ACCOMMODATION IN LIVERPOOL.—Great complaints are now being made by the shipowners about the depth of the water over the dock sills, and a strong letter of remonstrance has been addressed to the Dock Board by

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Mr. T. H. Ismay, of the White Star Line. He states that while the Canada Dock has an entrance 100ft. wide, the depth of the sill is only 7ft. 9in.; the Alexandra Dock has an entrance 60ft. wide only, with a depth of 12ft.; while the Birkenhead Docks, built twenty-five years ago, have entrances 100ft. wide, with 12ft. sills. When the North Docks were commenced twelve years ago, the largest ship to be accommodated was 6,000 tons; but steamers of 10,000 tons, and nearly 600ft. long, have now to be provided for, and the tendency is for the size to still increase. The "Majestic" arrived on the 23rd ult., but was unable to cross the bar on account of insufficiency of water; the low tides also prevented her from using the docks, although she had to pay £308 for dock dues, in addition to the cost of landing her passengers in tugs.

LEEDS, 7th May, 1890.

The Iron and Steel Trades.—The improved tone indicated a fortnight ago has been maintained in the present month. Specifications are coming forward more freely, and all the forges are actively employed. A steady business is being done in cut steel and iron nails at recent rates. Nearly all the branches of the engineering trade are fully occupied, though there continues in some departments to be a marked absence of fresh inquiries and orders. Locomotive builders are well off for contracts, and some of the leading firms engaged in the manufacture of heavy machinery have not much cause of complaint on the score of work. The machine tool trade has undergone very little change. The Leeds Chamber of Commerce has had under consideration the circumstances that in the negotiations between the Associated Chambers of Commerce and the Board of Trade for considering what is best to be done with reference to terminating charges between England and France, no representative of the iron and steel trades of this district was suggested. The Chamber in Leeds has now sent up the name of Sir James Kitson to the Associated Chambers of Commerce and the Board of Trade, with the view of his being a member of the conference, which is said to be likely to do some important work in connection with the exportation of Yorkshire-made iron and machinery to France.

The Coal Trade.—Pits are running from five to six days per week. All classes of house coal are in fair demand, but there is a tendency to a reduction in prices. Gas coal is declining, while the steam coal trade remains brisk. Manufacturing fuel is more plentiful and prices easier. The shipping trade is brisk. There has of late been a great falling off in the demand for coke, and consequently a lowering of prices. Stocks are accumulating.

SHEFFIELD, 7th May, 1890.

Iron and Steel.—All kinds of railway material are in good request, and orders booked early in the year are not worked off yet. A large firm of spring manufacturers here are turning out 300 springs for waggon and carriage bearings every week to the order of one of the English railway companies. Axles are now made with a lower percentage than ever of carbon, the tensile tests being from 27 to 30 tons per square inch, with an elongation of 40 per cent. in 2in., and a reduction in area of 50 per cent. Prices generally have dropped considerably during the last month. Engineers continue busy, although there are more men out of employment than for some time past. The recent advance of 2s. per week in wages recently granted to mechanics is leading to a great deal of friction in some shops. The societies insist upon paying all men equal wages, quite irrespective of their qualifications as individuals. The standard rate of pay is now 36s. for 54 hours.

Additional Railway Accommodation.—The Manchester, Sheffield, and Lincolnshire Railway Company are again fortunate in their application to Parliament for powers for extension. The Select Committee have passed the preamble of a Bill for the substituted railway from Staveley to Chesterfield, and for a new line from Chesterfield to Heath, over which the London and North-Western Railway Company will have running powers.

NORTH STAFFORDSHIRE, 7th May, 1890.

The Iron Trade.—Matters are getting very serious for manufacturers. Owing to the fall in prices consumers are withholding specifications on account of contracts entered at high figures, and new orders are very scarce indeed. Some firms have not enough work on their books to carry them on for more than a few days. It is becoming quite customary for the mills and forges not to start till Tuesday night. Altogether manufacturers are in a worse plight than they were at the lowest stage of the recent depression. The increased cost of production is such that present prices are not of a remunerative character. Bars are selling at about 7s. 5d. per ton, and forge pig iron at 55s. Unless the retogressive movement in prices is shortly stopped some reduction in wages must be the result.

The Coal Trade.—There is a fair demand for coal for manufacturing purposes, and slack is in good request. Prices show some signs of weakness, more particularly in the case of house coals, but there is no actual reduction in current quotations.

The Pottery Trade.—Manufacturers are fairly busy, and orders on American account are being received. A disastrous fire occurred last week at the Imperial Pottery, Longton, recently purchased by Messrs. T. Forester & Sons. The damage is estimated at about £6,000.

CARDIFF, 7th May, 1890.

Iron and Steel.—The decision of the steel makers to reduce the price of steel tinplate bars has caused some dissatisfaction amongst tinplate makers, whose contention is that the heavy reduction is only nominal, and is a lever to their buyers to induce them to further reduce their quotations. Most of the steel makers are well sold forward, and consequently will not offer at the association price. Steel rails are inactive. The hematite pig iron trade is no worse; considering the recent reductions every week, this is somewhat satisfactory. Makers still have contracts to execute at high figures, so there is a reluctance to accept market prices when quotations for raw material are comparatively firm. In iron ore there is little new business to record; the contracts made at the beginning of the year are quite equal to the production of the miners on the one hand, and the wants of the works on the other. Rubio ore is quoted at 15s. 6d. c.i.f. Cardiff or Newport, 15s. 9d. Swansea, 16s. 3d. Briton Ferry and Porthcawl, 16s. 9d. Port Talbot.

Coal and Coke.—Steam coal is steady; the price for first quality is 14s. 6d. to 15s. 3d. f.o.b.; second, 13s. 6d. to 14s.; and third, 12s. 9d. to 13s. 3d. There is a disposition amongst colliery owners to form limited companies of their undertakings. The first announced is that of Messrs. D. Davis & Sons, Ferndale and Blaengawr collieries, whose output is near a million tons per annum. The coal has a first-class reputation in foreign markets. Other collieries are likely to follow. For coke there is only a moderate inquiry, the contemplated blowing out of furnaces acting as a deterrent to ironmasters from making new purchases.

BARROW-IN-FURNESS, 7th May, 1890.

Steel.—There are no new orders coming to hand for tinplate bars, and the mills are all stopped. This means a reduction in the output of steel of 1,000 tons a week. Other departments of the steel trade are quiet. There is considerable briskness industrially so far as rails, shipplates, and angles are concerned, but the demand is quiet.

Hematite Pig Iron.—The men employed by the West Cumberland Iron and Steel Works have demanded an increase in their wages in face of a declining market. The directors have refused to consider the overtures of the men, and they have closed their works until it is possible to produce iron and steel at a profit. Eight hundred men are thus thrown out of work. Already 400 men have been made idle in consequence of the damping down of furnaces at the works of the Moss Bay and the Lowther Companies. It is probable that there will not be a resuscitation of activity at Workington until the market prices leave a profit to the producer. At present hematite warrants are selling at 55s. 3d., while makers are quoting 60s. to 65s. per ton net f.o.b. for Bessemer pig iron in mixed parcels. In the meantime stocks are gradually being reduced. They now amount to 334,013 tons, being 46,629 tons less than in the beginning of the year. There are forty-seven furnaces blowing out of seventy-nine, and other furnaces are to be damped down shortly.

MIDDLESBROUGH, 7th May, 1890.

Pig Iron.—The pig iron market, after giving promise of a more cheerful tone, has relapsed into the same uncertain state. This condition is perplexing the minds of buyers, who, in the meantime, hold aloof. Yesterday the market opened with No. 3 G.M.B. being sold at 46s. for prompt f.o.b. delivery, but towards the close 45s. 6d. was all that could be got, and there was not much done at that. Some makers have come down to merchants' prices. Middlesbrough No. 3 warrants are down to 45s. 3d., buyers offering 45s. cash. West Coast hematites are quoted at 55s. 6d. to 55s. 7½d. cash, and East Coast hematites at 65s. per ton. Connal's stocks stood on Monday at 129,582 tons, being 3,320 tons less than a week ago.

Ironmasters' Returns.—The total make of all kinds of pig iron during the month of April amounted to 235,157 tons, as against 244,889 tons in March, being a decrease of 9,732 tons, with one day less in the month. On the 30th of April the stocks of pig iron amounted to 277,597 tons, as against 274,022 tons on the 31st of March, showing an increase of 3,575 tons. During the month of April the shipments abroad from the port of Middlesbrough amounted to 59,886 tons, against 43,697 tons during March and 64,623 tons during April, 1889. The shipments coastwise during April amounted to 16,420 tons, against 16,986 tons during March and 39,826 tons during April, 1889. These show a total decrease on April, 1889, of 28,143 tons.

Manufactured Iron and Steel.—Iron and steel are comparatively dull. Specifications are difficult to obtain, and some works have had to run short time. The Esson Steel Works have ceased work entirely for the present. Iron ship-plates are at £6 5s., but £6 2s. 6d. and even £6 would be taken; angles are at £6 2s. 6d.; bars, £6 5s. per ton. Steel ship-plates, £7 7s. 6d.; angles, £7 7s. 6d.; rails, £5 2s. 6d. to £5 per ton, all less 2½ per cent. on trucks at manufacturers' works.

SUNDERLAND, 7th May, 1890.

Shipbuilding.—The fall in the cost of iron and steel may be expected to lead to the placing of some contracts with shipbuilders, by firms who wish to replace tonnage, although no great influx of orders can be expected until there has also been a corresponding reduction in the cost of labour. One contract has been recently secured on this river—viz, by Mr. James Laing, Deptford, from Messrs. Ballard, King, & Co., London. The vessel is to be a duplicate of the s.s. "Umbolozi," which was recently lost. She will be fitted with triple-expansion engines by Messrs. George Clark & Co., Ld., Southwick Engine Works.

Shipping.—The principal feature of the freight market during the last ten days has been the large number of fixtures that have been made for autumn loading on the Black Sea and Danube. Prompt rates for the same trade are at present much improved, but early loading is not satisfactory. The feeling as regards the future is generally not so despondent, and a large demand for tonnage in the American trade later on is anticipated in some quarters. The Baltic outward freights have improved, but coasting and outwards to the Mediterranean still rule low The local import and export trade has been very brisk during the last week; fifteen vessels arrived, with cargoes of iron ore, iron, timber goods, &c. The coal shipments were above the average, amounting to 86,165 tons, a net increase compared with the previous week of 16,965 tons; 43,001 tons were shipped to foreign ports, an increase of 15,163 tons, and 42,964 tons to home ports, an increase of 3,602 tons. There were also shipped coastwise 1,010 tons of patent fuel, 120 tons of lime, 20 tons of cement and sundry other merchandise; and to foreign ports, 405 tons of coke, 25 tons of sanitary pipes, a case of machinery, two anchors and chains, &c.

NEWCASTLE, 7th May, 1890.

The Iron Trade.—The prices of finished iron have further declined, and are now fully £2 per ton below the highest point attained. In the pig iron trade a more cheerful tone is being manifested, and hopes that business will be steadier for the remainder of the year are generally entertained. The Gateshead Ironworks, which for more than a century were owned and worked by Messrs. Hawks, Crawshay, & Sons, are advertised to be sold by auction on the 13th inst.

Shipbuilding.—There was launched on Monday, at the Elswick shipyard of Sir W. Armstrong, Mitchell, & Co., an armed cruiser, which has been built to the order of the Argentine Government. Another vessel, of smaller dimensions, will shortly be ready for putting off the stocks at the same establishment. The yard of Messrs. Schlesinger, Davis, & Co., which is one of the largest on the river, having seven building berths, is now quite empty, the last vessel on the stocks having been launched a few days ago. This is the first time since 1886 that an important yard on the Tyne has been wholly tenantless. The Blyth Shipbuilding Company have just opened their new graving-dock, and are now in a position to undertake all kinds of repairs to both the hulls and machinery of vessels. The dimensions of the dock are:—Length, 350ft.; width at entrance, 55ft.; depth of water on sill in ordinary spring tides, 19ft. The dock can be emptied in a little over two hours by a set of powerful centrifugal pumps, supplied by Messrs. Drysdale, of Glasgow.

Wages Movements.—The plasterers of Newcastle have come out on strike for an advance of wages, and it is understood that some employers have complied with the demand. The policemen have commenced an agitation for an improvement in the wages scale.

New Foundry at Tyne Dock.—A firm of ironfounders, Messrs. Wheatley & Taylor, have started a new foundry in extensive premises at Tyne Dock, and as engineers are still finding it difficult to get prompt supplies of castings, the new venture is likely to be a success. A 16 horse-power Stockport gas engine has been supplied.

The Coal Trade.—The shipments of coal and coke at Tyne Dock for the week ending May 3rd amounted to 111,451 tons, being an increase as compared with the corresponding week of last year of 3,479 tons.

DUNDEE, 7th May, 1890.

Flax and Jute Trades.—The linen branches of the local trade continue fairly active. Flax is quoted at higher rates, but transactions are limited in all positions. Coarser sorts of flax and tow yarns are not in brisk demand, but manufacturers are offering well for finer qualities. A good business is passing in linens on home account. The American demand is satisfactory, and makers are busy all round. Jute is in steady demand at good prices. It is expected that the export from Calcutta of jute this year will exceed the quantity sent out last year. Jute yarns are in strong demand. Prices of Hessians are well maintained, but transactions are limited in amount.

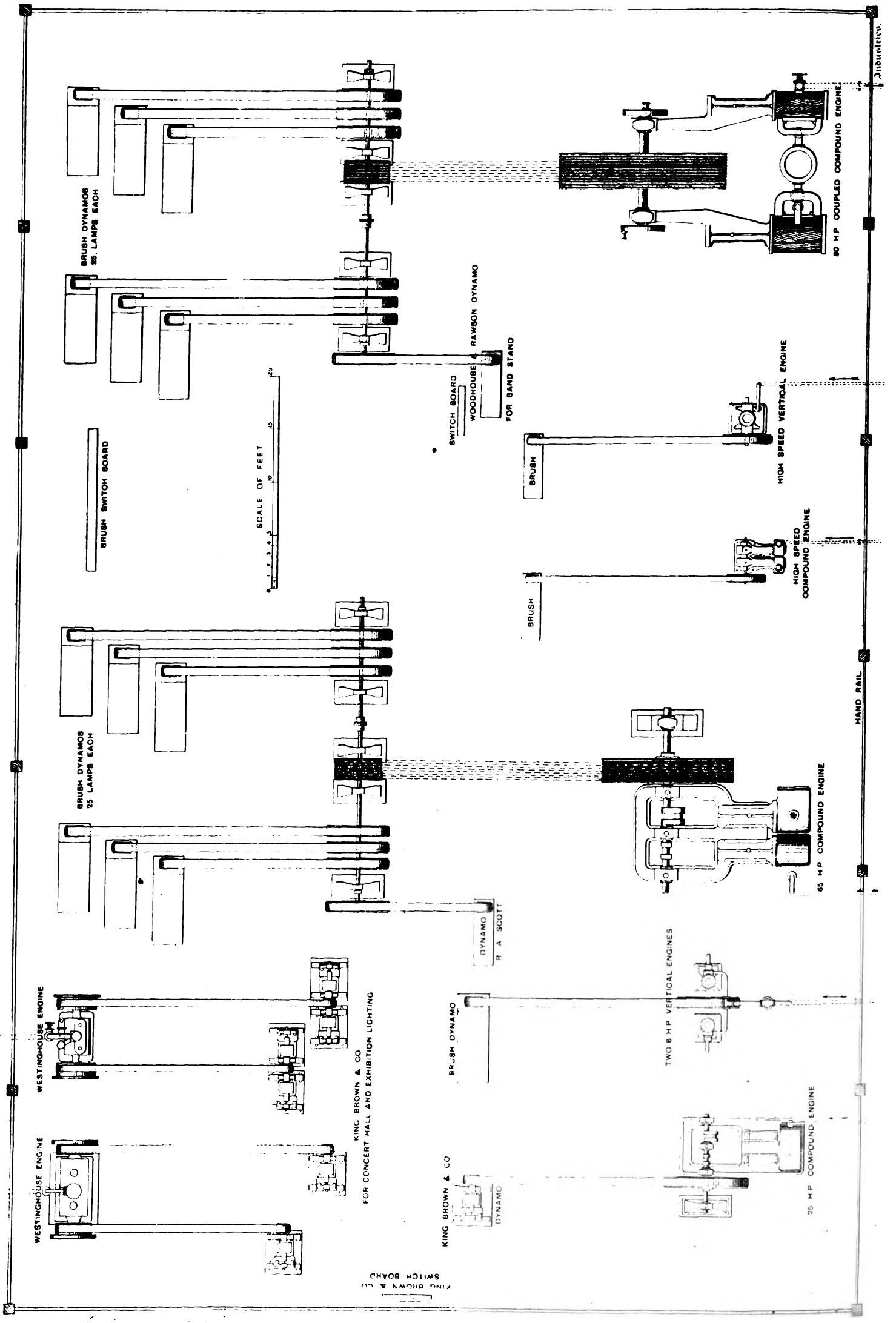
Technical Education.—A conference of teachers and others interested in the promotion of technical education has agreed to memorialise the employers of labour as to the necessity of recognising a scientific course of study on the part of apprentices. It has also been resolved, with this object in view, to enter into communication with the Dundee Educational Trust, in order to have the conditions modified under which technical bursaries are held.

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THE EDINBURGH INTERNATIONAL EXHIBITION.

General Plan of the Dynamo Plant.

(*For description see page 440.*)



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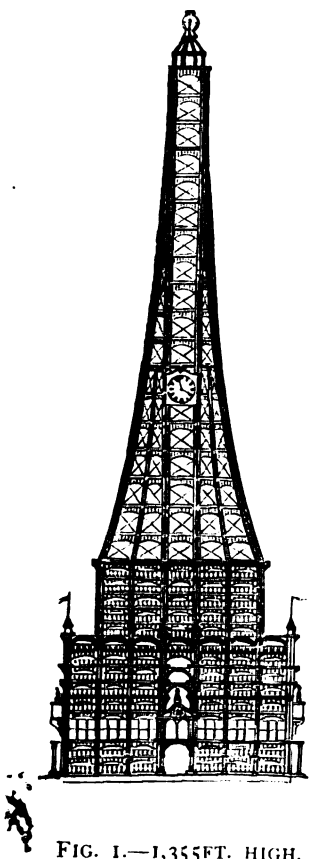


FIG. 1.—1,355FT. HIGH.
Mr. M. T. OTIS' DESIGN.

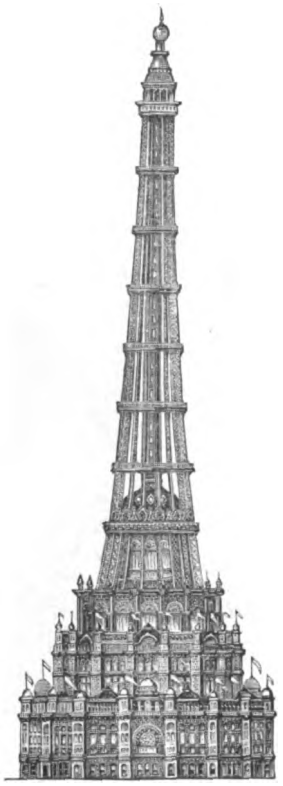


FIG. 2.—1,250FT. HIGH.
Messrs. KINKEL AND POHL'S DESIGN.

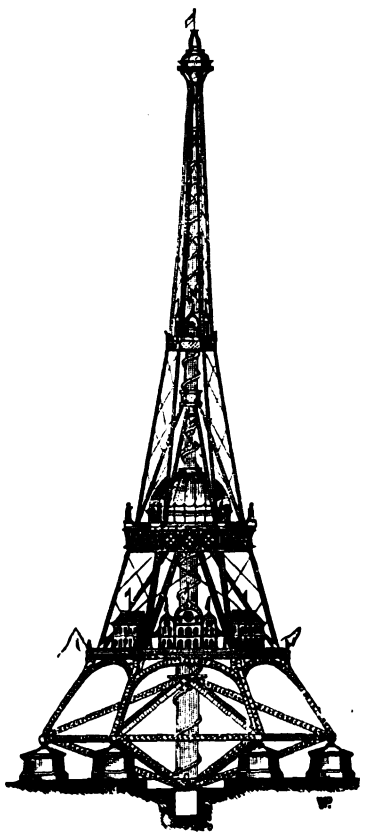


FIG. 3.—1,200FT. HIGH.
"W. P.'S" DESIGN

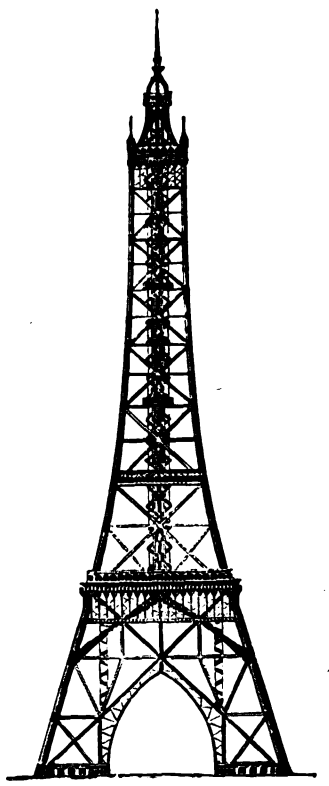


FIG. 4.—1,400FT. HIGH.
Mr. E. S. SHAW'S DESIGN.

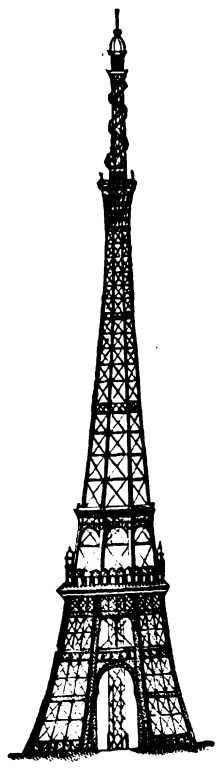


FIG. 5.—1,280FT. HIGH.
Messrs. T. C. CLARKE, J. MAYER, AND W. HILDENBRAND'S DESIGN.

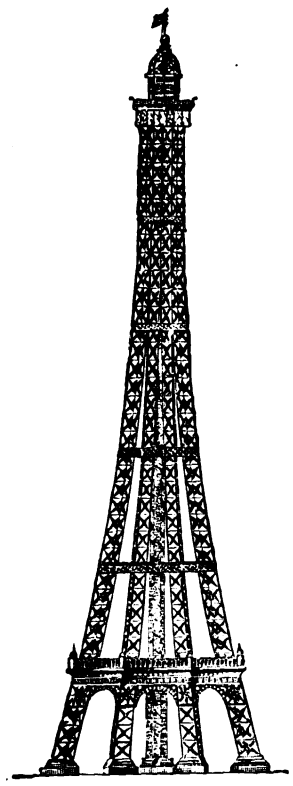


FIG. 11.—1,500FT. HIGH.
Messrs. WYNDHAM VAUGHAN AND W. H. TOMKINS' DESIGN.

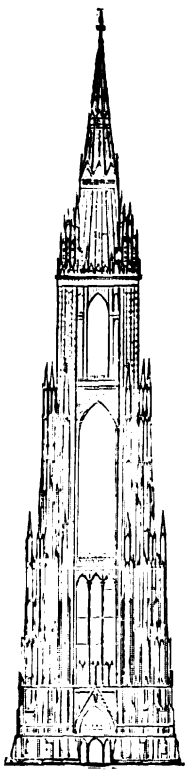


FIG. 12.—1,550FT. HIGH.
Mr. MAX AM ENDE'S DESIGN.

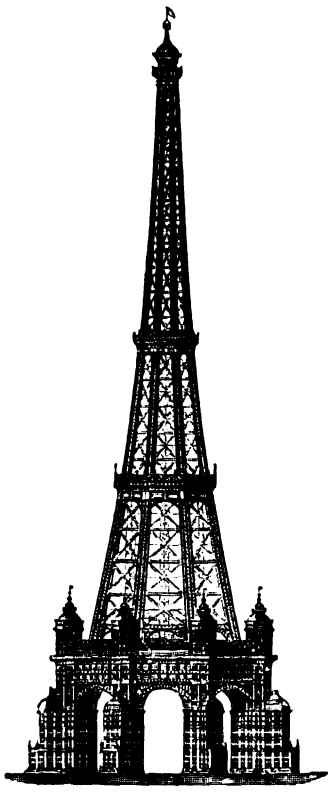


FIG. 13.—1,300FT. HIGH.
Messrs. J. J. WEBSTER AND J. W. HAIGH'S DESIGN.

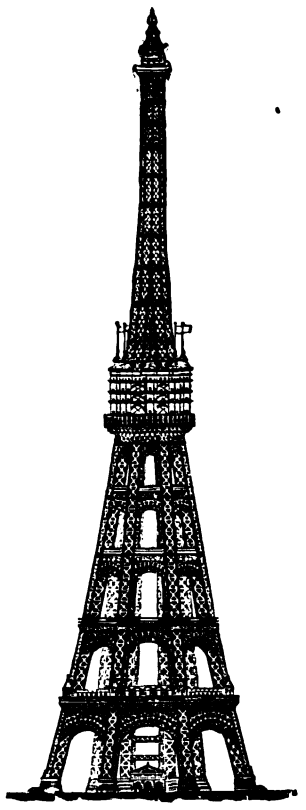


FIG. 14.—1,300FT. HIGH.
Messrs F. FOX AND G. E. GRAYSON'S DESIGN.

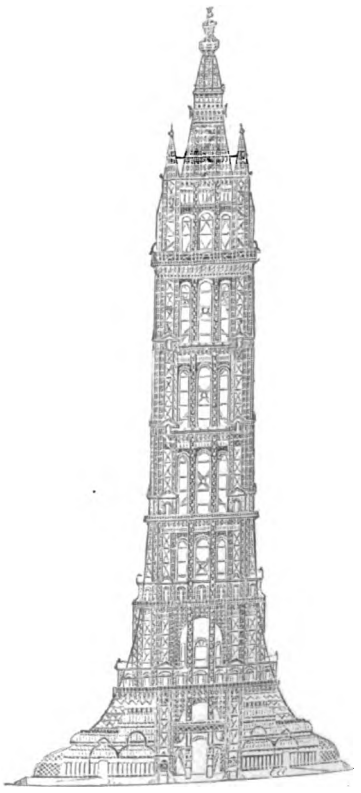


FIG. 15.—1,296FT. HIGH.
Mr. S. J. FAIRFAX'S DESIGN.

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FOR THE GREAT TOWER IN LONDON.

(see page 447.)

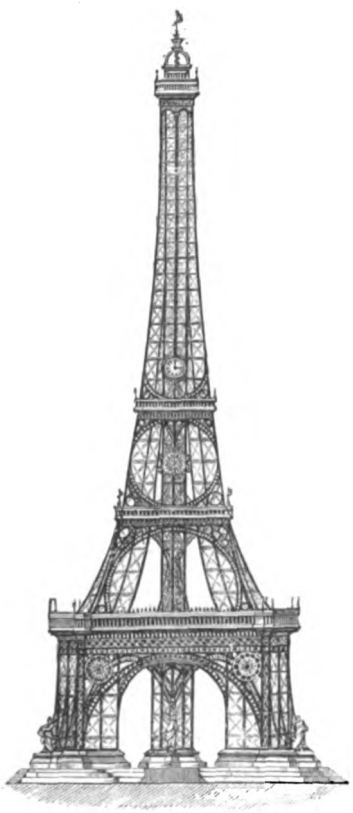


FIG. 6.—365 METRES HIGH.
Mr. P. CAMPANAKIS' DESIGN.

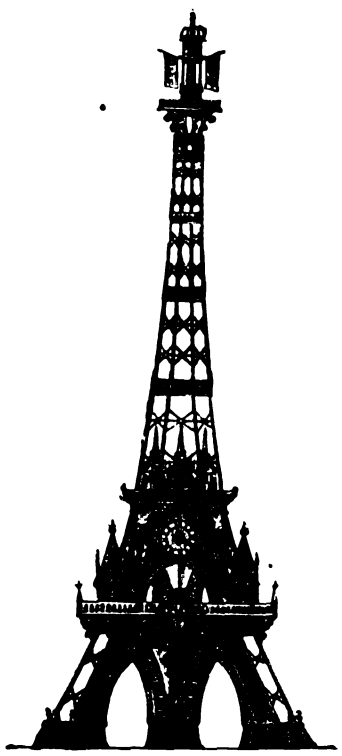


FIG. 7. 1,200FT. HIGH.
"TIME IS MONEY'S" DESIGN.

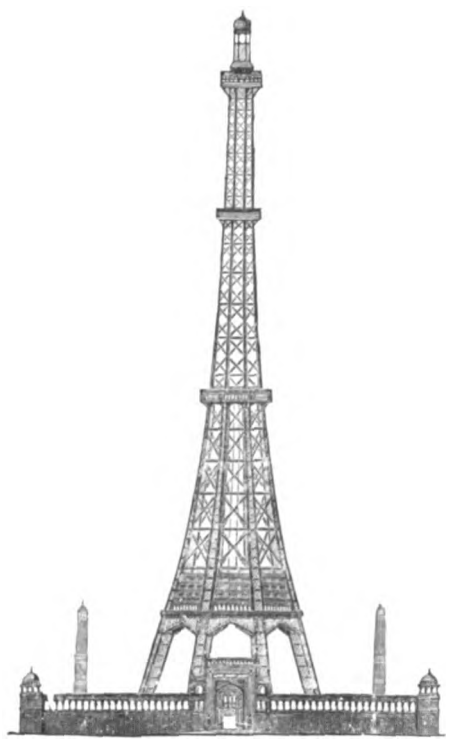


FIG. 8.—1,200FT. HIGH.
Messrs. A. D. STEWART,
J. M. MACLAREN, AND
W. DUNN'S DESIGN.

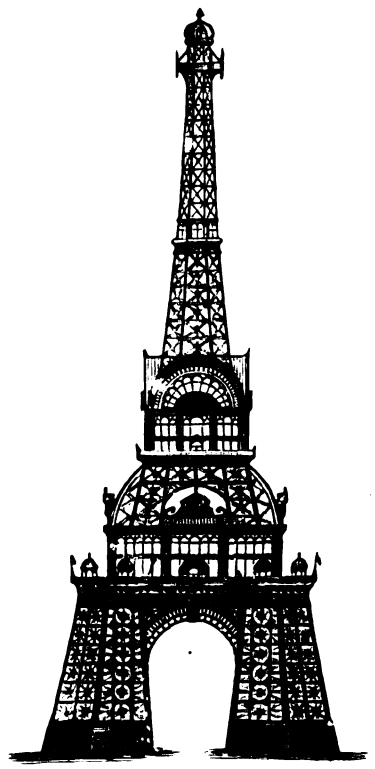


FIG 9.—1,470FT. HIGH.
Mr. ROBERT WYLIE'S DESIGN.

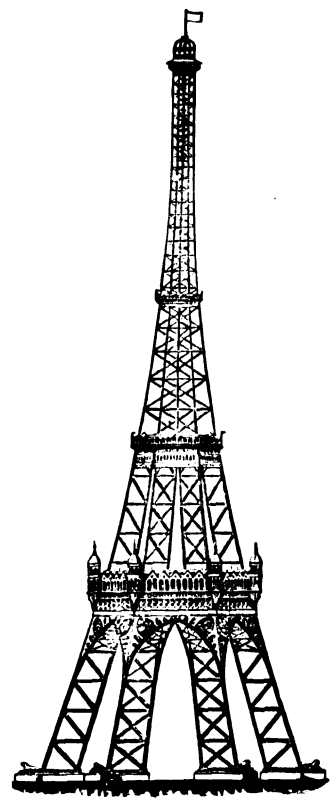


FIG. 10.—1,300FT. HIGH.
Messrs. E. HARPER,
H. A. H. HARPER, AND
J. GRAHAM'S DESIGN.

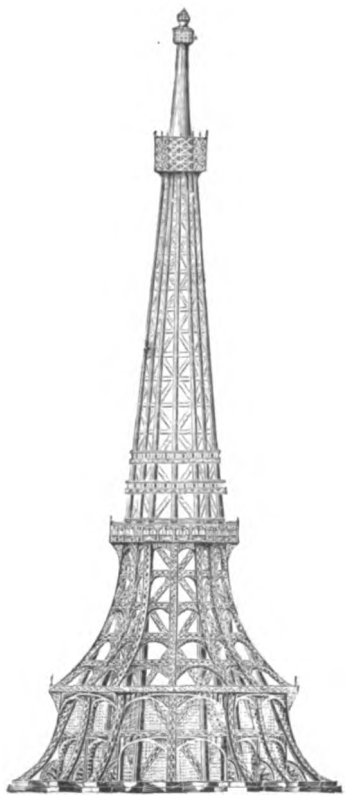


FIG. 16.—1,250FT. HIGH.
Mr. H. DAVEY'S DESIGN.

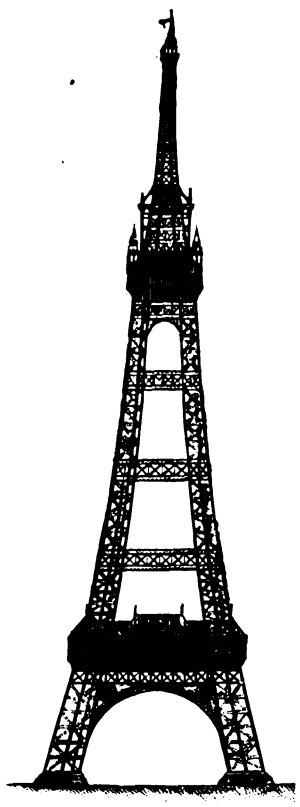


FIG. 17.—1,250FT. HIGH.
Messrs. R. J. G. READ AND
L. A. SHUFFREY'S DESIGN.

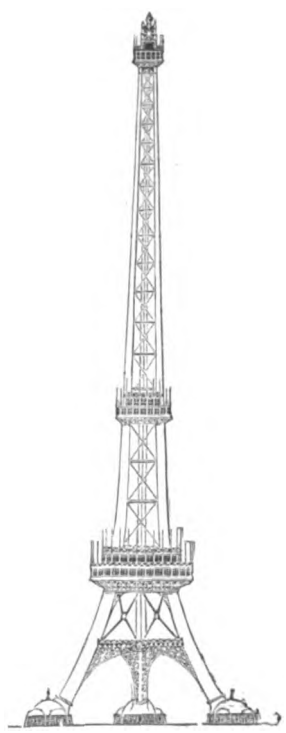


FIG. 18.—1,4COFT. HIGH.
Prof. R. H. SMITH AND Mr.
W. HENMAN'S DESIGN.

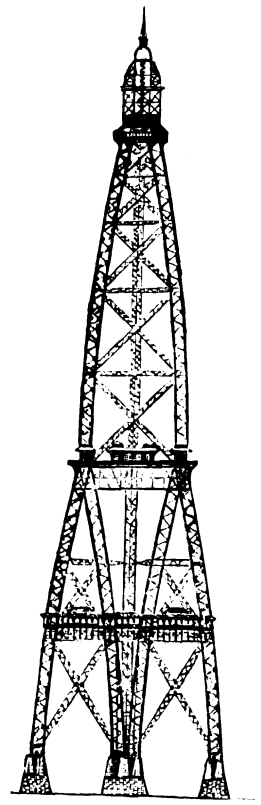


FIG. 19.—1,193FT. HIGH.
Mr. H. E. SKETCHLEY'S
DESIGN.

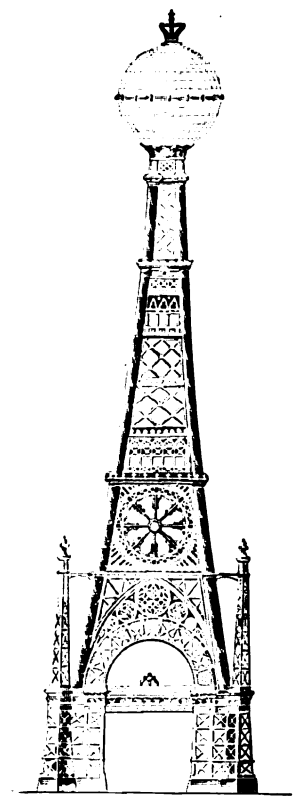


FIG. 20.—440 METRES HIGH.
Mr. LAMONT YOUNG'S DESIGN.

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As we go to press early with certain of our advertisement pages, all Alterations to Standing Advertisements should reach the Publisher not later than 2 o'clock on Wednesday afternoon in each week.

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

Contents.

	PAGE
Sensitive Drilling Machine (*Illus.*)	433
The S.S. "Prins Willem II." (*Illus.*)	433
The Institution of Mechanical Engineers	433
Foreign Industries (Corres.)	438-439
The United States Cruiser "Newark" (*Illus.*)	440
The Edinburgh Exhibition (*Illus.*)	440
Notices of Meetings	441
Prices Current	441
Home Industries (Corres.)	442-443
Scotch Affairs	445
Lighthouse Illuminants	446
The Late Mr. James Nasmyth	446
The Iron and Steel Institute	446
The Proposed Great Tower in London (*Illus.*)	447
Letters to the Editor:— The Institution of Naval Architects	447
Suggestion for a New Scottish Main Railway System	448
The Waller-Manville System of Electric Traction (*Illus.*)	448
Reviews	449
The Royal Mail Paddle Steamer "Princess Victoria"	449
The Physical Society	450
The Gold Chlorination Processes	450
The Gesner Rust-Proof Process (*Illus.*)	451
Notes	452
"Industries" Patent Record:— Applications and Acceptances	453-454
Illustrated Abridgments	454-456

Two-page Supplement illustrating a few of the Designs for the proposed GREAT TOWER in LONDON.

To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

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Industries:

FRIDAY, 9TH MAY, 1890.

SCOTCH AFFAIRS.

FORMERLY Ireland occupied so much of the public attention, that the innocent foreigner who chanced to take up a newspaper might have regarded that island as the most considerable in the Empire. Now, for the time being at any rate, Scotland steps into this position, and succeeds in securing a rather ample share of newspaper columns and public attention. The opening of the Edinburgh Exhibition, and the monopolisation of the time of Parliamentary Committees for the past fortnight, have combined to thrust Scotch affairs before the eyes of the public. The Edinburgh Exhibition has been so gallantly promoted, and so much enterprise has been exhibited in getting as many novel and interesting features together as possible, that, even if the result of these efforts had not been so successful as they happen to have been, it would have been somewhat graceless to criticise captiously. So far as electrical science is concerned, it can hardly be claimed, however, that the Exhibition meets expectations; but the railway exhibits are unusually interesting, and so also are many of the miscellaneous machinery exhibits. But an electric railway up to date, a new ship railway shown for the first time, and above all the Chemin de Fer Glissant of Messieurs Girard & Barre, exhibited last year at the Paris Exhibition and not until now seen in this country, are enough to give the Exhibition scientific interest. The external and non-scientific attractions are seductive enough to the average holiday maker, and, after all, Exhibitions are devices, not alone for instruction, but for amusement as well.

The other Scotch affairs which have been much in evidence of late are the Bills whose progress before the Parliamentary Committees have been watched with keen interest in Scotland. These are the Glasgow Boundaries Bill, the Clyde Navigation Bill, the Glasgow Police Bill, the Glasgow Subway Bill, and the group of railway Bills, chief among which are the Bills of the Caledonian and North British Railways respectively, who each want to absorb the Glasgow and South Western Railway. The Glasgow Boundaries Bill, so far as its original form is concerned, has met with a disastrous fate. Round Glasgow, as round all other large cities, there thrive groups of communities, separated from the city by no material barrier, and enjoying at once urban and at least partial rural advantages. These communities, to begin with, in some cases adopted systems of voluntary assessment for local communal purposes of a minor order, the main communal needs being satisfied by the city authorities, who supplied their neighbours with gas and water. The police administration of these districts was of a rudimentary character, but, it is only fair to add, was seldom called into requisition. One by one these communities formed themselves into burghs by means of an Act of Parliament known as the Lindsay Act. In addition to these mushroom burghs there are others of older date, whose municipal privileges in some cases it has been deemed wise to leave untouched. Obtruding beyond the city boundaries, and into the regions of the surrounding parasitic burghs, there are several public parks belonging to the city, and maintained by a rate levied on the city alone for the purpose. These parks are of course available for the inhabitants of the burghs who toil not nor pay for them, as well as for the city folk who both toil and pay for them. The burghs would neither be wooed softly nor won forcibly to meet their due share of the expenses. Things were in this pass when the Corporation succeeded in obtaining the appointment of a Royal Commission to take evidence. This Commission came and took evidence, and ultimately reported. The Report was strongly in favour of annexation all round, and the Corporation apparently rested content. It was expected that the Government would introduce a Bill which should put a stop to the perpetual bickering, and draw the whole valley of the Clyde round Glasgow into the net of the city. But the expected did not happen. The Government would not touch the subject. Still the Corporation, relying upon the Report of the Commission, went gaily forward with a private Bill, fortified by the assent of some of the burghs whose independent existence was involved. Others of the burghs, however, determined to continue the old contest, and did so to such purpose that the preamble of the Bill was found not proven, and the whole ponderous and expensive question left precisely where it was. But the representatives of the Glasgow Corporation have adopted the unusual course of seeking for leave to amend the Bill so as to exclude the dissentient and include the assenting burghs. It is, however, open to question whether or not the assent of these last was given on the understanding that the scheme was to be carried in its entirety. Among the other Glasgow Bills, the Police Bill grants increased power of sanitary inspection to the local authority, and a private Bill of the Corporation seeks powers to establish central stations for electric lighting.

The most important of the Scottish measures are, however, the Railway Bills. One of these, the Caledonian Railway Bill for a line to the Vale of Leven, has been thrown out, and the great struggle is now going on between the Caledonian and the North British Railways, nominally for possession of the Glasgow and South Western, practically for railway supremacy in Scotland. It seems that the able men who for some years past have been occupied in steering the North British Railway out of comparatively deep water into a commanding position in Scotch railway administration, saw the advantage which would accrue from their annexation of the Glasgow and South Western Railway. This railway, much smaller than either of the two great lines, is an important feeder both to the North British and to the Midland Railway Companies. For some years the association between the three railways has been very intimate, and the English company has become largely interested in the Scottish South Western through subscriptions to many of its special undertakings. At present the South Western Company and the Caledonian Railway compete together for the coast and shipping traffic by Greenock and Ardrossan, while the North British has no independent outlet to the shipping ports of the West coast, the coast line of that company being carried down the north bank of the Clyde, fruitful enough so far as tourist traffic is concerned, but barren for shipping traffic. The acquisition of the South Western Railway by the North British Company would give that company the outlet on the south bank of the Clyde which it needs, and would besides secure it further advantages—*e.g.*, direct connection with the great new dock at Glasgow at present being constructed by the Clyde Navigation Trust. From the point of view of the interest of the North British Railway the question is a simple one; the other point which it is the business of the Committee which is now

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sitting on the Bills to decide—viz., the policy of this railway amalgamation considered in relation to the interest of the public—is by no means so simple. Unfortunately railway administration as an exact science has not been studied in this country in such a way as to make it possible to determine precisely the results hitherto of the extensive amalgamations which have already taken place, and, therefore, we are driven to the commonplace conclusion, that there is a good deal to be said on both sides. What is gained in point of unification of administration may not be gained by the public so much as by the shareholders; for unification means the suppression of competition, and the suppresion of competition means the probable maintenance, if not even the raising, of rates. Railway property stands in a unique position as regards State control. Save so far as these are given by express Act of Parliament, railway companies have no vested interests. Their whole existence is determined by Acts of Parliament, and, therefore, the very fact that the railway interest is represented very largely in Parliament makes it all the more necessary for us to be scrupulously careful in granting privileges which some day may become a national burden. Indeed it seems worth while keeping in mind a suggestion, which was mooted many years ago, that, failing the utmost freedom of competition among railways and the discouragement of amalgamation, it might be well to make the land and permanent way of the railways national property for which a rent should be paid, while the rolling stock should remain the property of the companies, whose lease of the permanent way should be terminable and renewable. This plan has been found to work in municipal tramway systems. It is perhaps not wholly immediately practicable so far as the railways are concerned. Nevertheless, it is certainly a serious question as to how far we are justified in acquiescing in the gradual steps of our railway system towards monopoly, especially when we remember that the railway companies collectively hold enormous tracts of land in and near all our large cities. In the hands of conscientious and responsible persons, of course, the danger to the public interest is comparatively slight; but an adverse vote at a meeting of shareholders might bring into power men who would care little for the public interest. This has happened again and again on a large scale in America, and is not purely visionary. While it is extremely difficult to suggest adequate guarantees against the abuse of monopoly, there is *primâ facie* a case for the guarantees imposed being as stringent as possible. The immediate practical settlement of the question seems likely to be the amalgamation of the Glasgow and South Western with the North British, and the granting of extensive running powers to the Caledonian Railway. Though this compromise breaks the fall, the result, should the Bill pass, will be that the North British and the Caledonian will be brought face to face in a struggle for supremacy. But the probable natural result of the proposed amalgamation of the two companies, into whosesoever arms the South Western may fall, will be the amalgamation of all the Scottish railways into one large system. Far-seeing railway administrators are known to regard this as by no means an unlikely issue.

LIGHTHOUSE ILLUMINANTS.

We have on several occasions pointed out what an energetic and persevering advocate for the improvement of lighthouse illuminants Mr. J. R. Wigham is, and we now learn, from an important paper which he has submitted to the Royal Society of Dublin, that, while the special committee appointed to investigate the matter have been taking their ease over their experiments and their report, he has been developing his system of illumination, which has already been so successful. His latest improvement seems to be due to a suggestion of Sir George Stokes, President of the Royal Society, who asked to have the details of the double quadriform gas-light fully explained to him, and the highly trained scientific man was at once able to make some suggestions which the skilled technical man was soon able to apply to a working model, and make an arrangement which is applicable to double-revolving as well as group flashing lights. Instead of being two-sided, the apparatus is made four-sided, and thus, while its speed of rotation is reduced by one-half, the duration of its flashes increases in the same proportion. The distinctive character of the light is that it transmits to the observer two brilliant flashes succeeding each other at intervals of half a minute, followed by a period of darkness of one minute, to be again followed by two brilliant flashes of half a minute apart, as before, and so on continuously. The new light has been tested at the experiment house on Howth Baily, and the results have been most satisfactory, being a regular succession of remarkable beams with an illuminating power never before attempted in lighthouse practice. We will watch with considerable interest the action of the Board of Trade and of the Trinity House in this matter. Hitherto the Commissioners of Irish Lighthouses, pushed onwards by such men as Mr. Wigham, have led the way in the development of lighthouse illuminants, while the permanent officials of the Board of Trade and of the Trinity House have always been more or less obstructive, as is easily seen from a perusal of the correspondence which has been published from time to time. The Royal Society of Dublin adopted a resolution advising their council to recommend the lighthouse authorities of Great Britain and Ireland to have the invention tested. It might save time and correspondence if the matter were referred to the special committee already appointed. The proper authorities had better take up the matter at once, for they well know by this time that Mr. Wigham will give them little rest until it has been decided.

THE LATE MR. JAMES NASMYTH.

We regret to announce the death of Mr. James Nasmyth, which took place on Wednesday last, in the 82nd year of his age. He was born in Edinburgh on the 19th of August, 1808, and was the youngest of the eleven children of Mr. Alexander Nasmyth, a well-known landscape painter. James Nasmyth early showed a predilection for mechanical pursuits, and, although he also inherited great artistic abilities from his father, he preferred to confine his attentions to engineering. At Edinburgh he attended all the scientific classes at both school and university, and he there came into contact with many leading engineers and scientists, whose acquaintance he turned to the best account. At the age of 21 he came to London, and commenced to work for Messrs. Maudslay, Son, & Field. He only stayed here for a short time, and then returned to Edinburgh, and, after making a set of special tools, he went to Manchester to start business for himself in a very small way. Here he soon found the work that poured in upon him too much for his small premises, and he secured a large plot of ground at Patricroft, near Manchester. This site of twelve acres was soon covered by a vast series of workshops, which he called the Bridgwater Foundry. In the purchase of the site and the erection of the buildings he had considerable assistance from gentlemen who saw the ability of the young engineer. Here he invented and perfected a large number of mechanical tools which are used in workshops all over the world. The steam hammer, the safety founding ladle, the double-faced wedge sluice valve, a reversible rolling mill, a pile-driver, &c., were invented at the Bridgwater Foundry, and all of them were widely applied in works all over the country. Mr. Nasmyth retired from business in 1857, and devoted himself to scientific pursuits of all kinds. He wrote several books on mechanical subjects, and also one on the moon. Astronomy was a favourite recreation of his, and he made many suggestions as regards the physical conditions of the universe, which have had an important influence on the progress of astronomical science. The application of artistic principles to the designing of pottery, &c., was also one of his favourite studies. Many anecdotes are told of his capabilities as an artist, and those who knew him agreed that if he had not been an engineer he would have shone in the art world.

THE IRON AND STEEL INSTITUTE.

The annual meeting of the Iron and Steel Institute was commenced on Wednesday, the 7th inst., at the Institution of Civil Engineers. Sir James Kitson, the President, occupied the chair. The report of the proceedings of the Council during 1889 showed that the past year has been prosperous technically and financially. The Institute now numbers 1,427 members, and 72 new members were elected at this meeting. It is expected that some 300 members will visit the United States in the autumn, and the meeting held there will no doubt be instructive, agreeable, and successful. The Bessemer Gold Medal for 1890 was presented to Mr. W. D. Allen, of Sheffield, in recognition of his attempts to preserve the high quality of Bessemer steel. Mr. Allen was one of Sir Henry Bessemer's early coadjutors, and in former years managed the works at which bronze powder, an unpatented invention of Bessemer's, was manufactured by a secret process, a secret that Mr. Allen kept for forty years.

The first paper read was on a "New Form of Siemens Furnace, arranged to Recover Waste Gases as well as Waste Heat," by Mr. John Head, M.Inst.C.E., and M. P. Pouff, of Nevers. This paper was read at Paris in September, and was adjourned for discussion to this meeting. This furnace was illustrated in *Industries*, Vol. VIII., page 75. The waste gases are directed partly through an air regenerator and partly under the grate of the producer, there to be reconverted into combustible gases, and to do the work of distilling hydro-carbons from the coal. In fact, this gas producer absorbs or utilises the heat formerly deposited in the gas regenerators of furnaces, and in doing this transforms spent gases into combustible gases. At the time the paper was written there were two furnaces at work; there are now thirteen at work for heating iron and steel, in addition to fifteen in course of construction. The advantages claimed for this furnace, as compared with solid fuel furnaces, used for heating and welding iron, are a saving in fuel, amounting to 5 cwt. of coal per ton of iron heated, a reduction in the waste of iron equal to 5 per cent. upon the weight of metal heated, and considerable saving in labour and repairs.

This paper was followed by one on calculations concerning the possibility of regenerating the gas in the new Siemens furnace, by Professor Akerman, of the Stockholm School of Mines. The calculations are of a complicated character, and insecurity is caused by the uncertainty concerning the specific heat of gases at high temperature. The author, however, concludes that, in comparison with producers such as Wilson's, in which the air for combustion is introduced by means of a steam injector, the economy of fuel with the new arrangement becomes smaller, without question, in the same ratio, as the fuel consumed in them is less than in the gas producer with which steam injectors are not used; and it is only in comparison with common draught furnaces with solid fuel, still often used in countries rich in cheap coals, that such an economy can be possible as that stated by Messrs. Head and Pouff. It is, however, with Siemens furnaces that comparison should be made; and it is very fair if, besides the fuel necessary for the steam injector, 50 per cent. from the usual Siemens furnace consumption can be saved by the new arrangement.

In the discussion that followed the reading of these two papers, Sir Lowthian Bell, F.R.S., adversely criticised the new Siemens furnace, and pointed out that in trials of new inventions better results are obtained than are obtained in practical working. Mr. Cowper, on the other hand, thought the furnace extremely ingenious, and thought that economy of fuel ought to result from using carbonic oxide as a carrier of carbon. The President had found by experience that with the Siemens regenerative furnace there was a reduction in the waste of iron equal to 3 per cent. of the metal heated. This, Mr. Head pointed out in his reply, referred to an old form of Siemens furnace. In the new form the economy of fuel was greater. The cost of the coal used is a trifle more per ton than that used in the puddling furnace.

The next paper on the list was on "The Critical Points of Iron and Steel," by Monsieur F. Osmond, of Paris. The paper was a very voluminous one, and presented points of great theoretical interest. In the absence of M. Osmond, the paper was lucidly summarised by Professor Roberts-Austen, of the Royal School of Mines. The following is a brief abstract of the paper: If iron and steel are submitted to a gradual heating or to a slow cooling between the ordinary temperature and that of fusion, and if the variations of some physical property in relation to the temperature are followed, it will be seen that these variations, besides being subject to a constant law, present remarkable phenomena at certain critical temperatures. The mode of investigation adopted consisted in observing with a chronograph what takes place when masses of iron and steel are slowly cooled. To measure the temperature a very accurate pyrometer, recently invented by Le Chatelier, was employed. This consists of a thermo-electrical couple of platinum and of platinum containing 10 per cent. of rhodium. In order to represent the results graphically, the temperatures are taken as abscissæ, and, as ordinates, the times included between the passages of the index of the galvanometer over two consecutive divisions of the scale. An arrestation in the fall of temperature is shown by a sharp point in the curve. In this way, the author investigated the phenomena observed during the slow cooling of iron, steel, and white pig iron between 1,100° C. and 600° C. The results were plotted in a series of curves, shown on large diagrams on the wall, and it was seen that the first arrestation goes on increasing from electrolytic iron, in which it is almost

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nil, up to the hardest steel, where it assumes enormous importance. This point is identified by the author with the phenomenon to which Barrett gave the name of recalescence. The liberation of heat which produces recalescence is the result of the chemical combination of the iron with the carbon. The arrestation in the cooling that occurrs in electrolytic iron which is free from carbon must indicate a molecular change in the iron itself, and the author argues that iron is a polymorphous element, like sulphur, silicon, &c. There are, in fact, two kinds of iron—the α, or soft variety; and the β, or hard iron. The α-iron is pure iron at temperatures below 855° C., and iron containing certain other elements if cooled slowly. The β-iron is iron at high temperatures or if certain other elements be present after being rapidly cooled. When β-iron cools down from bright redness to 855° C. it changes into α-iron. In discussing the influence of the initial temperature, and of the rate of cooling on the position of the critical points, the author propounds a theory of hardening. In opposition to the opinion generally accepted, he believes that it is not carbon, but the allotropic β-iron, which is the principal cause of the new properties the metal acquires. In the case of tempering, the author believes that the β-iron returns to the α-condition, and the hardening carbon to the condition of iron carbide. A large portion of the paper is devoted to an exhaustive investigation of the influence of foreign elements on iron. A summary of his results was given in *Industries*, of the 2nd inst., page 409. From these results the author concludesthat Roberts-Austen's law is confirmed. That investigator, it will be remembered, by studying the effect produced on the mechanical properties of gold by the addition of an equal weight (about 0·20 per cent.) of seventeen foreign elements, has discovered a curious relation between the results obtained and the position occupied by the added metals in the periodic classification.

The names of the elements whose action on iron is known may be arranged as follows in two columns, in the order of their atomic volumes:—

I.		II.	
Name.	Atomic Vol.	Name.	Atomic Vol.
Carbon.....	3·6	Chromium.....	7·7
Boron	4·1	Tungsten	9·6
Nickel	6·7	Silicon	11·2
Manganese.....	6·9	Arsenic	13·2
Copper.....	7·1	Phosphorus ...	13.5
		Sulphur..	15·7

The elements in Column I., whose atomic volumes are ess than that of iron (7·2), delay during the cooling, other things being equal, the change of β-iron (hard) into α-iron (soft), and that of hardening carbon into carbide carbon. For these two reasons they tend to increase, with equal rates of cooling, the proportion of β-iron existing in the cooled iron or steel, and, consequently, the hardness of the metal. They are, in fact, equivalent to a more or less energetic hardening.

On the other hand, the elements in Column II., the atomic volumes of which are greater than that of iron, tend to raise, during the cooling, the change of the iron towards the normal position that it occupied in pure iron. Moreover, they render the inverse change more or less incomplete during the heating, and hasten, during the cooling, the combination of the carbon with the iron. Thus, they maintain the iron in the α condition at raised temperatures, and *a fortiori* in the cooled metal, and are theoretically a source of softness and malleability, like annealing. Thus, foreign elements of low atomic volume tend to make iron assume or preserve the molecular form in which it has itself its lowest atomic volume, and conversely with elements of great atomic volume. These conclusions are in accord with what is known of the influence of foreign elements on the magnetic properties of iron. Experiments made by the author show that within the limits in which carbon, silicon, sulphur, phosphorus, and manganese may vary in the manufacture of steel rails by the acid and basic Bessemer processes, these elements may be divided into two groups as regards permanent magnetism. In the first group carbon and manganese increase the permanent magnetism; in the second, silicon, phosphorus, and sulphur have no action on permanent magnetism.

In the discussion which followed, Mr. Wrightson referred to some experiments he made in 1879 on the change of volume of iron, when he noted two critical points. There was then no means of accurately determining temperature, and he was glad to hear that a satisfactory pyrometer had been devised. One of his critical points undoubtedly correspond with Osmond's. The critical points relating to volume, temperature, and electrical properties should be studied as a whole, and he trusted Professor Roberts-Austen would take the subject up.

Mr. Hadfield announced that he intended to instal one of Le Chatelier's pyrometers at his works, and he stated that a trustworthy indication could be obtained up to 3,500° F.

Mr. Snelus regarded the paper as an abstruse one, but thought that one point was perfectly clear—that was, that the law of Roberts-Austen seemed destined to place metallurgy on a scientific basis, a position that it had hitherto failed to occupy.

After some complimentary remarks on the paper from Sir Lowthian Bell, letters were read from Dr. G. Gore, F.R.S., who in 1869 was the first to notice a momentary molecular change in iron wire, and from Mr. W. F. Barrett, giving additional information.

(To be continued.)

THE PROPOSED GREAT TOWER IN LONDON.

Last week we gave a short notice of the Exhibition of designs for the above tower, now being held in the hall of the Drapers' Company, Throgmorton Street, London, E.C. In our double-page supplement this week we show some of the more striking designs. In the following description the figures in brackets are the numbers in the official catalogue. Fig. 1 (No. 1) shows a design sent in by Mr. M. T. Otis, of Rochester, U.S.A., of a tower of 1,355ft., with a base area of 400 feet square. It is intended to be constructed of iron, and bolts are to be used in place of rivets. Fig. 2 (No. 7) is a steel tower 1,250ft. high, with a base diameter of 192ft. The framework consists essentially of sixteen lattice legs and a central tube. Messrs. Kinkel & Pohl, of Washington, U.S.A., are the designers. Fig. 3 (No. 8) represents a very light tower of steel 1,200ft. high, in the form of a hexagonal skeleton braced around a cylindrical lift tube. Each of the feet is mounted on roller bearings. This design bears the initials W. P. Fig. 4 (No. 11) represents a tower of iron and steel 1,400ft. high, standing on a base of 500 feet square. It has four tubular columns and a central tube. Mr. E. S. Shaw, of Boston, Mass., U.S.A., is the designer. Fig. 5 (No. 20) is a design by Messrs. T. C. Clarke, Joseph Mayer, & W. Hildenbrand, of New York. This is a steel tower standing on a base area of 350 feet square, and measuring 1,280ft. in height. The skeleton is of octagonal form, but the lower part is square. Fig. 6 (No. 27) shows a design by Mr. P. Campanakis, of Constantinople, for a triangular tower 365 metres high. Fig. 7 (No. 28) is an imposing design for a steel tower 1,200ft. high, of triangular skeleton form, and carrying a huge three-faced clock. The designer adopts the motto, "Time is Money." Fig. 8 (No. 37) shows Messrs. A. D. Stewart, J. M. Maclaren, & W. Dunn's design for an octagonal tower of steel 1,200ft. high and 300ft. in diameter at the base. Mr. Robert Wylie, of Liverpool, has designed a steel tower, Fig. 9 (No. 46), 1,470ft. high, standing upon a masonry base of 8¼ acres. The framework is square at the lower extremity and octagonal above. Fig. 10 (No. 48) represents a design by Messrs. Ewen Harper, H. A. H. Harper, & John Graham, Birmingham. This tower is of slim appearance; it is 1,300ft. high, and has a base of 400ft. diameter. The skeleton consists of two equilateral triangles interlaced so as to form a hexagonal star. Messrs. Wyndham Vaughan & W. H. Tomkins, of 64, Broad Street Avenue, London, E.C., have sent in a design, Fig. 11 (No. 49), for a steel tower 1,500ft. high, with a base 500ft. diameter. The frame is of octagonal form, and consists of eight triangular columns, each of which is composed of three steel tubes with lattice bracing. Fig. 12 (No. 50) shows a handsome Gothic design by Mr. Max am Ende, of 5, Victoria Street, London, S.W. It is 1,550ft. high, and is made entirely of steel. The principal platform is situated 1,000ft. above the ground, and the lifts are situated in each of the four main columns. The design Fig. 13 (No. 51), sent in by Messrs. J. J. Webster & J. W. Haigh, of Liverpool, is for an octagonal steel tower 1,300ft. high, standing on a base 470ft. diameter, and shows ample building and platform spaces. Fig. 14 (No. 53) shows a design by Messrs. Francis Fox & George E. Grayson, of a steel tower 1,300ft. high, covering a floor space 370ft. in diameter. The skeleton consists of a double octagonal frame of sixteen lattice columns, each 20ft. square. Mr. J. Sinclair Fairfax, of 433, Strand, London, W.C., has designed a square steel tower, 1,296ft. high and 576ft. diameter at the base. This is shown in Fig. 15 (No. 54). The design shown in Fig. 16 (No. 55) is by Mr. Henry Davey, 3, Princes Street, Westminster. It is for a hexagonal steel tower 1,250ft. high. The skeleton framing consists of twelve steel columns, braced in the form of a truncated cone, on the top of which is a lighthouse tower and lamp with central staircase. Fig. 17 (No. 57) shows a design for a steel tower 1,250ft. high, having a square frame to the upper platform, and an octagonal spire above, by Messrs. R. J. G. Read & L. A. Shuffrey, 38, Welbeck Street, London, W. The design shown in Fig. 18 (No. 59) is for a "tripod tower" 1,400ft. high, the arms being hollow tapered steel tubes 30ft. in diameter at their bases. Their centres are 350ft. apart. It is intended to place the lifts in these tubes. Professor R. H. Smith & Mr. W. Henman are the designers. Fig. 19 (No. 60) shows a design by Mr. H. E. Sketchley, of 5, Gwendwr Road, West Kensington, for a steel tower 1,193ft. high, the upper portion of which is described as "equivalent to an independent tower resting upon four separate lower towers." Fig. 20 (No. 64) is a design by Mr. Lamont Young, of Villa Lucia, Naples, and is made up of a group of five towers, the main central one being 440 metres high, and supporting a large terrestrial globe, and four secondary ones. Fig. 21 (No. 72), below, shows a

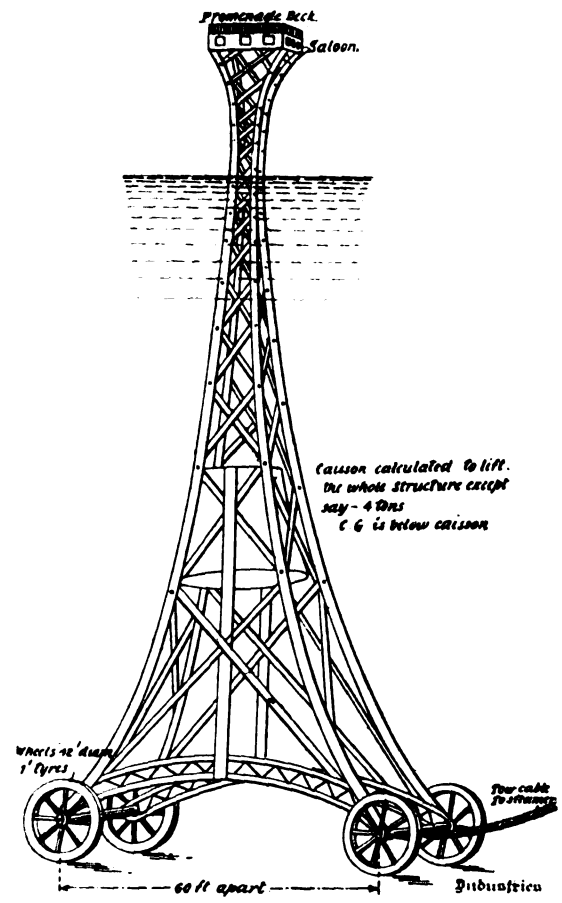


Fig. 21.

sketch of a design sent from Adelaide, Australia, which we scarcely need say was inadmissible for competition. The designer recommends it "for obviating the terrors of sickness on the Channel passage until such time as the Channel tunnel may have become an accomplished fact." The vehicle, he says, "can be towed across the Channel from one shore to the other by means of a cable attached to a steamer with great facility. It would be an enormous attraction, for fear of sea sickness and the novelty of the thing would combine to make it the talk of the day." There are other curious designs sent in which might well become "the talk of the day," but we have neither space nor desire to deal with them. As the adjudication of the Committee has not yet been made known, it would be invidious to make any comment on the designs.

Letters to the Editor.

THE INSTITUTION OF NAVAL ARCHITECTS

To the Editor of "Industries."

Sir,—In a recent issue you gave, in connection with the annual meeting of the Institution of Naval Architects, a partial *résumé* of the Society's work for the thirty years of its existence. In so far as it went, the article was perfectly correct in showing that the earlier volumes of the Transactions comprised the classics of the subject, without which probably our shipbuilders would have failed to attain that position of eminence in comparison with other nations that they have to-day. Allowing, however, for the advantages that have been derived from the reading of valuable papers, and the discussions thereon, in past years, I think it a serious question whether the Society has kept up with the times now that it has left behind its vigorous youth and reached what may be called maturity.

Signs were not wanting at the meeting just brought to a close that elements of weakness had crept in. There was, as you have already mentioned, a lack of papers. Members had to be hunted up to contribute to this year's proceedings. It is true that business had been somewhat heavy since the previous gathering, and that would militate against there being a surplus of subjects for reading on this occasion. Has there not, however, been a gradual falling off for some time in the quality of the matter submitted for criticism under the auspices of the Institution? There would not appear to be any real reason for a decline in this particular. The members exceed in point of

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THE WALLER-MANVILLE SYSTEM OF ELECTRIC TRACTION.

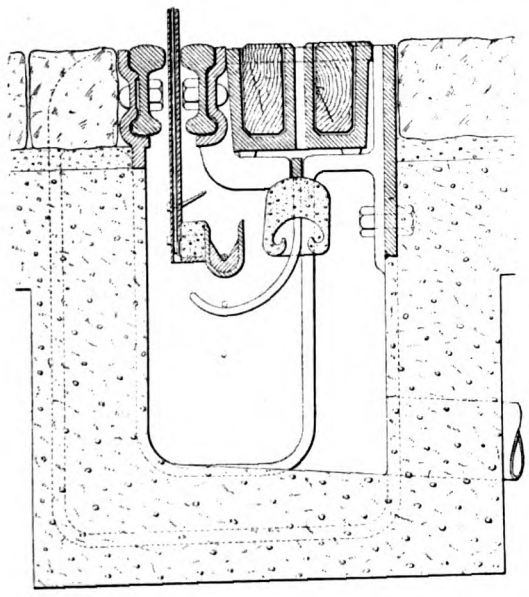


FIG. 1.

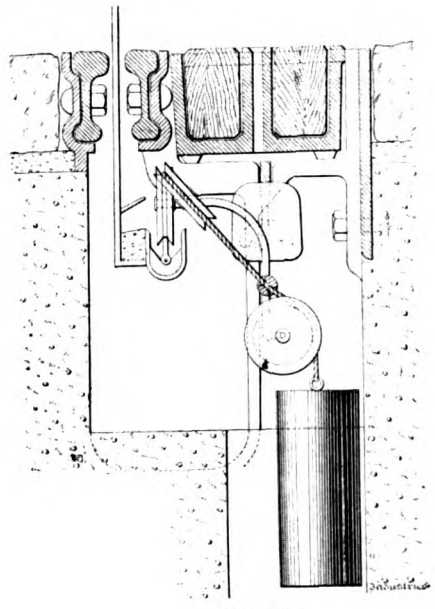


FIG. 2.

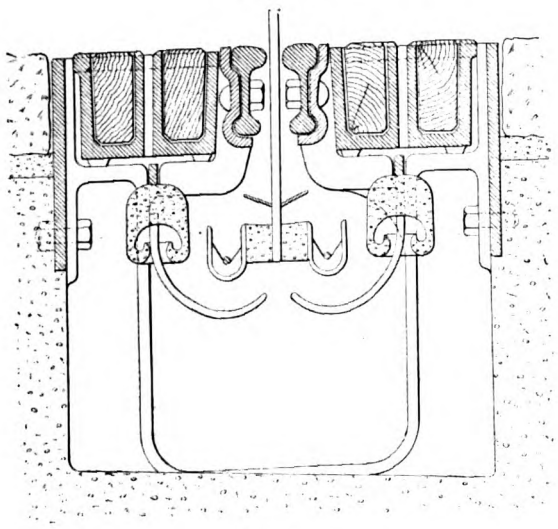


FIG. 3.

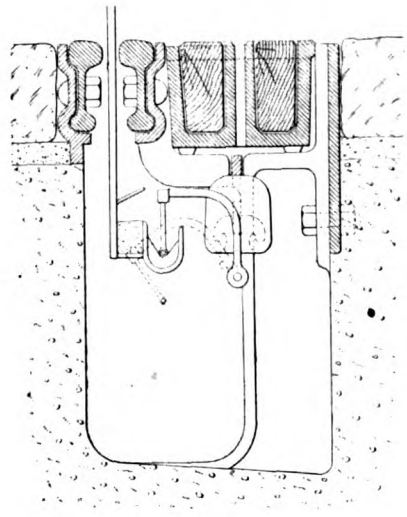


FIG. 4.

numbers any former total, and, with the developments in this branch of science, it would be supposed there was no lack of topics upon which to draw for new veins of thought. Yet it was generally acknowledged that there was a want of attraction about the meeting just closed, which has not been so strongly observable before.

To look for an answer to the probable cause of the decadence in the usefulness of which the Institution may be capable, I must call your attention to the fact that in its young days the Admiralty and Lloyd's lent a material support to the direction of affairs by permitting their officials to take a prominent part on the Council. Each department allotted an amount towards expenses, believing that it would further the improvement of ship construction. The end justified the means, for the experience made public in the Transactions has been disseminated over the world.

In another sense, however, the prominence which the Admiralty and Lloyd's secured has been a weakness. In the presence of the superior opportunities afforded to members who had such stock of information at their call others were in the background. As might be expected, the leading papers are from the pens of either Admiralty constructors or Lloyd's surveyors. Coupled with the fact that a year elapses between successive meetings—except when a summer visit is paid to outports—we also find the outside members forming other societies and coming together at shorter periods than the original Institution does. I am of opinion that no one benefits by a system which does not furnish members of the profession with the complete literature of the subject in one volume. This might have been achieved by reforms in the Naval Institution in the direction of a greater independence in its management as it emerged from childhood; an alteration, say, to four quarterly instead of one annual sitting, and an association with the sturdy rivals that have sprung up to contest for the favours of those able to contribute papers. Details will suggest themselves, but with branches fostered as part of a system, and everything appertaining to the subject regulated from a centre instead of from different disconnected head-quarters, I venture to say that members would be saved considerable trouble, and it would be to the intellectual gain of all concerned.

Yet the same mode of conducting its business rules to-day as was the case thirty years ago. Discussions have often had to be cut short to enable the programme to be completed. Now, however, that members do not come forward with sufficient readiness with material to enrich the Society's volumes, it may well be asked if the honourable record of the past is not in danger of being soon forgotten, if something be not done to revivify the present stagnation. The long intervals between the meetings seems alone a great element of weakness; but a greater one is the transference of valuable matter into channels which should form part of one great stream. I am led to make these remarks, because I think the importance of the subject demands them. I have confined myself to the main features There are other and minor ones which could also be introduced with advantage, and which would tend to strengthen the position which this leading branch of the country's trade holds. I trust, in concluding, that other members of the Institution will give their opinions on this important matter for the naval profession.

Yours, &c.,

London, 7th May, 1890. SIGMA.

SUGGESTION FOR A NEW SCOTTISH MAIN RAILWAY SYSTEM.

TO THE EDITOR OF "INDUSTRIES."

SIR,—An ingenious suggestion for the formation of a third great railway system in Scotland, in rivalry to the Caledonian and North British systems, was advanced by a correspondent in your issue of the 25th ult. The idea is to connect the Highland, Callander and Oban, and Great North of Scotland Railways with the Glasgow and South Western Railway. The necessary connections would be between the Highland Line and the Callander and Oban Railway at Tyndrum, and the construction of a line from the Callander and Oban Railway, *viâ* Ardlui, down the shores of Loch Lomond. So far no serious difficulty presents itself, excepting the inevitable destruction of the beauty of the western shore (the only practicable one) of Loch Lomond. When, however, your correspondent suggests that a high-level bridge should be built across the Clyde at Dumbarton, it is impossible to follow him in finding any advantage in such a scheme. The through traffic between England and the extreme North would hardly warrant such an enterprise; and for Glasgow and the greater part of Scotland it would be entirely out of the way. Of course, from an engineering point of view, it is no doubt quite practicable, but the carrying of a line at a high level down Loch Lomond side, and the crossing of the Clyde at a point either east or west of Dumbarton, thus avoiding the town of necessity, would not, it appears to me, be set off by any adequate compensation. Nevertheless it is ingenious. It is, of course, very likely that some day the Great North of Scotland may fall into the arms of the North British and the Highland Line into the arms of the Caledonian; the Callander and Oban Railway is at present, to all intents and purposes, a part of the Caledonian system.

Yours, &c.,

Glasgow, 6th May, 1890. M.

THE WALLER-MANVILLE SYSTEM OF ELECTRIC TRACTION.

THE essential feature of the invention is the employment of a flexible conductor sufficiently small to permit of its being placed in, or withdrawn from, the conduit through the slot. The conductor being flexible, the supports can be at long intervals; and can therefore be placed in side openings to the conduit itself By this means space is provided for large and efficient oil insulators. Removable covers are provided to these side openings or hatchways, giving ready access to the insulators. The insulators are mounted in such a manner that on removing the cover they can at once be lifted out. The collecting arm is designed so that the shank can be withdrawn through the slot, and the collector proper (or brush) through any hatchway. Under ordinary conditions the conductor simply rests on supporting arms without being attached thereto. When it is necessary to firmly attach the conductor to its support, as for instance on sharp curves, absolute flexibility is still maintained, as the supports are so designed that, whilst rigidly resisting either a longitudinal or a lateral strain, the same freedom of upward movement is allowed as in the case of the conductor itself when unattached. Simple automatic apparatus is provided at intervals to maintain a constant strain upon the conductor. The current is collected by means of a U-shaped collector in which the conductor runs; the collector lifts the conductor off the ordinary supports during its travel, and, in the case of those supports to which the conductor is attached, lifts the support itself.

A reference to the illustrations will explain the arrangements adopted in this system. Fig. 1 is a cross section through a hatchway, and shows the ordinary form of curved support on which the conductor rests, and the oil insulator to which this support is attached. The conductor is shown lifted off the support by the collector. Fig. 3 is similar to Fig. 1, but shows the arrangement for two conductors in the tube. Fig. 4 gives a side elevation of a swivelling arm mounted on oil insulators. It will be observed that the conductor is held by this swivelling arm, both being lifted by the collector, thus maintaining the flexibility of the conductor as regards upward movement, while rigidly resisting either a longitudinal or a lateral strain. Fig. 2 shows a side elevation of the tension or straining gear. This consists of a gun-metal plate or yoke mounted on two swivelling arms and supported by oil insulators, and provided with small pulleys so arranged that the conductor, or cat-gut cord in continuation of the conductor, is led to one side, so that a balance-weight can be attached thereto. This weight serves to keep the sag of the conductor between its supports constant in all changes of temperature. As the pulleys are arranged on the swivelling arm, the whole apparatus is free to lift in a similar manner to the single swivelling arm, and as the conductor is led through an eye in the shaft on which the apparatus revolves, the upward or downward movement of the tension frame in no way affects the length of the conductor, and consequently no resistance to this movement is caused by the weight of the counter-balance. This tension-gear would only be required at long intervals, occurring, say, every quarter of a mile.

It will be observed that this invention relates entirely to mechanical details, and that no new electrical conditions are introduced. The system is applicable to the distribution of electricity from a central station by any known method, whether in parallel or in series, or employing one or two conductors. It can be laid in a conduit situated either beneath one of the ordinary track rails, or between the rails, or outside the track. The first method is generally preferable for new lines, as being less costly and exposing less metal on the road surface. The second method might be desirable in some cases, for instance, in the conversion of a cable tramway into an electrical line. The fact that in this system none of the electrical parts are built in would enable this conversion to be made without practically interfering with the traffic on the line. The last method is suitable in applying the system to ordinary existing tramways, as in constructing a conduit outside the track but little interference with the traffic would be necessary. The facility with which the collecting arm can be removed renders it easy to use this system in continuation of an overhead line.

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Reviews.

ELECTRICAL ENGINEERING FOR ELECTRIC LIGHT ARTIZANS AND STUDENTS. By W. Slingo, Principal of the Telegraphists' School of Science, Director of the Electrical Engineering Section, People's Palace, and A. Brooker, Instructor in Electrical Engineering at the Telegraphists' School of Science and Art at the People's Palace, London. London: LONGMANS, GREEN, & Co.

On receiving yet another elementary book on electric light, our natural impulse was to turn to the preface to find what apology the authors had to offer for adding to the numberless existing text-books and *brochures*, and we were surprised to find it stated that, in the absence of any single work covering the whole field of electric lighting, the authors have endeavoured to fill such a gap. We must confess that it was not until after careful examination of the work that we realised the truth of the statement and the admirable manner in which the gap has been filled.

The book is in no sense a text-book on electricity. Pith balls, Leyden jars, and Thales himself are even not mentioned; fur and sealing-wax are dismissed in three paragraphs; and the remainder of the 622 pages form a work which we can strongly recommend, not only to every student, but to every engineer who wishes to have an excellent account of modern electrical apparatus and machinery, with clear explanations of the principles involved.

A very considerable proportion of the 307 illustrations given have been specially prepared. The definition of current is not quite in lecture-room style, but the subsequent treatment of it is admirable. Resistance, instead of being considered as the ratio of difference of potential to flux, or as a velocity, is dealt with merely as an attribute of matter. The descriptions of modern dynamos, instruments, and lamps are very good, and though there are a few slips, we congratulate the authors on their valuable addition to the literature of technical science.

ENGINEERING ESTIMATES, COSTS, AND ACCOUNTS. By a General Manager. London: CROSBY LOCKWOOD & SON. 1890.

In an engineering establishment there is no department more important, and of which it is at the same time more difficult to obtain a thorough knowledge, than that in which the estimates of work to be done, the cost of that actually carried out, and the accounts generally are kept. In a few special cases the learner may make the round of the pattern, machine, and fitting shops, and finish in the drawing office, but the inner precincts of the counting-house are carefully guarded against all but confidential clerks and members of the firm. This, of course, is only to be expected, because few are inclined to make their system of bookkeeping, and far less its details, known to outsiders. When a practical engineer starts in business, unless he is fortunate enough to secure the services of one who has had experience in a confidential position, he is under a great disadvantage, and many firms have come to grief through the want of a proper knowledge of estimating and account-keeping. We are not aware that the subject is taught in any technical school in this country, and we have not seen any book except the one before us which attempts either to cover the ground which the author has traversed or to attain the object which he has in view. Of course we do not think that either class work or books can replace actual experience in a counting-house, still a very useful introduction to the methods of such work could be given. This could be supplemented by work in the counting-house by those who had opportunities for it. Considering, however, the exclusiveness of this department of an engineering establishment, the author has done good service in giving to the public the results of some of his experience, and placing at least a general acquaintance with commercial engineering within the reach of young men receiving a practical training in engineering shops and drawing offices, so many of whom are often placed at serious disadvantage later on in their lives for want of commercial knowledge.

We think the author has carried out his plan very successfully, and produced a book which will be of use, not only to the younger men connected with the business of engineering, but also to many principals, managers, and others who are already engaged in directing the commercial work of engineering establishments, for many of these have picked up their knowledge of methods as they found they required it, and their work is very often sadly unmethodical. The author divides his work into twenty-two chapters, each of which takes up a special department of engineering or explains the details of methods. The first five chapters are of a general nature, and contain information which will be of use to all classes of engineers, regarding the methods of making out estimates, prices, calculations, and forms. The chapter on indirect expenses should be carefully studied, as these are often neglected, and land the engineer with a deficit instead of a profit. The cost of the materials used and the labour expended upon them are, of course, the most important items, but the general expenses of the establishment ought not to be overlooked. These include rent, rates, insurance, interest, depreciation and maintenance, managers' salaries, office expenses, the wages of firemen, enginemen, and common labourers generally about the place, cartage, coal, water, gas, oil, and the thousand and one sundries which are required to keep an engineering establishment in motion. The author enters into details of the methods of estimating the cost of different kinds of millwright work, machinery of various classes, prime movers and steam boilers, and gives numerous examples of costs and estimates, which in themselves are very valuable. The parts on steam engines and boilers are specially good, and should be made an essential part of the instruction given in technical drawing classes, as they are really more important than the mere drawings. The last chapter and the longest gives an account of "costs" book-keeping. Of course, in the space available, it is not possible to give systematic instruction in book-keeping, still specimens are given of the various books required and of the forms of accounts employed, which will enable those who have not had experience in a counting-house to understand the methods which are usually adopted. On the whole we think that this will be found one of the most useful books in the valuable series by the same publishers. The author has certainly broken new ground, and his work is most creditable to him.

CAPILLAR-ANALYSE. Separat-Abdruck aus den Mittheilungen des K. K. Technologischen Gewerbe-museums in Wien. By Prof. Dr. F. Goppelsroeder. Wien. 1889.

Also, *Beilagen*, to the above. Mulhausen i. E. WENZ und PETERS. 1889.

Dr. Goppelsroeder has made a summary of his work since 1861 on this novel method of analysis, and has shown that it is capable of application in many directions. Chemists will be familiar with his earlier investigations, in which he showed that a slip of paper or thread of wool immersed in a coloured liquid afforded a simple means of deciding whether one or more dyestuffs were present in the liquid by the zones of colour produced on the paper or thread. In this way, murexide in the presence of picric acid, or a mixture of indigo and picric acid, can be readily identified, but the author has shown that the method can be applied to colourless inorganic mixtures by cutting the paper slips into separate portions and examining them or their extracts by different reagents. Mixtures of alkaloids can also be similarly treated, and in food analysis the method is serviceable in detecting the presence of adulteration in coffee, or the addition of colouring matter or salicylic acid to beers. Dr Goppelsroeder has also shown that it is possible to form an opinion on the condition of a sample of wine by this method of capillary analysis, which seems to show that there may be a future in pathological chemistry for his process. By subjecting extracts of various parts of plants to this treatment he has succeeded in showing the presence and distribution of the colouring matters in plants, and has also shown that the rate at which the dyestuffs travel in plants varies with their molecular weight and chemical constitution. Want of space prevents us from entering upon a criticism of the two pamphlets before us, and we must refer our readers to them for details of the experiments which Dr. Goppelsroeder has so patiently and ingeniously carried out.

A TREATISE ON THE METALLURGY OF IRON. By H. Bauerman, F.G.S. Sixth Edition. London: CROSBY LOCKWOOD & SON. 1890.

The new edition of this well-known manual, as we are informed in the preface, differs little from the previous one, and the additions required to bring the information up to date have been mostly placed as supplementary notes at the end. These include a table showing the progressive increase in size in the Cleveland blast furnaces; analyses of purple ore and of the gases from the Bessemer converter; the recent investigations of Sir F. Abel on the condition under which carbon exists in steel; short accounts of Mr. Hadfield's manganese steel and of Nordenfelt's "Mitis" iron; also a reference to Gjers' soaking pits and to the newer forms of open-hearth furnaces; concluding with an article on the new direct reduction processes and an account of the work done by the furnace of the Edgar Thompson Steel Works, from which a maximum yield of 419 tons of pig iron had been obtained in one day. The inconvenience of such an arrangement is to a great extent removed by a copious index, in which, however, we regret to note at least one inaccuracy, page 477 being given as the reference for Siemens' ore process, whereas this is to be found in page 469. There are few points of importance relating to the subject that go unnoticed in this work, although one could wish to see something more than a mere reference to the recovery of the tar and ammonia from furnaces worked with raw coal, a matter that is daily growing in interest. Objection may be taken to the heading under which at least one of the subjects is placed, namely, the Siemens rotator, which has to be looked for amongst mechanical puddling furnaces, presumably because, like them, it is a revolving apparatus. The author correctly apprehends its purpose, but, none the less, it would have found a more appropriate place amongst "Methods of Making Wrought Iron Directly from the Ore," a chapter that is almost entirely devoted to the Catalan forge and its imitations. There can be little doubt that the next great stride in this department of industry will be the solution of the problem which the rotator was meant to accomplish on a large and practical scale. The work is well illustrated with numerous wood engravings from drawings by J. B. Jordan, and the whole range of the metallurgy of iron is covered in a clear and succinct form that must greatly facilitate the path of the student.

THE ROYAL MAIL PADDLE STEAMER "PRINCESS VICTORIA."

IN the construction of paddle steamers rapid strides have been made on the Clyde during the past ten years, and, with few exceptions, each succeeding vessel has been a marked improvement on her predecessor in construction, general utility, and speed. Scientific research, combined with practical experiments, has done much to develop the general efficiency of this class of vessel. In the matter of acceleration of speed the most recent honour at present rests with Messrs. William Denny & Brothers, of Dumbarton, and their latest production, the "Princess Victoria," has thrown them well to the front in the "paddle world." During the past few days the "Princess Victoria," recently completed for the Port Patrick and Wigtonshire Railways Joint Committee, underwent a series of trials on the Clyde. On each trial the contract speed was exceeded, and the engines worked throughout with the greatest possible smoothness. The vessel, which is of a particularly handsome model, has been designed to accomplish the journey between Larne and Stranraer —the shortest sea passage from Ireland to Scotland— in at most two hours. Her principal dimensions are as follows:—Length between perpendiculars, 280ft.; breadth, 35ft. 6in.; depth to promenade deck, 22ft.; and the gross tonnage is fully 1,000 tons. She is lightly rigged with two pole masts carrying fore and aft sails. There are two funnels, between which is a deck-house containing a special ladies' cabin and four other distinctive cabins, all fitted up and decorated in a most tasteful manner. The main deck-house, which is built of steel, is situated forward of the fore funnel, and contains the music-room. Contrary to the usual practice in paddle steamers, the dining saloon is amidships, immediately forward of the machinery space, and is lighted and ventilated by a skylight and well overhead. Aft of the dining saloon, ladies' cabins and lavatories are fitted on the port side, while on the starboard side there is similar accommodation for gentlemen. The long poop, bridge, and forecastle are connected by broad gangways, forming a splendid promenade, from stem to stern, for first-class passengers, and is accessible from the saloon by a double staircase. Provision is made for the accommodation of a large number of deck passengers under the forecastle, while the crew's quarters, having direct communication with the forecastle, are in the lower deck. The steamer can also accommodate 750 head of cattle, the spaces set apart for them being ventilated by powerful fans driven by auxiliary engines supplied by Messrs. Matthew Paul & Co., Dumbarton. A complete installation of the electric light is fitted, the dynamo for supplying the current being driven by a Tower spherical engine.

The machinery of the "Princess Victoria" consists of a pair of compound surface-condensing diagonal engines, steam being supplied by four steel return tube boilers of the ordinary marine type, situated two at each end of the machinery space. Forced draught on the closed stoke-hold principle is applied, the four fans for the same being driven by Brotherhood's three-cylinder engines.

Quite recently the "Princess Victoria" went on her official trial, between the Cloch and Cumbrae lights, in the Firth of Clyde. As regards weather the day was most unfavourable for testing speed qualities, for a heavy westerly gale was blowing throughout the trial; notwithstanding this, however, a mean of the up and down runs resulted in a speed of 19·7 knots. On the up run against the tide the speed registered was 19·92 knots, but on the down run the speed recorded was less, it being accomplished in such a storm of wind and rain that it was impossible to keep in view the point to be steered for. On a previous private trial over the same course a mean speed of 19·77 knots was obtained, and similar results

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were also recorded on a pleasure trip made two days after the official trial. The speed guaranteed by the builders was 19 knots, and much to the satisfaction of the owners this speed has been exceeded on each of the trials by three-quarters of a knot. Speaking at one of the trials of the margin obtained over the guaranteed speed, Mr. James Denny said: "The builders had certainly expected she would do something over 19 knots. . . . They had had some very reliable data to go upon, as the vessel had been very carefully tried and the results taken over an extended series of tank experiments." It is interesting to learn that from accurately conducted experiments with models Messrs. Wm. Denny & Brothers can predetermine, without risk of failure, the speed and i.h.p. of such a particular type of steamer as the "Princess Victoria." It is evident that in dealing with vessels to attain high rates of speed the importance of experimental work in connection with ship design cannot be estimated too highly; and as Messrs. William Denny & Brothers are the only private shipbuilders who have attached to their works an experimental establishment controlled by experts, they are in an exceptional position to guarantee maximum rates of speed economically and with surety.

The "Princess Victoria" is the third fast-speed paddle steamer constructed by this firm within the last two years. The other two—the "Princesse Henriette" and the "Princesse Josephine," each 300ft. in length by 38ft. in breadth—were built for the Belgian Government, for mail service between Ostend and Dover, and attained on the measured distance speeds exceeding 21 knots, which gives them the reputation of being among the fastest passenger paddle steamers afloat.

THE PHYSICAL SOCIETY.

At a meeting of this Society on the 2nd inst., Mr. C. A. Carus-Wilson read a paper on "The Distribution of Flow in a Strained Elastic Solid." The author pointed out that when a bar is subjected to tensile stress the elements of the bar are distorted by the resulting shearing stresses, which attain maxima in planes at 45° to the axis. If the bar be supposed to be divided into diagonal elements, then, if the shearing stresses are equal in the two directions parallel to the sides of the elements, the bottom points of the strained elements will be directly below their top corners, whereas, if the stresses be different in the two directions, there will be a displacement to one side or the other depending on which side the greater stress occurs. Since each inclined section is subject to the same total shearing force, the shearing stress along any diagonal section may be taken as inversely proportional to the length of the section, the bar being supposed of uniform thickness. From these considerations it may be seen that a diagonal element will be subject to equal stresses, hence the lower point of the element will remain vertically below its upper point. In this region, therefore, a horizontal straight line drawn on the unstrained bar will remain horizontal and straight on the strained bar. A diagonal element of a section, which cuts through the bar in a region where its cross section varies, will be subjected to unequal stresses, hence the lower points of the element will be displaced towards the axis. This displacement will increase as the distance from the axis increases, and an originally horizontal line will become curved at the ends. In a similar way it was shown that horizontal lines should assume various curved shapes, whilst vertical lines should become pinched inwards above and below the shoulder. To test whether the reasoning by which the above conclusions were arrived at was satisfactory, a copper bar was carefully prepared, ruled, and subjected to permanent strain. The curvatures of the various lines clearly showed the characteristics predicted by theory.

Professor Perry inquired whether it was correct to assume the stress uniform over the plane sections inclined at 45° to the axis. He also said that the general character of the flow somewhat resembled that of a viscous fluid passing from a wide to a narrower channel.

Professor Herschel thought Mr. Carus-Wilson was justified in assuming the stress uniform over the diagonal sections. The latter said he only made the assumption as a provisional hypothesis, but the results of his experiment agreed so closely with his theoretical deductions that he thought the hypothesis correct.

Mr. C. V. Boys then read two communications—first, "On Photographs of Rapidly Moving Objects," and second, "On the Oscillating Electric Spark." A collection of apparatus by which he had been able to photograph drops of water in their various stages of formation was exhibited. It consisted of a lantern and lenses, by which a trough in which the drops were formed could be strongly illuminated, combined with a camera and revolving disc with one perforation. By this means exposures of about $\frac{1}{600}$ of a second could be made about 20 times a second. The slide of the camera was about 3ft. long, and could be moved across the field by hand so as to take the consecutive impressions on different parts of the plate. The resulting photographs showed with remarkable clearness the formation, breaking away, oscillations of the drops, and their rebounding in the liquid into which they fall. By cutting the photographs into strips, each strip representing a single exposure, and mounting them on a disc, Mr. Boys had arranged a kind of thaumatrope which represented the phenomena in a very realistic manner. He also exhibited photographs of small water fountains broken up into drops by musical sounds, which he had taken by the electric spark without the aid of lenses. The shadows of the drops were sharply defined even when magnified considerably, and the various stages of transition from the liquid column to the detached particles were well shown. Finding it possible to obtain such good results from a simple spark, it occurred to him that he might get a succession of photographs from the intermittent light of an oscillating spark, and in this he was fairly successful. An apparatus devised to show the oscillatory character of a discharge was next exhibited in operation. It consisted of a disc carrying six lenses arranged in two sets of three. The members of each set were at different distances from the axis, so that the images of the spark on the screen did not coincide. The disc can be revolved at a high speed, and the successive sparks are seen as bright patches on the screen. By this apparatus a single discharge can be examined, whereas with Dr. Lodge's apparatus it is desirable to have a fairly rapid succession of sparks. Photographs of an oscillatory discharge taken with the apparatus were exhibited, and these show that the duration of the illumination is a considerable fraction of a complete period.

Lord Rayleigh said he was greatly interested by Mr. Boys' apparatus. He (Lord Rayleigh) had photographed water fountains, both when broken up and when made to coalesce, under electrical influence, but it had never occurred to him that it would be possible to get enough light or sufficient sharpness from a single spark. Mr. Boys' success he believed to be owing to the fact of his using no lenses, which would absorb the ultra-violet rays. He also thought the method might be developed so as to give shaded pictures instead of mere representations in black and white.

Mr. Gregory asked Mr. Boys if he had tried to get greater potentials for his oscillatory discharges by using Dr. Lodge's "impulsive rush" arrangement.

Mr. Trotter inquired whether the single sparks used to photograph the water fountains were as large as those required to show oscillations.

Mr. Boys said he had not tried Dr. Lodge's "impulsive rush" arrangement, because of the enormous capacity of the condensers required. The sparks used to photograph the broken-up fountain were very small, being only about $\frac{1}{4}$in. long and from a few jars.

Professor Perry asked Lord Rayleigh whether it would be possible to compare the shapes of the water drops shown in the photographs with the shapes of the liquid surfaces of revolution given by Sir W. Thomson at the Royal Institution some years ago, or whether the changes of shape were too rapid to permit of the surface tension being all important.

Mr. Boys thought the motions of the drops would be too rapid, and that inertia would play an important part.

Lord Rayleigh pointed out that by forming a drop slow enough the effect of inertia might be made negligeable until such time as the unstable state was reached; after that, however, inertia must have considerable influence on the shape.

THE GOLD CHLORINATION PROCESSES.

During the last few years the large quantity of low grade gold ores which have been valued, and the accumulation of tailings, has directed the attention of inventors to the chlorination processes. Many patents have been taken out with this object, and large sums of money have been sunk in the formation of companies to work the processes, but, so far, with indifferent results. Many of the companies have undoubtedly increased the yield from the ores, and their processes can be applied more or less profitably, but still they do not recover the whole of the gold, and until this is done there is room for further improvement. We have recently illustrated and described two or three of these processes, so that it is unnecessary for us here to repeat what we have already said concerning them. We have also pointed out (see *Industries*, Vol. VII., page 156) that the chlorination of gold ores is by no means a new process. As far back as 1848 Dr. Duflos applied successfully barrel chlorination to the extraction of gold from the roasted arsenical residues in Silesia, but even then a percolation process seemed preferable to barrel treatment. Processes of chlorination have also been in use in America for many years, and were described in 1868 by Professor Küstel. Of these the best known is the Plattner process, which is in use for very mixed ores, and which is successfully employed for the recovery of both gold and silver. The Russel process, and that founded on Longmaid and Claudet's patent of roasting the ore with salt, are also old-established and satisfactory methods of treatment.

Dr. Mears, of Philadelphia, was the first to lay any particular stress upon the influence of pressure in augmenting the solvent action of chlorine, and the Mears process may be regarded as the type of these modern chlorine extracting processes. In its simple form the roasted ore is introduced with water into a revolving barrel lined with lead, and chlorine gas is then pumped in. The improvement gained by using chlorine under pressure appears to have been discovered accidentally by Dr. Mears, through the apparatus with which he was working becoming closed; and thus the new departure, which has given rise to so many processes, may be attributed to an accident. With certain grade ores, Adolph Thies has shown that the original Mears process gives as good results without pressure as with the highest pressure (see *Industries*, Vol. VII., page 156); and in the Haile Gold Mine, in South Carolina, the plant has been remodelled by closing up the hollow trunnion, and substituting a valve for the gooseneck and acid chamber, so that the chlorine is allowed to act at ordinary pressures. It seems, therefore, of importance to recollect that different ores require different treatment, and that the additional cost of compression, forcing in air or steam, using liquid chlorine, &c., which are being recommended by their several inventors, may in many cases be a useless waste of money, and be sufficient to change what otherwise might be a remunerative process into one which leads to considerable pecuniary loss. The directors of gold mines will do well, before making arrangements with any one of these chlorine companies, to submit to each a sample of their ore, and then to receive an estimate of cost and yield obtainable by the process; and we should expect to find that, not only will the different companies find the amount of gold which can be extracted vary, but that the process which is most costly will not necessarily be the one which gives the best results. The success of a chlorination process also depends on the condition of the ore employed, and in many cases a preliminary roasting is absolutely necessary. The chlorination methods are applicable, of course, to all float or fine gold quartzes, such as those met with in the Transvaal, and also to those refractory quartzes which contain iron or arsenical pyrites. These latter cannot be treated at all by the amalgamation process, as, from the sulphur they contain, they soon foul the mercury and render it useless. In the Transvaal there are also large quantities of quartz of this character which hitherto have not been worked, but with the chlorination process it is necessary to roast such grade ores so as to convert the iron pyrites into anhydrous oxide of iron, which is unacted upon by chlorine. Some of the float gold quartzes also contain hydrated oxide of iron, and in that case it is also necessary to roast first so as to render this oxide of iron anhydrous. When an ore has to be roasted before it can be treated by the chlorination process, it seems possible that it would be more economical to roast with salt as in the Longmaid and Claudet process, or as Mauliés suggested with ammonium chloride, as then silver chloride and gold chloride are formed in the roasting process, and the chloride of gold produced can be extracted by washing with water.

In the Pollok process, we notice that the poorer ores are concentrated by roasting, with or without the use of salt, which seems to point to the conclusion that the inventors have found that their chlorination process does not extract the whole of the gold in low grade ores, and that roasting with salt is then better than their chlorination process. In most of the chlorination processes of this type a preliminary roasting seems necessary. In Count Rottermund's process the roasting is effected in a Munktell furnace, and the ore subsequently leached with water containing dilute acid before being subjected to the action of the nascent chlorine, and even then the coarse gold is not attacked, but has to be separated mechanically from the residue. In the Newberry-Vautin chlorine process we understand that, although there is no preliminary roasting, the process consists in a combination of the chlorine extraction with the amalgamation process—the mercury completing the work that the chlorine has not been able to accomplish; and in another process of the same kind, after rotating the ore with chlorine and water under pressure, mercury is added to the contents of the barrel and the liquid run over copper plates—the gold in solution as gold chloride being subsequently recovered by an electrolytic process. According to the report of the State mineralogist for California, at Deloro, in Canada, the ore, after being crushed, is roasted in a Howell-White revolving cylinder, and after this treatment is

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sent to the chlorinators. In the Munktell process, which was at work at Falun as far back as 1887, a preliminary roasting is also found requisite before treatment with chlorine; and in the Plattner process, already alluded to, roasting the ore is always resorted to.

The condition in which the chlorine exists also seems to have an important influence on the results obtained by its use. Although, as we have seen, the influence of pressure on the efficacy of a chlorine process has been for a long time known, and Vautin suggested and patented the use of compressed air in the vessel to increase the action of the chlorine on the ore, it also seems desirable that the chlorine should be generated *in situ* in contact with the ore in order to get the best results. Many processes have, however, been devised in which the chlorine is generated away from the ore and subsequently made to act upon it. Thus, in Greenwood's patent, a solution of chlorine is pumped on to the ore in a closed vessel until a pressure of 80lb. to 100lb. per square inch is obtained; and, more recently, Hannay has devised and patented an apparatus for the preparation of liquid chlorine to be used for extracting gold from its ores. The Badische Anilin und Soda Fabrik have also recently described a process for compressing and storing chlorine in a perfectly dry state, which may at some future period be found to be an economical way of obtaining chlorine for use in these mining operations. Atkins also recommends (see *Industries*, Vol. VI., page 288) a mixture of steam and chlorine to be generated, and then forced along a pipe, into which the ore falls from a hopper, and then into a chamber. It is well known that nascent chlorine is far more energetic in its action than gaseous chlorine, so that it seems probable that unless these processes have advantages over the older methods they will not meet with much success.

Many processes have also been devised for generating the chlorine by an electrolytic method, and for subsequently electrolysing the gold chloride solution obtained. Those in which the chlorine is generated in contact with the ore should yield satisfactory results, but in these cases it is well to bear in mind that the production of chlorine by an electrolytic method has long been attempted for bleaching and other purposes, but has not yet been firmly established on a commercial basis. One of the earlier patents in this direction was taken out by Thickett and Noad, who electrolyse a solution of salt mixed with oxide of manganese, and then warm the ore with the solution so obtained. The Cassel process is the best known of these electrolytic processes, and in it the electrolysis of salt solution takes place in a rotating vessel in contact with the ore. Scott also has patented a process which is electrical in its action. The ore is first mixed with bleaching powder, and, after standing, is placed in a porous vessel, which stands in a larger one made of iron or zinc, and filled with salt solution. The outer vessel is then put in metallic connection with pieces of coke placed with the ore in the porous cell. As a result the gold is said to be first dissolved and then precipitated by the metal of the external vessel. Stolze has also devised an electrolytic process which consists simply in covering the ore with salt solution or sea water placed in a large wooden barrel, and then electrolysing the solution, using carbon electrodes.

Allied to the chlorination processes are those which are based on the use of bromine, and from the readiness with which this liquid can now be transported, and its comparative cheapness, there seems no reason for doubting that the processes in which it is employed will be powerful rivals to the comparatively well-known chlorination methods. Parkes patented in England the use of steam under pressure in conjunction with bromine mixed with other oxidising agents, such as chlorine, nitric acid, and chromic acid, but we have not been able to ascertain whether the process has come up to the expectations of the patentee. Simpson has overcome the difficulties attending the transport and manipulation of the liquid by first saturating a solution of caustic soda with bromine and evaporating the solution to dryness, when it forms a powdery material which can be exported in this condition. When this material is heated, with sodium acid sulphate, bromine is liberated, and if an alkaline carbonate be also added the solvent action of the bromine is increased by the pressure set up by the liberated carbonic acid. Burfeind also uses bromine water as being more convenient than chlorine gas. In presence of sulphur compounds the ore is first roasted with or without salt, and then shaken with bromine water. All the gold goes into solution, and can be run off and precipitated by sulphate of iron or a charcoal filter in the ordinary way.

This brief review of the modern methods of extracting gold from its ores by means of the halogens shows that there are many processes based upon their use, and time and further experiments can alone determine which may eventually prove to be the best. It may be that a cyanide reduction method, such as that devised by McArthur and Forrest, of Glasgow, and worked by the Cassel Company at several mines under their control, will eventually be found more efficient and more economical than those based on the use of free chlorine or free bromine. In any case, it is premature to form an opinion until the different companies have had sufficient time to demonstrate the merits of their respective processes.

THE GESNER RUST-PROOF PROCESS.

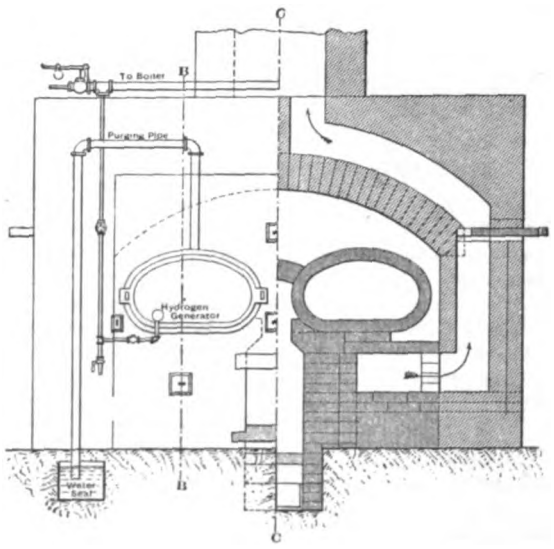


FIG. 1.

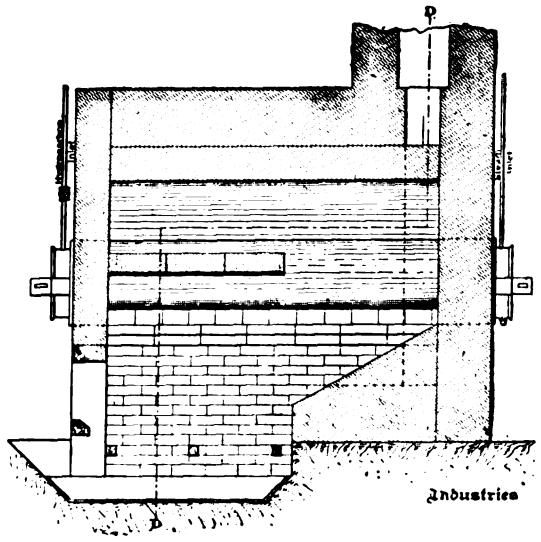


FIG. 2.

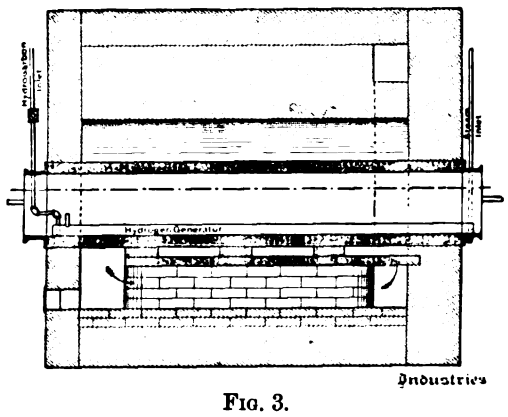


FIG. 3.

THE GESNER RUST-PROOF PROCESS.

FOR several years Mr. G. W. Gesner, of New York, has been experimenting with a process for giving articles of iron and steel a rust-proof coating. Plant has been established at South Brooklyn, which has been in operation for some time past. The accompanying illustrations, Figs. 1, 2, and 3, show its construction. It consists substantially of a bench of two ordinary gas retorts placed side by side in a furnace heated by a grate. Each retort is heated to a temperature of 1,000° F. to 1,200° F., as may be determined by the character of the articles to be treated. The latter are introduced by means of a crane and pulley, care being taken that they do not touch one another. After closing and testing the retort, the heating continues for about twenty minutes. Then steam is introduced into what Mr. Gesner calls a "hydrogen generator," shown in Figs. 2 and 3. It is a simple pipe, open at the rear end. Mr. Gesner claims that in the passage of the steam through this generator hydrogen is generated, which fills the retort. This operation goes on for thirty-five minutes, at the end of which time half a pint of naphtha is permitted to flow into the retort for ten minutes. The flow of hydrocarbon is then stopped, and the steam which has been allowed to enter the generator during the whole operation is continued for fifteen minutes longer. The whole time employed in the operation is therefore one hour and twenty minutes. The "purging pipe," which dips into an open vessel of water, as shown in Fig. 1, to the depth of 1½in., carries off any excess of gases produced in the operation. In cases where articles treated are ornamental, such as art hardware, they are given a bath of cold whale oil or paraffin oil to render them more even in tone. In other articles no oil is used. The plant now established at South Brooklyn is rated at a capacity of six tons per day of boiler tubes, 7½ft. in length, or two tons of ornamental hardware, the rate of production of treated goods depending upon the time required for handling them. The average cost in America of fuel per day is reported by Mr. Gesner to be 7s., including coal for the boiler.

To substantiate his claim that hydrogen has a function in the creation of a rust-proof coating, Mr. Gesner quotes the following analysis, made by Messrs. Stillman & Gladding, of New York, of a sample of the surface of cast iron prepared by the process: Carbon, 1·01 per cent.; hydrogen, 0·22 per cent.; sand, 6·70 per cent.; and iron, 66·10 per cent. The chemists add that the iron is present as metallic iron and as oxides of various constitution.

In order to determine whether the treatment had any adverse effect upon the strength and resistance of wrought iron and steel suitable for boiler, ship, and bridge purposes, a series of tests were made by Mr. B. H. Coffin, in charge of the testing department of Mr. Henry Warden, Germantown Junction, Philadelphia, Pa. We quote as follows from this report:—

"Five test pieces of iron were cut from a single plate ⅛in. thick, and five more similarly from a ⅜in. steel plate. These were machined to suitable sizes for the standard 8in. test piece, giving a section of about 0·71 square inch for the iron and 0·51 square inch for the steel. Three of each of these sets were forwarded to Mr. Gesner for treatment, who retained one and returned the remainder. The tests were made with a 200,000lb. Olsen machine, and the measurements with Messrs. Brown & Sharp's micrometer gauges, and are believed to be accurate.

"The pieces were gauged both before and after treatment, and showed no change. The tests show practically no effect whatever upon the iron, with the exception of a slight decrease in the elongation. As the reduction of area is not fully ascertained, it is impossible, without further evidence, to say whether or no the ductility is affected. At any rate the ductility being so low, this small reduction, if proved to exist, would be of comparative unimportance in affecting the value of the metal. The steel is benefited. The annealing undergone during the treatment has softened it to some extent; it has lost about 5 per cent. in strength but gained 5 per cent. in elongation. This metal as originally would not have come up to specifications, being insufficient in stretch. The treatment has not reduced the tensile strength below the assigned limit; at the same time it has brought the elongation up to requirements. Pieces of both iron and steel were bent cold to an angle of 45° without showing any fracture or scaling of the treated surface."

The following are the results of the tests:—

	Elongation. Per Cent.	Reduction of Area.	Elastic Limit.	Ultimate Stress.
IRON—				
Untreated	10·5	12·9	32,350	45,040
	10·1	11·6	33,750	44,880
Treated	8·4	13·4	33,740	42,620
	6·6	11·6	33,640	45,770
STEEL—				
Untreated	21·6	43·3	41,960	58,250
	19·1	42·8	43,050	59,120
Treated	24·1	40·9	39,050	55,880
	26·0	44·9	37,390	55,220

A large variety of iron and steel goods have been already treated in quantities by the South Brooklyn Rust Proof Iron and Steel Works, among them being builders' and art hardware, roofing shingles, stove fittings, pipe and pipe fittings, parts of water meters, steam radiators, pistols, and other articles. The colour produced is a dark blue. We are indebted to *The Iron Age* for the above illustrated description.

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Notes.

COAL PRODUCTION IN JAPAN.

We have on several occasions recently directed attention to the increasing importance of the production of coal in Japan, and also to the great activity in the floating of imited liability companies. The latest development of such companies seems to have reached the "Land of the Rising Sun," for it is reported that a syndicate has been formed in Northern Japan for the purpose of developing the coal mines of that region, which are said to be capable of producing 1,000,000 tons a year. The proposals include a considerable extension of the railway system and the exportation of coal to China and America.

MALTA AS A COALING STATION.

The nature of the trade done in Malta has changed very considerably in character during the past few years. Formerly it was a distributing centre for Egypt and the towns and stations along the northern shore of Africa. Of late, however, this has almost entirely ceased, and shipments are now made direct to Egypt, Barbary, and Tunis, and at present the trade of Malta is confined to the import of goods for local consumption and the export of the surplus produce of the island. For trading purposes Malta is chiefly a place of call and a coaling station, the import of coal in 1889 being 600,000 tons, mostly from Cardiff. Almost all the steamers going to or returning from the Levant and the Black Sea put in at one of its ports.

SOUTH CAROLINA PHOSPHATES.

On several occasions we have referred to this subject, and further information is afforded in a consular report from Charleston. The trade is constantly increasing, and whereas in 1880 there were 210,000 tons of phosphate rock mined, the output last year had risen to 510,000 tons. The demand for the crude rock comes from the United Kingdom, France, Germany, and even Japan, while local works last year used 80,000 tons for manufacturing fertilisers. In order to increase the value of the phosphate rock for fertilising purposes these firms mix chemicals and other fertilisers with it, so that a new import trade has sprung up in kanit from Germany, brimstone from Sicily, and nitrate of soda and muriate of potash from Chili.

BAKU PETROLEUM.

Contradictory accounts are received from time to time as to the petroleum industry at Baku, some alarmists stating that the supply is giving out. This is, however, emphatically disputed by the British Consul at Batoum, who says there are no signs of exhaustion, but that in territory thoroughly explored it is now necessary to sink the wells deeper than formerly to reach the oil-bearing strata. The total production of crude oil in 1888 was 2,580,000 tons, while last year it rose to 3,306,000 tons. In the event of the territory where borings are conducted being exhausted, it is pointed out that there are other petroleum fields along the Caspian at Khidirzindi, Aliata, and Shemakha, which have not yet been explored, as there has been no necessity to do so.

THE CHINESE TELEGRAPH CONVENTION.

About two years ago a telegraph convention was signed at Cheefoo, between the representatives of the Chinese Telegraph Administration, the Eastern Extension, and the Great Northern Companies, and we understand that it has now been confirmed by the Tsung-li-Yamen. At the time it was first heard of the agreement was objected to by the mercantile communities, as they thought that the arrangement would prevent any advantage to trade arising out of the extension of Chinese inland telegraphs to the Siberian lines on the one hand, and the Burmese on the other, and they protested against the Chinese Government being a party to a "ring" or "pool" of this character. A protest on behalf of some of the foreign mercantile communities was presented to the Government by Colonel Denby, the United States Minister, who is the *doyen* of the Diplomatic Corps, and he has been informed in reply that the protest is based on a misapprehension of the facts, and at the same time he is reminded that it was usual for vendors, not purchasers, for owners, not customers, to fix the price of their wares. The rates agreed upon are not definitely known, but it is thought that they will not be higher than at present, and that before long they will be considerably reduced. It is said that there is no mention in the agreement of a subsidy from the companies to the Chinese Government, and that there is nothing to prevent a new company from laying cables from China except, perhaps, the combined competition of the existing telegraph companies and the Chinese telegraphs. The main feature of the arrangement is that these three work in combination, and that neither can reduce its rates without the consent of the other two.

IRON AND MACHINERY IN ROUMANIA.

Bar iron was at one time exclusively imported into Roumania from Wales, but of late years, says Consul-General Sanderson of Galatz, it has been losing its hold of the market. Belgian and German makes are supplanting it. Heavy iron goods still hold their own, and machinery as a rule. Railway plant of all kinds is, however, now obtained from Germany and Belgium. The imports of tinplates from England are decreasing, while those from Belgium are advancing. Much of the hardware that was formerly obtained from Birmingham is now obtained from Westphalia; but iron and brass bedsteads, iron buckets, and sickles come almost entirely from England. The system of agriculture is very crude, and carried on without the use of modern implements other than small iron ploughs of German make. The smallness of the holdings accounts for this state of affairs.

THE TRADE OF CHILI.

From a report, which has recently been published by the Foreign Office, we learn that the commercial operations of Chili in 1888 exceeded in value those of any previous year, and that this prosperity is attributed to the favourable rate of exchange, to the better prices obtained in Europe for copper and nitrates, and to a law of 1887 which gave stability to the rate of exchange at which Customs duties were to be levied. The combined value of the general and coasting trades amounted to $324,500,000 currency, being an increase of 12·76 per cent. over the previous year. The general trade alone amounted to $140,692,000, showing an increase of more than 20 million dollars over the previous year. The Customs receipts showed an increase of 7½ million dollars, while shipping increased to the extent of 119 vessels and 169,400 tons. The imports from Great Britain exceeded those of the previous year by 28·77 per cent. Of the total imports of $60,717,698, more than 26 millions' worth came from Great Britain, while 80 per cent. of the exports went to Britain, but as these latter are classed according to the nationality of the exporting ship this return is somewhat misleading. For instance, nitrates, which formed about 60 per cent. of the total exports, are classed under exports to Britain, whereas the greater part was destined for Germany and France. Britain is credited with 26½ million dollars of imports, Germany with 14, France with 6, the Argentine Republic with 4, and the United States and Peru with a little over 3 million dollars each.

PUBLIC WORKS IN FRANCE.

A long report from Consul-General Bernal, of Havre, states that a project has been considered for deepening the River Seine, perfecting the embankments, and for making improved approaches and a new entry to the port of Havre, but owing to disputes these improvements seem to be postponed indefinitely. Two new dry docks have, however, been constructed at Havre, and several additional hydraulic cranes have been put up or are in course of erection. At Rouen, a slip, constructed at a cost of £31,000, gives some trouble. Vessels are hauled on to it broadside on. The following description is given of it:—It is 295ft. long, and can receive a vessel 312ft. long, weighing 1,800 tons. The slope of the inclined plane of the slip is 1 in 5; its breadth (in the direction of the hauling) is 168ft. 3in., and the cradle's course is 119ft. 9in., which corresponds to a vertical rise of 23ft. 6in., which course can be traversed in 5, 3½, or 2 hours, according to the speed at which the machinery is working. When the cradle is at the bottom of its course the checks are 14ft. 9in. below high water in neap tides, but owing to the projection of the side cushions for shoring, this is reduced to 14ft. When the cradle is at the summit of its course, the level of the checks is 39in. above high water at ordinary spring tides, and 30in. higher at equinoxial tides. The inclined plane is formed of 42 main beams resting on piles, to which they are mortised in a longitudinal direction; these main beams support steel rails, on which the cradle runs. The cradle is formed of 42 beams strongly framed together, which correspond with the main beams of the inclined plane; each beam also carries a steel rail; between the rails, which are beneath the cradle, and those on the inclined plane of the slip, are placed a series of rollers on which the cradle runs. The length of the cradle is divided into two parts, which measure respectively 162ft. and 132ft. 8in., which can be raised, if desired, together for large vessels, or used separately for small vessels. On the land side the cradle has along its entire length a foot-bridge, which is high enough to be always out of water. The hauling chains, 40 in number, are fastened to the cradle in the spaces between the beams; the chains are not fastened to the cradle itself, but work on movable pulleys, over which runs a compensating cable, which equalises the strain on all the chains; this cable passes alternately on a movable pulley, and on another fixed to the cradle; its two ends are fastened to the cradle. Each hauling chain works over a windlass wheel, which is driven by an endless screw, and the screw itself is driven by a bevel wheel on a shaft which runs from one end of the ship to the other. The motive power is a 50 h.p. steam engine. The British steamer "Fire Queen" and the Swedish steamer "Cuba" were unable to make use of the slip a short time ago, on account of the sand and mud, silting up with the flood tide, having rendered the gear unworkable. They had given three days' notice, and after losing a day gave it up. It is the opinion of masters that this will be of frequent occurrence. At Caen it is proposed to make extensions of the west pier at a cost of about £6,000. The Darlington Waggon and Engineering Company are building a promenade pier at Trouville. The ironwork and woodwork is English, and English artisans are engaged in erecting the pier. Harbour and dock works have been carried out at Dieppe, and a new dry dock is to be completed this year.

STATISTICS OF THE SUEZ CANAL FOR 1889.

The returns of the navigation of the Suez Canal for the year 1889, as compared with that of previous years, were recently issued in the form of a Parliamentary paper. The increase for 1889 over 1888 was 142,352 tons of shipping, and in the dues paid 1,335,306fr. The actual number of vessels, however, was less by 15, being 3,425, as against 3,440 in 1880; but this was more than compensated for by the increase in the mean tonnage per vessel, which was to be expected from the increasing tonnage of the vessels which have been recently built. Great Britain's share of the tonnage continues to increase, being last year 78·91 per cent. of the total, as against 78·65 for 1888 and 76·52 for 1887. The percentage of France has fallen slightly, being 5·33 per cent. for 1889, as against 5·83 for 1888 and 6·51 for 1887. Germany had last year 4·27 per cent.; Holland, 3·87; Italy, 2·76. Austria, Spain, and Norway follow next in succession, and the other nationalities only give a very small percentage of the total navigation.

FOREIGN SHIPBUILDING.

The following table has been published by Lloyd's Register of Shipping, showing the number and tonnage of vessels, excluding war ships, under construction at various foreign ports, according to the latest returns, excluding vessels of less than 100 tons:—

Country.	District.	Total. No.	Total. Gr. Ton.
Austria	Trieste	6	2,620
Belgium	Antwerp	1	1,500
China	Shanghai	1	550
Denmark	Copenhagen	11	8,095
France	Dunkirk	—	—
	Havre	4	—
	Nantes and St. Nazaire	5	17,590
Germany	Bremerhaven, Vegesack, Geestemunde	13	14,098
	Hamburg, Flensburg, and Kiel	22	37,470
	Rostock, Lubeck, and Stettin	17	30,775
	Danzig	1	300
Holland	Amsterdam	5	5,720
	Rotterdam	7	10,008
	Various other ports	8	11,570
Italy	Genoa	32	31,480
New Brunswick	St. John	4	2,424
Norway	Bergen, Christiania, Christiansand, Drontheim, and Stavanger	23	15,178
Philippine Islands		2	—
Prince Edward Island		2	800
Russia	Riga, Gulf of	13	4,280
Sweden	Gothenburg, Oscarshamn, and Thorskog	9	4,350
	Stockholm and Gefle	5	3,600
Turkey	Constantinople	2	416
United States of America	Baltimore	2	2,200
	Philadelphia, Camden, Chester, and Wilmington	21	31,610

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Patent Record.

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

21st April, 1890.

5991. Claridge, J. W. ..... Mechanical stokers.
5992. Newton & Quiggin ..... Couplings for pipes.
5997. Newlands & Adair ..... Steam engine.
6002. Simpkins, J. ..... Railway chairs.
6004. Fisher, R. C. ..... Sash cord machines.
6006. Sullitoe, E. ..... Washing machines.
6008. Guelbaum, D. ..... Direct-acting steam pumps.
6013. Heathorn, T. B. ..... Steering and propelling vessels.
6015. Hamillon, J. H. ..... Gas engines.
6017. Rau, O. A. H. ..... Transmitting motion.
6021. Newton, A. V. ..... Rifles (*Nobel*).
6023. Hart, A. M. ..... Spreading machines for coating fabrics with indiarubber.
6024. Bowler, T. ..... Brakes for tramcars.
6025. Fletcher, G. ..... Pump gear.
6030. Picard, R. ..... Cutting and stamping metals.
6031. Conway, P. ..... Valves.
6033. Fornander, C. ..... Friction clutches. (23rd September, 1889.)
6039. Lake, H. H. ..... Rotary engines (*Beck & Hartung*).

22nd April, 1890.

6044. Lord, W. T. ..... Steam engines.
6050. Morton, J. S. ..... Propelling vessels.
6054. Cunliffe, R. ..... Steam generators.
6055. Edward Cockbill & Son & Cockbill ..... Preventing smoke.
6057. Story, J. J. ..... Machine for cutting textile fabrics.
6059. MacLaine, A. ..... Heating feed-water.
6060. Churchill, J. D. ..... Fluid pressure reducing apparatus.
6067. Kershaw, W. H. ..... Mules.
6070. Sturrock & Macdougald Motors.
6073. Storch, E. ..... Slide or sluice valve.
6085. Capitaine, E. M. ..... Aërial navigation.
6088. Brook, E. ..... Kilns.
6092. Jensen, P. ..... Rotary engines (*Stout & Underwood*).
6098. Prall, W. E., Jun. ..... Street car motors.
6099. Eli, A. J. ..... Ironing machines (*Choteau*).
6100. Scott & Davis ..... Machines for covering wire.
6104. Victorin, A. ..... Breechloading ordnance.
6106. Wood & Houston ..... Valves for steam engines.
6107. Mewburn, J. C. ..... Evaporation of brine (*Peck*).
6108. Vicars, H. ..... Self-launching ships' refuge.
6109. William Foster & Co., Ld. ..... Machines for hulling maize (*Pfaff*).
6110. De Pass, E. ..... Apparatus for combing fibrous materials (*Imbs*).
6111. Drummond, D. ..... Tubular boilers.
6112. White, F. H. ..... Ships' propellers.
6113. Otto, N. A. ..... Gas engines.
6115. Brown, C. A. ..... Machinery for dressing skins.
6119. Lake, H. H. ..... Permanent way (*Oliver*).
6124-5. Munsie, J. F. ..... Underground conduits.
6128. Cook, J. ..... Harvesters.
6129. Smith & Tregoning ..... Crushing apparatus.
6131. Thompson, W. P. ..... Condensers (*Schulte*).
6139. Evans, G. F. ..... Transmitting power.
6140. Baker, W. S. G. ..... Railway car trucks.
6141. Hopkinson & Hopkinson Water gauges.

23rd April, 1890.

6142. Walker & Lowe ..... Looms.
6146. Crossley & Holden ..... Jacquard machines.
6154-5. Croker, G. H. ..... Machinery for cleaning cotton seed.
6161. Redmayne, R. N. ..... Pulp boilers.
6163. Howard & Young ..... Railway chairs and fastenings.
6164. Brown & Evans ..... Couplings for railway carriages.
6170. Boult, A. J. ..... Machines for re-blocking cloth (*Hutchinson & Moore*).
6176. Barker, G. ..... Harvest binders (*Jones & Wedlake*).
6181. Bayly, J. P. ..... Pipe wrench (*Smead*).
6182. Bayly, J. P. ..... Car coupling (*Toberer*).
6191. Hindell, J. ..... Railway or tramway rails.
6194. Deer, W. ..... Railway chair.
6201. Boultbee, F. R. ..... Long truck.
6203. Sonnet & Gomhault ... Measuring and registering speed.
6204. Augwin, H. ..... Machine for applying hose couplings.
6207. Cameron, D. ..... Cores for journal boxes (*Sterril*).
6208. Cameron, D. ..... Rice mills (*Tilton*).

24th April, 1890.

6229. Ainsworth, I. N. ..... Loom pickers.
6230. Harling, Harling, & Hebden ..... Winding machines.
6231. Fielding, A. ..... Pottery kilns.
6232. Rowbotham, T. ..... Wheels and axles.
6234. Gare, T. ..... Machines for finishing boots.
6238. Pallister, E. A. ..... Feeding printing machines, &c.
6240. Cleminson, J. ..... Permanent way.
6243. Fouracre, C. ..... Clack boxes.
6249. Hurrell, M. H. ..... Couplings for railway cars.
6250. Glover & Garde ..... Machinery for making warps.
6258. Kirk & Lee ..... Machinery for finishing fabrics.
6261. Andrews, G. ..... Lubricator.
6262. O'Donnell, Timmis, & Smith ..... Railway signalling apparatus.
6263. Torrance & Torrance Grinding machines.
6264. Lidstone, J. P. ..... Calculating machines.
6275. Simon, H. ..... Apparatus for recovering sludge of washed coals or ores (*Luhrig*).
6276. English, T. ..... Mounting guns.
6281. Redgate, H. ..... Twist lace machines.
6282. De Soldenhoff, R. ..... Charging coke ovens.

25th April, 1890.

6285. Bayliff & Bayliff ..... Valves of steam engines.
6289. Gregson, J. ..... Looms.
6295. Pullar, H. ..... Locking screw nuts.
6296. Smith & Smith ..... Machines for cross-cutting iron bars.
6297. Gillespie, W. ..... Machines for cleaning rags.
6302. Tyler & De Vesian ..... Three-way hydraulic valves.
6303-4. Bentley, J. ..... Looms.
6307. Armstrong, W. ..... Holding and detaching gear for ships' boats.
6316. Fox, S. ..... Manufacturing steel.
6317. Hornish, F. W. ..... Boiler cleaners.
6318. Lacy, H. ..... Railway couplings.
6321. Scott, A. ..... Controlling steam engines.
6323. Vernon, T. T. ..... Consuming smoke.
6324. Taylor, A. ..... Steam hammers.
6327. Witter, E. E. ..... Adding machines.
6334. Schneider, H. ..... Breechloading ordnance.
6336. Holmström, C. ..... Breechloading guns.
6340. Taaffe, W. J. ..... Machinery for the manufacture of felt hats.
6342. Kelly, G. ..... Flat coiled springs.
6344. Singer & Judell ..... Apparatus for pressing wool.
6349. Brookes, A. G. ..... Drill grinding machines (*Higgins & Morgan*).
6351. Sloan, H. ..... Hackling machines.
6353. Cole, Dobson, & De Mouzilly ..... Knitting machines.
6354. Willans, P. W. ..... Steam engines.

26th April, 1890.

6357. Brain, H. G. ..... Centrifugal governors.
6360. Bollé, C. ..... Wheel ploughs (*Moser*).
6368. Croker, G. H. ..... Machinery for cleaning cotton seed.
6369. Kellner, C. ..... Pulp boilers.
6370. Dickinson, A. ..... Joints of tramway rails.
6371. Bamforth, S. ..... Preventing smoke.
6373. Vonhof, E. G. ..... Tubular boilers.
6374. Ives & Barker ..... Elevated railways.
6375. Greaves, J. E. E. ..... Steam engines.
6376. Sutor, W. J. ..... Railway chairs.
6379. Moverley, R. ..... Thrust bearings.
6380. Bartholomew, C. W. ... Sharpening miners' picks.
6382. Haddan, R. ..... Storing and expelling liquid under pressure (*Azcona*).
6390. Evans, E. ..... Grain binding harvesters.
6393. Milovanovitch - Koka, K. R. ..... Repeating firearms.
6396. Simonds, G. F. ..... Manufacture of ball bearings.
6398. Dürr, G. ..... Steam generator.
6399. Von Langer & Cooper Reverberatory furnaces (*Pietzka*).
6400. Von Langer & Cooper Utilising waste heat of furnaces (*Pietzka*).
6404. Simonds, G. F. ..... Axle bearings.
6407. Dawson, H. T. ..... Gas engines.
6410. Alfred, J. W. ..... Tip waggons.

ELECTRICITY.

21st April, 1890.

5996. Sayers, W. B. ..... Electric incandescent lamps.
6000. Scott & Laurence Paris & Scott ..... Electric distribution.
6005. Sayer, G. H. ..... Electric lamp adjuster.
6032. Dewey, M. W. ..... Electric heating apparatus.
6037. Dewey, M. W. ..... Electric railway vehicles.

22nd April, 1890.

6041. Dewey, M. W. ..... Transformation of electrical energy.
6082. Waller & Manville ... Electric propulsion of vehicles.
6083. Gordon, J. ..... Electric propulsion of tramcars.
6120. Kintner, C. J. ..... Electrical distribution.
6126. Radcliffe, R. D. ..... Electrical signalling apparatus.

23rd April, 1890.

6156. Schultz, G. ..... Electrical switch.
6177. Barker, G. ..... Secondary batteries (*Woodward*).
6202. Stepanow, S. ..... Electrolytic bleaching.
6223. Ancizar, M. ..... Galvanic batteries (*Bayon*).

24th April, 1890.

6236. Jarman, A. J. ..... Storage battery.
6266. Marx, J. ..... Electrolysis.
6267. Marx, J. ..... Connecting electrical conductors.

25th April, 1890.

6326. Batault, E. ..... Electricity meters. (28th September, 1889.)

26th April, 1890.

6359. Peddie, H. J. ..... Electric railways.
6389. Blattner, A. ..... Electric motor.
6392. Bláthy, O. T. ..... Safety fuses.

CHEMISTRY.

22nd April, 1890.

6046. Pointon, J. ..... Alkaline silicates and aluminates, &c.
6047. Pointon, J. ..... Alkaline aluminates.
6048. Pointon, J. ..... Alkaline silicates.

23rd April, 1890.

6195. Bromhead, S. S. ..... Colouring matter (*Grünau, Landshoff, & Meyer*).
6216. Vautin, C. T. J. ..... Extraction of gold and platinum
6217. Griffin, S. ..... Producing gas

24th April, 1890.

6256. Rock, T. D. ..... Anthracite gas.
6274. Imray, O. ..... Colouring matters (*Meister Lucius & Brüning*).

25th April, 1890.

6333. Lyte, F. M. ..... Magnesium oxychloride.
6346. The British Alizarine Company, Ld., & Bendix Alizarine compound for dyeing and printing.

MISCELLANEOUS.

22nd April, 1890.

6087. Goodman, J. ..... Planimeters.
6127. Norman, A. H. ..... Treatment of ramie.

23rd April, 1890.

6149. Tullis, J. K. ..... Belting.
6169. Blackwood, J. ..... Belting.

24th April, 1890.

6226. Walsh, I. ..... Spindle bolsters.
6245. Moor, C. G. ..... Treatment of sewage.
6246. Bonné, C. R. ..... Prevention of incrustation (*Bender, Wüster, & Reinhard*).
6252. Longshaw, J. ..... Purifying water, sewage, &c.

25th April, 1890.

6315. Harrison, R. ..... Bleaching, &c., fibrous materials.
6347. Lake, H. H. ..... Driving belt (*Schultz & Alvord*).

26th April, 1890.

6377. Bartholomew & Ward Fog signals.
6397. Hill, F. B. ..... Treatment of sewage.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form of such opposition.

Year 1889.

3758. Dowland.
6867. Richardson & Hill.
6884. Atkinson.
6901. Macgown.
7001. Mitchell.
7341. Waddell.
7346. Armstrong.
7386. Clegg.
7839. Peyman.
8111. Hassall.
8299. Willcox (*Farbenfabriken vormals Friedrich Bayer & Co.*).
8584. Drury.
8702. Emery.
8762. Turnock.
8862. Thorp.
9032. Allmark.
9166. Wells.
9278. Pearce & Webb.
9498. Nordenfelt.
9529. Sinclair.
9568. Allchin & Walker.
9591. Cunningham.
9717. Dunbar.
9748. Hunter & Marshall.
9768. Hurst.
9796. Blakely.
9824. Blackwell & Blacklock.
9880. Moffatt.
9964. Rignault.
10025. Entwistle & Entwistle.
10053. Seck.
10065. Griffith.
10104. Bartsch (*Lechler*).
10125. Frankenburg.
10142. Ramage.
10157. Jeffries.
10204. Jacoby.
10229. Wise (*Maggi & Co.*).
10248. Corney & Francis.
10260. Griffiths.
10277. Dewar & Redwood.
10292. Evans.
10303. Wood & Wood, Jun.
10329. Edmeston.
10362. Hale.
10373. Horne.
10392. Haddan (*Amoroso*).
6748. Cordenons.
6883. Atkinson.
6885. Atkinson.
6983. Moon.
7121. Edwards.
7343. Foster.
7354. Griffin.
7525. Dearden & Dearden.
7985. Taunton.
8156. Lake (*Leonhardt & Co.*)
8453. Mordey.
8468. Hollick.
8567. Taylor.
8636. Johnson & Hanson.
8718. Abel & Dewar.
8778. Imray (*Glaser*).
8950. Lake (*Starrett*).
9043. Le Clair.
9209. Parfitt.
9433. McGavin (*McGavin*)
9499. Henneman.
9567. Jones.
9571. Kingsbury (*Welles*).
9600. Buechee.
9723. The Electrical Power Storage Company, Ld., & Rea.
9822. Giles.
9862. Guy & Percy.
9887. Bayliss.
10020. Empson, Hewitt, & Baker.
10048. Newton (*Theisen*).
10061. Atkins.
10077. Waddington.
10111. Fonson & Schmid.
10141. Hall & Lucas.
10155. Raworth.
10199. Elcoate.
10215. Blakely.
10236. Box.
10258. Tomlinson & Gifford
10269. Burstow.
10283. Fonson & Schmid.
10298. Pollok.
10319. Mansell & Frith.
10345. Smith.
10363. Stuart.
10375. Harris, Sheldon, & Baker.

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10394. HARPER.
10404. HARPER.
10413. MCNEILL.
10428. LAMB & BOYDE.
10706. ANDERSON.
10720. BRINDLEY.
11613. IMRAY (*The Society of Chemical Industry in Basle*).
12009. MCKELLAR.
13084. RUMBELOW & RUMBELOW.
13197. COLE.
13349. GILL.
13640. THOMSON.
14063. WOOD.
17058. GILLAM.
17350. DIESELDORFF.
17599. HEIGHINGTON & HEIGHINGTON.
18345. DOMBRAIN & TRUMPER.
18481. PAYEN.
18812. KASELOWSKY.
19348. GREENFIELD.
19897. BOULT (*Eastman*).
20493. STANLEY.
10398. ZIEGLER.
10406. BLACK & RADFORD.
10416. HOLLINGWORTH.
10577. LINSEY, BARTON, & BENSTEAD.
11058. FRANCIS & BANFIELD.
11848. IMRAY (*The Society of Chemical Industry in Basle*).
12135. HEYS (*Chaize & Chaize*).
13142. DODGE. (12th April, 1889.)
13236. ROBINSON & EDWARDS.
13602. COLLINS.
13748. CUMMING.
15901. HASLAM.
17145. AMBLER & HAYTON.
17450. STURROCK & MACDOUGALD.
18184. CHEESBROUGH (*Felton*).
18435. DANVERS.
18644. MOUNTFORD.
19230. COOKE.
19430. CLIFFORD.
20059. SMYTHE & PAYNE.
20903. HAINSWORTH.

1890.

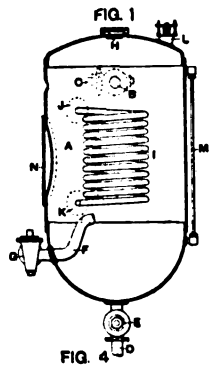
70. BANG & RUFFIN.
244. DUNLEVIE.
601. WATKINS.
731. CLIFFORD.
1472. HÜBNER & HÜBNER.
2089. THOMPSON (*Wirth & Co.*).
2500. BAYER.
2652. MICHAELES.
3261. LAKE (*Jewell*).
3439. CURRIE.
3487. LAKE (*Walker*).
3549. SABEL.
3717. WEIGERT.
3817. LAKE (*Knell*).
3916. ENGLISH.
3970. LÜBBECKE.
4162. NEWTON (*Cartwright*).
4222. RICHARDSON & RICHARDSON. (23rd September, 1889.)
4354. EICHHORN & JASPER.
4385. OAKLEY.
4393. LACOSTE.
4411. DIENST.
4459. CUSSONS.
4464. PECKHAM.
4512. BAVEY.
4533. LAKE (*The Thomson-Houston International Electric Company*).
4535. RÖMER.
4557. ANDERSEN & GIRDLESTONE.
4574. KASELOWSKY.
4585. EDWARDS (*Naumann*).
4626. HINDE.
4656. LAKE (*Gibert*).
4658. JOHNSON.
4665. CLARK (*Fischer, Schwarzwaelder, Schwarzwaelder, & Hicks*).
4685. COPE.
4690. HADDAN (*Conkling*).
94. SNAYDON.
289. THOMPSON & CORDÈ.
627. HUSKISSON.
1167. RICHARDSON.
1741. BOWDEN, PENN, DOWNING.
2618. HADDAN (*Wellman*).
3019. LAKE (*Williams*).
3318. MÜLLER.
3473. MALAM.
3492. MÉNARD & MOSS.
3612. HEATZMAN.
3761. FOLEY.
3853. LORIMER.
3917. ENGLISH.
4089. CAHILL.
4219. ENGEL (*Grossheim*).
4256. THOMPSON (*Young & Robinson*).
4353. MÜLLER.
4379. HESLOP.
4390. LIEBBECK.
4398. BOULT (*Rankin*).
4448. BOULT (*Sanborn*).
4460. FOOKS.
4472. TUERK.
4521. LEONARD (*The Canterbury (N.Z.) Seed Company, Ld.*).
4534. SCHRABETZ.
4537. SCHWINTZER & MÜLLER.
4568. FREEMAN.
4571. STARMFORD.
4578. IMRAY (*Welch*).
4600. MINTON.
4645. HEARSON.
4657. LAKE (*Thomson*).
4659. COPE.
4671. BOULT (*Stanwood*).
4678. HINCKLEY.
4683. BOULT (*Koblenzer & Koblenzer*).
4726. MARTIN.

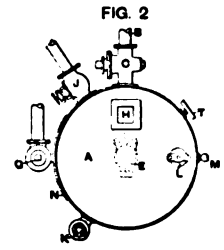
ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

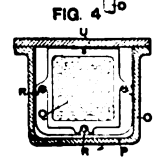
ENGINEERING.

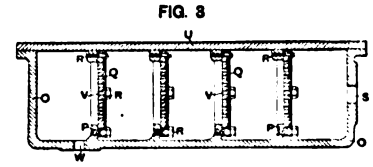
HOISTING MACHINERY.—*Pickering Ld., J. T. Pickering, E. W. Sant, & A. R. Davies, Stockton-on-Tees.*—In this machine an automatic intermittent stopping action is obtained by means of differential gear, working in connection with the ordinary starting arrangement, but leaving it free for independent use. Suitable powers of adjustment are provided so that by the use of the invention a hoisting machine can be made to arrest itself automatically at any point in its travel. The winding shaft is geared by toothed wheels to a countershaft carrying the driving belt pulleys. Upon the ends of these two shafts are loose drums geared together by an endless chain. The drum upon the winding shaft is fitted with differential gear, which imparts to the drum as the shaft is revolved a reduced rotary motion. This motion is transmitted by the endless chain to the second drum whose surface is grooved similarly to a worm. A series of small rollers or bowls constituting a rack are secured to the sliding rod of the belt shifting forks. These bowls work in the manner of teeth in the grooves of the second drum, so that as this drum is revolved the striking gear gradually shifts the belt from one pulley to the other, and stops or reverses the motion of the hoisting barrel. Claims: (1) In the construction of hoisting apparatus, the combination of differential gear, a grooved wheel, and shifting bar, fitted with rollers as described; (2) the combination and arrangement of the several and respective parts together forming the improvements in apparatus for starting and stopping hoisting machinery as described.—No. 5704. April 3rd, 1889. 8*d.*

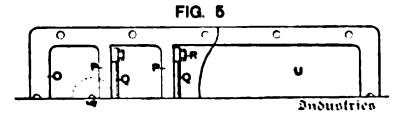
PURIFYING SEA WATER.—*V. B. Lewes, Greenwich.*—The salts of calcium and magnesium are removed from sea water by this invention, leaving it fit for use in boilers, &c. The sea water is mixed with some salt that precipitates the calcium and magnesium salts, and the mixture is then heated under pressure. After this treatment the water is filtered, and is then ready for use. The apparatus used in this method is as illustrated. Figs. 1 and 2 are respectively a vertical section and plan of the precipitating vessel; Figs. 3, 4, and 5 vertical longitudinal section, transverse section, and plan of the filter. The precipitating vessel A has an inlet pipe B for admission of sea water, outlet pipe D for discharge of impurities, and outlet pipe F for the treated water. The chemical used for precipitating the salts is carbonate of soda, which is introduced at the top opening H. To raise the pressure in the vessel the water is heated by a current of steam passed through


FIG. 1


FIG. 2

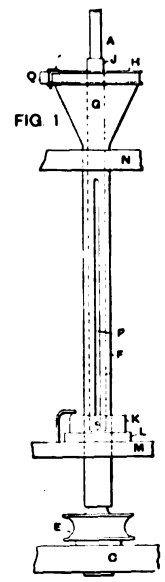

FIG. 4


FIG. 3


FIG. 5

the coil I. The filter comprises a vessel O fitted with a series of perforated partitions Q, composed of two iron plates, with a suitable filtering medium between them. S is the inlet, and W the outlet. Claim: The herein-described method or process of treating sea water for use in steam generators, by mixing with the water a salt or compound such as carbonate of soda, capable of precipitating the calcium and magnesium salts contained in the water, heating the mixture to boiling in a closed heating vessel separate from the steam generator in which the purified water is to be used, allowing the insoluble precipitated impurities to deposit in the said closed heating vessel, and causing the supernatant water on its way to the boiler to pass through a pipe having its open end above the bottom of the closed heating vessel and through a filter external to the said heating vessel as set forth.—No. 5339. March 28th, 1889. 8*d.*

SPINNING, &c., MACHINERY.—*P. Wallace, Huddersfield.*—The apparatus referred to in this invention is employed in spinning, doubling, and roving wool and other fibres, the object being to wind the yarn upon a bare sleeve. If the sleeve is composed of metal a tube of paper or other suitable material is placed upon it. An elevation and vertical section of these improved parts are given in Figs. 1 and 2 of the illustrations. A represents the spindle, resting in a footstep B, attached to the lower rail C, such spindle being secured in a bush formed at the top of the tube D, rising up from the wharle E, by which the spindle is driven. There is also fixed to the tube D of the wharle another tube F, extending upwards, on the top of which is a conical cup G, made with one or more rings or flanges H for receiving a traveller I (Fig. 4). On the spindle is placed loosely a sleeve or tube J, upon which the cop is formed; the bottom of


FIG. 1

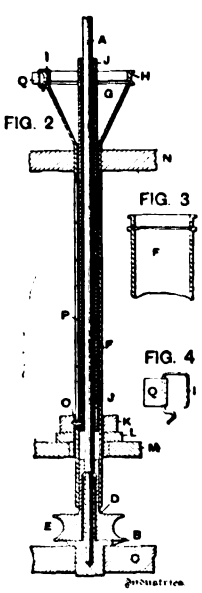

FIG. 2

FIG. 3

FIG. 4

the tube J rests upon or is taken hold of by a pin or stud O projecting from the loose collar K and resting upon a washer L carried by the lifting rail M, so that as the lifting rail is made to reciprocate up and down the tube J is made to rise and fall with it, and the yarn is built on the tube in the form of a cop. It will be understood that the wharle E drives both the spindle A and the tube F with its cup G, but the tube F is made with a long slot P through which the pin O slides up and down as the lifting rail rises and falls. A rail N is employed to steady the tube F and parts connected therewith. The traveller I is carried around on the ring H by the yarn as it is being wound, and its motion is retarded by a wing Q. Claims: (1) In machines for spinning, doubling, and roving yarns, the employment of the outer tube F, having a cup G on the top thereof, whilst the bottom of the said tube extends near the bottom of the spindle, in combination with the reciprocating tube J and the spindle A, all arranged as described and shown; (2) in machines for spinning, doubling, and roving yarns, the employment of the outer parallel tube F, the bottom of which extends near the bottom of the spindle, in combination with the reciprocating tube J and the spindle A, all arranged as described and shown; (3) in spinning and other machinery, the use of a traveller I having a wing or flap Q for retarding the speed of the said traveller in manner substantially as described.—No. 8410. May 21st, 1889. 8*d.*

PUMPS.—*G. Savin, Margate.*—This describes a hand-pump of the three-throw type, which may be easily transported and quickly brought into use. The pump comprises three vertical pump barrels communicating at the bottom with a common suction chamber fitted with perpendicular or horizontal suction connections, according to the circumstances under which it is worked. The pump barrels also open at the top into a delivery chamber provided with a suitable delivery pipe. The three-pump barrels, with the suction and delivery chambers, are mounted in a frame composed of a pair of A standards braced together and adapted to be temporarily fixed in the required position for use. The pump buckets are connected by stirrup-shaped connecting rods jointed to the bucket rods, which slide in cross-guides at the top of the delivery chamber. The crank shaft is mounted at the upper part of the frame and provided with winch-handles and fly wheel. Claim: The herein described construction of portable hand-pump.—No. 7433. May 3rd, 1889. 6*d.*

TWISTING, &c., YARNS.—*T. Hall, Huddersfield.*—Reference is here made to machines employed for reeling yarn, the improvements consisting in combining with such machines apparatus for enabling two, three, or more yarns or threads to be twisted or doubled and wound on to the ordinary reel at one operation. The necessity of twisting or doubling such yarns upon an ordinary mule is thus obviated. In the figures A represents the reel, C a spindle (one only being shown). The spindle has two discs, one for supporting the cops E, and the other carrying eyelets for the threads of the cops. The threads are passed upwards through

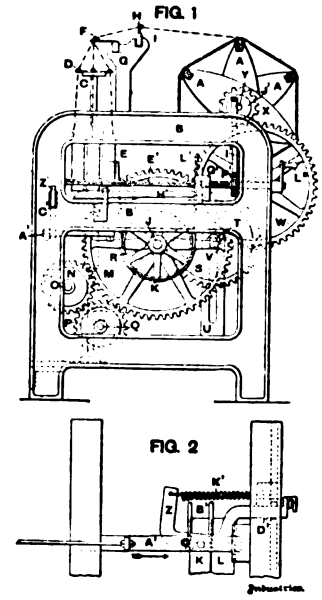

FIG. 1

FIG. 2

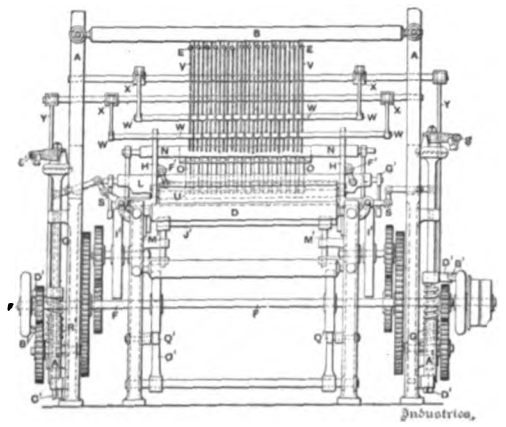
a single stationary eyelet F, and thence to a second eyelet H, secured to a reciprocating bar I, and finally it is wound upon the reel A. The rotation of the reel draws the yarn from the several cops, which are rapidly carried round by the spindle, and the yarns thus twisted together into one thread in the usual manner. The reciprocating motion of the bar I causes the twisted yarn to be traversed laterally on the reel to build the yarn to the required section upon it. The speed at which the spindles are driven determines the number of twists to be put in the yarn a certain length. The mechanism employed for rotating the spindles and the reel consists of a number of gear wheels and shafts driven off the main shaft J. In order to automatically stop the machine when the hanks are completed, a hook-ended lever Z (Fig. 2) is hinged to the setting on rod A^1 carrying the striking fork B^1. In Fig. 2 the belt is shown upon the fast pulley, the forks being held in that position against the resistance of the spring K^1 by the projection D^1 engaging with the frame of the machine. By lifting the lever Z it is obvious that the projection D^1 will be disengaged, and the fork B^1 moved over to the loose pulley. The lever Z is raised at the required instant by a sliding rod H^1, propelled by a screw block G^1, whose screw is rotated by a ratchet wheel F^1, driven by the crank disc J^1 upon the reel spindle. Claims: (1) Apparatus for doubling yarns and simultaneously reeling same in manner substantially as described; (2) in apparatus for doubling yarn the revolving plates for carrying cops, together with the revolving plates for carrying eyelets in combination with the reeling apparatus.—No. 6765. April 23rd, 1889. 8*d.*

BEARINGS FOR SHAFTS.—*C. Taylor & G. B. Taylor, Birmingham.*—Instead of making bearings of top and bottom parts, as is usual, the inventors make them solid, and slit the metal radially and longitudinally around the bearing hole, to admit of adjustment. One slit is carried right through the metal in the manner of a clamp, and by a bolt passed through them the parts are closed. Claim: Constructing an elastic bearing for rotating shafts, axles, and spindles, by dividing the bearing part of the cheek, upright, or support, by one or more slots opening into the hole in which the shaft-axle or spindle works, so that the divided or slotted bearing is capable of a slight opening and closing at the slot or slots, and the consequent enlargement or diminution of the spindle or axle hole, and the combination with the said elastic bearing of an adjusting screw and clamping screw, or adjusting or clamping screws, as described.—No. 9058. May 31st, 1889. 8*d.*

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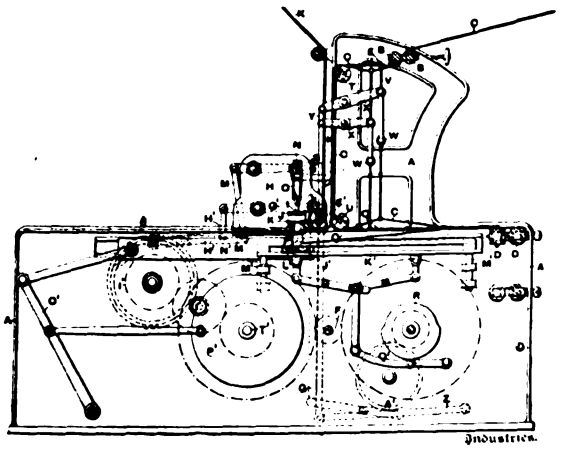
COIR YARN MAT MACHINERY.—*E. Hodder & R. Swain, Manchester.*—A loom is employed for operating the warp and weft composed of coir yarn in conjunction with an arrangement of mechanism for first producing the thrums, and then carrying them forwards on to and along the warps so as to become interwoven with the warp and weft. In the illustrations, Fig. 1 is a front view of the improved machine and Fig. 2 a side elevation. On the top of the loom frame A are a series of rollers B, to create the necessary drag upon the warps C. The warps are led from these over a roller T, down to a roller U, and thence forward to a pair of delivery rollers D. On their way the warps C are passed through eyelets E, attached to the top and bottom heald rods W, which are carried by the levers X, in turn con-

FIG. 1.



nected to the tappet lever Z of the tappet A^1. The loom has an ordinary shuttle, operated by the tappet B^1. The picking shaft G at each side of the loom is provided with a tooth or projection D^1, to which is attached one extremity of a strong spiral spring R^1, having its lower extremity affixed to the frame side of the loom. When the shuttle is timed to be thrown across the loom, the tappet B^1 comes in contact with such projection D^1, and has the effect of winding up or increasing the tension of the spring I, and of bringing the arm or distaff S^1 back to its farthest point. It will be seen that when such tappet B^1 is passed, the projection D^1 is instantly released, the spring recoils, and, actuating the picking shaft G, causes the shuttle to be thrown across the loom. It now remains to describe the formation of the thrums, and how they are carried forwards on the warps. A frame H extends across the back of the loom, and is provided with a series of vertical holes I. Across each of these holes is formed a horizontal passage J, to receive the ends of the yarns required to be formed into thrums. These thrum yarns K are drawn off a reel at the back of the loom, and are pushed into the horizontal passages J by feeding rollers E^1, intermittently revolved. Behind the feeding rollers is the cutting-off knife L, which descends and cuts off the thrum yarn at the proper instant. The knife is raised and lowered by the cam wheel I^1 and its connecting levers G^1 H^1, the lever H^1 carrying at its extremity a bowl running in a groove in the cam wheel. The bar O is similarly operated by a groove and bowl upon the opposite side of the cam wheel I^1. To this bar are secured chisel-shaped plungers, projecting slightly into the holes I. In descending, these plungers are given a half turn upon their axes. As the thrum yarns are applied to the horizontal passages J, they are pushed forward by the plungers, and formed into the necessary U shape, and upon passing out at the bottom of the holes are turned to the proper angle, to be carried forwards by the thrum carriers on to the warps, to form the coir pile. The thrum

FIG. 2.



carriers consist of a set of projections, arranged comb-like along the upper surface of a transverse bar J^1, capable of sliding to and fro in the horizontal guide grooves K^1. Claims: (1) The combination and arrangement and mechanism for the manufacture of coir mats, substantially as hereinbefore described and illustrated in the accompanying drawings; (2) in machinery for the manufacture of coir mats and other similar coir fabrics, the employment of thrum-forming mechanism, mounted and operating substantially as and for the purpose hereinbefore described and illustrated in the accompanying drawings.—No. 5062. March 23rd, 1889.

FEED-WATER APPARATUS.—*L. J. Porion, Nord, France.*—The invention consists essentially in utilising the rise and fall of a float within the boiler, not for regulating the passage of the feed-water as is usual when a float is used, but for controlling and regulating the supply of steam from the boiler to work the feed-pump or other appliance. Upon the top of the boiler is vertically connected the steam supply pipe for the feed-water appliance. The pipe is fitted with a valve, which is opened and closed by an up and down vertical movement. The rod of this valve is connected to the float directly below it. Thus, as the water falls in the boiler, the float and the valve fall with it, and steam is passed to operate the feed supply, the effect being reversed as the water increases in height. Claim: The herein-described apparatus for ensuring an automatic and continuous supply of feed-water to steam boilers, consisting essentially of a plug-valve received in a conical seat and attached to a float as described.—No. 8797. May 27th, 1889. 6*d.*

CONVERTERS FOR METAL.—*A. J. Boult, London. (J. W. Bookwalter, Springfield, Ohio, U.S.A.)*—In converting iron according to the Bessemer process there is a tendency to produce local currents in the metal so that only a portion of the metal comes under the full action of the air blast. To break up these currents and bring the whole successively under the action of the blast the inventor divides the converter into two compartments, one being the main reservoir for the metal, and the other and smaller one for the process of conversion. The metal flows from all parts of the larger chamber to the smaller during the process of conversion. In one form of this converter, where the blast is admitted vertically from beneath, the converting chamber is a short tube, placed in the converter with its axis coincident with the blast of air. The lower end of this tube or cylinder is a short distance off the bottom of the converter, so that the blast of air as it proceeds upwards blows the metal in the tube over its top edge, whilst a fresh supply passes in from the lower part of the converter under the lower edge of the tube. Nine claims are made.—No. 10324. June 25th, 1889. 8*d.*

BOOT MACHINERY.—*J. W. Sharp, Kettering, Northamptonshire.*—This improved machine is for forming rands or split lifts to a required shape for use in making heels for boots and shoes. Referring to the illustrations, Fig. 1 represents a front elevation of the improved machine, Fig. 2 a broken plan, and Figs. 3 and 4 enlarged details. To the frame A is cast a cylindrical box or inside former E. In this box is the disc D, carried by the

FIG. 1

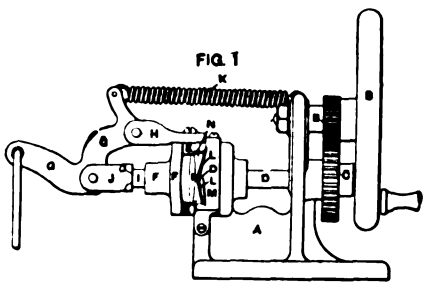


FIG. 2

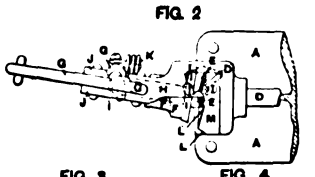
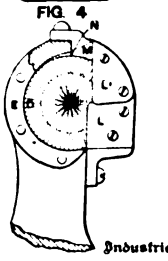


FIG. 3



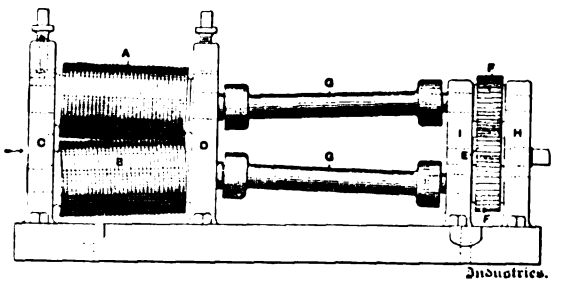
FIG. 4



spindle D and rotated by the gear and hand-wheel B. Facing the disc D is a second disc I placed at an angle to suit the bevelled face of the disc D. The disc I is secured to a spindle not free to rotate, but having a horizontal sliding motion which may be imparted to it by the operator pressing down the lever G. The lever G is normally held up and the discs apart by the spring K. The operation of the machine is as follows: The machine is first put in motion; the splits or rands being then placed between the two discs on to guard L are then firmly gripped by the operation of the lever G and pass round inside the cylindrical box or inside former to opening N and on to guards M and L^1. Claims: (1) The peculiar form of the cylindrical box or inside former E as illustrated; (2) the combination of cylindrical box or inside former discs and guards as shown in the accompanying drawings; (3) the combination of discs I and D as shown in Fig. 2, discs I being thrown out of line with disc D as herein described and illustrated in the accompanying drawings; (4) in combination with sliding and revolving discs the application of bell cranks or levers for the purpose of giving a firm grip to the material during the operation of the machine.—No. 5818. April 5th, 1889. 6*d.*

HYDRAULIC MAINS FOR GAS.—*N. Meiklejohn, Longwood, Huddersfield.*—Reference is made to the dip pipes of hydraulic mains. In the hydraulic main, an alternate thoroughfare is provided in addition to the usual dip-pipe, for discharging the gas coming through the ascension pipe. This thoroughfare is situated above the level of the water, and is opened and closed by means of a slide valve. When the alternate thoroughfare is closed, the gas is compelled to seek an exit by the dip-pipe and through the water in the usual manner, while when the alternate thoroughfare is open the gas passes through it directly to the hydraulic main without passing through the water. Normally, the alternate thoroughfare is opened and the gas passes through it, but when the retort is recharged it is closed, and the gas made to pass through the water. The slide valve may be operated by connecting it to the retort lid, so that the act of opening the retort closes the slide valve. Three claims are made.—No. 11456. July 17th, 1889.

MANUFACTURE OF METALLIC TUBES.—*C. Faulkner & W. E. Lloyd, Birmingham.*—The machine consists essentially of three horizontal rolls driven in the same direction and at equal rate. The illustration shows a side elevation of this machine. The three nearly horizontal rollers A, B, C are driven by the four pinions E, F, F, F carried by the housings or standards H, I; the pinion E being the driving pinion. The shafts of the rollers and the shafts of the three pinions F are coupled together by the rods G. The face of each roller has a helical or spiral groove formed in it as represented, and the rolls slightly converge towards the housing D. In using the machine represented the tube is formed from a hollow ingot or short thick hollow cylinder supported internally by a fixed mandrel, by introducing it between



the rolls endwise or in the direction of the arrow, that is, between the rolls at their widest ends, or the ends at which the distance between them is greatest. By the rotation of the rolls, the tubular ingot, introduced between them, is made to rotate, and by the action of the helical or spiral grooves on the acting faces of the rolls is drawn into and carried through the machine. The hollow ingot is thereby lengthened and its external diameter reduced. The tube may be passed several times through the machine according to the length and external diameter required, the tube after each rolling operation being heated and the upper roll or all the rolls being readjusted. The tube thus produced has a helical or spiral groove on its exterior which is removed either by the ordinary rolling or drawing process or by making the surface of the rollers plain at the finishing ends. Claim: Combining a series of rolls slightly inclined to one another, one or more of the said rolls having on its or their acting surface or surfaces a helical or spiral groove or grooves, the said rolls and their driving mechanism being constructed and arranged substantially in the manner hereinbefore described and illustrated in the accompanying drawings, so that the hollow ingot or short thick tube to be operated upon may be introduced between the rolls endwise at the ends of the rolls most distant from one another, the said hollow ingot being made by the action of the rolls to rotate, its external diameter being reduced and its length increased, and delivered from between those ends of the rolls opposite to the ends at which it had been introduced, the advancing motion of the ingot or partly made tube being effected by the helical groove or grooves on the roll or rolls, substantially as described and illustrated.—No. 8496. May 22nd, 1889. 8*d.*

DRYING SUBSTANCES.—*P. Cornish, Jun., Leyton, Essex.*—This invention is devised primarily with the object of removing the moisture from such materials as contain a considerable quantity, such as the residual matter arising from the chemical treatment and pressure of fœcal sludge and the like at sewage works; and thus, by means of the invention, to convert into a valuable manurial base what would otherwise, owing to the large percentage of water contained in it, be a comparatively useless substance for manure. The apparatus employed is illustrated, Fig. 1 being a plan and Fig. 2 a side elevation. It consists of a number of metal troughs B, arranged step-like in a specially constructed brick furnace. One end of each trough communicates with the trough above and the trough below it. In the troughs are helical propellers C, whose spindles D are geared to each other by wheels G, and the whole rotated by a V-grooved pulley I. The matter to be desiccated is placed in the hopper F, from whence it flows to the top trough. From the top vessel it is propelled by the helical propellers to the bottom

FIG. 1

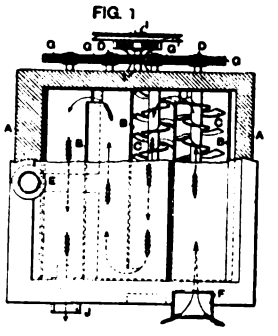
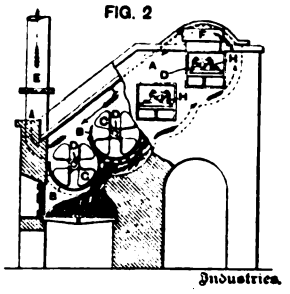


FIG. 2



vessel, whilst the heat from the furnace playing upon the under parts of vessels gradually evaporate the moisture. The moisture evaporated passes off with the fumes from the furnace, as indicated by the arrows. Claims: (1) The improved means for drying or desiccating substances or materials substantially as described and shown; (2) in the improved means for drying or desiccating substances or materials, the combination of cylinders or troughs heated in the manner described, and the arrangement

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employed for conveying the materials or substances alternately through each cylinder or trough in opposite directions substantially as herein set forth and shown and for the purposes specified.—No. 6102. April 9th, 1889. 8*d*.

Screw Propellers.—*T. Fisher, Holywood, Down, Ireland.*—To facilitate the motion of propeller blades in the water the inventor lubricates them in the following manner: A tubular duct leads from the cavity of the boss to the leading edge of the propeller blades. The cavity of the propeller boss is filled with lubricant so that it flows from the boss above the leading edges of the blades, and issues from them through small perforations. The oil is supplied to the boss from a reservoir within the vessel, through a hole in the centre of the shaft. Claims: (1) The use in steam ships of a screw propeller arranged with blades having perforated channels or tubular ducts constructed and employed in the manner and for the purpose described; (2) the use in steam ships of a bored screw shaft arranged with a gland and stuffing box and an oil pipe or conduit, constructed, connected, and employed in the manner and for the purpose described; (3) the combination and arrangement of parts constituting the improved lubricating apparatus, constructed, connected, and employed in the manner and for the purposes described.—No. 3330. March 3rd, 1890. 6*d*.

ELECTRICITY.

Carbons for Electric Lamps.—*H. H. Lake, London.* (*Lacombe & Co., Paris, France.*)—A description of the invention is given in the following claims: (1) A carbon or electrode composed of plates or discs of carbon arranged side by side and having between them a steadying substance or composition, the whole being united by pressure; (2) the improved method of manufacturing carbons or electrodes for electric arc lamps, consisting in first slightly compressing carbon mixed with a suitable binding or agglutinating material, and thus forming one of the elementary discs or other pieces, then covering one side of the said disc or other piece with a layer of the steadying substance and placing thereon a second disc or other piece prepared in the same manner as the first, and then subjecting the whole to heavy pressure and baking it; (3) the improved method of manufacturing carbons or electrodes for electric arc lamps, consisting in placing in a suitable mould, a layer of carbon mixed with binding or agglutinating material, covering this layer with the steadying substance or composition, and placing thereon a similar layer of carbon, and then uniting the whole by pressure or otherwise; (4) a cylindrical or other carbon or electrode having the steadying substance or composition extending helically around the same; (5) the method of manufacturing carbons and electrodes for electric lamps, consisting in forming a spiral or coil of carbon, extending the same longitudinally, placing between its convolutions the steadying substance or composition, and then effecting an intimate union between the convolutions and the steadying material by pressure or otherwise.—No. 9133. June 1st, 1889. 6*d*.

Automatic Switch for Accumulators.—*M. E. Unger, Berlin.*—The switch is used in charging electric secondary batteries in series for the purpose of transferring the electric current from one series to another. A disc of insulating material is mounted on a shaft revolving in bearings. Around the disc are a set of metallic coatings corresponding to the number of connections to be made. The coatings are insulated from one another step like on the disc, their number being one more than the number of series. On the disc there are also places not coated with metal corresponding to the several segments. The contact pieces are passed over and consecutively rubbed by springs in communication with the source of electricity, and which conduct the current to the metallic coatings. From the metallic coatings proceed short metal strips in connection with contact rollers fixed insulatedly on the shaft of the disc. The rollers rotate in quicksilver in vessels insulated from one another, but in connection with the poles of the series. The uncoated parts of the disc serve upon the sliding off of the springs to interrupt the current from the contact surface in connection with the last negative pole of the series, until upon the further turning of the disc a spring once more comes in contact with a contact surface in connection with the negative pole of the corresponding series, so that by this means short-circuiting between the poles of the secondary batteries is prevented. Two claims are made.—No. 8030. May 14th, 1889. 6*d*.

Supporting Electric Conductors.—*W. A. S. Benson, London.*—The inventor binds together the insulated conductors forming part of an electric circuit by a wire wound spirally around them. This gives the conductors an ornamental appearance and lessens the risk of injury. If the conductors have to take a longitudinal stress, wires are laid parallel to them and bound together with them. The conductors are attached to walls, &c., in the following manner: Over the conductors is passed a tube, which is screwed upon the outside. This tube is slotted to receive the longitudinal supporting wires and the end of the protecting wire. The wires are turned over into the slots from the inside of the tube, and the tube is then screwed into a receiving socket attached to the walls. Claims: (1) In a support for electric conductors the combination of a spirally wound wire or wires enclosing the conductors with a longitudinal wire or wires for taking the end stress: (2) in a support for electric conductors the combination of a spirally wound wire or wires enclosing the conductors with a longitudinal wire or wires for taking the endway stress, the ends of these wires being held by an inner tube on which is screwed an outer tube or socket.—No. 7796. May 9th, 1889. 6*d*.

Arc Lamps.—*G. Hookham, Birmingham.*—In the simplest form of arc lamp constructed according to this invention the feed mechanism is actuated by the weight of the upper carbon and the carbon-holder. The descent of this weight is retarded by the eddy-currents generated in a Foucault disc, to which the weight is connected by multiplying gear. It is so arranged that when the current and e.m.f. are normal, the rate of approach of the carbons is approximately that required to maintain the current and the e.m.f. at their normal values. If C represents a circuit carrying the main current, and E a circuit formed by a shunt between the terminals of the lamp, then the Foucault disc may be retarded by two magnets, one whose magnetising force is proportional to C − E and the other to C + E. The C + E magnet may clamp the disc, and so stop the feed when the E C exceeds the normal. In practice, however, the current supplied to lamps is approximately constant, and in this case a single magnet producing currents in the disc will suffice. In a lamp constructed with one retarding magnet the disc revolves between the poles of the magnet through whose coils the main circuit passes. A second magnet in a high resisting shunt circuit operates a catch, which locks the disc when the lamp is not at work, and so prevents the disc racing. A third magnet in the main circuit acts upon the lower carbon-holder, and pulls it down against the resistance of a coil spring to strike the arch as the current passes across the carbon. Claim: In an arc lamp the construction and arrangement of parts whereby the feed of the carbon is regulated by the increase or decrease of electrical currents generated in a metal disc as described.—No. 6578. April 17th, 1889. 8*d*.

Primary Batteries.—*R. A. Burnell, London.*—The battery is constructed upon the principle of the Leclanché batteries, in which the electrodes consist of zinc and carbon and the exciting liquid of a solution of sal-ammoniac. In the present invention, instead of surrounding the carbon with a mixture of granulated manganese and carbon, and hermetically sealing the porous cell, the carbon is made of a rifled cylindrical form and with a hole extending from the bottom to the top. In the grooves of the carbon are placed porous sheaths filled with granulated unheated manganese. In one of these grooves is placed a zinc rod forming the zinc electrode. The zinc is insulated from the carbon by a glass sheath, and clears the bottom of the vessel. The porous sheaths and zinc rod are held firmly to the carbon by surrounding bands. The battery is completed by partially immersing the part above described in a vessel containing the exciting fluid. By this construction the manganese comes into direct contact with the exciting liquid, and also with the atmospheric air, so that the hydrogen generated is at once absorbed by its oxygen. The sheaths can also be easily removed and filled with fresh manganese. Claims: (1) A Leclanché battery in which the carbon for increasing the surface is made of a hollow body, which is parallopipedic, or provided with longitudinal grooves upon the outer surface of the said body being imbedded, the porous sheaths filled with unheated granulated manganese, and the rod of zinc that is separated by a non-conductor from the carbon in such a manner that the sheaths are in direct contact with the atmospheric air, and the electrolyte, for the purpose of bringing the hydrogen generated in contact with continually renewed oxygen, so as to impart to the battery a great durability, and obtaining on the other hand with the least space and weight an increased electromotive force and convenient accessibility; (2) the modification of a Leclanché battery, in which the zinc electrode surrounds the carbon electrode with the filling of manganese like a casing, a layer of insulating material adapted to allow the passage of the exciting liquid being inserted, and that, if necessary, it is provided with holes and tightly surrounded by a layer of insulating material impregnated with the exciting liquid, for the purpose of converting the battery into a dry battery.—No. 6410. April 15th, 1889. 8*d*.

CHEMISTRY.

Extracting Precious Metals from Ores.—*R. L. Cousens, Johannisberg, South African Republic.*—In the first place the ore is pulverised, and the resulting powder passed between or over magnetised iron rollers, so that the magnetic constituents, such as iron, are eliminated, as these matters adhere to the rollers, and may be collected. The ore powder freed from iron is then put into a strong wooden barrel mounted upon metal trunnions. A quantity of salt and lime is added to the powder, and the whole is moistened by water. The barrel is then closed and revolved, whilst a current of electricity is transmitted through the contents.

FIG. 1

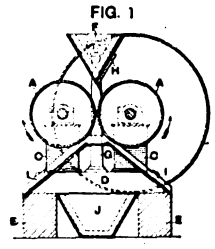


FIG. 2

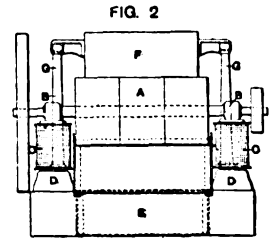


FIG. 3

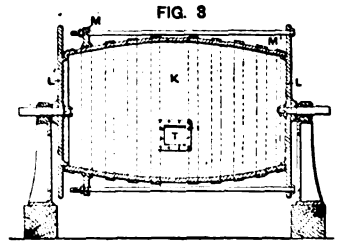


FIG. 5

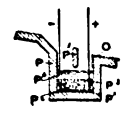
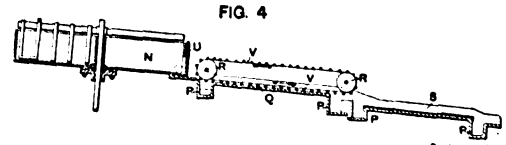


FIG. 4



Industries.

After a time mercury is introduced into the barrel, and the revolution continued. The mixture is next run into a receptacle, and, after being agitated, is delivered to an electrolysing vessel. In the accompanying illustrations, Figs. 1 and 2 show the magnetised rollers. Their bearings C are the poles of electromagnets, which have the effect of magnetising the rolls with opposite polarity. The powdered ore is fed into the hopper F, and falls down between the rollers A, which revolve in the direction of the arrows. The structure of the wooden barrel will be readily understood from Fig. 3. After the treatment of the ore in the barrel, it is fed to the circular receptacle N, in which works a rotating rack. From N it flows to the electrolysing vessel P (shown enlarged in Fig. 5). The vessel P is made of wood, and has at its bottom a copper plate P^1 connected to the terminal of a dynamo. On the plate P^1 is a layer of sand P^2, moistened with acid and covered by a porous diaphragm P^3. On the diaphragm is a layer of mercury, which is connected to the terminal of the electric generator. A partition P^5 extends down nearly to the mercury, so that the material as it flows down the vessel has to pass under the partition in close contact with the mercury. From P the material flows over a sheet of copper Q coated with mercury, and having a series of rubbers V, faced with flannel, travelling over its surface. The plate Q and the rubbers V are connected to the different poles of a battery. After leaving the plate Q the tailings pass through two or more electrolysing vessels P like that above described, and then over a woollen or felt blanket S, between a lead plate below it and a copper plate above it, these plates being connected to opposite electrical terminals. The tailings that flow from the blanket may be passed through a final electrolysing vessel P or through several of these in succession. The amalgam collected from the vessels P, the plate Q, and the blanket S, is distilled in the usual way. Claims: (1) The herein-described process for extracting precious metals from ore or quartz by crushing the material, clearing the pulverised material of the magnetic constituents by passing it between magnetic rolls, effecting amalgamation under electric action in a revolving barrel, and passing the material through electrolysing vessels, over amalgamating surfaces electrically cleansed, and through a blanket subject to electric action; (2) the magnetic rolls constructed and operating substantially as described with reference to Figs. 1 and 2; (3) the amalgamating barrel K constructed and operating substantially as described with reference to Fig. 3; (4) the construction and arrangement of the electrolysing vessel P substantially as described; (5) the combination of the agitating vessel N, the mercury-coated plate Q with its rubbers V, the blanket S with its enclosing plates, and several electrolysing vessels P, constructed and arranged substantially as described with reference to Fig. 4.—No. 8608. May 23, 1889. 8*d*.

Colouring Matters.—*O. Imray, London.* (*The Farbwerke Vormals Meister, Lucius & Brüning*).—This invention relates to the manufacture of a blue violet colouring matter unknown up to the present time, the hydrochlorate of which is soluble in hot water, and has the composition $C_{24}H_{18}N_4HCl$. The colouring matter is obtained by heating a mixture of five parts of aniline, 3·9 parts of hydrochlorate of aniline, and two parts of amidoazobenzol. A compound is thus produced which contains the said colouring matter, and from which it can be separated by the following means:—The compound, which contains a mixture of indulines, is boiled twice or thrice with a large quantity of water and filtered; hydrochloric acid is added to the reunited filtrates, whereby the whole of the new colouring matter is precipitated, together with other indulines in the form of hydrochlorates. This mixture is collected on a filter, pressed and dried at a temperature of from 70° to 80° C. The process for the separation of the new colouring matter from the above-mentioned mixture is founded on the fact that, of all the colouring matters which form in the mixture, the new colouring matter alone is capable of forming a stable acetate. The mixture of the hydrochlorates of the indulines is for this purpose mixed with diluted soda lye for from twelve to twenty-four hours; the induline bases thus obtained are then collected on a filter and washed carefully with cold water. The mixture of the bases, in a still wet state, is suspended in 100 to 150 parts of water; acetic acid is added and the whole is boiled, when the new induline $C_{24}H_{18}N_4$ will dissolve. It is filtered hot, and the filtrate is evaporated to one-fourth of its volume, when the acetate of the induline $C_{24}H_{18}N_4$ will crystallise, forming blue leaflets with brown lustre. It is collected on a filter, pressed, and dried at 80° C. The acetate thus obtained is easily soluble in cold water, and is a colouring matter very valuable for dyeing and cloth printing purposes. Claim: The described manufacture of salts of the induline base which are soluble in water.—No. 7857. May 10th, 1889. 4*d*.

MISCELLANEOUS.

Signal Bells.—*J. Hall, Swadlincote, Derbyshire.*—Means are here described for actuating the striker of alarm or signal bells used in engine-rooms, railway signal-boxes, &c. The striker is attached to the vertical arm of a bell crank lever, which is pivoted at its angle, and whose other arm is horizontal and weighted. In its normal position the striker is just held clear of the bell by a pin against the vertical arm of the bell crank lever. The arm carrying the striker is made of sufficient flexibility to strike the bell once when the lower arm is raised a certain distance and suddenly released. To raise the lower arm a lever pivoted at one end to the frame, and having at the other a knuckle-jointed finger, is caused to partly revolve upon its pivot and its finger to strike and lift the arm. After the arm has been raised a certain height, the finger slides out of contact with the end of the arm, and the latter thus falls, and the bell is struck. The lever carrying the finger is operated by a slotted bar, to which a longitudinal motion is given by the operator. A pin in this bar slides in a slot in the finger lever. The knuckle joint of the finger enables it to pass over the end of the lower arm of the bell crank lever when the parts resume their normal positions. Claim: The combination of parts as described, forming an apparatus for actuating the hammer or striker of an alarm or signal bell.—No. 9274. June 4th, 1889. 6*d*.

Copies of the British specifications may be obtained on application to H. Reader Lack, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at* ½*d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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AN IMPROVED ROAD WHEEL.

We illustrate herewith in elevation and axial section an improved form of road wheel invented by Mr. Claude Carter, Levenshulme, near Manchester. The arms and nave are of cast steel in one piece, and the ends of the arms have soles cast upon them, to which the wooden felloes are attached. Each felloe is thus given a much better support than is usually the case, and it is prevented from being so readily splintered. An iron hoop is shrunk over the felloes in the usual way. The wheel is not dished, as is the case with wooden ones, but on the contrary the tyre is perfectly cylindrical. An advantage in it is that the expansion and contraction of the arms and hoops will be practically equal, and the shrinkage will not produce the loose fitting so often noticed in wooden wheels in warm, dry weather. The chief feature is found in the strength obtained with a weight not exceeding and in some cases less than that of the ordinary type. As the arms are entirely free during the process of casting, no initial strains are set up.

THREE MODERN PROFESSIONS.

At the recent graduation ceremony at Edinburgh University, Professor Masson delivered an interesting address to the graduates, in which, among other things, he pointed out that the three great old professions of the Church, Law, and Medicine are not now the only employments entitled, by the dimensions they have assumed in the body politic, to the distinctive name of "professions." There have sprung up among us at least three other professions, competing with the three older, namely, Teaching, Journalism, and Engineering; and on each of these he gave some useful advice.

He spoke of teaching as a new profession, for it is only within recent years that it has become an independent part of the public service, having previously been to a great extent a kind of dependency of the Church. It is now organised and graded very thoroughly and definitely, and more than ever demands higher and more varied qualifications. Journalism had made more rapid advances than even teaching. What with the effects of the telegraph and the telephone on communication, added to those of steam navigation and the railway on locomotion, there never was a time in the history of the world when what may be called the throb of the present was so feverishly felt. To stimulate and maintain this fever of interest, what an abundance we have now of newspapers, and what an army of men are now enlisted in their service! Professor Masson pointed out, moreover, that the applications of the physical sciences to modern industrial purposes had not been sufficiently recognised by the Universities. He mentioned, what we have very often stated to our readers, that in Germany there was hardly a great manufacturing or mining establishment but has a staff of highly trained chemists or other scientific experts attached to it, applying their theoretical knowledge to the practical exigencies of the processes they superintend, suggesting improvements and simplifications, and amply repaying the cost of their salaries by the economies which they effect.

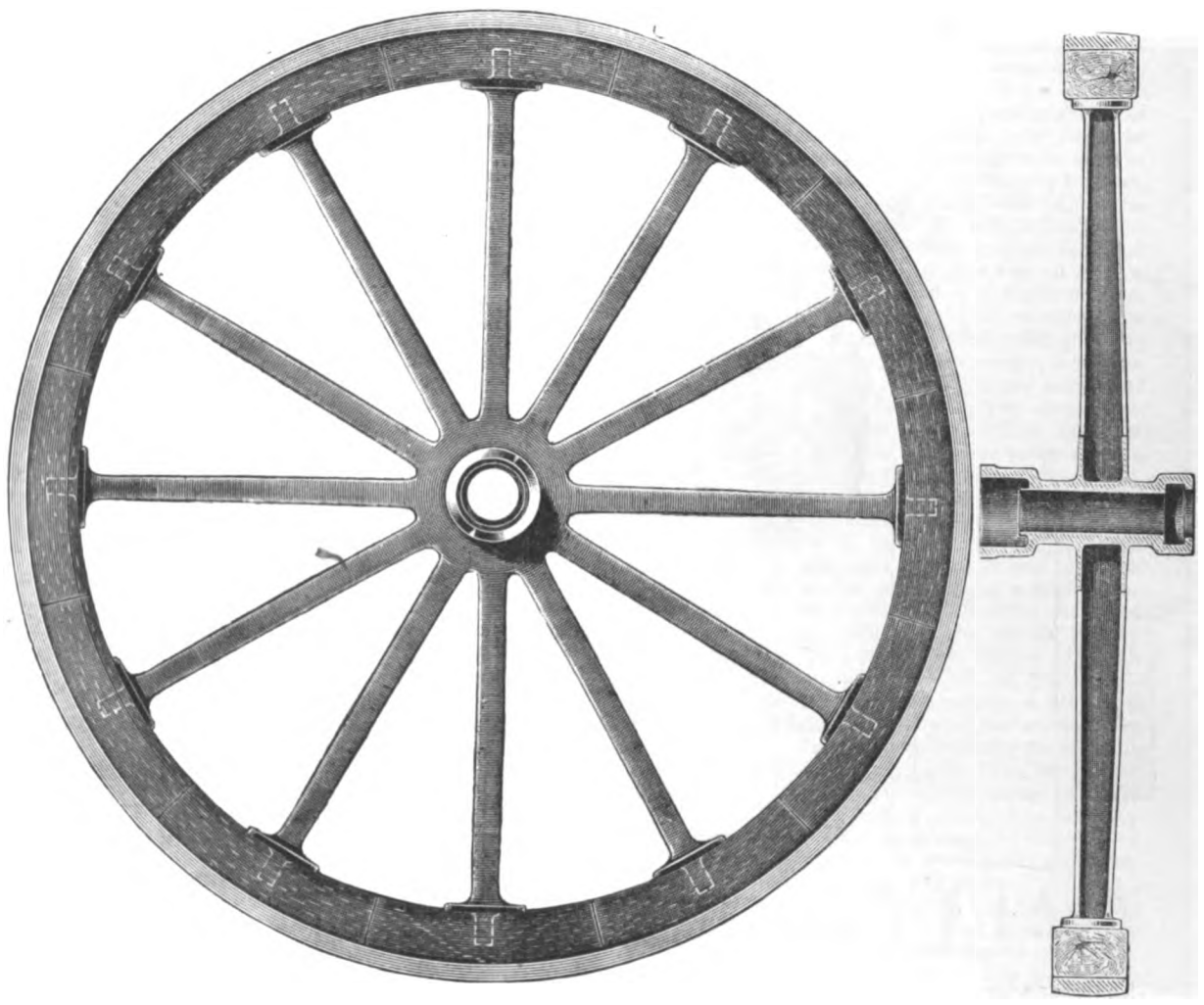
It would seem to be in Scotland that the first systematic attempt to organise engineering education on anything like a complete basis is to be made. At present a Commission is sitting for the purpose of reconstituting the Scotch Universities, and bringing them more in harmony with the wants of the times, and the members are being flooded with suggestions of all kinds. Unfortunately engineering is not directly represented on the Commission, and there is therefore the more necessity for those who are interested in the matter to do all they can to impress their views on the Commissioners. Fortunately this is being done.

We lately received a copy of a paper on "A University Faculty of Engineering," read by Mr. Henry Dyer before the Institution of Engineers and Shipbuilders in Scotland, in which the requirements of the different departments of the profession are forcibly pointed out. We also observe a paper by the same author in the *Scots Magazine*, and it is quite evident from these papers that events in Scotland are shaping themselves very much in the direction which Mr. Dyer has frequently indicated in our columns; in fact, all the main principles for which he has been contending seem to have been conceded, and all that is now required is the filling up of details and furnishing the necessary appliances.

Mr. Dyer takes the enumeration of the different sections of the profession of engineering which was given by the Council of the Institution of Civil Engineers some years ago, and points out that the whole field is fairly well covered by the following group of practically distinct professions:—(1) Civil Engineering; (2) Mechanical Engineering; (3) Naval Architecture; (4) Electrical Engineering; (5) Architecture; (6) Chemical Engineering; (7) Metallurgy; (8) Mining Engineering; and he advises that complete courses of instruction should be given in each of these departments. As a matter of fact, this is already done in fully equipped technical colleges on the Continent and in America. In this country the tendency is rather to extend the existing science faculties by having a department for applied science or engineering. In the second paper by Mr. Dyer, to which we have alluded, he proposes that there should be a faculty of science, which, with the classes in colleges affiliated to or recognised by the University, or with those conducted by recognised University teachers, will embrace the main departments of general and applied science; and he points out that, as Glasgow is the centre of the most important engineering works in the world, it might also soon have the most complete school of engineering. He claims for the various departments of engineering a place amongst university studies, not only because of their immense importance in our present state of civilisation, and therefore deserving the highest culture and training the Universities can afford, but also because of the good general education and of the preliminary training in pure science which they require of those who would successfully pursue them.

For engineers and manufacturers generally, mere technical skill and knowledge are of little use unless they are accompanied by manly spirit and enthusiasm, and even these will not tend to the greatest good unless combined with depth of social spirit. An engineer's general education should therefore include, in addition to the ordinary subjects, a knowledge of existing political institutions in Britain, both local and central, and this should be obtained by a historical study of their development and of the political ideas therein involved. In addition, however, to the more general subjects, the historical development of the different departments of engineering might be made a most valuable means of developing the minds of the students, by showing the influence they have had on the advancing civilisation of the world. The most instructive and interesting, and ultimately the most useful, method of studying any subject whatever, is the historical, and in none could it be made more interesting and instructive than in engineering. It would not be a mere case of collecting facts, figures, and formulæ, all in a cut-and-dried shape, ready to be poured on an examination paper, but would give the students a living interest in the subject. In what, for instance, is usually called civil engineering, the development of roads, railways, canals, harbours, lighthouses, &c., might be traced from the earliest periods to the present time, with the side lights they threw on the lives of the people and their several habits. The history of mechanical engineering is bound up with that of the great industrial revolution which has changed the face of the globe, and the methods of carrying on almost every department of work. The study of the effects of these on economic and social conditions should be an essential part of the education of all mechanical engineers. In naval architecture the development of ships of all kinds, the effects of improved navigation on the trade and commerce of the world, would afford a similarly interesting field for historical, economic, and social studies. Electrical engineering, which has shrunk the globe to insignificance and has levelled the inequalities of commerce, and promises to again revolutionise our industrial system, opens up many fields both for economic inquiry and speculation. Architecture, from an historical point of view, is simply the manners and customs and ideas of the people built up in wood, brick, or stone. The applications of chemistry and metallurgy, which have been the means of utilising substances formerly thought useless, and have afforded work and subsistence to large bodies of the people, have had an immense effect on social conditions, while mining in all its departments has afforded the raw materials for many of the arts and manufactures. Moreover, engineering is entitled to a place among liberal branches of education on account of the training in pure science required of those who practise it. All engineers should have a fair knowledge of mathematics. Not necessarily, as Mr. Dyer remarks, such a knowledge as would secure them a high position in such phantoms as mathematical triposes or other University honour lists, but a real knowledge, which would not only train their intellectual powers, but also fit them to solve the problems which they meet in everyday life. They should also have a fair knowledge of French and German, and at least of one general subject—such as literature, history, and political economy—so that they may be able to rise out of the narrow groove of scientific and professional interests.

CARTER'S IMPROVED ROAD WHEEL.

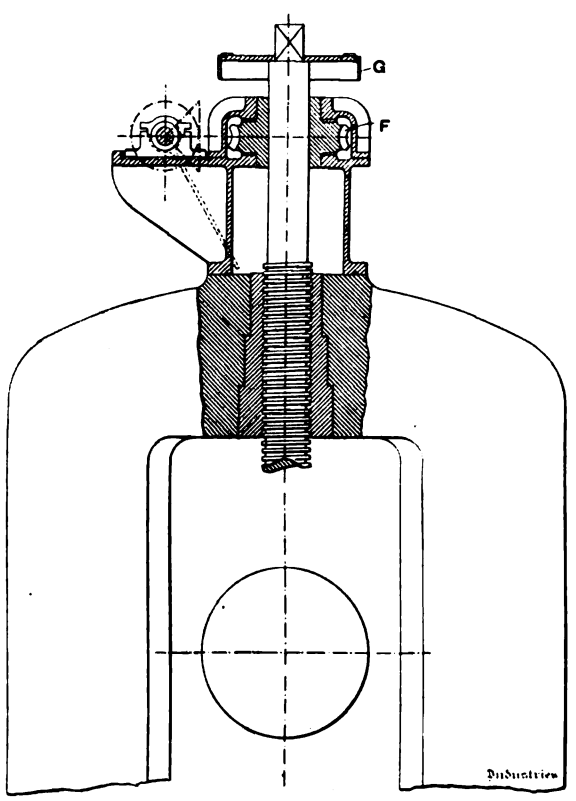


Side Elevation. Axial Section.

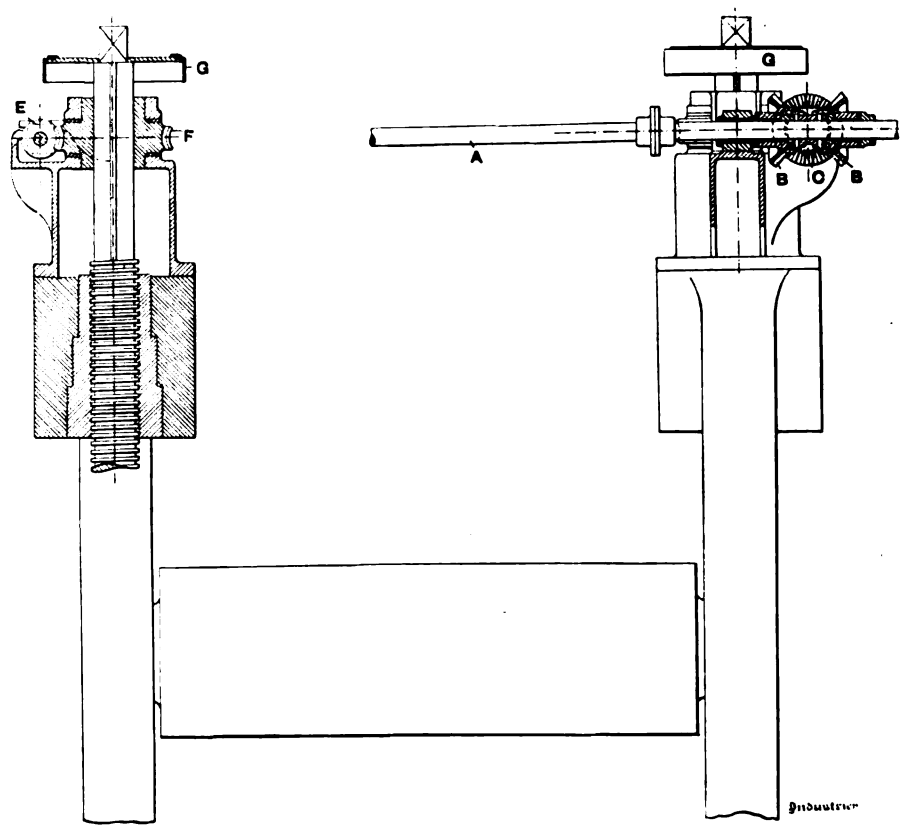
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JARDINE'S HOUSING GEAR FOR ROLLING MILLS.

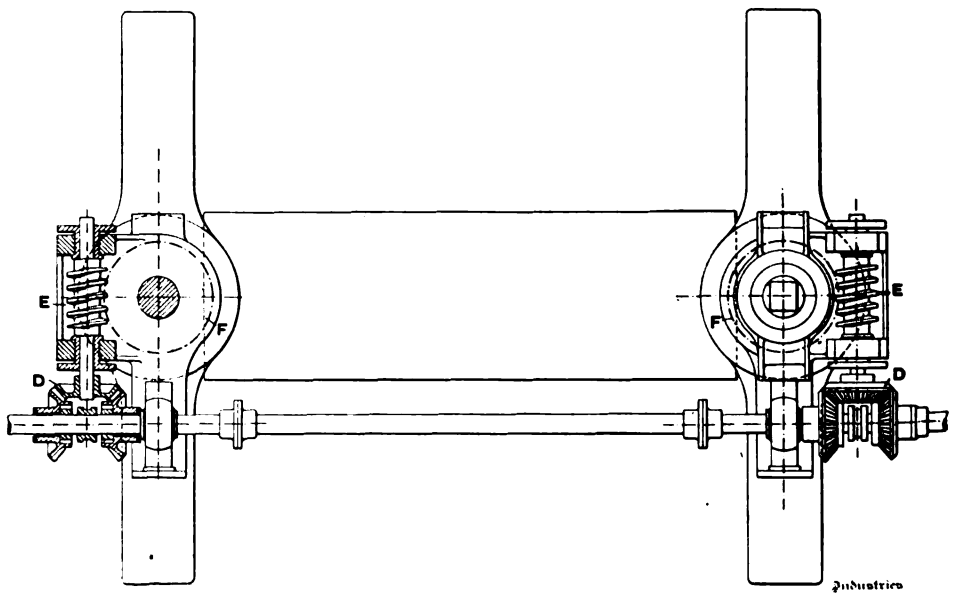
CONSTRUCTED BY MESSRS. GRIEVE & CO., MOTHERWELL, NEAR GLASGOW.



END ELEVATION.



FRONT ELEVATION.



PLAN, PARTLY IN SECTION.

The arrangements made by the students for obtaining a knowledge of the practical parts of their profession will, to a large extent, depend on their private circumstances and opportunities. Some may enter the university or technical college on leaving the secondary school, and take what practical work they can during the recess, and complete their apprenticeship at the end of their university or college course; some, on leaving school, may go direct to the workshops and attend classes in the evenings, and when they have finished their apprenticeship they may go to the day classes for a session or two; while others may try a combination of the two systems.

We feel convinced that if the proposals made in Mr. Dyer's two papers be carried out, not only will there be ample opportunities for the specialised study of pure or general science, but further, the newer professions which have arisen during recent years from the great development of manufactures will be placed in the same position as regards training as the older professions. We are pleased to observe that Mr. Dyer attaches so much importance to the social aspect of engineering education. He points out that every social improvement must have its foundation in an improvement in education, and that the welfare of the producers, be they employers or employed, and not simply the cheapness of the products, the organisation of capital and labour, the arrangement of all disputes by reason and not by force, are the great problems of the future, and their solution will demand the best efforts of our noblest men.

JARDINE'S HOUSING GEAR FOR ROLLING MILLS.

HITHERTO, the manipulation of the large housing screws for adjusting the upper roll of rolling mills has usually necessitated the employment of four men, two to each screw. By means of the gear, which we illustrate above, this manipulation can be easily performed by one man. The gear has been patented by Mr. John Jardine, 108, Windsor Terrace, Motherwell, N.B., and is being made by Messrs. Grieve, of the same town. As will be seen from the illustrations, showing a front elevation, end elevation, and plan, all partly in section, the action of the gear is very simple. The shaft A is driven continuously from any convenient source, and carries at either end a pair of mitre wheels B B, which run loose. Either wheel of these pairs may be driven at will by means of a special form of clutch C, which slides upon a feather in the shaft, and is actuated by a conveniently placed hand lever. A third mitre wheel D, on either side, and deriving motion from the wheels B B, actuates the worms E, which in turn transmit motion to the screws by means of the worm wheels F. The screws are also provided at their upper extremities with graduated brass index rings, by the aid of which a delicate adjustment can be effected. It is claimed that by the sensitive yet certain action of the clutches employed, the screws can be rapidly manipulated with the greatest nicety, that the slab is worked much quicker than by hand screwing, and that consequently the risk of breakage is reduced to a minimum. We are informed that this form of gear has been at work on a plate mill in Messrs. David Colville & Son's steelworks for upwards of nine months, and that this firm have decided to apply it to two new mills in course of construction by Messrs. Goodwin, Jardine, & Co., Limited, Motherwell.

THE IRON AND STEEL INSTITUTE.

(*Concluded from page* 447.)

A PAPER was afterwards read by Prof. W. C. Roberts-Austen, F.R.S., on "The Carburisation of Iron by the Diamond." It is universally recognised that the presence of carbon determines the physical properties of iron. It is, however, a singular fact that recent work, which has clearly shown the importance of the presence in iron of elements other than carbon, has in no way lowered the position which carbon holds as the element which confers upon iron the wide range of properties characteristic of steel. After an interesting summary of the historical experiments by which the true nature of steel was established, the author described Clouet's classical experiment, made in 1798, of melting a little crucible of iron containing a diamond, and obtaining a fused mass of steel. This experiment has been repeated by the author, using a vacuum instead of an atmosphere of gas. The use of the electric current rendered it pos-

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sible to heat pure electrolytic iron in vacuo in the presence of diamond, and also to heat the iron itself before contact with the diamond is effected, and thus to deprive the iron of its occluded gas. The combination does not take place until a full red heat is reached. This experiment derives its theoretical interest from the assertion that no two elements can react on each other unless a third element be present.

The next paper which was read was by Dr. Edwin J. Ball, of the Royal School of Mines, on "The Changes in Iron produced by Thermal Treatment." The experiments described were made in 1884, and were not considered at the time sufficiently complete for publication, but in view of the researches of Osmond they have acquired new significance. No claim to priority is, however, in any way suggested. The author shows that changes in the magnetic capacity and tensile strength of steel, which occur at definite temperatures, may be made evident when the metal is rapidly cooled in water or in oil. The results are shown in the form of curves, and it is noticeable that in steel quenched at certain temperatures the changes both in magnetic capacity and in tensile strength are most distinct. The experiments consisted in heating pieces of steel to definite temperatures in a muffle, three pieces at a time. When the desired temperature was reached, one of the pieces of steel was rapidly removed from the muffle and plunged vertically into distilled water of a temperature of 15° C., the second was similarly plunged into oil of the same temperature as the water, and the third was allowed to cool slowly in air. In order to determine the temperatures, a pyrometric scale of metals of known melting-point was employed. The curves given by the author show that certain critical points are well marked. Two of these correspond with Osmond's; but the third is a new point, that has not been noticed by Osmond, whose experiments did not relate to so high a temperature.

In the discussion on these two papers, Mr. Snelus thought that it would be interesting to repeat Professor Roberts-Austen's experiment on a sufficiently large scale to enable the product to be analysed. He thought the carbon was dissolved in the iron, rather than in chemical combination. Seeing that diamond can be introduced into iron, he wondered whether the converse was possible. Dr. Ball's paper, he thought, threw light on the process of tempering, a process hitherto dependent on rule of thumb.

Dr. Ball, in replying to the discussion, pointed out that the critical point mentioned by Mr. Wrightson corresponded with his own.

Professor Roberts-Austen, in replying to Mr. Snelus, believed that, although the diamond could not be extracted from iron in the laboratory, the separation had been observed in certain meteoric irons.

The last paper dealt with on Wednesday was by Mr. F. Lynwood Garrison, Assoc.R.S.M., on "The Robert-Bessemer Steel Process." This paper was read at Paris in September, and was adjourned for discussion. The modification of the Bessemer process described was originated in 1884 at Stenay, as the Walrand-Delattre converter. It is elliptical in shape, having a flat surface, in which the tuyeres are always placed on the same plane parallel to the axis. It swings on trunnions, and the tuyeres are so arranged as to impart a rotary motion to the bath.

In the discussion which followed, Sir Henry Bessemer pointed out that sometimes a very small difference in a machine or process will produce highly advantageous results. He was disappointed to find, however, that in the Robert modification of his converter the difference likely to produce good results was wanting. Similar converters had been tried in his early experiments and abandoned. Rotation had been tried in Sweden. There was found to result a want of heat, and the metal could not be tapped; this was on account of the extreme purity of the Swedish iron. He had patented a vessel resting on axes in 1862.

On Thursday morning, the 8th inst., the proceedings commenced with Mr. W. J. Keep's paor on "Aluminium in Carburetted Iron." "Keep's tests" are relative, and are made on a test bar ½in. square by 12in. long, to show the strength of the metal to resist weight and impact, deflection set, and elasticity. They show where proportionality ceases, and give the rigidity, hardness, and shrinkage of cast metals. Rigidity is defined as the ability of a material to withstand stress and retain its original form, and its diagram follows the curve of the tests up to the limit of proportionality, after which point elasticity and set are recorded. Elasticity is the property possessed by matter of regaining its shape after distortion. The diagram of a test records the elastic deflection and the set deflection, and, by removing the effect of the former, a diagram of rigidity is obtained. The author considers the influence of aluminium on iron, as shown by a stress of 200lb., and for impacts of a fall of 1¼in., ten blows having been struck from a ⅛in. fall up to this blow. Tabulated results of a large number of experiments are given to show the effect of aluminium alone, and of the modifying influence of carbon from ¼ per cent. up to saturation. Aluminium diminishes deflection in Robert-Bessemer ingot iron by decreasing the set and elasticity; the rigidity is increased, the grain is closer and more uniform, and the metal is improved in every way when considered as a structural material. Aluminium softens iron whether it contains carbon or not. Wrought iron with 2·45 per cent. of aluminium welds well, and can be bent nearly double when cold, and can be melted and cast nearly as easily as cast iron. Where carbon is low, aluminium does not change it into graphite, but drives out some of the existing graphite. Its action on white cast iron is to decrease the total carbon and change part of the remainder into graphite. The rigidity and elasticity are accordingly increased, while the hardness is decreased. The rigidity of grey cast iron is not affected, but other effects are similar to those in white iron. As a structural material, therefore, iron is improved, but the use of aluminium is not advocated under existing conditions. If grey cast iron could be produced by aluminium instead of silicon, with no increase in cost, such metal would be better for most purposes. Even at its present price aluminium can be used with great advantage, especially on ingot iron caught directly from the converter.

In the discussion which followed, Mr. J. Riley stated that he had tried to use aluminium several times, but he did not find its effect so good as is generally believed, and, accordingly, its advantages do not compensate for its extra cost. He attempted to use it in order to reduce the melting point, so that cracks and ruptures in ingots and castings, incidental to hot casting, might be eliminated. The influence in this direction was very considerable, but a fresh defect was introduced—the metal solidified more quickly. This was especially noticeable in the case of an alloy made from 20 per cent. of second quality aluminium and 80 per cent. of steel. By analysis this alloy contained 18·30 per cent., and had a specific gravity of 6·23. It was very fluid at a full heat, but it set so rapidly that only half could be poured from the crucible. The same effect is marked with 3½–4½ per cent., and is even noticeable with 2½ per cent. The tensile strength is increased some two or three tons, but the elastic limit is raised considerably, and there is some addition to the ductility. If it could reduce the heads of castings by even 25 per cent. it might be economical, but Mr. Riley came to the conclusion that it could only be used succesfully for small, thin, light, or intricate castings. In large charges the effect of the aluminium seems to be dissipated. In making alloys, the use of this metal is of great importance, as it renders alloys of copper and iron homogeneous, and a similar effect was noticed with a nickel iron alloy.

Mr. Spencer, of Newcastle-on-Tyne, agreed with the previous speaker, and thought that the value of aluminium would be less when the carbon contents were increased. It could only be successfully used in the case of Mitis or similar castings.

Sir Lowthian Bell stated that in making aluminium-copper alloys there appeared to be a true chemical combination, as the temperature rose considerably when the aluminium was introduced.

Mr. Allen said that analysts rarely looked for aluminium. Most likely Dr. Percy's strong opinion on this point had had something to do with this. But nevertheless, aluminium, like titanium, often exists in pig iron, though probably it rarely occurs in steel or wrought iron. It may be put into the metal, but it is often a question whether it stops there.

Mr. E. Riley inquired whether aluminiun combined with oxygen in the metal; in this case it would disappear into the slag, but would at the same time improve the material. It had a similar effect in aluminium copper alloys.

Mr. Stead had never failed to find at least traces of aluminium in metal to which it had been added, and he considered it quite possible for the alloy of iron and aluminium to exist. Any oxidising influence would tend to remove it, but some of the alumina might be mechanically entangled in the steel, and it was difficult to differentiate between alumina and aluminium in the analysis. In any case the analysis of alumium steel is difficult, for potassium hydrate will not separate traces of alumina from ferro-hydrate. A remarkable property of aluminium iron alloys is the expansion and consequent lowering of the specific gravity. An alloy of 2·6 parts of aluminium and 7·8 parts of iron expands 6·8 per cent.

Mr. Hadfield questioned whether aluminium really reduced the melting point of iron. The effect might be due to the oxidation of aluminium, which has a higher calorific power than silicon, or the apparent difference might be due to the greater fusibility of the slag. An experiment had been made with an alloy containing 5 per cent. of aluminium and no carbon, and the melting point was estimated at about 1,475°, as compared with 1,500°, the melting point of steel.

Mr. Galbraith thought that the loss of aluminium may decide the question of the cost. The metal is certainly found in pig iron, but in the case of Mitis castings it probably only acts on the oxide present. Mr. Keep, in one of his tables, had only given the estimated aluminium; so in this case, at least, there was no certainty that it was really present.

Mr. Galbraith proceeded to read a paper on "Certain Chemical Phenomena in the Manufacture of Steel." Difficulty is often experienced in the manufacture of soft steel in the Siemens or Bessemer process, especially when using basic lining, in keeping the metal quiet in the moulds and also in teeming it. It occasionally gets cold and sets in the ladle, and this is most likely to occur when the metal is "wild." In order to be able to ascertain the cause, and, if possible, the remedy for this, the following facts should be considered:—(1) The difficulty in teeming is *not* due to any lack of heat—*i.e.*, in such a case there has probably been as much heat put on the furnace as it could bear; (2) the slag in such a case invariably contains a large excess of oxide of iron, and is blacker and more metallic in appearance than usual; (3) there is an enormous evolution of gas; (4) there is a larger consumption of spiegeleisen or ferro-manganese than usual before we can get any additional carbon in the steel. The first fact has often been noticed, especially when the slag is thin. It is, of course, absurd to suppose that the mere presence of a "thin" slag can influence the fusing point of the metal, and it is preferable to suppose that the slag, containing an excess of oxide of iron, oxidises the metal so rapidly and so effectually that it becomes charged with an oxide of iron; that this oxide of iron is one of those lower oxides likely to be produced at a high temperature, and is almost absolutely infusible; and that when the slag is non-oxidising the metal is free from these oxides, and hence more fusible. If such a lower oxide can be formed at all, all the conditions of its formation are present, namely, a very high temperature, a very oxidising basic slag, and a very large excess of the metal. In the basic-Bessemer process the consumption of spiegeleisen is greater than in the acid process, and if the slag contains a large excess of oxide of iron, the metal is wild and infusible. The difficulty in making steel ship plates is attributed to this fact of the varying consumption of spiegel or ferro-manganese, due to the character of the slag. The heat will not teem; it will be "cold"; if the slag is black and metallic, the loss of spiegeleisen and metal is then greatest. The same difficulty is met in the basic-Siemens process. The author knows of no serious attempt in this country to make hard steel by the basic-Siemens process by *means of additions to soft steel;* this can only be successful if the slag is thoroughly non-oxidising, or, better still, by removing it, and proceeding as described later on. Occluded gas from basic steel contains more carbonic oxide and less hydrogen than gas from other steels. This may be explained by the existence of the oxides above referred to. Indeed, the extra absorption of carbon in the basic process, and the liberation of the extra quantity of carbonic oxide, are about the only evidence that can be adduced as to the presence of these oxides in the molten metal. These is another disadvantage in having too much oxide of iron in the slag; it is that of loss. Both in the basic-Bessemer and basic-Siemens processes the oxidation of the iron goes on with such a slag much faster than that of phosphorus. If the phosphorus has to be oxidised easily, and without much loss of iron, the slag must contain an excess of lime. There are thus three advantages in keeping the slag as basic as convenient. The formation of the oxides of iron, and consequently of cold and lively metal, is prevented, the loss of iron is reduced, and a slag with more phosphoric acid, and therefore of more value, is obtained. There is still the difficulty of controlling the carbon in the steel, and so as a partial remedy molten spiegel may be added before the slag comes, but the author prefers to proceed as follows: The steel is teemed as usual (with possibly a previous addition of some ferro-manganese) into a ladle with a large nozzle. From this ladle the soft steel, containing, say, 0·07 per cent. carbon, is teemed into another ladle, until the basic slag begins to come, when the stream is stopped. While teeming the soft steel into the second ladle there is also run into it sufficient alloys to give the required carbon, and at the same time there is run into it some siliceous slag, somewhat similar in character to the ordinary Siemens slag. From this second ladle the steel is teemed into moulds in the usual manner. Thus, by eliminating the tendency to form oxides through the basic slag, it is possible to have the conditions of an ordinary Siemens-Martin charge, and to make hard or soft steel as required.

Mr. Galbraith then proceeded to read his second paper, on "The Estimation of Phosphorus in the Basic-Siemens Steel Bath." One of the difficulties in the basic process is the uncertainty of knowing exactly when the phosphorus is low enough. The usual method is to examine the fracture of a small sample, but this is not entirely trustworthy, as it may vary on account of the size or treatment of the specimen. The following chemical method was accordingly devised. Dissolve 0·20 gramme

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DOUBLE BAND SAW MACHINE.

Constructed by Messrs. John Watts & Co., Broad Weir Engine Works, Bristol.

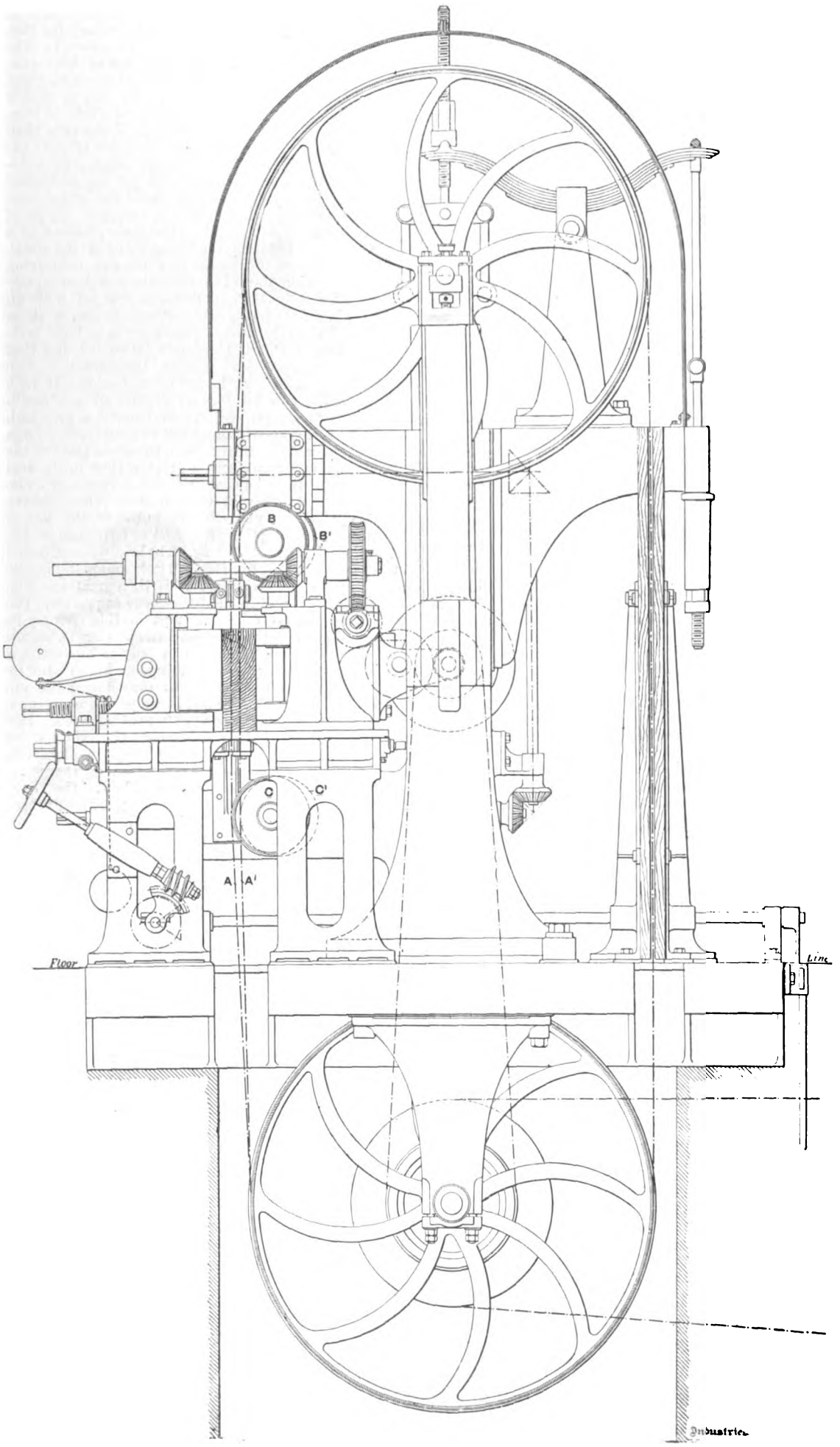


Fig. 1.—End Elevation.

of the drillings in 3 c.c. aqua regia in a small flask, then add about 3 c.c. water and sufficient ammonia to precipitate all the iron, and afterwards redissolve the precipitate in nitric acid, adding it drop by drop until the solution is distinctly clear. There is now added about 10 drops of molybdic acid solution, and the solution is transferred to a small bottle, about 2in. high to the shoulder, by ½in. diameter, which after being made up to a definite mark on the bottle, is shaken well. This is also done with a steel containing a known percentage of phosphorus (say 0·05 per cent.), and the opacity is compared; and if a number of similar bottles are kept varying from 0·01 per cent. to 0·10 per cent. phosphorus, the comparison becomes comparatively simple. The method is rapid and trustworthy, and by its means any phosphoric heat can be detected at once. It is not intended to use the test during the blow.

These two papers were discussed together, and the discussion on them was opened by Mr. Paul, who thought that the views offered in the first paper were decidedly new and required consideration. The effect of oxygen on iron has often been dealt with, and he had made experiments to show that brittleness often depended on the presence of oxygen. The author had not, however, given any analyses to show how far oxygen had any effect on the teeming of the metal. With regard to cold heats, when the slag is tranquil the flame passes over it and does not give up so much heat, but he hardly liked to say that Mr. Galbraith's theory was correct.

Sir Lowthian Bell said the effect of the basic slag is to remove the phosphorus when the two are agitated together. Phosphorus is not removed directly by the blast, but only by the oxides in the slag. The agitation of the slag and metal, according to Mr. Stead, causes the evolution of gas by the reaction of carbon and oxides. The addition of silicon spiegel, as used by Mr. Richards, caused the bath to be quieter, and so the iron was not oxidised.

Mr. Allen thought there was some confusion in the paper between the oxide of iron in the slag and in the metal. The method for the determination of phosphorus was a distinct advance; it could hardly be called a colorimetric method.

Mr. Gilchrist said that the slag must contain a large amount of oxides to remove the phosphorus. Darby's process of filtering molten steel through a layer of carbon has been considerably used on the Continent for making the harder grades of steel containing from 0·2 up to 1·0 per cent. of carbon with a low percentage of manganese.

Mr. Edward Riley said that the method of determining phosphorus had already been used on the Continent, but Mr. Stead pointed out that the method there used depended on the measurement of the volume of the precipitate, and not on the turbidity produced.

Mr. Richards defended the sample method of testing. The sample is always of uniform size, and uniformly treated, so that it is possible to estimate phosphorus within a few hundredths per cent. His experience with spiegel was that more was used for the acid than for the basic process. He also referred to the use of silicon spiegel.

Mr. Wailes preferred to dilute the slag at the end of the operation with an excess of lime, instead of using silicon spiegel to prevent the evolution of gas.

Mr. Galbraith then shortly replied to the various objections that had been made. He agreed with Sir Lowthian that phosphorus was removed by the slag, but it was the excess of slag that affected the teeming. With a thin slag it is impossible to get the heat for teeming the metal properly; the furnace would be melted down first. He had had no experience with Darby's process, but he thought that there would be considerable difficulty in obtaining the correct proportion of carbon. He had not been aware that his process for determining phosphorus had already been used in Germany, or he would not have read a paper on that subject.

The last paper was by Mr. Rollet on "The Rollet Process for Producing Purified Castings." This process of purifying pig iron is intended to be auxiliary to the manufacture of special qualities of steel, its object being to eliminate sulphur, phosphorus, and silicon from the castings. It consists in melting pig iron, and maintaining it at a very high temperature under a double action, slightly reducing and slightly oxidising, in the presence of a slag obtained by admixtures of limestone or lime, iron ores, and fluor-spar, in proportions depending on the quality of the pig or castings employed. The apparatus employed for this purpose is a blast furnace or modified cupola, using coke and hot blast. The burdens are introduced in the same way as in blast furnaces and cupolas. It consists of a shaft, several rows of tuyeres, a siphon arrangement for separating metal from slag, and a front chamber.

It has a sheet metal casing and is lined preferably with magnesia. Water jackets are used where necessary. Water tuyeres are used and project into the furnace; the lower row are placed near the hearth so as to prolong

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the action of the blast on the slag and metal in order to ensure a greater elimination of phosphorus. The metal is separated from the slag as soon as possible, so as to remove the phosphorus and to prevent too great a recarburisation. The temperature of the blast is as high as possible to prevent clogging at the tuyeres. The production is 50 to 75 tons daily; the elimination of sulphur is complete up to 99 per cent., and the phosphorus up to 80 per cent. or even more. A casting may be treated over again, as the carburising action is limited, and so any degree of purity may be obtained. The product may be used in a Siemens acid furnace, or for puddling, crucible melting, or cementation.

Only one speaker made any remarks on this paper. Mr. Hugh Bell said he had been doing the same as Mr. Rollet at the Clarence Iron Works, Middlesbrough, but as yet he had not been led to attach great importance to the method. Practically, all the sulphur is eliminated, and also the larger part of the silicon, but only a small proportion of the phosphorus is removed. He was sanguine, however, that in time the process would be developed, and it was useful to show that more than one mind was working in the same direction.

Lord Granville then proposed a vote of thanks to the President, who, in his reply, referred to the approaching visit to America, and requested the support of all the members. The other usual votes of thanks were also passed, and the meeting terminated.

WATTS' DOUBLE BAND SAW MACHINE.

Timber is generally cut into planks and boards by means of vertically reciprocating saws, but in some cases, when the logs are smaller, by means of circular saws. Both these methods of sawing, however, are rendered expensive in power by the friction which is inherent to the operations, and a great deal of waste is also caused owing to the thickness of the saw kerf. The band saw, in which there is a very small surface in contact with the timber, owing to the comparative thinness of the blades, has not generally come into use for deep cutting; but Messrs. John Watts & Co., of the Broad Weir Engine Works, Bristol, have lately brought out a substantial band saw machine capable of making two cuts 24in. deep simultaneously. We illustrate this machine in Figs. 1, 2, and 3 herewith and on pages 460 and 468. One very distinctive feature in their machine, in addition to that just mentioned, is that the portion of the saw blade actually engaged in cutting does not, as is usual, form a tangent to its carrying pulleys, but is thrust outwards by guide or distending pulleys in a line parallel with the tangent. The blade is thus supported so rigidly, both above and below the timber, that a perfectly straight and uniform cut is produced, and a much thinner blade can be used. The kerf is barely $\frac{1}{16}$th of an inch, and the surfaces, whether in hard or soft woods, are so true and smooth as to require very little subsequent planing. To the underside of the base plate, which is at the floor level, are attached the inverted plummer blocks of the driving shaft, with its fast and loose pulleys, the two saw pulleys, and the cone pulley for driving the feed gear. On each side of the upper portion of the vertical member of the standard are V-slides, in which the pulley arms carrying the bearings of the upper saw pulleys have a vertical range of about 18in., this being sufficient for a wide range of different length saws. For maintaining the saws at the requisite degree of tension for cutting, the pulley arms are slung from the inner ends of the two leaf springs, the outer ends of which are drawn downwards by screws at the back of the machine and within easy reach of the workman. Both saws, shown by dotted lines A A^1 (Fig. 1), are driven by the same shaft and pulley, and therefore at the same speed; and yet each saw may be adjusted independently of the other. A belt from the feed cone pulley on the main shaft below the floor drives the corresponding pulley on a transverse shaft. On this shaft there are worms which gear into four worm-wheels, and these latter are keyed to mitre wheels driving the four feed rollers in the back fence. By means of horizontal shafts which are provided with feather keys, and are free to slide in and out of these mitres when it is required to remove the saws, motion is transmitted to the mitre wheels driving the corresponding four feed rollers, which are mounted on the front fence slide. These rollers are contained in brackets, the bases of which slide in V guides, and are held up against the timber whilst it is being sawn, and are capable of moving inwards and outwards, adjusting themselves to any irregularities there may be on the outer surface of the timber to be sawn. This very necessary adjustment is effected by means of the counter-weighted levers which terminate in sectors working through intermediate wheels into racks on the front fence slide. The saws are set out and supported close to the work both above and below the cut, by means of guide pulleys B B^1 and C C^1, for giving rigidity to that portion of the blade which is actually engaged in cutting, and the leading saw has a lateral movement for determining the thickness of the second board. The upper and lower guide pulleys of the leading saw have their bearings in brackets sliding horizontally in the upper and lower members of the standard. Both brackets are controlled by a screw, a few turns of which will bring the leading saw in advance of the following saw to any required distance within the range of the thickness of the timber to be cut. The usual practice is adopted of supporting the back of the saws against the thrust of the feed by steel rollers.

In several mills, where these double band saw machines are in use, flitches or planks 3in. or 4in. thick are taken from the horizontal reciprocating saw to be re-sawn by the double band saw, thus ensuring a considerable saving in time, as the greatest speed of cut of the horizontal reciprocating saw seldom exceeds, say, for timber 20in. wide, 1ft. per minute, while it gives only one cut, as against two cuts of about 4ft. per minute each for the double band saw. Inch boards up to 24in. wide may be re-sawn with two simultaneous cuts, giving a total net produce of $\frac{3}{8}$in. The double band saw machines will re-saw fine woods 1in. thick by 24in. wide at a speed of feed of about four lineal feet per minute for each saw, thus giving with the two saws a speed of cut far beyond anything that can be obtained from a frame saw while cutting timber of equal width.

DOUBLE BAND SAW MACHINE.

Constructed by Messrs. John Watts & Co., Broad Weir Engine Works, Bristol.

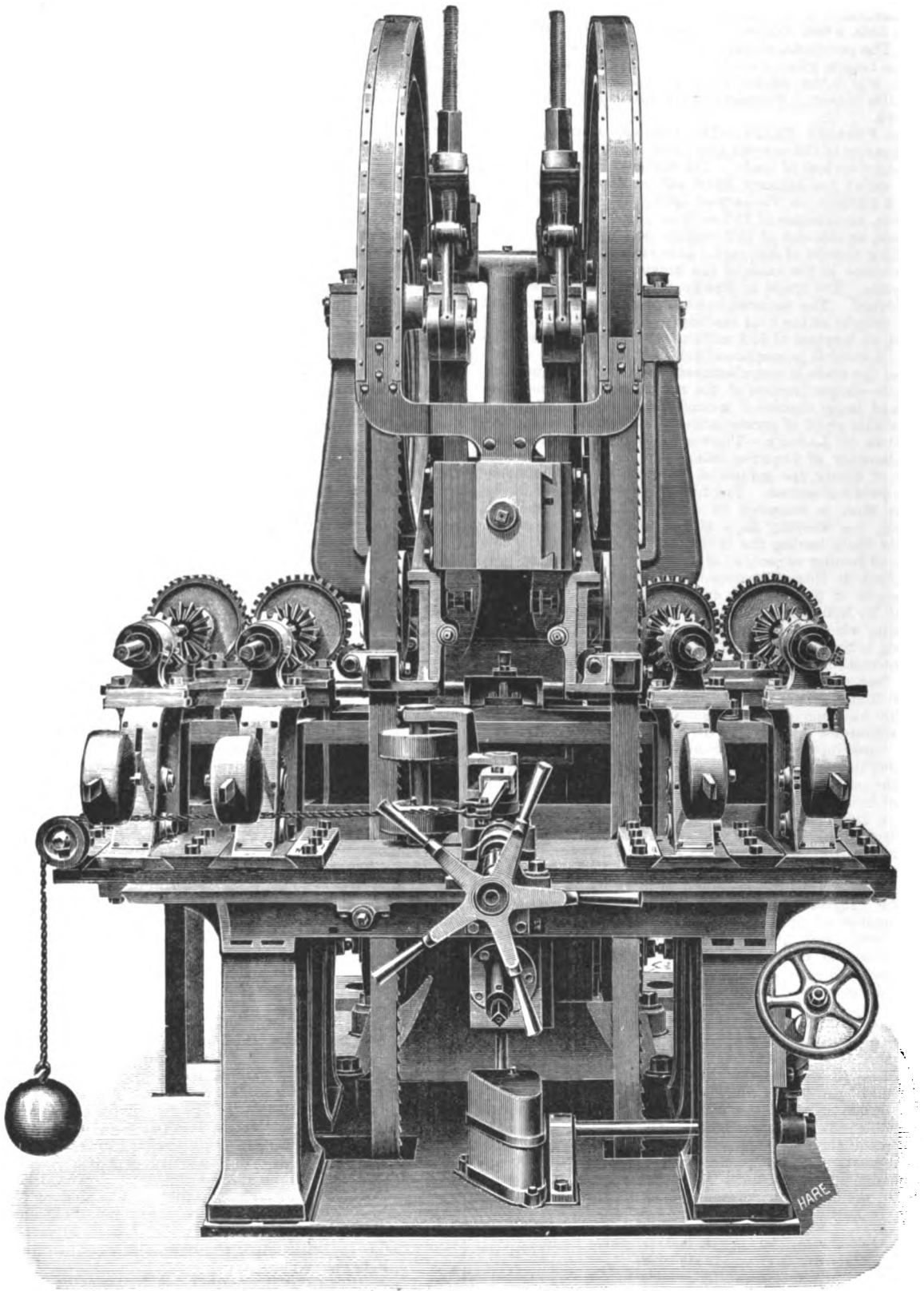


Fig. 2.—Front View.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 13th May, 1890.

IRON.—The iron market is distinguished by a firmer tone this week; not, however, from any revival of business, but in consequence of the strikes in the coal-mining industry and the fear of similar disturbances among the iron workers. The merchants of the capital refuse to sell bars or joists under 156s. a ton. Old rails are weaker, and are now quoted 88s. The provincial markets are generally quiet, but firm, for the reason given above. If there is any weakness anywhere, it is in the market for pig iron, for which there is but little inquiry. Founders in the Haute Marne are short of work.

THE FOREIGN TRADE.—The Customs returns for the first quarter of the current year show a clearly marked and persistent revival of trade. The declared value of the imports were: For January, 334·6 million francs, an increase of 29·4 millions on January of 1889; for February, 393·4 millions, an increase of 21·2 millions; and for March, 393·7 millions, an increase of 15·2 millions relatively to the corresponding months of last year. It is important to note that the increase in the value of the imports is confined to raw materials. The trade in foreign manufactured goods has diminished. The declared value of the exports in the first three months of the year reached a total of 853·1 million francs, an increase of 60·3 millions on the same quarter of 1889. A notable proportion of this increase is due to expansion in the trade in manufactured goods. These important features—larger imports of the raw materials of manufacture and larger exports of manufactured goods—afford incontestable proof of greater activity in the home industries.

HOURS OF LABOUR.—There are now three Bills before the Chamber of Deputies relative to a reduction of the hours of labour, the industrial question that is monopolising public attention. The first of these, brought in by M. de Mun, is intended to introduce English practice, namely, five working days of ten hours and one of six hours a week, leaving the latter half of Saturday and the whole of Sunday as periods of complete rest. The second, for which M. Piérard is responsible, proposes simply to fix the length of the working day at ten hours. The third, signed by MM. Ferroul, Baudin, and Thivrier, the Socialist Deputies who were at the head of the May Day manifestations, is nothing more nor less than the reproduction of the resolutions voted at the International Socialist Congress last year. These several proposals have been referred to the Labour Commission to report on. This Commission has completed its report on the question of women and children's labour. It is unanimous in prohibiting night work for women. It recommends the limiting of the working day for women to ten or, at most, eleven hours, and the prohibition of all work for children under thirteen, except in cases where they, being twelve years of age, can show a certificate as proof of having reached a certain standard of education.

THE LIGHTING OF PARIS.—At the meeting of the International Society of Electricians at Paris, on the 7th inst., M. Fontaine, the President, read an interesting paper on the "Lighting of Paris." He made a comparison of the amount of light used in the years 1855, 1872, 1877, 1883, and 1889, and gave the approximate figures for each source of light, such as candles, paraffin lamps, gas, compressed oil gas, and electricity. On the whole, paraffin oil is the most used at present, gas remains stationary, and electricity is rapidly growing in favour. The consumption of tallow candles has fallen from 1,200,000 kilogs. in 1855, to 800,000 kilogs. in 1872, 600,000 kilogs. 1877, 400,000 kilogs. in 1883, and 450,000 kilogs. in 1889; whilst the consumption of wax candles during the same years was—50,000 kilogs., 30,000 kilogs., 35,000 kilogs., 45,000 kilogs., and 50,000 kilogs. The calculation of the amount of vegetable oils used for lighting purposes is difficult, on account of these oils being also used in cooking, &c. The employment of mineral oils commenced about 1855, and gradually increased until 1883, since when it has advanced rapidly. The consumption of gas during the same years is given in the following table:—

1885	40,000,000	cubic metres.
1872	144,000,000	,, ,,
1877	150,000,000	,, ,,
1883	253,000,000	,, ,,
1889	289,000,000	,, ,,

Compressed gas has only recently been adopted; 6,500,000 cubic metres were consumed in 1889. Electric lighting commenced in 1877, during which year 230 h.p. was in use; the horse-power in 1883 was 900 h.p., and 1889 17,400 h.p. During 1889 there were 322 installations driven by steam engines, 97 by gas engines, 77 by compressed air, and 22 by vacuum. In addition to the 17,400 h.p. actually in work, there are installations representing 10,500 h.p. in course of construction.

BERLIN, 12th May, 1890.

IRON.—The iron market is steady and the tone somewhat stronger than it was a week ago, the recent reductions in prices having placed the trade on a more practicable basis. The effect of these reductions in the markets of the Western provinces is no longer observable in Upper Silesia, where the demand continues active. Business is especially brisk in joists, which are very firm in price. The state of the trade in crude iron is such as to guarantee the continuance of prosperity for some time to come. The Donnersmarkehütte blast furnace owners have contracted to supply the Finished Iron Makers' Association in the course of the current year with 15,000 tons at 80s. a ton, and 4,500 tons at 84s. a ton. A second contract disposes of the whole of the produce in the next two years, that is, in 1891 and 1892, according to a sliding scale dependent on the price of bar iron. Founders are still very busy, and there is no diminution of activity in the machine shops. The imports of pig iron are still heavy; but fresh business in foreign iron now takes place on only a small scale.

GERMAN IRON ABROAD.—The key to the recent reductions in the price of German iron is to be found in the Customs returns for the first quarter of the year. Foreign iron, finished as well as crude, was being imported in rapidly increasing quantities, while the exports of German iron were as rapidly falling off. The total of the exports in the month of March reached only 68,413 tons, against 79,294 tons in the shorter month of February. The following is a classified account of these exports in the first three months of 1890 and 1889 brought together for the purpose of comparison:—Pig iron, 31,274 (50,876) tons; old and scrap iron, 6,421 (7,265) tons; half-wrought iron and steel, 3,794 (5,836) tons; finished iron and steel (angles, bars, and plates), 49,688 (75,130) tons; iron and steel wire, 29,767 (47,417) tons; wire nails, 8,977 (13,260) tons; rails, 31,421 (25,348) tons; other railway iron, 15,298 (12,490) tons; heavy castings, except ordnance, 5,849 (3,424) tons; other manufactured goods, except machinery, 29,552 (27,118) tons. Total, 212,041 (268,164) tons—a falling off of about 21 per cent. The shrinkage, it will be observed, is in finished iron and steel, wire, and wire nails. The shipments of wire nails to Great Britain in the three months amounted to 3,221 tons.

METALS.—The general aspect of the metal market has changed in the course of the last week. The reduced prices have brought speculators into the market. Brisk buying has taken place, and, as a consequence, prices have recovered a little, and still show an upward tendency. Copper is quoted higher for English brands, and is very firm for Mansfield refined. Tin has improved, Banca being quoted at £5. Spelter has recovered 10s. a ton. Lead has shared in the improvement in a slight degree. This stronger tone of business is likely to bring consumers into the market.

STEERING BY ELECTRICITY.—An officer on board the German ironclad "Preussen" has, in conjunction with the engineer of that ship, invented an electrical steering apparatus, about which there is much talk just now in naval circles. By means of this apparatus the captain can control the rudder from the bridge or from any point on the deck—an important advantage in the noise of a storm or in action. That the invention is regarded by the authorities as one likely to prove of great importance is shown by the fact that the ironclad "König Wilhelm," on the very next day after her return with the Mediterranean Squadron, was sent to sea to test it.

A SHIP CANAL FOR BERLIN.—At a recent meeting of the Berlin Polytechnic Society, the possibility of constructing a canal between Berlin and Stettin was discussed. A canal between Berlin and Stettin offers no extraordinary difficulties, and the cost is estimated at 265,000,000 marks. It would be advisable not to go up the Oder to Schwedt. The shorter way is from the Tegel Lake to Schönwalde; then proceeding in a westerly direction to Bernau and past Biesenthal, and cutting the Finow Canal near Steinfurt. It would be best to lay the locks north of Steinfurt and near Neustadt. The total length of this canal to Stettin would be 160 kilometres. A depth of water of 6½ metres would be available, which is amply sufficient for marine vessels. The estimated traffic on the canal in two hundred and fifty days is 8,000 vessels.

THE ODER-SPREE CANAL.—The opening of the great Oder-Spree Canal which leaves the Oder near Furstenberg, will probably take place in the course of the present month. At first vessels of a carrying capacity of 300 to 350 tons were only expected to be used on this canal, but vessels of 750 tons are now being built, and they will be able to pass Berlin when the Spree bed has been lowered. The canal has a depth of 2½ metres and a breadth of over 50 metres. The canal is the most important hydraulic work at present existing in Germany.

A NEW BUILDING MATERIAL.—A material known as xylolithe has been introduced by Messrs. Cohnfeld & Co., of Pottschappel, Dresden. Xylolithe is composed of a mixture of sawdust and certain chemicals, and is compressed into plates at a pressure of 2,500,000 kilogs. per square metre. Without losing the property of wood, it possesses the hardness of stone, and it is practically fireproof. A 7-centimetre cube of the material was exposed to the action of a coal fire in the heating chamber of a stove for five hours at the Royal Experiment Station without taking fire or the internal structure being destroyed, although it became red hot.

VIENNA, 12th May, 1890.

THE IRON MARKET.—The business in the iron market has been restricted within narrow limits lately, but the tendency is firm, and prices have not changed. It is not possible to say what is the cause of this absence of life. It may be that the uncertainty as regards the actions of the labourers has caused the buyers and sellers to shrink from entering into contracts; but, on the other hand, it may be the influence of the German and English markets and the fall of prices in foreign countries. The works are well supplied with orders, the completion of which will occupy a long time. The 1st of May demonstrations were followed by many strikes in the iron industry, principally in Prague, where five machine works will have to cease work shortly. There is a good prospect for railway construction. In Styria 10,000,000fl. is to be employed for railway purposes soon. After two years of interruption, the Simmering Waggon Building Company is now paying a dividend amounting to 8fl. for each share. The company last year made a profit of 300,000fl., whilst the previous year the loss amounted to 76,000fl.

THE COAL MARKET.—The coal market continues to be animated. The strikes in the Ostrau district have terminated, and the business has regained its old briskness. The union of the Westphalian coke producers has failed to influence our market; indeed, coke prices are very firm, and an increase is to expected. The Lankowitz Coal Company produced last year 54,000 tons of coals, against 46,000 in the previous year; the profit amounted to 32,000fl., and a dividend of 4½ per cent. has been declared. For steamship purposes a great part of the fuel comes from England, and the largest steam-shipping enterprise of Austria, the Austro-Hungarian Lloyd, is using English coals exclusively. The increase of the import of coal from England is visible in the following table:—

	Tons.	Value in Florins.
1885	141,138	 1,933,298
1886	159,503	 2,110,420
1887	164,956	 2,098,202
1888	176,376	 2,317,117
1889	178,249	 2,513,277

BRUSSELS, 13th May, 1890.

THE IRON MARKET.—The state of the iron trade is the reverse of satisfactory. The orders come in very irregularly, and they are hardly worth having when they do come. The prices cannot be quoted with any certainty, as they vary with each order. The prices of the raw materials are so very high, that perilous times are ahead for the iron merchant if affairs do not take a better turn shortly. A good many makers are keeping their works going for four days a week, but they are only increasing their stocks and so placing themselves in a worse condition than ever. There is some talk of an increase in the number of blast furnaces at Thy-le-Chateau and Monceau, a step which appears to be little short of insanity. Steel is in a much better condition at present, although the state of the English market is likely to have an adverse effect upon the markets in Belgium before many weeks are out. There are sufficient orders to occupy the mills for some time, and the prices are remunerative.

THE COAL MARKET.—The prices have not changed very much during the past week. The strikes have had some effect in sustaining them, but the tendency is towards a fall. Indeed many concessions have been obtained—more than was expected a week ago. The condition of the coke makers has not been good during the whole of April, and a large number of furnaces are, therefore, to be damped down in order that the commodity may become more scarce. The price of 35fr., which has ruled in the coke market for a long time, was broken a few weeks ago by the low price of German coke. However, the figure has never gone below 30fr., and most of the business has been transacted lately at 32fr. The exports of coal during the first three months of the present year compare very favourably with those of the corresponding period of 1889. Altogether 344,983 tons were exported, as against 284,822 last year. The imports also increased from 4,727 tons to 7,675 tons. The Government will shortly take over the canal from Bossuyt to Courtrai, and the consequent reduction of the tariffs will be a considerable aid to the export of coal from the Charleroi district.

GLASS.—Very little can be said of the glass market this week. The same depression continues, and the production is too great for the demand. However, several manufacturers have damped down their furnaces, and this course of action will probably be followed by a number of others. Several satisfactory orders have come from England, and the American buyers have renewed their orders, but at reduced prices.

DÜSSELDORF, 13th May, 1890.

IRON.—Business in iron is gradually settling down on a more solid basis now that prices are in better accord with those of foreign markets. The demand, however, shows no signs of immediate revival, but hopes are entertained that some improvement will take place in the course of the next month. Following on the reductions of last week comes the announcement that the West Germany Sheet Makers' Association has reduced the price of sheets 25s. a ton, making the present quotation 225s. The manufacturers of joists have resolved to maintain the present rates, which were formerly low relative to those for bars and plates. Bars are in very slack demand, both for home consumption and for export, and wire is neglected. The state of the export trade in wire causes much anxiety. Relatively to the corresponding period of last year, the exports of wire in the first quarter of the current year have fallen off 37 per cent. The production of pig iron in the Rhenish-West-

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phalian district in the month of April amounted to 118,756 tons, against 127,231 tons in March. Notwithstanding this diminution, the stocks increased from 40,656 tons to 47,483 tons.

COAL.—The foreign trade in coal continues active in the matter of imports, but the exports compare unfavourably with past years. The statistics of the imports in the first three months of the years 1890 and 1889 are as follows: Lignite, wholly from Austria-Hungary, 1,515,280 (1,054,884) tons; coal, chiefly from Great Britain, 799,820 (735,813) tons; coke, chiefly from Belgium, 120,607 (64,064) tons; and briquettes, from Belgium and Austria-Hungary, 16,998 (6,181) tons. The exports of German produce in the same time consisted of 2,080,752 (2,258,839) tons of coal, 3,236 (2,306) tons of lignite, 210,319 (222,171) tons of coke, and 24,656 (26,046) tons of briquettes.

PRICES OF IRON CASTINGS.—At the general meeting of the Lower Rhenish-Westphalian Association of Ironfounders, held the other day at Dortmund, it was resolved, in view of the increased cost of production which the new labour laws must occasion, to maintain the present prices for castings.

RAILWAY SPEED ON SECONDARY LINES.—The Bundesrath has under consideration a proposal to increase the speed of railway trains on secondary lines from 30 to 40 kilometres (18½ to 24¾ miles) an hour. This measure has been rendered necessary by the great increase of traffic in the last two years.

LILLE, 13th May, 1890.

IRON.—The strikes in the coal-mining industry of the Pas de Calais have given rise to much anxiety on the part of the ironmasters. There is no scarcity of coal yet, but many are nearly at the end of their stores. It is not surprising that in such circumstances manufacturers maintain their prices firmly. There is, however, no revival of business. Consumers buy sparingly and sufficient only for present necessities. The market is supported by the prospect of higher costs of production arising out of the contemplated changes in labour legislation; certainly not by a strong current of business, or even by the hope of brisker trade.

TEXTILE MANUFACTURES.—The state of the market for linen goods has not materially changed in the course of the last week. The amount of business transacted is fairly good, and the prospect has nothing discouraging in it. The woollen goods trade of the Roubaix-Tourcoing district has, of course, been deranged by the great strike of weavers and spinners; but the current of business has not been completely stopped. No one believed that the conflict would last long, and as a matter of fact it has practically ended. A brisk business is being done in raw wool. The commoner qualities of home production are in good demand, and prices have an upward tendency.

FLAX AND YARNS.—There is no abatement of the demand for home-grown flax, but rather an increase; as a consequence, prices are steadily advancing. The supply is scarcely sufficient to satisfy the demand. A similar state of things is reported from the markets of Belgium. Russian produce, too, is being largely dealt in at higher prices. The better classes of tows are in brisk demand. The business done in yarns continues sufficient to absorb the whole of the production, so that the market remains firm. There is an active market for jute yarns.

GLASS WORKS.—The window glass and glass bottle works of Renard & Sons, at Fresnes, have been converted into a share company, with a capital of 2,030,000fr. Henceforward they will be known as the Verreries de Fresnes-sur-Escaut.

AMSTERDAM, 12th May, 1890.

THE PORT OF ROTTERDAM.—The East African Steamship Company, of Hamburg, which is going to start the new line of subsidised mail steamers between that port and East Africa, has decided to make Rotterdam a port of call for their outgoing vessels.—The town authorities have proposed to the Town Council to build a third dock, as the existing accommodation has proved insufficient in consequence of the growth of the town and the rapid development of its trade. The Town Council had already decided to construct such a dock in April last year, for which it had allowed a sum of 700,000 guilders. The new proposal is, however, to build a dock that is estimated to cost 940,000 guilders, with a depth of 6 metres and a length of 110 metres, and to accommodate vessels of 6,000 tons.

POSTAL MATTERS.—The Dutch Government has introduced a Bill into the Second Chamber of the States-General for the amendment of the present Postal Act. The postage of letters is to remain as at present, but the maximum weight of 1,000 grammes per letter will be abolished. As for newspapers, the postage will remain ½ cent. for every copy, which is less than half a farthing, whilst the maximum weight will be raised to 35 grammes for a single postage or part thereof. Up to 100 grammes in weight, a newspaper (including its supplements) may be sent through the Post Office for 1 cent., which rate will be maintained for any weight above 100 grammes. It will become lawful to send newspapers by rail or boat at a special rate.

THE NEW CUSTOMS BILL.—The Commission of the Second Chamber has submitted an unfavourable report on the Government proposal for a revision of the Customs dues upon the basis of an *ad valorem* tariff.

THE FORTHCOMING EXHIBITION AT AMSTERDAM.—The Government has granted a subsidy of 3,000 guilders in aid of the forthcoming Exhibition at Amsterdam of appliances for the minimising of danger to workmen in factories and workshops.

NEW STEAMSHIP LINE.—Efforts are being made for the establishment of a new line of steamers between Holland and Mexico.

COPENHAGEN, 10th May, 1890.

RAILWAYS IN SWEDEN.—The works on the Swedish State Trunk line in the north of Sweden will now be proceeded with in earnest, and the Swedish Parliament has just voted 4,665,000kr. for the next financial year for this purpose. There can be no doubt that this line will really be of very great importance to industry and commerce in Northern Sweden, and the decision of the Parliament has been received with much satisfaction.—The Swedish Government has introduced a Bill authorising the purchases by the State of the Swedish Norwegian Railway. The sum required for the purchase is 7,000,000kr., or about one-fourth of the company's debenture debts; 4,725,000kr. will be required for putting it in good repair and for purchasing rolling stock.

SHIPBUILDING IN NORWAY.—The iron ship "Skonvar" was launched on the 23rd ult. from the Laxevaag Engineering and Shipbuilding Company, Norway. Her principal dimensions are as follow:—Length, 273ft.; length between perpendiculars, 250ft. 6in.; breadth, 38ft.; and depth in hold, 22ft. 6in. The "Skonvar" is the largest sailing vessel hitherto built in Norway. The Laxevaag Company is at present very fully employed. They have in hand a 4,000 tons steamer, a steam ferry boat, and two or three important repairs. The new steamer "Britannia," intended for the Newcastle-Bergen trade, and specially built for tourists, is approaching its completion, and is being fitted in the best possible manner.

MAGNETIC SEPARATORS.—Two magnetic separators have recently been sent to Nepaul from the Anboga Mechanical Works in Sweden. These separators are designed by Mr. J. Wenström, and are similar in size and general aspect to those illustrated in *Industries*, Vol. VI., page 114. The only difference is that the frame is arranged above the apparatus, which is suspended from it in brackets, and that the feeding apparatus is altered to suit the fine materials to be worked. To each separator has been attached a dynamo giving 50 volts and 4 amperes for the magnetisation.

TELEPHONES IN SWEDEN.—The widespread use and development of the telephone in Sweden is something extraordinary, considering the thinly peopled country and its small resources. The telephone may be said to be an important household article, and it may be safe to assert that in no other country in the world do the children and servants in a house use the telephone daily to make appointments, to order supplies, to discuss business, and talk with friends, &c.

MADRID, 12th May, 1890.

NEW IRON ORE DISTRICT.—The first shipload of iron ore from the Carieno mine in Asturias has been exported from the port of Gijon. The cargo was only a little over 400 tons, as the port will not accommodate vessels of large draught. It will be seen that on account of the smallness of the harbour the new mine will never be developed to any great extent.

A CABLE TO CUBA AND PORTO RICO.—The Minister of the Colonies of Spain advertises for tenders, to be received during the ninety days from the 3rd inst., for the laying of an electric cable from Spain to Cuba and Porto Rico. The cable is likely to be the longest that exists, as it will exceed 5,000 miles. The intention of the Government is to leave a good deal to the judgment of the applicants, both technically and commercially, and they will not fix beforehand any special conditions to which the proposals are to be subject. It is clear that some assistance will be required from the Government, for the cable could hardly be self-supporting.

OUTPUT OF LEAD ORES.—The output of lead ores at Linares and Carolina district, from the 1st of January to the 31st of March, 1890. are given in the following table:—

	Tons.
Figueroa & Company, Arrayanes Mine	6,493
Thomas Sopwith, La Fortilla Group	2,260
Andres Pereda, San Miguel Group	1,705
Linares Company, 15 mines	1,653
Fortuna Company, 26 mines	1,471
Mamillos Company, 21 mines	937
Heredia Sons, 3 mines	791
Socorro Company	757
Familia Company, Los Angeles Mine	738

There is every prospect that the output will increase and some new mines are to be started soon. The above-mentioned companies produce two-thirds of the total output, which is 28,000 tons by 68 companies in 306 mines.

THE LABOUR QUESTION.—The labour question caused some anxiety to the authorities during the first week of May. However, all the meetings were quiet enough everywhere, with the exception of Barcelona, Valencia, and Alcoy. The strikes of labourers of some industries are still continued, but generally the employers have acceded to the eight hours demand. In the cotton mills the employers say they cannot allow only eight hours' work unless it becomes general in the competing countries.

A SCHOOL AT THE SHIPBUILDING YARD IN BILBAO.—On the occasion of a recent visit to Bilbao of Sir Charles Palmer, a school was opened which is expressly intended for the children of the British labourers there employed. Sir Charles Palmer and Señor Martinez de las Rivas are much praised for their liberality and goodwill.

NEW YORK, 3rd May, 1890.

THE IRON AND STEEL TRADES.—There is more disposition to do business and less to reduce prices than there was a short time ago, although some of the specialties have not yet fallen into line with the general trade. The feeling is better, and with the increased business now in prospect prices are likely to remain steady and firm. In pig iron there is a decided tendency towards better prices, particularly in foundry irons. There is still plenty of iron to be had at low figures, but the better grades are bringing a little better rates than a month ago. Some of the owners of furnaces have increased the number of orders on their books, and as other furnaces are to be put out of blast the general tendency is towards a healthier state of affairs. Business in manufactured iron is not as heavy as it ought to be at this season, but the demand in some departments is becoming quite active. The bar trade is dull, and prices are weak, at 1·85c. to 1·90c. per pound delivered, for best refined. Plates and shapes are active, and the mills have as much as they can do to meet the demands. Prices are not what might be desired, and in view of the increase in cost manufacturers are not as well off as before the advance. Plates are quoted at 2·10c. to 2·15c. per pound, and angles at 2·20c. to 2·25c. In steel rails the market is dull and prices are rather inclined to weaken. Sales have been made at $33 by Pittsburgh mills, and on desirable orders Eastern mills would probably accept the same rates, although $34 is the usual price asked.

THE COAL TRADE.—The anthracite coal trade has decidedly improved. The demand has increased, and prices are from 10c. to 20c. per ton higher. The producers have the market in their own hands. An attempt will be made at the next meeting of the representatives of the great companies to raise the prices, and this course will probably be carried out. The outlook is favourable for a much heavier trade from now. The settlement of the difficulty about the rates for bituminous coal to Northern points has been quite an important event to all the carrying companies, for the contest for coal to Buffalo and other points has been very damaging. Under the new arrangement rates for coal will be advanced from 74c. to $1·10 per ton, and it is believed that the new rates will be fully maintained by all the roads. The tonnage affected is more than 4,000,000 annually.

MOUNTAIN RAILWAYS.—The peaks of Ixtaccihuatl and Popocatapetl in Mexico are to be made accessible to tourists, and a concession has been granted for a railway to connect them with the Inter-Oceanic Railway. As the latter mountain is 17,800ft. above sea level, or about 10,000ft. above the Mexican tableland, there will be some heavy engineering work in building the road.

DESTRUCTION OF SINGER'S SEWING MACHINE FACTORY.—The works of the Singer Sewing Machine Manufacturing Company at Elizabethport, on Newark Bay, New Jersey, have been destroyed by fire. Three thousand persons have in consequence been thrown out of employment, and a loss incurred of over $2,000,000.

PHILADELPHIA, 2nd May, 1890.

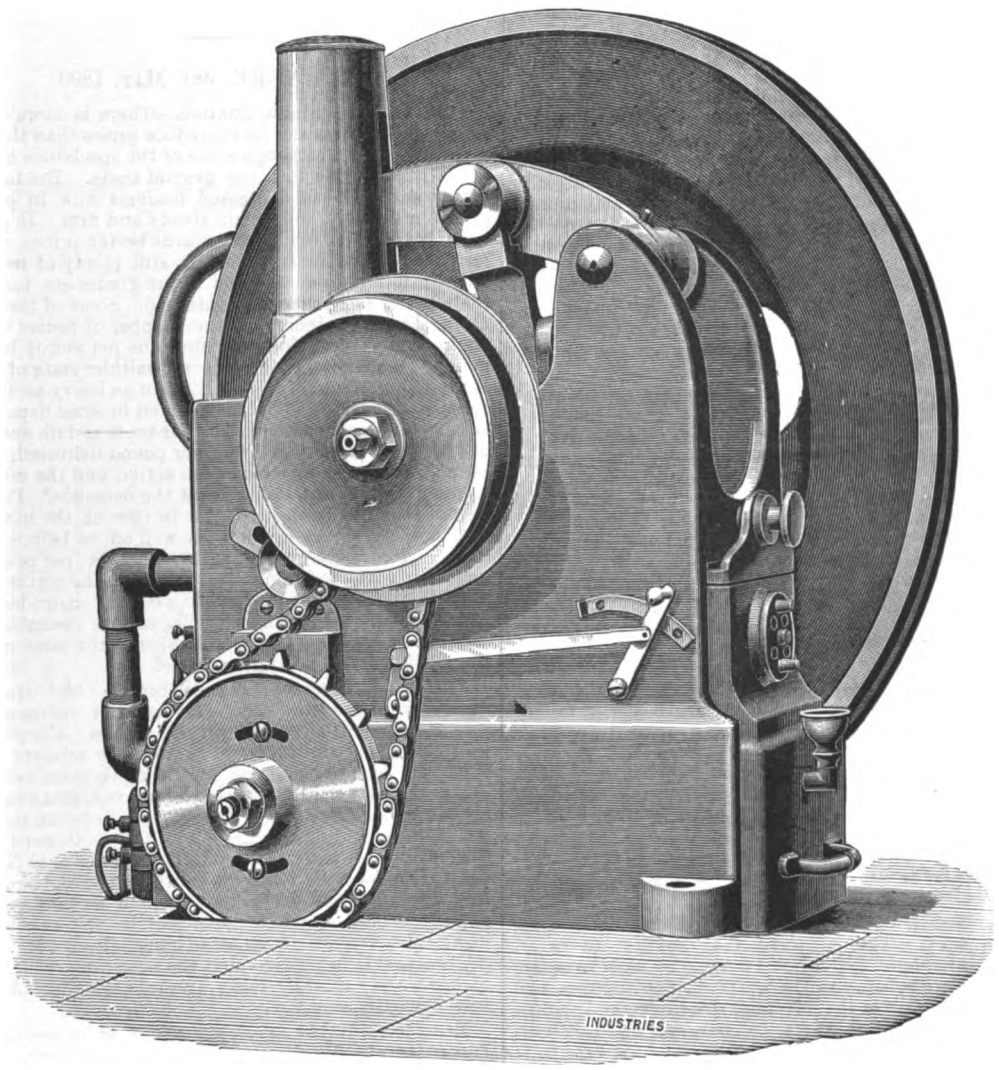
NEW LOCOMOTIVES.—At the Pennsylvania Railroad engineers' offices, at Altoona, a new compound locomotive is being planned, with the object of saving fuel. If the new engine proves a success it will probably make a change in the whole motive power of the road. A new freight locomotive is also being designed, half as heavy again as the largest of any freight locomotive in use at present.

A LARGE GOODS STATION.—The Pennsylvanian Railroad Company, following its policy of making more freight yards between Pittsburgh and Philadelphia, will very much enlarge the facilities at Altoona. The new yards, when completed, will be the largest in the country, and will be nearly three miles long. It will require the digging and hauling away of nearly 800,000 cubic yards of earth, and this work is being vigorously pushed. The Railway Company has large yards at Pittsburgh, Walls, Altoona, Harrisburg, Philadelphia, and Jersey City. Goods consigned to all points on the road come to these yards, and before a train is made up the cars have to be classified. When there is room enough it can be quickly done. Now it is almost impossible to marshal a train in the yards. The Altoona yards will have at first 50 tracks, and room for more when needed.

COKE AS A LOCOMOTIVE FUEL.—Coke is still being experimented with on the Baltimore and Ohio Railway with good results. Six engines on the Philadelphia division and two on the main line now burn coke exclusively. Coke is as clean a fuel as hard coal, and it is claimed to cost very much less. The kind of coke which has been found to answer best is that which has been burned for thirty-six hours.

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BUTLER'S DOMESTIC PETROLEUM ENGINE.



GUNBOATS FOR THE ZAMBESI.

THE present policy of our Admiralty authorities in the more extended employment of private firms for doing Government work is not only a sound one on economic grounds, but is also a useful and convenient one from a national point of view. The convenience of the policy is well illustrated in two gunboats of the stern-wheel type, named the "Mosquito" and the "Herald," which Messrs. Yarrow & Co., the well-known torpedo boat builders of Poplar, have just completed to an Admiralty order.

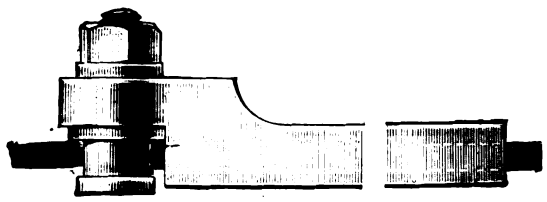
The order for these gunboats was given on the 1st April, and the first boat, the "Mosquito," was completed and set to work on the Thames on the 3rd inst., which, after allowing for the Easter holidays and Sundays, leaves twenty-five working days for building. This performance shows what can be done in this country by private enterprise in case of emergency. The dimensions of these steamers are 77ft. in length by 18ft. beam. They have a draught of 18in. with steam up, and run ten statute miles an hour, which is as high a speed as is at all practicable when navigating a very shallow river, the channel of which is not known, and where there are no pilots. The boiler, which is placed forward, is of the locomotive type, and is adapted for burning wood, which is the only fuel obtainable up the rivers in East Africa. The weight of this boiler at the bow is balanced by the wheel and horizontal engines aft, which are of very simple construction. On the main deck are cabins and sleeping accommodation for the chief officer, three petty officers, and eight men, who will form the European crew, in addition to which hammocks will be swung from the upper deck for the accommodation of natives. On the top of the upper deck is placed the pilot tower, from which the steersman can obtain an all-round view.

In arranging for these special service craft the question arose as to the most suitable class to adopt. The difficulties which presented themselves were considerable because it was not possible to ship entire gunboats of sufficient size to be of any practical utility; and it was also out of the question to navigate to East Africa vessels of a description suitable for river navigation, which must necessarily be very lightly constructed and flat-bottomed, and, consequently, too weak to withstand the strains which would come upon them during a sea voyage. It was, therefore, decided to build the boats in sections, and send them out in that form. The usual plan of constructing river boats is to erect them at the builders' yard in the first instance, then take them to pieces for shipment, and ultimately rivet them up and launch them close to the place where they will be used. This plan, however, was deemed undesirable in the present instance, because the river banks are Portuguese territory, and consequently, under existing political conditions, would not be available. Messrs. Yarrow & Co., therefore, proposed to the Admiralty the adoption of the present plan, which they have successfully carried out on one or two previous occasions, viz., to build the hull in floatable sections, each section being really a pontoon or tank, and of such a size as to render it easy of shipment in a ship's hold. On arriving at the destination each section will be lowered into the water, and then connected together by means of suitable straps and bolts, thus making the hull complete, after which the machinery and woodwork will be put on board. It will be readily understood that as each section contains a number of bolt-holes, some provision is necessary to insure floatability when the section is lowered into the water to be connected to the adjoining ones. The provision made by Messrs. Yarrow to meet this difficulty is both simple and effective. The mode of construction not only enables the vessels to be put together quite independent of the river banks on either side, but lends itself to being very speedily carried out. So rapidly can this be done, that Messrs. Yarrow & Co. have undertaken to have the vessels under steam within twenty-four working hours from the time when the sections are lowered into the river. It was felt to be important that the type of craft adopted should be of such a character that all the working parts should be repairable from above the water. In a stern-wheel boat the chief part liable to damage is the wheel, which can be easily got at for repair, in case of accident, while afloat. In comparing this class with a side-wheel boat, the stern-wheeler offers several other advantages. In the first place, the wheel, being at the stern, is well-protected from floating obstructions by the hull, and, in the next place, from a structural point of view, it is possible to build a much lighter craft, and, consequently, of less draught of water, than if the machinery were all placed amidships, as the system of trussing which may be adopted virtually increases the structural depth of the boat. Again, the extreme width of the boat is simply equal to the beam of the hull, while in a side-wheeler the width of the channel necessary for it to pass is equal to the beam of the hull plus the width over both wheels. Each of these boats will carry four 3lb. Hotchkiss quick-firing guns on the main deck, and on the upper deck will be placed a number of ·45in. five-barrelled Nordenfelt machine guns. The engines are not protected, but are scarcely likely to suffer injury in the intended service, as they are of the simple horizontal non-condensing description, with cylinders 10½in. diameter and a stroke of 2ft. 6in. The maximum boiler pressure will be 140lb. per square inch. Messrs. Yarrow built three similar gunboats for the Portuguese Government before the difficulty with Portugal arising out of the over-zealous action of Major Pinto, and they have six more under construction for the same Government. We hope to give an illustration of the "Mosquito" in an early issue.

On Saturday last an opportunity was afforded us for witnessing a trial trip of the "Mosquito" on the Thames, and, having regard to the remarkably quick time in which the vessel was built, the trip was highly successful, and the work reflects great credit on Messrs. Yarrow's enterprise and skill.

BENT'S TOOL HOLDER.

THIS tool holder is intended for use in boring and cutting internal threads. The cutters or tools can be made of ordinary round rod steel, and it is not requisite



to employ a skilled smith in forging them. This holder, which we illustrate herewith, has been designed by Mr. B. H. Bent, Demonstrator of Applied Mechanics at the University of Cambridge, and it is made by the Britannia Company, Colchester.

BUTLER'S DOMESTIC PETROLEUM ENGINE.

THERE should be a great field for a small and simple motor which could be used for household purposes, and many attempts have been made from time to time to produce such a motor. One of the latest machines of this kind is the motor invented by Mr. Edward Butler, of Greenwich, and we have seen one of this pattern at work at Messrs. F. B. Shuttleworth's, at Erith. From the illustration which we give herewith, it will be seen that the motor is very compact and is entirely self-contained. It stands on a base 12in. long by 7in. broad, and measures 16in. to the top of the fly-wheel; these dimensions are smaller than those of any other gas engine in the market. It runs at 1,200 revolutions per minute without load, and at from 250 to 800 revolutions when doing work. The power developed is one-fifth of a horse-power. The explosive mixture is formed of the vapour of benzolene, together with a certain proportion of air. The cylinder is vertical and single acting, and is 2in. diameter by 3½in. stroke. The piston is of the trunk type, with one end of the connecting rod attached to it. The upper end of the connecting rod works a vibrating lever, which transmits motion by a second connecting rod to the crank shaft. The fly-wheel is at the back end of the crank shaft, and the driving wheel is at the front end. The fixed centres of the vibrating lever are on the same casting as the bed-plate. The lower part of the bed-plate forms a small reservoir for the benzolene, and this small receptacle is connected with the main reservoir, which is placed in any convenient position, by a pipe about ⅛in. in diameter. In the present case about a quart is the capacity of the larger reservoir. From the small reservoir the benzolene is drawn up by a pipe about $\frac{1}{16}$in. diameter, and the air, which is passed through a small inspirator, mixes with it and converts it into an explosive mixture. The explosions take place at the bottom of the cylinder once in every two revolutions. The supply of vapour is controlled by a rotating plug

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valve with suitable inlets and outlets; this valve runs at one-fourth the speed of the crank shaft, to which it is geared by an Evart's chain. Igniting sparks are obtained by a current from a bichromate battery with carbon and zinc elements, and the current is transformed by an induction coil into one of higher pressure. Contact is made twice in every revolution of the valve, and as the valve only rotates at one-fourth of the speed of the crank shaft, this is equivalent to one explosion in every two strokes of the piston. A small water tank placed at a higher level provides the means for keeping the cylinder cool by circulating water around it. A tiny throttle valve regulates the speed of the motor. An opening of $\frac{1}{400}$in. in the valve is quite sufficient for the working of the motor, one-eighth of a turn on a screw with fifty threads to the inch giving this opening. It is stated that the amount of benzolene used is from one-quarter to three-quarters of a pint per hour, so that the cost would not exceed, in any case, a penny per hour.

We are informed that one of these motors has been working for the last ten months at intervals with perfect success. The motor can be fixed on a kitchen table, shop counter, bench, or floor, and the small water tank on a shelf or bracket, whilst the battery, as in the case of house bells, may be conveniently placed in a cupboard or cellar. The motor is started by giving it a few turns by hand, after which it runs without further trouble. The same principle has been applied by Mr. Butler to a three-cylinder compound engine for driving a launch 40ft. long with 6ft. beam, about which we may have more to say on another occasion. The motor appeared to us to do its work very well and without vibration. A syndicate has been formed for introducing these small motors into the market, and is known as the Butler's Petrol-Cycle Syndicate, at 10, Throgmorton Avenue, London, E.C.

SHIPBUILDING NOTES.

On the 22nd ult. Messrs. R. & H. Green launched at Blackwall the first of two composite lightships, which they are constructing for the Hon. Corporation of Trinity House. These vessels are built from designs prepared by Mr. F. C. Goodall, surveyor of shipping to the Trinity House, and their construction presents some novel features. Each is on the composite principle, and is metal-fastened throughout. All the ironwork is coated with soapstone paint, a composition which is now largely employed in iron and steel ships for preventing oxidation, and the bottom has been covered with bitumastic cement, which is lighter and more elastic than any other cement in use for marine purposes. In each lightship there is a large windlass of great power, driven by compressed air, which is supplied and stored by a caloric engine placed in the hold. The first of the two is intended for service at North Haisboro'.

On the 3rd inst. Messrs. Edward Withy & Co. launched from their yard at Hartlepool a large steel screw steamer, called the "Norna," built to the order of Messrs. Herskind & Woods, of West Hartlepool. She is an excellent type of a modern cargo boat, measuring over 300ft. in length, and built throughout of Siemens-Martin steel. The vessel has a long raised quarter-deck, short poop, long bridge-house, and topgallant forecastle. The holds are fitted with iron grain divisions, and all decks, deck erections, skylights, bulwarks, bulkheads, &c., are constructed of steel and iron. In the main and after holds the vessel is built on the web-frame system. The cellular bottom is fitted all fore and aft for water ballast. She will be fitted with triple-expansion engines by Messrs. W. Gray & Co., Limited, Central Marine Engine Works, West Hartlepool.

On the 5th inst. there was launched from Messrs. Craig, Taylor, & Co.'s Thornaby Shipbuilding Yard, Stockton-on-Tees, an awning-decked vessel, built to the order of Messrs. Pile & Co., London, for the Japan Mail Steamship Company. The vessel is of the following dimensions:—Length, 177ft.; breadth, 26ft. 6in.; and depth, 20ft. 6in. Triple-expansion engines are being supplied by Messrs. Hanna, Donald, & Wilson, of Paisley. The cylinders are 13in., 21in., and 34in. in diameter, by 24in. stroke.

On the 5th inst. the steamship "Reaumur" was launched from the yard of Messrs. W. Doxford & Sons, at Pallion. She has been built to the order of Messrs. A. D'Orbigny & Faustin Fils, of La Rochelle, France. Her principal dimensions are:—Length between perpendiculars, 250ft.; breadth, extreme, 35ft.; depth, moulded, 18ft. 6in. The engines are of the triple-expansion type, and have been built by Messrs. Doxfords. The cylinders are 21in., 33in., and 54in. diameter, by 36in. stroke.

On the 6th inst. Messrs. Laird Brothers launched from their yard at Birkenhead the second of the two torpedo gunboats they are building for the Government of the Argentine Confederation. The "Rosales" is a duplicate of the "Espora," launched by Messrs. Laird on the 22nd ult. Her tonnage is 615 tons, and her machinery is intended to develop 3,250 i.h.p.

On the 6th inst. Messrs. Fleming & Ferguson, shipbuilders and engineers, Paisley, launched a paddle tug steamer, "Mana," built to the order of Timaru Harbour Board, New Zealand. The "Mana" is to be fitted by the builders with two sets of independent compound surface condensing engines to indicate 600 horse-power.

On the 7th inst. Messrs. Richard & Henry Green launched from their shipbuilding yard at Blackwall the first of two paddle passenger steamers which they are building for the Bosphorus Steam Navigation Company. The dimensions are:—Length, 165ft.; breadth, 21ft.; and depth, 10ft. She is built entirely of steel, and will be fitted with compound oscillating paddle engines by Messrs. John Penn & Sons, Ld., Greenwich.

Notices of Meetings.

NEXT WEEK.

The Institution of Civil Engineers. — Tuesday, May 20th, at 8 p.m. Paper to be read: "The Keswick Water-Power Electric Light Station," by Messrs. Fawcus and Cowan.

The Society of Arts.—Wednesday, May 21st, at 8 p.m. Paper to be read: "The Mannesmann Process for Making Seamless Tubes," by Mr. J. G. Gordon.

The Royal Statistical Society.— Tuesday, May 20th, at 7.45 p.m. Paper to be read: "The Position and Prospects of Industrial Conciliation," by Mr. L. L Price, M.A.

The Royal Meteorological Society.—Wednesday, May 21st, at 7 p.m. Papers to be read: "Rainfall of the Globe—Comparative, Chronological," by Mr. W. B. Tripp; "Mutual Influence of Two Pressure Plates upon each other, and Comparison of the Pressures upon Small and Large Plates," by Mr. W. H. Dines; "On the Variations of Pressure caused by the Wind Blowing across the Mouth of a Tube," by Mr. W. H. Dines.

PRICES CURRENT, 14th May, 1890.

Quotations at per ton, unless otherwise specified.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	6 5 0	.....	6 15 0	f.o.t. wks.
„ Angles	6 2 6	.....	6 12 6	„
„ Plates	6 5 0	.....	6 15 0	„
Staffordshire Bars (cheaper makes)	7 15 0	.....	8 5 0	London.
„ Angles	7 15 0	.....	8 5 0	„
Crown Sheets	7 5 0	.....	7 15 0	„
„ Hoops	7 0 0	.....	7 10 0	„
"Siemens-Martin" Steel Boiler Plates			8 15 0	„
„ Ship and Girder			7 15 0	„

Market quiet, but works not disposed to make further reductions.

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	71/6	..... 61/6

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

METALS.

Spelter: Ordinary	£24	0	0	to	£24	5	0	
Copper: British Cakes and Ingots	57	0	0	„	58	0	0	
„ Chili Bars, G.O.B.'s	52	10	0	„	52	15	0	
„ Other sorts, G.M.B.'s (equal to Chili Bars)	52	10	0	„	52	15	0	
„ Manufactured (strong)	66	0	0	„	.....			
Lead: Common Pig	13	12	6	„	13	15	0	
„ English Sheet	14	7	6	„	14	10	0	
Tin: Straits	93	5	0	„	93	10	0	
„ Australian	93	10	0	„	94	0	0	
„ English Ingots	98	5	0	„	.....			

Messrs. Carrick & Brockbank, Manchester, report as follows:—

Copper: A strong market has ruled in copper during the week, and prices have advanced considerably. The old French stocks are still held off the market for higher rates, and this has no doubt been the principal factor in the rise. For some time there has been a scarcity of G.M.B.'s offering for early delivery, and this, aided by a reported improved demand for consumption, has induced speculative inquiry and forced up prices. Throughout the week there has been a very active demand for raw, and a large business has been carried through. Manufactured is now quoted £66 sheets, £69 bottoms.

Tin: A decided advance has taken place in the price of tin during the present week, but an easier feeling is again observable, with a tendency to lower values.

Lead has been dull and inactive, and prices are slightly lower on the week.

Spelter has advanced considerably, the stocks being very small and the output of the spelter works being sold for some months ahead. The galvanising trade continues very slack, but there has been a large demand from India for yellow metal, which absorbs a good deal of spelter. It seems likely that spelter will be dear for some time to come, as the production is regulated by a strong syndicate.

PIG IRON.

Middlesbro' Warrants, No. 8.	41/8	Cash
Scotch Warrants, m/n	44/6	„
Hematite Warrants, m/n	54/-	„

Stocks in Stores	Scotch		
	Middlesbro'	127,330—Dec. for wk. endg. 10th,	2,202 Tns.
	Hematite ...	327,840—Dec. „ „	6,173 „

	No. 1.	No. 3.	
Coltness	67/-	60/-	f.o.b. Glasgow.
Gartsherrie	63/-	58/-	„ „
Langloan	56/-	55/-	„ „
Summerlee	47/6	47/-	„ „
Glengarnock	66/-	57/6	„ „

CHEMICALS.

		£ s. d.		£ s. d.
Acid: Carbolic Crystals	lb.	0 0 9	to	0 0 10½
„ „ Liquid	gal.	0 1 2	—	.....
„ Citric	lb.	0 1 7	—	.....
„ Oxalic	„	0 0 4	—	.....
„ Sulphuric	ton	1 12 0	—	.....
„ Tartaric	lb.	0 1 4	—	.....
Alum: Lump (powder 10/- ex.)	ton	4 17 6	—	.....
Ammonia: Carbonate	lb.	0 0 3½	—	.....
„ Muriate (Grey)	ton	22 15 0	—	.....
„ „ (White)	„	26 10 0	—	.....
„ Sulphate	„	11 5 0	—	11 7 6
„ Liquor	lb.	0 0 3¾	—	.....
Antimony	ton	.....	—	.....
Bleaching Powder	„	5 0 0	—	5 2 6
Bisulphide of Carbon	„	18 10 0	—	.....
Borax	„	30 0 0	—	.....
Benzole (90 %)	gal.	0 3 10	—	.....
„ (50/90 %)	„	0 2 10	—	.....
Copper Sulphate	ton	24 10 0	—	25 0 0
Copperas	„	2 0 0	—	.....
Kieserit	„	.....	—	.....
Lead: Nitrate	„	22 10 0	—	.....
„ White Sugar	„	24 0 0	—	.....
„ Brown „	„	19 0 0	—	.....
Potash: Bichromate	lb.	0 0 4	—	.....
„ Caustic	ton	22 0 0	—	.....
„ Carbonate	„	19 10 0	—	.....
„ Chlorate	lb.	0 0 5	—	.....
„ Prussiate (Yellow)	„	0 0 9½	—	.....
„ Sulphate (Basis 90 %)	ton	9 10 0	—	.....
Precipitate: Red	lb.	0 3 1	—	.....
„ White	„	0 3 2	—	.....
Salts: Epsom Bags	ton	3 0 0	—	.....
Salts: Epsom Casks	„	3 15 0	—	.....
„ Glauber	„	1 10 0	—	.....
Sulphur: Sublimed Flowers	„	9 0 0	—	.....
„ Recovered	„	4 10 0	—	.....
Soda: Ash	deg.	0 0 1½	—	.....
„ Caustic (White 70%)	ton	8 7 6	—	.....
„ „ „ 60%)	„	7 10 0	—	.....
„ „ (Cream 60%)	„	7 7 6	—	.....
„ Crystals	„	3 0 0	—	3 2 6
„ Bicarbonate	„	6 5 0	—	.....
„ Hyposulphite	„	6 5 0	—	.....
Solvent Naphtha	gal.	0 4 0	—	.....
Tartar, Cream of	cwt.	5 12 6	—	.....
Zinc Sulphate	ton	7 10 0	—	.....

Messrs. S. W. Royse & Co., Manchester, report as follows:—

Chemicals: There have been no changes of moment in the chemical markets during the last week. Bleaching powder has had a fair demand and is steady. Caustic soda is pressed for sale at lower figures. There is less inquiry for soda ash, and prices are rather easier. Soda crystals firm. There is a very strong demand for sulphate of copper, and only small supplies now obtainable for this month. Prices of carbolic acids are unchanged, but there is more inquiry for crystal, and some good sales of crude have recently taken place. Benzoles are firmer. Acetates of lead, lime, and soda are all steady.

OILS.

		£ s. d.
Cocoanut: Cochin	per ton	29 0 0
„ Ceylon	„	25 10 0
Cottonseed	„	22 10 0
Cod	„	21 0 0
Lard	„	36 10 0
Linseed	„	23 15 0
Palm, Lagos	„	25 10 0
Rapeseed: English	„	32 10 0
Seal: Pale	„	27 0 0
„ Brown	„	22 0 0
Sperm	„	45 0 0
Whale	„	24 0 0
Turpentine	per cwt.	1 9 3
Coal	per gal.	
Petroleum (Refined)	„	0 0 5½d.
„ Spirit	„	0 0 7

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HOME INDUSTRIES.

LONDON, 15TH MAY, 1890.

THE MONEY MARKET.—Money has been rather easier this week owing to the freeing of resources by the maturing of Treasury Bills, only part of which were renewed. There has been a good demand in connection with the conclusion of the Stock Exchange settlement, and rates are higher. Discounts have not been quite so firm as last week, the foreign exchanges moving a little in our direction. Something of a lull has occurred in the activity of the stock markets, and a more irregular tendency has shown itself. Home railways have kept pretty good. Brighton Deferred is still weak, but South-Eastern and Chatham stocks have improved. The heavy railway securities have been firm. Caledonians have fallen, and North British risen, on the rejection of the former's and the acceptance of the latter's Bill for amalgamation with the Glasgow and South Western Railway. American railway stocks are still supported, but not quite so energetically as they were for a time. Canadian railways are in favour. The foreign market is strong in tone. Egyptian and Turkish securities have been favoured, and most "international" stocks have advanced a little. South American stocks have had fewer friends. Among mines, copper shares have been actively dealt in at rapidly improving quotations on the rise in the price of the metal. Gold shares have attracted little notice. Nitrate securities have fluctuated considerably. Among industrial companies the market has paid attention to little else but the shares of the two American meat importing companies, Eastman's and Hammond's, which have risen considerably.

COMPANIES.—The following companies have been registered since our last report:—Wilkes, Ld., with a capital of £20,000, to carry on the business of engineers; Collins Automatic Coupling and Continuous Brake Syndicate, Ld., with a capital of £2,000; Gamgee Steam Generators, Ld., with a capital of £100,000; Torbay Brewery and Cider Co., Ld., with a capital of £70,000; Rust's Mosaic, Ld., with a capital of £10,120, to acquire a patent and business for the manufacture of vitreous mosaic; The Kimberley Diamond Mining Co., Ld., with a capital of £100,000; The Lake Superior Queen Silver, Ld., with a capital of £175,000, to acquire certain mining property on the north shore of Lake Superior; D. Davis & Sons, Ld., with a capital of £450,000, to acquire and work certain collieries in South Wales; The Colombian Quartz Mining Co., Ld., with a capital of £200,000; The Thornebury Miners' Safety Lamp Co., Ld., with a capital of £50,000, to acquire certain patents, &c.; The Guanta Railways, Harbour, and Coal Trust Co., Ld., with a capital of £250,000, to acquire the right of constructing certain harbours, &c., and to work certain mines, &c.; Ketley Brick Co., Ld, with a capital of £10,000.

THE BOARD OF TRADE RETURNS.—The exports for April show an increase, and the imports a decrease. The total value of the former was £20,344,367, as compared with £19,634,715 in April, 1889, being an increase of £709,652. Yarns and textile fabrics were £8,270,501, as against £8,547,754, a decrease of £277,253; metals and articles manufactured therefrom, except machinery, £3,785,367, as against £3,272,716, an increase of £512,651; machinery and millwork, £1,269,541, as against £1,201,648, an increase of £67,893; and chemicals, £750,574, as against £632,737, an increase of £117,837. The imports amounted to £35,680,242, as compared with £37,255,785 in April, 1889, being a decrease of £1,575,543. Metals were £1,856,217, as against £1,871,161, a decrease of £14,944; chemicals, dyestuffs, and tanning substances, £786,767, as against £879,505, a decrease of £92,738; oils, £435,581, as against £452,004, a decrease of £16,423; and raw materials for textile manufactures, £9,507,074, as against £9,384,656, an increase of £122,418. For the four months ending 30th April, the exports in 1890 amounted to £83,082,369, as compared with £80,291,594 in 1889, an increase of £2,790,775. In the same period the imports amounted to £140,839,258, as compared with £143,881,786, a decrease of £3,042,528.

CONTINENTAL TRAIN SERVICES.—Some improvements in these services are announced by the London, Chatham, and Dover Railway Company as coming into force on and from the 1st prox. The St. Gothard and Italian Adriatic Railway Companies deserve the credit for these changes. A new express train, first and second class, will leave Milan at 6 p.m., after the arrival of the 11 a.m. from Victoria of the previous day, and will reach Bologna at 9.41 p.m., Florence shortly after midnight, and Rome at 7.35 a.m. This is an improvement of six hours to Rome. On the return journey the fastest express will leave Rome at 8.25 a.m. and Florence 2.37 p.m., arriving at Milan in time to join a new sleeping-car express at 10.20 p.m. for Bâle. Bâle is reached at 8 a.m., and the train starts at 9 a.m. for Rheims, due 7 p.m., Calais due 1.20 night, and Victoria 5.55 a.m. This is an acceleration from Rome to London of ten hours. The sleeping cars from Milan to Bâle will shortly be of a new type, built, worked, and owned by the St. Gothard Company, who have sent men over to England to study the most improved form of east and west coast cars. As a new fast service will leave Rheims at 9 a.m. for Victoria (due 7.25 p.m.), passengers who dislike crossing the Channel at night can conveniently stop at Rheims. The best express from Brindisi to London is also quickened by two hours, but it leaves at the early hour of 5.58 a.m. instead of 5 p.m. The connection from Venice will leave at 4 p.m., reaching Milan 9.30 p.m., improving the service to London by seven hours. It is in contemplation to run a train from Calais to Bâle, leaving Victoria 3.15 p.m., due at Bâle 8 a.m., Lucerne 10.30 a.m., Milan 7.30 p.m. The return is to be from Bâle at 7 a.m., reaching Victoria 11.15 p.m., travelling from Switzerland to London within the day.

THE RATING OF MACHINERY.—In the Rating of Machinery Bill, of the present session, it is proposed to exclude waterworks and gasworks. It would appear that central stations for the supply of electricity to the public are entitled to be placed upon the same footing as gasworks, and an endeavour is being made to introduce an amendment to this effect.

THE JUNIOR ENGINEERING SOCIETY.—At a meeting of this Society, held on the 9th inst., a paper was read by Mr. W. J. Tennant, Chairman, on the "Slide Valve and Radial Valve Gears." The author introduced the subject by a consideration of the elementary principles underlying the action of the slide valve, and then proceeded to a deduction of the proportions and setting of slide valves and eccentrics. The effect upon steam distribution of external and internal laps and leads, and of variations in the setting of the eccentric and proportioning of the ports, was illustrated by a special model, the invention of the author. The Trick, Thom, Brock-differential, double-ported marine, and other types of flat and piston valves were next referred to; and general considerations having reference to reversing and expansion valve gears were followed by an explanation of a graphical method of determining the speed of a valve or piston at every position in its travel. A demonstration, with the aid of models, diagrams, and lantern slides, of the principle and mode of operation of the Hackworth, Marshall, Joy, and Morton radial valve gears, brought the paper to a close.

THE INSTITUTION OF MECHANICAL ENGINEERS.—The summer meeting of this Institution will be held at Sheffield on the 29th, 30th, and 31st of July and the 1st of August next. The Mayor of the town and the Master Cutler are at the head of the reception committee, and the honorary local secretaries are Professor W. Ripper and Mr. R. H. Radford. In addition to the reading of papers there will be a number of excursions to places of interest, technical and otherwise.

THE ROYAL AGRICULTURAL SOCIETY.—The annual exhibition of the Royal Agricultural Society will be held at Plymouth on the 23rd, 24th, 25th, 26th, and 27th of June.

ADELAIDE ROYAL AGRICULTURAL SOCIETY.—Messrs. Ransomes, Sims, & Jefferies, Ld., of the Orwell Works, Ipswich, have been awarded the first prize for their portable steam engines, exhibited at this year's show of the above Society. The report mentions, in addition, that the engine to which the award was made was very much admired for its construction and smoothness of working.

CASTOR OIL.—Messrs. Petty & Co., Silvertown, have recently commenced to work a new process, by means of which castor oil is made palatable. We have tried a sample of it, and find it not at all unpleasant to take.

BUSINESS ANNOUNCEMENT.—Mr. J. D. F. Andrews has taken into partnership Mr. H. Gray, late assistant civil engineer to Messrs. W. H. Barlow & Son, Westminster. The business hitherto carried on by Mr. Andrews as electrical engineer, manufacturer, and contractor will be continued under the style of J. D. F. Andrews & Co., at the same address, 41 and 42, Parliament Street, Westminster.

MANCHESTER, 15TH MAY, 1890.

THE IRON TRADE.—The market for iron shows no signs of improvement. Buyers are not numerous, although plenty of iron is being used. Contracts have not run out yet, but new specifications are not easily obtained. The continued low price of warrants prevents much business being done. Bar iron makers are beginning to be without orders in some cases, and prices are being cut. There are not, however, any large parcels offering, and merchants are able to meet the requirements of the market.

LINEN AND JUTE TRADES.—During the week under notice a fair amount of business has been passing in the fancy departments, and heavy goods have also moved off freely. The principal topic of discussion in that section of our shipping trade more directly concerned with the New World is still the McKinley Tariff Bill, which will, if passed, considerably alter the course of trade from this country to the States. As far as the main clauses of the measure are concerned, it is generally considered that the duties proposed by the framers of the measure are ridiculous, seeing that most of the articles taxed are not produced in the States owing to climatic and other difficulties. In the home trade there is a fair amount of business passing, and sales, considering the season, have been of fair volume. Jute goods are inflated in price owing to the upward movement in raw material. The jute market is always a difficult one to follow owing to the erratic movements of the fibre. Linen threads are in active request at unchanged prices. Manufacturers are well engaged for a long time ahead.

RING BOBBINS.—Messrs. Wilson Bros., Limited, have introduced a method of enamelling ring bobbins, by which they are rendered impervious to damp or oil. It is often necessary to store away bobbins when full of yarn in a damp cellar in order to "condition" the yarn, and sometimes they are steamed. This warps the bobbins as usually made, and renders them untrue. Messrs. Wilson Bros. have taken up an American invention by which an enamel is put on the bobbin. We have made a number of experiments with sample bobbins coated in this way, and find that they resist the action of warm water and oil perfectly. One important feature in the enamel is that it does not become sticky, and the yarn can therefore be easily unwound. Old bobbins, if they are undamaged, can be coated with the enamel, and are then practically as good as new ones.

INLAND NAVIGATION.—An international conference on this subject is to be held in Manchester on the 28th of July. At the meetings papers will be read on various topics connected with canals, and there will be two sections, one of which will deal with the engineering side, and the other with the economic side of the problems involved. An executive committee has been formed, with Sir Joseph Lee as chairman, and Mr. A. A. Gillies, of 46, Brown Street, Manchester, as secretary. A large number of representatives from all over the world are expected to be present at the meeting.

WEAVING PRICES.—One of the chief difficulties existing in Lancashire is caused by the various wages lists existing in different districts. Each district has a distinct list of prices by which wages are regulated, and there is a good deal of confusion in consequence. A determined effort is being made to establish a uniform standard, and the negotiations have now made considerable progress, and a basis for agreement has been established. It is hoped that the adoption of a list of this character will prevent the occurrence of local strikes throughout Lancashire.

GLASGOW, 15TH MAY, 1890.

PIG IRON.—Since our last report the Scotch pig iron market has remained pretty steady, although Cleveland warrants have experienced rather a severe fall. Large transactions have taken place daily within a few pence of 44s. 6d. cash. Warrants seem to be well held, and are, in fact, scarce. It is difficult to reconcile the frequent statements about a falling off in the demand with the good shipments and with the constant large deliveries from the store.

GLASGOW CENTRAL UNDERGROUND RAILWAY.—It is reported, though not yet authoritatively, that the contracts for the central railway to be constructed by the Caledonian Railway will be let as follows:—The eastern portion to Messrs. Charles Brand & Son, the central portion to Messrs. James Young & Son, and the western portion to Mr. A. H. Boyle. The work of constructing the intercepting sewer is proceeding rapidly. This sewer ultimately will form part of the future system of sewage which some day or other the city must adopt. It has been designed with this in view.

EDINBURGH RAILWAY STATIONS.—A proposal has been mooted, which seems to have received some support, to enable the Caledonian Railway Company to acquire the Waverley Market, a huge enclosure below the level of Prince's Street, and situated between that street and the Waverley Station. The project includes the formation of a central station, into which both Caledonian and North British trains should run. The advantage to the travelling public of such a station in the centre of Edinburgh would be very considerable. The Waverley Market belongs to the city, and has for many years been used for great public functions. Normally it is not nearly utilised to the full extent of its space.—The Caledonian Underground Railway Bill has not yet been reached in the press of Scotch business now before the Parliamentary Committees. It will not now come before Sir John Dorington's Committee until after the Whitsuntide recess.

GOLD SHARES.—The shares of the Cassel Company have again been the subject of excited speculation. About three years ago they were to be had for nothing, or even with a gratuity of 6d. per share, subject to contingent liability for calls. When, however, the existing management got fairly to work, the shares gradually advanced. For some time they ranged from 30s. to 35s., but in the beginning of this week they took a sudden jump to 57s. 6d. Subsequently they fell off a little, but the excitement still continues in a more moderate degree. The company has not yet paid a dividend, but great hopes are entertained of the Macarthur-Forrest process of gold extraction which the company now work, the original Cassel process having been long ago abandoned. The cause of the advance in the price of the shares is the receipt of information from the representative of the company, who is now in Colorado, that a company had been formed there for working the process in the United States, and that the sum of $2,000,000 in shares had been allotted to the parent company as the price of the concession. Mr. Macarthur, the technical manager of the company, is in South Africa, and should similarly satisfactory information be received from him the shares may be expected to take another leap upwards.

THE SCOTTISH RAILWAY AMALGAMATION.—After an inquiry of great length, the Select Committee of the House of Commons, presided over by Sir John Dorington, have decided to throw out the Bill promoted by the Caledonian Railway Company for powers to take over the Glasgow and South-Western Railway, with the option to the North British Railway Company to become joint owners. The Committee, however, passed the preamble of the North British Railway Bill giving them powers to acquire, upon agreed terms, the undertaking of the Glasgow and South-Western Railway. In giving their decision the Committee enumerated numerous conditions upon which they passed the preamble, the main objects of which are to grant running powers to the Caledonian and North-Western

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Railway Companies, and for protecting the interests of traders. The Committee decided to adjourn until Tuesday next in order to allow time for the North British Railway to consider the conditions and to draft clauses.

(From our own Correspondents.)

LIVERPOOL, 14th May, 1890.

Conference of Average Adjusters.—At the conference of average adjusters, held in Liverpool last Friday, some important resolutions were passed which will affect future claims, amongst them being the following:—"That on all claims on ships' machinery for repairs no claims for a new propeller or new shaft shall be admitted into an adjustment unless one adjuster shall obtain and insert in his statement evidence showing what has become of the old propeller or shaft;" "That the managing committee consider the question of the revision of the York-Antwerp rules, in order that they may be adapted to the requirements of modern practice, as affecting bills of lading and charter parties;" "That the damage caused to machinery and boilers of stranded vessels in endeavouring to refloat be allowed in general average when shown to have arisen from actual intention to refloat the ship at the risk of such damage."

The Mersey Bar and Dock Accommodation.—Since the notable letter of Mr. Ismay to the Mersey Docks and Harbour Board, mentioned last week, Mr. Edmund Taylor has sent an equally strong letter endorsing the opinions raised by Mr. Ismay, and dwelling upon the necessity of providing a landing place capable of allowing the large steamers to go alongside at any state of the tide without entering the docks. In view of the deepening of the channel over the bar, which is shortly to be attempted, this landing place would confer enormous advantages on the American passengers, by doing away with the tedious and uncomfortable transfer from the steamer to the tender, and thence to the stage, to which they are now submitted.

SHEFFIELD, 14th May, 1890.

Iron and Steel.—Recent reductions in the prices of manufactured goods are leading to inquiries from consumers; evidently orders are waiting to be placed directly the prices come down. The Parkgate Iron and Steel Company, Ld., have now practically completed their extensive additions to plant. Local makers of rolling stock are complaining of the difficulty in obtaining sections of iron or mild steel suitable for the under frames of carriage or waggon stock. Railway material of all kinds is rather easier in value than for some time past. Locomotive tyres are quoted from £12 to £15, carriage and wagon tyres £10 to £12, and mild axles £11. Springs are quoted according to the amount of work in them, from £10 to £13. The Kilham Rolling Mills Company, Ld., who do general rolling of all kinds for the Sheffield trades, have issued their report for the past year, and announced a dividend of 5 per cent. against 2½ last year.

LEICESTER, 14th May, 1890.

Wool Spinning and Yarn Trades.—The condition of the wool market is on the whole unsatisfactory, though there is not much alteration since last report. Quotations are fairly firm, but generally there is a marked uneasiness in the market, and in some quarters there is a disposition towards a weakening. In this condition the consumers operate very cautiously. But even in these not very favourable conditions, the turnover in the aggregate is large, and, moreover, it is not speculative. New business in spinning is slow, as the users want lower prices and spinners try for an advance. Yarn merchants are moderately busy. Cashmeres are slightly weaker in price.

Boot and Shoe Trade.—Business continues remarkably active, and the difficulty experienced by manufacturers is to obtain sufficient labour. Overtime is being worked, and up till Whitsuntide there will be a very busy time. Leather merchants are doing a good, steady trade; the aggregate output is very large, and the sales effected are mostly for immediate use. Prices are steady, with no indications of any alteration.

SWANSEA, 14th May, 1890.

Tinplates.—The ready manner in which fifty-seven works—seven more than on the last occasion—have consented to stand idle for a second period of a week is a very convincing proof of the further difficulties that have recently beset the tinplate trade. The increased business that it was anticipated would follow the reduction in the price of bars has not been realised. Merchants appear willing to place orders at about 9d. per box below prevailing quotations, but makers insist that these are even yet too low, making new business a matter of impossibility. Although the nominal price of Bessemer tinplate bars is £5 10s. per ton,' some contracts have been entered into with north-country houses, whose agents have been diligently working this district, at £5 5s. per ton, with a liberal discount.

Wages of Riveters.—It was given in evidence during a recent trial under the Employers' Liability Act that a riveter employed by the Bute Shipbuilding Company has drawn an average of £3 15s. per week during the last three years, the amount never being less than £3. Day wages of riveters are 39s. per week.

Professor of Engineering.—The Council of the South Wales University College have resolved to advertise for a professor of mechanical engineering in the new engineering department, the stipend to be £300 per annum.

The Rhondda and Swansea Bay Railway.—The delay in opening the tunnel, due to the refusal of the Board of Trade Inspector to pass it as fit for passenger traffic, is a matter of less consequence than was at first supposed. The restraint does not extend to goods traffic, and the lining of the tunnel, which has been insisted on, will be the work of only a few weeks. Meanwhile, that part of the railway recently constructed between Cymmer and Blaengurynfy can be operated for passenger traffic. Three new levels are being opened at the London and South Wales Colliery at Blaenrhondda, which will give work to nearly a hundred additional hands.

CARDIFF, 14th May, 1890.

Iron and Steel.—There is a rather better tone noticeable in the pig iron market, and makers seem less inclined to stock. Prices are firmer all round, and unless the quotations are maintained several furnaces will be blown out. The Cwmavon Works, which were purchased by Messrs. Wright, Butler, & Co., Ld., last year, are about to be stopped, all the men having received notice. On the other hand, the Briton Ferry Ironworks will be set going next month. Steel tinplate bars are quoted nominally at £5 10s., but all depends upon the position of the makers as to whether they will accept this figure.

Coal and Coke.—The advance in wages, amounting to 13¾ per cent., accorded by the Sliding Scale Committee, came somewhat as a surprise to commercial circles generally. But, on consideration, the circumstance is not one that should cause much surprise, seeing that the contracts made at high figures are only now running out. For present business, however, the market looks very flat, and coal is realising far less than its value a few weeks ago. First quality steam sells at 14s. 6d. to 15s. 6d.; second, 13s. 9d. to 14s. 3d.; third, 12s. 6d. to 13s. 3d. Small steam coal is firm, notwithstanding the fact that makers of patent fuel are compelled to stop their works on account of unremunerative prices. Coke is fairly steady at 19s. to 20s. at ovens for furnace coke and 22s. to 24s. for foundry.

BARROW-IN-FURNESS, 14th May, 1890.

Hematite Iron.—The market is again quieter, and the general disposition of trade is anything but buoyant. Orders are small in number, and as they have for some time been chiefly confined to transactions in hematite warrants, some makers have at length come down in their prices. This they have been enabled to do by cheaper labour, cheaper iron ore, and cheaper coke; 7½ to 10 per cent. has been taken off the cost of labour, iron ore of ordinary quality has been reduced to from 10s. to 12s. per ton, and coke delivered from the East Coast has been reduced to 21s. per ton. Forty-seven furnaces are in blast, the number having been increased during the week by two furnaces, one at Carnforth and one at Cleator. The production of iron at Barrow, where there are thirteen out of fourteen furnaces in blast, is likely to be reduced next month by the blowing out of two furnaces. Stocks show a further reduction this week; 6,173 tons of hematite warrants have been cleared during the week, making a reduction since the beginning of the year of no less than 52,802 tons, but still leaving an aggregate of 327,840 tons.

Steel.—The steel trade is weaker. There is no activity in the demand in any of the departments, and the mills are only working five days per week. Rails are in fair but not brisk request, heavy sections being quoted at £5 per ton. Plates and angles for shipbuilding purposes are in quiet request at £7 5s. and £6 15s. respectively. Tinplate bars are quiet at £5 10s. per ton.

Shipbuilding and Engineering.—Although there are no immediate prospects of new orders in the shipbuilding and engineering trades, there are undoubted indications of the continuance of the present brisk trade, and of an improvement in both the erecting and the engineering departments.

Shipping.—The shipping returns still show marked activity. The exports of pig iron and steel during the week amounted to 23,553 tons, compared with 18,021 tons in the corresponding week of last year, an increase of 5,532 tons. The aggregate shipments this year represent 399,953 tons, compared with 392,041 tons during the same period in the previous year, an increase of 7,912 tons.

MIDDLESBROUGH, 14th May, 1890.

Pig Iron.—The Cleveland pig iron market is extremely flat, and there is very little business done. Merchants are asking 43s. per ton for prompt f.o.b. iron. Makers, too, have abandoned their reserve, and are competing for orders. Middlesbrough warrants can be obtained at from 41s. 9d. to 42s. cash. West Coast hematites are from 53s. 4½d. to 53s. 5½d. cash. East Coast hematites are nominally 60s., but can be had for less. The stock in Connal's store on Monday amounted to 126,243 tons, being 3,339 tons less than a week ago.

Shipments of Pig Iron.—These shipments have decreased at a time when they should have increased. Up till Monday the shipments for the month amount only to 24,548 tons, as against 34,902 tons to a similar date last month. Last year over a similar period they amounted to 35,078 tons. Germany and Holland maintain their demand, but other foreign countries have taken little more than half their usual quantity. Scotland, of course, still declines to buy on account of the difference between Scotch and Cleveland not being great enough. Wales also seems to be obtaining her iron more from Scotland than from Cleveland.

Manufactured Iron and Steel.—There is no change in the state or prospect of the iron and steel trade. Both are dull, and likely to remain so. Prices are nominal. Iron ship plates are at £6; angles, £5 17s. 6d.; bars, £6 2s. 6d. per ton, less 2½ per cent. on trucks at works; steel ship plates, £7; ship angles, £6 17s. 6d.; rails, heavy sections, £5 per ton f.o.t. at works, less the usual discount. The Eston Steel Works have resumed work, but on short time.

NEWCASTLE, 14th May, 1890.

The Iron Trade.—The demand for the various descriptions of finished iron continues to be of an extremely limited character, consumers being apparently determined to confine themselves to barely supplying current needs. Thin sheet iron appears to be the specialty most in request, and the firms which are engaged exclusively in the manufacture of this article have still enough work to keep their machinery fully going. In the forges the pressure of work which was noticeable a few months ago no longer exists, and in a few instances the evidences of coming slackness are very apparent. Foundries, however, are still pretty busy, though in most cases the work in hand consists of orders received several months ago, and which had to wait their turn to be dealt with. Galvanisers are busy, and chain and anchor works continue to be kept in steady operation.

Shipbuilding.—There is now a second yard on the Tyne which has the whole of its building berths empty, this being the Edwards Company's Yard, Howden, from which the last vessel was launched a few days ago. Messrs. Schlesinger, Davis, & Co., the other firm who are in the unenviable position of having no vessels on the stocks, are understood to have received an order for three or four vessels of a small type, and their establishment may consequently be expected shortly to resume its customary activity. The Tyne Shipbuilding Company have three large vessels on the stocks, and the only vacant berth will shortly be occupied with the keel for another. Builders are at present free from labour troubles, but the necessity for reducing wages will possibly soon arise, and it is to be feared that the peaceable relations now existing will then be difficult to maintain.

Protective Paints for Ships.—Messrs. Holzapfel are now placing on the market a special paint for preserving iron and steel decks, called their "special black soapstone composition." It dries in an hour, and covers a very large surface. Judging by several trials it appears to be the very thing required by shipowners.

The Coal Trade.—Lower prices are now being quoted for most descriptions of coal, but the tendency to lessened value is, of course, most conspicuously shown in connection with the house coal trade. The shipments of coal and coke at Tyne Dock for the week ending May 10th amounted to 120,938 tons, being an increase, as compared with the shipments in the corresponding week last year, of 23,808 tons.

BELFAST, 14th May, 1890.

Shipbuilding and Engineering.—Work in all the shipyards here continues good. There were two launches during the last week, and the stocks are already re-occupied by vessels of large tonnage. The riveters in Messrs. Workman, Clark, and Co.'s yard, who have been out on strike for the past two weeks for a rise in the piecework prices, have returned to their work again on the old terms. Messrs. D. & W. Grant have almost completed their contract for four of the bridges for the new City of Dublin Junction Railway. Three of the bridges have been already delivered, and the fourth will soon be ready to leave the contractors' yard.

The New Straight Channel to Belfast.—This huge work is now nearly finished. The erection of the light-houses, which will be three in number, has been commenced, and it is expected that the channel will be open for traffic in a few months. There will be a depth of 17ft. of water at low tide, and, besides enabling large vessels to reach the port at all times, it will shorten the route up the Lough by about one-half.

Linen Trade.—The market still continues stagnant, and the turnover would fall decidedly short of production. Prices, however, remain steady, and a more hopeful feeling exists in some quarters. Stocks generally are not large, and were it not for the prevailing anxiety to keep selling, there is no reason why higher prices should not be obtained. Yarn purchases have been small, and confined to the supply of immediate requirements. Goods have not been much inquired for except special makes, but the existing contracts will keep the manufactures from going into stock for some time to come. The production of handloom goods still continues miserably small.

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IMPROVED DOUBLE BAND SAW MACHINE.

CONSTRUCTED BY MESSRS. JOHN WATTS & Co., MACHINISTS, BROAD WEIR ENGINE WORKS, BRISTOL.

(*For description see page* 461.)

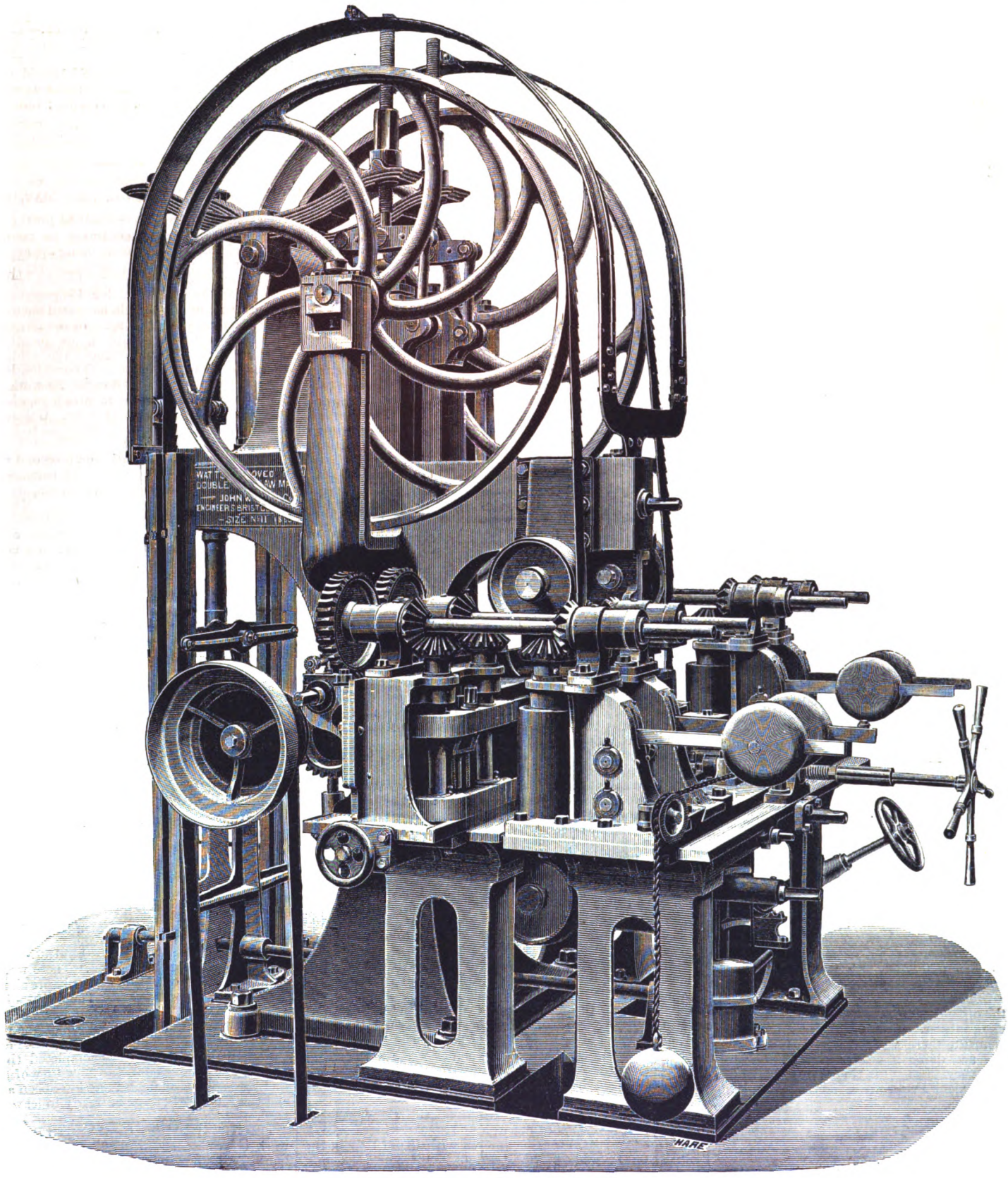


FIG. 3.—GENERAL VIEW OF MACHINE.

INSTITUTE OF MARINE ENGINEERS.

A MEETING of the Institute of Marine Engineers was held on the 29th ult., at which Mr. J. D. Churchill read a paper on the "Churchill" Marine Governor. He remarked that, as by far the larger percentage of breakdowns occurred in fine weather, or in weather which could not be described as rough, the necessity for having a governor attached to the engines, always in operation, became apparent. By having such a governor fitted risks of drainage to the rest of the machinery, in the event of a breakdown to one portion, were reduced to a minimum. Cases were cited where, on account of shafts breaking, the engines—relieved of the load of driving the propeller through the water—increased in speed, and caused serious damage. It was pointed out that generally the governor fitted to a marine engine was too small, and was placed in such a position that it was difficult to keep it fit for service.

The discussion was entered into by a large number of members. The remarks all tended to show that, as a rule, the governor and connecting gear did not receive that attention which the importance of the subject warranted. One or two of the speakers spoke very highly of the Churchill governor, which, in their experience, had been found to give excellent results in practice. It was remarked, very forcibly, that the governor was frequently badly fitted, and placed in a position dangerous of access. Thus, when the governor belt is designed to run close to the engine-room bulkhead, the engineers have to go below the platform into the bilges to place the belt on the pulley.

At the meeting of the Institute on Tuesday, the 6th inst., Mr. R. E. Crompton read a paper on "Electrical Engineering," in which he gave a full account of all the various types of dynamos, and the details of their construction. Mr. Crompton was listened to with great interest.

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As we go to press early with certain of our advertisement pages, all Alterations to Standing Advertisements should reach the Publisher not later than 2 o'clock on Wednesday afternoon in each week.

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

Contents.

	PAGE
An Improved Road Wheel (*Illus.*)	457
Three Modern Professions	457
Jardine's Housing Gear for Rolling Mills (*Illus.*)	458
The Iron and Steel Institute	458
Watts' Double Band Saw Machine (*Illus.*)	461
Foreign Industries (Corres.)	462-463
Gunboats for the Zambesi	464
Bent's Tool Holder (*Illus.*)	464
Butler's Domestic Petroleum Engine (*Illus.*)	464
Shipbuilding Notes	465
Notices of Meetings	465
Prices Current	465
Home Industries (Corres.)	466-467
Institute of Marine Engineers	468
Can an Improved Education Prevent Strikes?	469
The Railway Rates Inquiry	470
The Carlisle Railway Accident	470
Letters to the Editor:—	
The Institution of Mechanical Engineers	471
Compressed Air Tramcars	471
Suggestion for a New Scottish Main Railway System	471
Morison's Evaporator and Feed Water Heater (*Illus.*)	472
The Royal Society Conversazione	472
Reviews	472
The "Audio" Telephone Mouthpiece (*Illus.*)	473
The Lane Fox Patents	473
The Institution of Electrical Engineers (*Illus.*)	473
Notes on Alloys—V.	475
The Society of Chemical Industry	476
Notes	476
"Industries" Patent Record:—	
Applications and Acceptances	477-478
Illustrated Abridgments	478-480

To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

We cannot undertake to return manuscripts or drawings, and must request correspondents to keep copies.

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In half calf, gilt lettered, may be obtained at our London, Manchester, and Glasgow Offices, Price 20s. each.

Industries:

FRIDAY, 16TH MAY, 1890.

CAN AN IMPROVED EDUCATION PREVENT STRIKES?

A STRIKE is undoubtedly, in one form or another, a very ancient institution, the origin of which is lost in the mists of antiquity. Probably the earlier strikes were those of slaves or soldiers, and generally partook more of the character of a revolt or mutiny. The refusal of mercenaries to fight so long as their pay was in arrears might justly be considered as a military strike, and such an occurrence during the Middle Ages was by no means uncommon; but as long as the majority of labourers were in the position of serfs or slaves, industrial strikes, as we now understand them, were practically impossible. A refusal to work would have been looked upon by the masters as rebellion, and promptly treated as such, and the heads of the mediæval Burns and Tillet, in the company of those of their more prominent followers, exposed in some convenient place to the public gaze. Under these conditions, a strike, to have any chance of success, must necessarily take the form of rebellion pure and simple. The strike of which the present and preceding generations have experience is, however, essentially a modern development, and, owing to its frequent occurrence within the last twenty-five years, has come to be regarded almost as a necessary accompaniment of industrial activity. It is now, we believe, hardly disputed that the artisans of this country have, on the whole, improved their condition by combination and occasional strikes; but few, and least of all the artisans themselves, are apt to consider how much of their success, in the long run, is due only indirectly to their own action, while it has been rendered possible by the operation of agencies which, as a rule, they have done their best to thwart and oppose. Paradoxical as it may seem, the material improvement in the condition of our wage-earning classes is, to a large extent, the result of the substitution of machinery for hand labour in industrial processes, and its continual improvement. But for this it would have been impossible, without eventual loss to the community, for the employer of labour to have granted the concessions demanded of him. As it is, in spite of strikes, and the not unnatural prophecies of disasters from the perennial croakers, the prosperity of the country has advanced and the welfare of the artisan has been promoted. The introduction of improved machinery to increase the productive capacity of the nation has, in many cases, met with opposition on the part of the workmen, and is still looked upon with distrust and aversion even by the more intelligent members. Yet it is quite obvious to those who are able to look beyond their own immediate and apparent interests, that the substitution of machine for hand labour must necessarily be to the advantage of the community, and, sooner or later, of all classes of labourers. Experience has proved this to be the case. For strikes have stimulated the manufacturer to increase his output by improved machinery and processes; strikes have insured to the operative a share in the advantages of increased production which might otherwise have benefited only the employer. As in so many natural processes, we have here an example of action and reaction. Had the action of the men not resulted indirectly in improved machinery, either a further advance in wages and reduction of the hours of labour must have long since ceased, or many of our industries by this time been irretrievably ruined. It does not follow that because hitherto the policy pursued by the trades unions has on the whole been successful, that it can be continued indefinitely without evil results. With few exceptions, a strike has always aimed at two objects—first, an increase of pay; secondly, a reduction in the hours of labour. It is very evident that, with the best conceivable machinery, in those classes of manufacture where mechanical appliances can be utilised to the fullest possible extent, absolute limits must sooner or later be reached, and these limits are the sooner reached in the presence of foreign competition. Up to a certain point the men may gain at the expense of the employers, but the margin for this gain is much smaller than is generally supposed; and if no compensation took place a simultaneous rise of wages and reduction of the hours of work would very soon remove employers from the scene of action. Unless the compensating action we have referred to keeps pace with concessions to labour, employer and employed, and with them the whole nation, must alike suffer by diminished production. The British working man is often apt to forget that wages must be earned by an equivalent production on his part. He frequently seems to have an impression that there exists, somewhere or other, a vast industrial goose, which only requires sufficient squeezing in order to lay an indefinite number of golden eggs, quite irrespective of any nutriment she may receive. The fact is ignored that this prolific bird requires a proportionate amount of food, and that this food must be the workman's own effective labour.

As regards hours of labour, there is undoubtedly for every class of work a certain daily period for which in the long run the performance of the average individual is a maximum; this period, however, must vary very considerably with circumstances. Where the work done is performed chiefly by machines of a more or less automatic character the production is much less dependent on the individuality of the workmen or attendants than in those industries where the labour is largely manual. It must not be forgotten, however, that a continual strain on the attention unaccompanied by physical exertion is of itself very fatiguing, and when exerted in the moist and close atmosphere of a spinning and weaving shed is probably as exhausting as, and certainly less healthy than, many kinds of outdoor employment demanding a constant expenditure of muscular energy. Certain of the trades union leaders have expressed themselves strongly against overtime, but it is extremely doubtful whether, if a *plébiscite* were taken, they would find themselves supported in this matter by the rank and file. We think it not unlikely that, with a very large proportion of the members of trades unions, the leading attraction in an eight hours working day is the greater opportunity it affords for "making overtime." Thus the candle is burnt at both ends and expected to become no shorter. Meanwhile, foreign competition increases, while foreign wages may not rise in the same proportion as those of the British workman It is a pity that those professional leaders, who are so ready to instruct their followers as to the iniquities of the capitalist, will not or cannot declare the full truth about foreign competition, and the extent to which the inhabitants of this country depend for their existence on foreign trade. So far from doing this, the typical professional leader rather prides

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himself on indifference to imperial matters. What to him are India, British prestige, or British interests, if only he can secure the immediate object in view?

Piece-work is a fruitful subject of dispute between employers and employed, and officially the trades unions are generally very strongly opposed to it. To the uninitiated it may seem strange that a system which, on the face of it, is the fairest that could be devised, and by which, as a matter of fact, the highest wages are earned, should be regarded by artisans, as a body, with aversion. The first explanation that occurs to those who think about the matter is probably that the workman prefers taking things easy, on comparatively low pay, to obtaining good wages by high-pressure work. There is perhaps a little of this feeling at the root of the matter, but it is, we are inclined to believe, not the immediate cause of the aversion to which we have referred. Most employers, when they find that those of their men who are doing piece-work earn wages very considerably in excess of the average day wage for the same class of employment, reduce their piece-work rates, so that, as the artisan becomes more skilled and increases his production, he cannot obtain the full benefit of this increase. As a consequence, as we know from our own practical experience, artisans paid by contract purposely abstain from working to their full capacity. We have in our mind a case in which men engaged on a certain class of pattern-making always turned out on one particular day in the week at least double the quantity of work performed on any other day. As the time boards, with a record of the patterns made, were only given in once a week, this discrepancy in the daily achievements did not appear. Among the men themselves the day in question was known as the "making up day."

The state of affairs as regards piece-work in engineering workshops to which we have alluded results in a kind of hide-and-seek game between masters and men. Before fixing his piece-work rates in the first instance, the employer tries to arrive at some idea of what his men can do in a given time; he knows that the average artisan can get through without distress an amount of work considerably in excess of his daily performances on day wages; consequently, after making the necessary observations and calculations, the employer so arranges his contract prices that the artisan will have to work somewhat harder than before to earn the equivalent of his previous daily remuneration, but, on the other hand, the latter by exertion can easily make a good deal more. If, as frequently happens, this increment becomes with practice very considerable, the rate of pay is reduced, as already stated. If, while still on day wages, the workmen suspect that their output is being analysed in order to serve as a basis for contract prices, they will do their best collectively to hide their capacity for work under a bushel; lathes and other machine tools are run at somewhat lower speeds than necessary, articles require an unusual amount of "setting" in the lathes, tools get blunt very soon or break frequently and require much grinding, while the cranes and hoisting tackle are always engaged when wanted—in short, great ingenuity is displayed in wasting as much time as possible without its being too apparent. Of course experienced foremen and managers, having gone through the same mill, know these little manœuvres, and discount them as far as possible. We are inclined to the opinion, however, that the whole matter stands on an unsound and, we may even say, immoral basis. On both sides there is what amounts almost to sharp practice, and the only true remedy is greater candour and hearty co-operation. There is to all industrial affairs a moral as well as a material aspect, and the former is, as we have often pointed out, as important as the latter, while both are intimately connected.

An increased sense of responsibility, and a distinct realisation of the extent to which our continued prosperity must be dependent on foreign trade, are things greatly to be desired on behalf of the wage-earning classes. Whatever well-meaning enthusiasts may preach, there is very little doubt that for a very long time to come the struggle for industrial existence among nations must continue, and that the strongest will prevail. In our own country, however, much may be done to mitigate the asperity of the conflict both between individuals and classes, and we believe that the Boards of Arbitration, originally suggested by us, and since taken up by the London Chamber of Commerce, if judiciously managed, may prove powerful instruments for effecting this desirable end. Let it not be thought, however, that we would wish to abolish competition within healthy limits; it is good for the human race that the fittest should survive, and what is more, in spite of all efforts, Socialistic or otherwise, to crush out individuality, the fittest will survive.

THE RAILWAY RATES INQUIRY.

The inquiry on the revised classifications of merchandise traffic, and schedules of maximum rates and charges, proposed by the various railway companies under the Railway and Canal Traffic Act, 1888, which has been most exhaustive, was brought to a close at the beginning of this week. The inquiry was divided into two parts, the one dealing with rates, terminal charges, and general conditions, and the other solely with classification. The former, to which we have already referred, lasted no less than sixty-eight days, and each side—that is, the traders and the railway companies—were represented by counsel. The other part took eleven days, and, as a rule, the cases were conducted by the goods managers of the railways, and by delegates of various trades, this portion of the inquiry being of a more technical character.

The procedure in dealing with the classification has been as follows:—The railway companies deposited with the Board of Trade a schedule of all the various articles which they carry, the schedule being founded on the Clearing House list, but with numerous alterations, omissions, and other modifications. The classes are denoted, A, B, C, 1, 2, 3, 4, 5, in ascending order of rates, Class 5 being the highest. Copies of the schedule were furnished to all who were interested—*e.g.*, the various chambers of commerce and numerous trading associations. Where it was considered that any article was classed too high, or was improperly defined, or had been omitted, objections were lodged setting forth the classification in the present Clearing House list, the class in the deposited schedule, and the class proposed by the objector, together with statements in support of the objection. To these the companies replied, in some cases conceding the class asked for, but generally making a defence for the deposited schedule. Conferences were held in a few cases between the traders and the railway companies. The objections with the replies were printed, and were taken in alphabetical order for discussion. The alphabetical order, while convenient for reference to the notes, greatly increased the difficulty of insuring the attendance of the delegates of the various trades. The procedure of the Court consisted generally of an opening address by one or more traders in support of some particular objection. Elucidatory questions were put by Lord Balfour and Mr. Courtenay Boyle, sometimes developing into a close examination. One or more of the representatives of the railways followed, supporting their printed replies, and were generally subjected to questions by the Court. Occasionally a considerable discussion arose, and finally the trader had a right to reply. Though, as a rule, it was not evident in which direction the Court had been influenced by the evidence and arguments—their duty being to make a report, not to give a decision—great satisfaction was expressed at the impartiality and perseverance with which the above-named gentlemen conducted the inquiry. They frequently assisted a trader who was unaccustomed to a position combining that of a counsel and that of a witness, and made amends for his ignorance of the art of pleading, by putting very pertinent questions to the railway companies.

From the shorthand notes might be extracted interesting statistics of nearly every trade, accompanied, as is too seldom the case in such literature, with a considerable amount of criticism. Thanks to Mr. Courtenay Boyle's inquiries, a new Child's Guide might be compiled from this source, for no strange commodity, such as "kentledge," "kainit," "carferel," "divi divi," "matchetts," "munjeet," or "babool," was allowed to pass without a brief definition, generally supplemented by an account of its uses and value per ton. The principal points on which the Court thought that the classification should be decided were—value in proportion to weight, bulk, risk, and damageability. The market values were constantly challenged by the railway companies, who did not always appear to improve their cases by such assertions as that £10,000 per ton might be taken as the value of gloves, because one pair, weighing an ounce, cost 4s. 6d. to 5s., or by calculating the value of a truckload of Epsom salts from the price quoted per lb. in the price list of the Army and Navy Stores.

It is impossible to give an idea, within the limits of our space, of the nature of the arguments or of the probable result of the inquiry, but we must express our surprise that so many trades failed to put in an appearance when their cases came on. So important an industry as that of the tea trade could surely have afforded to keep a representative to watch their interests, and to have given some better statistics of the comparative value of tea and coffee than can be obtained from a stores price list, which appeared to carry but little weight with the Court. Printing ink, boots and shoes, and several other articles were unrepresented by any trader, and had to be dealt with by the assistant secretary of the London Chamber of Commerce, which body has most carefully watched the numerous interests of its members, both in the organisation of the objections and in the legal part of the case.

Much discussion arose on definitions. For instance, Are needles drapery or hardware? Where must the line be drawn between toys and musical instruments? It was suggested that "hardware" should be defined as "all that leaves Birmingham and goes into an ironmonger's shop." Drysaltery appears to be "all that a grocer sells except coffee, sugar, and tea." The Court were very anxious to come to some understanding on the subject of mixed parcels, but they could never get any trader to see the points on which they wanted to get an opinion. "Mixed drapery" and "mixed grocery" were entries of this character. It was suggested that an unscrupulous trader might open a parcel containing 1 cwt. or 2 cwt. of cloves, and put in 1lb. of soap, and then send it as "mixed groceries" at a lower class. For the want of a few words from an expert, "oxygen gas in approved bottles or cylinders" was classed as "dangerous."

The classification which will be settled upon as the result of this inquiry will be the statutory maximum which the railway companies will be allowed to charge, and will supersede all the special agreements which have hitherto been made. It is difficult to judge to what extent some traders were right in complaining that any increase in the rates would absolutely ruin their industry, or how far the railway companies are stifling their own business by placing such checks on their goods traffic.

THE CARLISLE RAILWAY ACCIDENT.

The report of Colonel Rich, the Board of Trade Inspector, has just been issued. We quote his judgment as follows:—

The collision was caused by the mismanagement of the engine-driver and consequent want of brake power to stop the train, which ran down the incline from Shap Summit, at a speed of about sixty miles an hour, and approached Carlisle Station at a high speed. If the engine-driver had obeyed his instructions, whistled for the guards' brakes, and kept the steam brake on his engine and tender from the time that he said he tested his automatic vacuum brake at Wood Bank, and thought it did not act, I am of opinion that he would have stopped his train before he reached Carlisle Station. The train was then more than two miles from the point of collision. I think that it must have been much nearer Carlisle, when he tested and thought that the automatic vacuum brake would not act. It is impossible to make the driver's evidence agree with what the train would or should have done under the circumstances stated, and more particularly so from what occurred when I ran an experimental train from Carlisle to Penrith and back, which was made up of similar vehicles, with similar brakes, and in the same manner. I found that, although the rails during my experiments were particularly dry, by keeping steam on the engine, I could run for many miles when the small ejector was shut off, and that, although the train vacuum pipe gradually leaked off to zero, the reservoirs only leaked off 3in. to 4in. of vacuum in about ten minutes, and kept the brakes on, but not tight on, and that the brake by this slow leaking on acted more on some coaches than on others. Although the ejector would blow up the vacuum to 22in., 19in. was the highest vacuum I maintained, and 17in. about the standard vacuum. The van wheels alone heated after running a considerable distance, although the friction as the brakes leaked on must have been more severe during my trials, when the rail was perfectly dry, than on the morning of the accident, when it was dropping sleet and rain, and was considerably warmer at the north than at the south side of Shap Summit. When I made a very quick stop at the north side of Penrith Station, I observed that the driver shut off his small ejector at once, and on asking him why, he said they were directed to shut it off

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in the large stations to prevent noise; but on my remarking that the train was not at a station, I gathered from his reply that it was his practice to do this. It appears to be the rule to do so. This rule should be altered and the practice discontinued.

Taking this practice into consideration, I think the accident was caused in the following manner:—The engine-driver shut off his small ejector on arriving at Shap Summit, and forgot to open it before proceeding on his journey. If so, the brakes would gradually and partially leak on, but they would not stop the train on a steep falling gradient, while the engine was steaming hard, and particularly on a greasy rail, such as existed on the night in question. When the driver tested his vacuum at Wood Bank, there would be little or none in the pipe, he would feel no further check to his train than was already applied by the leaking on, and the guards would find the same when they tried to apply the vacuum brake by opening the valves in their vans. The driver then became anxious, and instead of carrying out what his rules directed him to do, and whistling for the guards' brakes, he took out the pin, and altered his lever so as to work simple vacuum instead of automatic. By doing this, he took off whatever brake power he had left, except the steam-brake on his engine and the screw brakes on the vans, which may not then have been applied by the guards, and he also must have taken the steam-brake off his engine during the time when he first tried to obtain automatic brake power by blowing up his vacuum with the large ejector, and before he took out the pin. He appears not to have whistled for the screw-brakes until he got close to the station, but the guards put them on when they were at Upperby Bridge Junction. After the train stopped, the wheels of two coaches were found to be heated. They must have been so heated while running with the automatic brake on between Shap Summit and Wood Bank, as there was not time or brake power put on between Wood Bank and Carlisle Station to heat them. The same effect would have been produced by the vacuum-pipe between the engine and tender becoming stopped with a plug of ice after the train left Shap Summit, but in this case the automatic brake would have leaked on, and could not have been taken off by the driver so long as the ice remained, and I think that, as the driver shut off steam at Wood Bank, the train would have been stopped with this brake power, the guards' screw-brakes, and the steam-brake on the engine and tender before it reached Carlisle.

When the automatic vacuum brake machinery was examined after the accident it was found to have been in good order. About half-a-pint of water was found in the belly of the pipe between the engine and tender, but this quantity of water, if frozen, would not be sufficient to plug the pipe and stop the air-way. From the evidence of the signalman it appears doubtful whether the engine-wheels were braked when the train passed the station and the signal-cabins at the south side of the station. This would be the case if the engine-driver had only pulled his lever into the notch in the slide, instead of pulling it right over, as he said he did. If he pulled it only to the notch he would take the brake off his engine and every vehicle in the train, except those to which the screw-brakes were applied, which the witnesses who saw the train pass said was the case. I think that there was nothing the matter with the brake, but that the driver, by shutting his small ejector at Shap Summit, lost a great part of his vacuum, and that he did not notice this before he reached Wood Bank. He then got thoroughly confused, and omitted to do what he should have done if he had acted as his rules direct, and did what he ought not to have done, by altering his engine to work simple in place of automatic vacuum. I think that great allowance should be made for the mistakes that he made, as it must be a most confusing thing to have both the simple vacuum and the automatic vacuum brake to deal with. The simple is put on by pulling a lever towards you, and the automatic vacuum brake is put on by pushing the *same lever* from you. I recommend the London and North-Western Railway Company to put a stop to this confusion by doing away, as the company have some time since determined, with the simple vacuum as fast as possible, and I would further recommend the company, as they have now adopted the automatic brake, to carry this out in the best manner, and to work it with a proper amount of vacuum. The company now work it at an average vacuum of about 17in. This is not enough. It should be worked up to 25in., and not allowed to go below 20in. when running. This should be done by means of an air pump or an ejector. If done by an ejector the exhaust pipe should be taken through the boiler, which will prevent the steam condensing as it does when the pipe is outside, and drivers should not shut the small ejector while their engine is attached to a train. I understand that the London and North-Western Railway Company are now fitting their engines with air pumps. The drip trap, with a valve, should be placed at the bottom of a vertical down pipe, and close enough to the ash pan to prevent the valve freezing.

The driver of the Caledonian engine did what he could. He had fortunately time to reverse his engine and get steam on, to run in the same direction as the London and North-Western train, before the collision occurred. The conductor and guard with the London and North-Western train appear to have done their duty; and as to the state of their gauges, these would be affected by the driver's action in working his big ejector. When they opened their release valves to put on the automatic vacuum brake it was impossible for the brake to act, as the driver was pulling it off with his large ejector. I place no reliance on the driver's evidence as to the state of his gauge while descending the Shap. I think that he probably did not observe it till he wanted to use the brake when the train arrived near Carlisle.

I recommend that the crossing to the sidings at the north end of Carlisle Station should be reversed, so that engines may run directly across the main line when going to the sidings.

Letters to the Editor.

THE INSTITUTION OF MECHANICAL ENGINEERS.

To the Editor of "Industries."

Sir,—Referring to your preliminary observations in your last week's issue on the very interesting address of the President of the Institution of Mechanical Engineers, permit me to say that I commenced work as a railway engineer in January, 1852, and am therefore another living example who has had a long experience in railway work.

Yours, &c.,
Gorton Foundry, Manchester, 13th May, 1890. Thos. Hunt.

To the Editor of "Industries."

Sir,—With reference to the statements put forward in the report of the Research Committee of the Institution of Mechanical Engineers in your last issue, while being most interesting, I can hardly think there is that knowledge shown on the subject which one would be led to expect. The only marine member of the Committee strongly protested against one of the findings—that there was priming in the boilers of the "Tartar." There were none of the well-known evidences denoting such a state of things, and it seems to have been pure assumption to get out of the difficulty in this way. Of course, without a design of the boiler, one is in the dark on many points, but there is the protest that no signs were apparent of any priming. In view of doubts upon the matter, the Committee should certainly have published more facts to have borne out their contention.

What other explanation is there possible for the water which was found in the cylinders besides that of its having passed over from the boilers? Here, it must be remembered, that the steamer was running light, and not in the condition for which she was designed. Her boiler pressure, therefore, stood at its highest point, 141lb., whereas the admission to the high-pressure cylinder was only 121lb. There was thus a certain amount of expansion in travelling from the boilers to the engines. Then again, without diagrams to consult, it is not rash to suppose that the engines were linked up to their utmost, and wire drawing would follow. In short, the conditions all round appear to have been conducive to a want of economy, and especially to a possible formation of water in the cylinders. This supposition is certainly not more out of the way than many brought forward at the meeting, and may, therefore, be worthy of the attention of your readers. It would appear to be a matter of regret that the Institution did not see their way to have a preponderance of marine members at these trials; the value of the report would thus have been considerably enhanced. We have now the ludicrous feature that the one gentleman representing the marine branch is "staggered" at the findings in a report which he is supposed to have had a share in framing.

There may, of course, be more elucidation of the whole subject when further details are published. I cannot but think, however, that the Institution has done nothing towards advancing our knowledge of the design and working of marine engines, as one might have supposed, and with the opportunities obtained, they should have been enabled to do.

Yours, &c.,
London, 14th May, 1890. Marine Engineer.

COMPRESSED AIR TRAMCARS.

To the Editor of "Industries."

Sir,—I have carefully studied the letter of Messrs. Hughes & Lancaster, in your issue of the 2nd inst., and fear that they have hardly given full consideration to what they have written. I do not think that anyone except Messrs. Hughes & Lancaster would interpret a new roadway to indicate that new rails were required. The laying of a gas or water main, or their own 4in. air-pipe, does not involve a new roadway, they say, but a cable tramway and electrical systems with underground cables do. I wrote to you on this subject for information, and have gleaned something. For instance, that electric traction on the storage system requires a new roadway when the gauge is different. Where has the gauge had to be changed to suit accumulator cars? Certainly not at Barking, nor in New York, nor in Philadelphia, nor at Brussels. The line or lines referred to are unknown to me; but Messrs. Hughes & Lancaster can, doubtless, furnish the information.

Another interesting item of intelligence is that electric traction cannot hold out in America. Mr. T. C. Martin quite recently stated that at the present time there are running or building in nearly 150 American towns some 2,000 cars on about 1,200 miles of track. The mileage in operation is, I think, about 650 miles, and this does not much look like an industry which is shortly going not merely to cease but to vanish. I have before me the *Street Railway Gazette* of Chicago, a paper run in the interests of tramway men, and its items of news fairly bristle with paragraphs announcing the construction of new electric lines and the conversion of horse-power lines into electric lines. The Street Railway Company in Minneapolis has just thrown aside an unused cable plant that cost £80,000, and is putting on electric cars over 100 miles of road. From all this I should have judged that electric traction in the United States was in a healthy condition, but I bow to the superior knowledge of Messrs. Hughes & Lancaster.

I must, however, take exception to their theories of financial operations. It is utterly absurd to say that electric traction is being "boomed" in this country because the American lines are going to smash up. In the first place, such a course would be futile, and anything analogous is unknown in Stock Exchange transactions, peculiar though many of these are; and, secondly, there is no boom. "Bears" and "bulls" are both glad to pick up hints for new departures, and it would be of value if your correspondents would explain how these supposed efforts in Great Britain are to take effect on the dying concerns in the United States.

Only a few words more, and I shall conclude, but I have to point out that Messrs. Hughes & Lancaster speak of the trial on the Barking line in the past tense. Though they are "behind the scenes" as to American electric traction, they do not appear to be even in the auditorium as far as English traction is concerned. The Barking line, I may mention, is still at work. As regards the cost of running it, Messrs. Hughes & Lancaster suggest that it does not pay at 4½d. per car mile. Mr. Baines, on the other hand, asserts that it does. Authoritative information on this point ought to be given.

Yours &c.,
Portsmouth, 10th May, 1890. Car.

SUGGESTIONS FOR A NEW SCOTTISH MAIN RAILWAY SYSTEM.

To the Editor of "Industries."

Sir,—In reply to correspondent "M.," in your issue of the 9th inst., perhaps by this time he may have seen something more of the details of my scheme which appear in some of the Scotch papers to-day. They will, I think, answer his objections on some of the points which he raises. There are, however, others which I intend dealing with in a more amplified form than newspaper correspondence will permit of, but which I may now refer to shortly. The first is the high-level bridge over the Clyde. In proposing this bridge the remarks of your correspondent are just such as I anticipated; and in my condensed communication I was careful to point out that the navigable channel of the part of the Clyde to be crossed *is only 800ft. wide.* The remainder of the bed of the river, a mile wide at this point, is dry or nearly so at low water. The greatest rise of the tide is only 12ft. On first mention of a high-level bridge of the length in question, the idea of the Forth Bridge and its gigantic cost looms on the mind. There is, however, really no comparison in point of either difficulty or cost between the two. The crossing of the Clyde at Dumbarton is more to be compared to the crossing of a dry land valley by a structure of metal or masonry, or the two combined (of which there are numerous instances in this country and abroad), rather than a broad deep estuary such as the Forth. The two, therefore, will not admit of comparison in this respect. There is one point, however, common to both—that is, the suitability of the elevation of the banks on both sides of the Clyde for a structure of the kind.

A second objection is "that for Glasgow and the greater part of Scotland such accommodation would be entirely out of the way." A perusal of the article referred to will, I think, convince your correspondent of this erroneous impression, while bearing in mind that the proposed is essentially a west-coast route, and that Glasgow, so to speak, is essentially a west-coast place. Also that all the traffic from the north-west, the north, and part of the north-east, to Glasgow, the west of Scotland, and *vice versâ*, has to make a great detour toward the east coast. In my letter of the 25th ult. no mention is made of any other arrangement than the connection of the three northern railways with one system in the south. In the amplification referred to it is shown, that in the event of the Glasgow and South Western being confirmed in her suicidal policy, there are several other alternatives. One omitted may now be added, which, as far as this scheme is concerned, would save a high-level bridge, and make the communication between the north, Glasgow, and the south the most direct possible. It would be in the new main line being made to connect with the Glasgow Central Railway. This, besides giving more direct communication with Glasgow, would shorten the distance. It would also supply the Caledonian with what she desires to get, and has just missed getting, a line to the Leven Valley. It would also bind together and strengthen immeasurably her connection in all parts of the north, and especially in the North-West and Western Highlands, with the centre of her system—Glasgow. The adoption of all the proposals of this scheme would be a barrier, too, to designs which her rival has on the north-west. And if the North British are sustained in their action for amalgamation with the Glasgow and South Western, the Caledonian may fully put forth its claim to "gobble up" the remainder of the minor Scotch companies as a sort of balance of power.

The third objection to be dealt with is "the inevitable destruction of the beauty of the western shore of Loch Lomond." In this paragraph your correspondent uses a word for which I think something milder might be substituted. Although it is pretty much an understood fact that railway engineering as at present practised does interfere with romantic and solitary beauty, still there is no reason why it might not be mitigated, and that perhaps in a simple way. To my mind there is little that is inconsistent in the puff or streak of vapour issuing from the copse or being seen through "the lattice work of pines." If gone properly about such artifice might be so employed as to call forth commendation from even Ruskin himself as a blending together in nature of ugly utility and art for the good of mankind. Be this as it may, however, railway engineering "has something to answer for" in this respect in the past.

Yours, &c.,
London, 10th May, 1890. "Eon Strathaar."

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MORISON'S EVAPORATOR AND FEED WATER HEATER.

CONSTRUCTED BY MESSRS THOS. RICHARDSON & SONS, HARTLEPOOL.

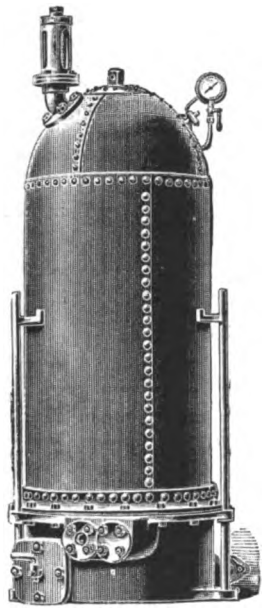


FIG. 1.—GENERAL VIEW.

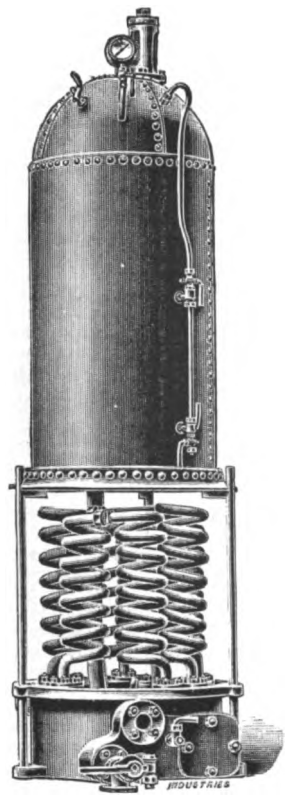


FIG. 2.—VIEW WITH SHELL RAISED.

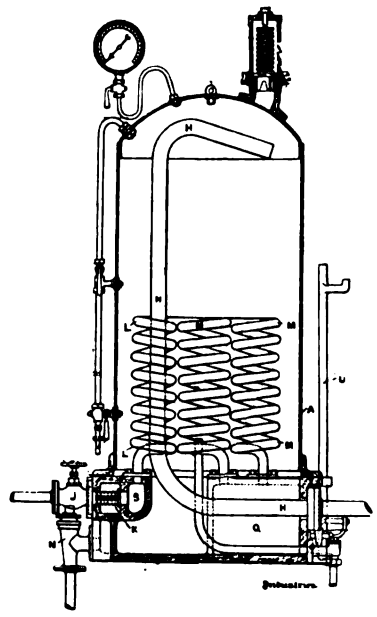


FIG. 3.—VERTICAL SECTION

MORISON'S EVAPORATOR AND FEED WATER HEATER.

THE necessity for skilled and careful attention in the management of marine boilers was never greater than with the present high pressures; for, although the utmost care may be taken in design and construction, a single voyage of careless working is sufficient to cause very great expense. The mismanagement of a boiler frequently results in collapsed furnaces, leaky tubes, decreased efficiency of the boiler as a steam generator, and consequent increased consumption of coal. In ocean-going steamers the loss of water due to leakage at the glands, &c., has to be made up by auxiliary feed, which is usually taken from the sea, and thus solid matter becomes deposited in the boilers. As the greater the evaporation on a given surface the greater is the deposit, the furnace crowns and back tube plates suffer from scale more severely than other parts of the boiler; and the undue formation of scale in boilers for triple and quadruple expansion engines must be recognised as a very dangerous element. It is, therefore, evident that to prevent such formation salt water must not be used as an auxiliary feed in marine boilers. The best method for making good the loss from leakage is to obtain a supply of fresh water by some convenient method, and various modes for purifying feed water have been proposed.

The combination evaporator which we illustrate above is an apparatus for giving this supply. In this apparatus salt water, which is obtained from the circulating pump discharge, is boiled, and the pure steam given off is condensed into water and pumped into the boilers as auxiliary feed water. Figs. 1 and 2 show general views of the apparatus, and Figs. 3 and 4 vertical and horizontal sections. The apparatus consists of a lower vessel, on which the heating coils L M and all the connections are arranged, and a dome-shaped shell or cover. The salt water to be evaporated enters through the non-return valve G, and is heated by means of steam which circulates through the pipes L M. The steam enters these coils through the valve J, and passes through the pocket S, first to the coils marked L, and then to those marked M. By the time it has arrived at the end of M it becomes condensed, and falls as water into the trap Q. A strainer K is placed in the pocket S in order to catch any dirt as it enters. The steam from the salt water enters the

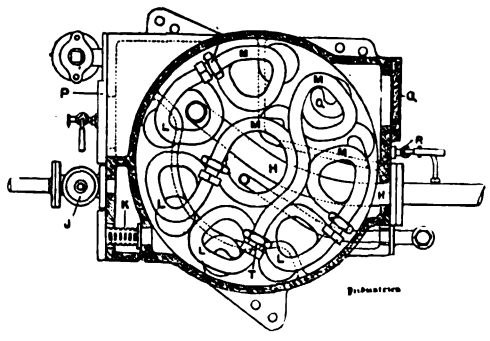


FIG. 4.—HORIZONTAL SECTION.

pipe H, and passes from thence to the condenser. The whole of the dome-shaped casing A may be lifted up along three iron guides U in order that the coils and inner parts may be got at, as shown in Fig. 2. The shell is made of Siemens-Martin steel, with a stamped steel lower ring riveted to it, which forms the flange which joins it to the lower part. The condensation of the steam formed by the evaporator may take place in the main condenser, or the evaporator steam may be arranged to mix with the steam condensed in the coils, and the whole passed through a special feed water heater (not shown in the illustrations), in which the heat is as far as possible utilised.

The whole arrangement is well worked out, and we understand has been fitted into over seventy steamers during the last six months. It is the patented invention of Mr. D. B. Morison, manager to Messrs. T. Richardson & Sons, Hartlepool, and is made by this well-known firm.

THE ROYAL SOCIETY CONVERSAZIONE.

THE Royal Society held a *conversazione* on Wednesday evening, in the rooms at Burlington House. The exhibits were as varied and as attractive as in past years, and the experiments and demonstrations were watched with great interest.

Perhaps the most interesting of all the experiments was Professor Roberts-Austen's illustration of the recent investigations of M. Osmond, on molecular changes which take place during the cooling of iron and steel. A mild steel rod was allowed to cool from 1,100° C., and when the temperature arrived at 750° C. and at 660° C. there appeared to be a temporary but distinct accession of heat.

No Royal Society *conversazione* is complete without some ingenious experiment by Mr. C. V. Boys. His oscillating spark experiment is a modification of the method employed by Dr. Oliver Lodge to show the oscillatory nature of a spark formed under proper conditions. Six lenses are mounted on a disc and are made to rotate. Each forms an image of the spark on a screen, which is drawn out by the movement of the lens into a broken band of light. The lenses are not at exactly the same distance from the axis, so that the band formed by one is not overlapped by the band formed by the next. Thus the whole duration of the spark from the first to the last oscillation may be observed or photographed. Mr. Boys also showed a series of photographs exhibiting the results of experiments intended to demonstrate the formation of drops.

Mr. Shelford Bidwell's experiment with a steam jet attracted much attention. The jet on being electrified cast a markedly deeper shadow, which assumed a peculiar orange-brown hue.

Professor Silvanus Thompson had a number of ingenious arrangements for the more effective carrying out of physical experiments. He also showed an ingenious colour experiment. Two liquids, incapable of mixing, are placed over one another in a flat bottle. They are chosen so that each absorbs all the rays that the other one can transmit. Though each is transparent, they are jointly absolutely opaque. They are also opaque when shaken up together.

Professor Norman Lockyer exhibited various spectrum photographs. As a result of investigations it is now shown that all parts of the spectrum can be photographed, that actinism is not peculiar to any part.

The exhibits shown by Dr. A. Geikie, the Director-General of the Geological Survey, were intimately connected with the subject of coal in the London district. A series of cores and specimens were shown from all the deep bores which, during the last thirty years, have been made in the South of England in search of water. Professor Judd showed some interesting specimens of minerals brought from Ceylon by Mr. C. Barrington Brown, of which the most attractive was an enormous beryl, weighing between 5lb. and 6lb.

The meteorological exhibits showed how increasingly important a place exact measurement is taking in scientific research. Mr. G. J. Symons, for example, showed a brontometer, or thunder-measurer. The object of the apparatus, devised jointly by Mr. Symons and the MM. Richard, of Paris, is to determine precisely the sequence of the various phenomena attending a thunderstorm, during which the barometer often rises and falls with puzzling irregularity.

Mr. D. Morris, of the Royal Gardens, Kew, exhibited a sugar-cane seed and seedlings. As the result of some experiments with self-sown seedlings, it is anticipated that, by cross fertilisation and a careful selection of seedlings, it will now be possible to raise new and improved varieties of sugar cane, and renew the constitutional vigour of plants that have become deteriorated through continuous cultivation by cuttings or slips. Great importance is attached to the subject in sugar-producing countries, as it opens up an entirely new field of investigation in regard to sugar-cane cultivation. Of equal practical interest was Professor Marshall Ward's exhibit of a selection of transparent photographs, showing—(1) the habit, &c., of various trees from different parts of the world; (2) the comparative structure and anatomy of several European timbers; and (3) some of the more prominent features of diseases of wood, &c., and fungi causing them.

Reviews.

AN ELEMENTARY TEXT-BOOK OF APPLIED MECHANICS By David Allan Low, M.Inst.M.E. London: BLACKIE & SON. 1889.

The name "Applied Mechanics" was introduced from the French when the science of engineering was still in its infancy, and was intended to show the applications of theoretical or rational mechanics to some of the ordinary problems of engineering. Rankine's well-known treatise gave it a position in scientific nomenclature, and it will be rather difficult now to get rid of it, when it has been rendered meaningless by the wide extension of engineering in all its departments. That treatise was really an introduction to the different departments of civil and mechanical engineering, and was largely incorporated in the special treatises which he afterwards published. On the other hand, there has been a growing tendency, which is right and proper, to introduce into books on theoretical mechanics a number of examples

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taken from engineering practice, instead of the specimens of undoubted absurdity with which the older works abounded. In fact, the line of division between theoretical and practical mechanics has almost disappeared. This book of Mr. Low's is really a treatise on theoretical mechanics, in which the theory is restricted to what ordinary students require, and the examples chosen are from applications to the simpler machines, and will be found very useful in schools and evening classes, and the teachers can easily supplement the theoretical part where it seems to be wanted. We need not go over the contents of the book, which, in its scope, is very similar to others which have been published in recent years, but we commend it highly for its clear and concise arrangement and method of exposition, and for the large number of well-chosen examples which are to be found in it, and think it will be useful to a large class of students.

THE MARINE TRANSPORT OF PETROLEUM. A Book for the Use of Shipowners, Shipbuilders, Underwriters, Merchants, Captains, and Officers of Petroleum-Carrying Vessels. By George Herbert Little. E. & F. N. SPON, 125, Strand, London; New York—12, Cortlandt Street. 1890.

The work before us should assist in insuring greater safety to life and property. While the author disclaims any pretence to original research, he has not failed to compile practically all the information extant bearing on the subject. The book has, however, defects. Some of the woodcuts and description are very much like advertisements. Occasionally extraneous matter is introduced and exaggerated language used, which is not commendable in technical literature. As an example, ventilating fans are stated to be "not by any means a necessity, and are generally a source of trouble *and tribulation* to the engineers, *besides* taking a great deal of steam to drive them." "Marine engineers have a rooted and very natural objection to anything which revolves above the normal speed of marine engines, and fans which make from 200 to 700 revolutions per minute are a source of *vexation of spirit, besides* being very liable to give out." The phrase "vexation of spirit" also occurs in connection with the construction of ballast tanks.

While the author has freely made use of papers read before technical institutions, and other works by Sir E. J. Reed, Mr. W. H. White, Chief Constructor to Her Majesty's Navy, Professor Jenkins, M.A., and Mr. B. Martell, there is much valuable advice offered to those in charge of petroleum vessels, resulting from the author's practical experience in the trade. As the author correctly states, "loading and discharging are the most dangerous times in the career of an oil-tank steamer," and, accordingly, he gives minute instructions as to the conduct of these operations. A matter which is not, however, referred to is the danger of pumping drainages from petroleum cargoes into harbours. This is a practice which should be strictly prohibited, as already it has occasioned considerable damage to several vessels by the oil, after being discharged into a river, being ignited.

There are seven chapters in the book, the first being introductory, dealing with petroleum generally, its forms, chemical composition, distilling, liability to explosions, &c. Very properly, the raising of the legal limit (from 73° Fahr. to 120° Fahr.) of the flashing point of ordinary commercial petroleum is advocated. A few pages are devoted to "Liquid Fuel," on which the author holds advanced views, stating, "it only requires the expenditure of a little enterprise on the part of shipowners, and the erection of astaki storage tanks at the coaling stations, to render its use possible on ordinary cargo and passenger vessels." Five explosions, including the "Petreana" and "Ville de Calais," are referred to. The risk of vessels carrying petroleum in bulk, due to the likelihood of being struck with lightning, is referred to; but in iron or steel built vessels the author states, "we may safely dismiss all fear of explosion of oil or vapour through the agency of lightning." The chapter concludes with an attack on the "low standard of education" of ordinary shipmasters.

Chapter II. deals with ship designing, stability, &c., and is written so that it may be comprehended by seagoing men. The author is apparently not himself if he is not severe, and enlivens what otherwise would be the most technical chapter by satire. Chapter II. is one of the best. A knowledge of the conditions requisite for the stability of a vessel are especially requisite when liquid cargoes are carried.

In Chapter III. the question of stability more directly concerning oil in bulk steamers is considered. Ballast tanks below the oil compartments are condemned, amongst the reasons given being that leakage into them causes a loss of stability due to the ballast tanks being only partially filled. Incidentally, horizontal oil-tight flats, in addition to longitudinal and transverse bulkheads, are advocated for the subdividing of large steamers. Professor Jenkins' inquiries into the stability of this type of vessel under various conditions are given at length, and the graphic results shown, and most of the principal designs of "tank" vessels illustrated and described.

Chapter IV. is devoted to pumps, loading, discharging, ballast tanks, and ventilation, and it is satisfactory, as it enters into the minutest details; and Chapter V., a brief chapter on "Testing," explaining the use of the hydrometer, and directing how samples of oil should be taken so as to obtain a correct mean specific gravity. Abel's tests are referred to, and a modification of the Abel tester suited for use on board ship illustrated and described.

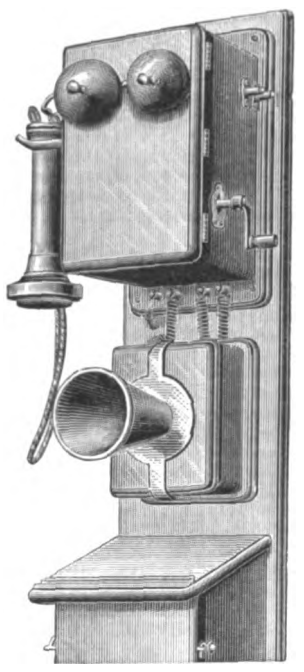
In Chapter VI. the lighting of petroleum steamers by electricity is considered. No other form of illumination should be adopted, although even an electric light installation may become a source of danger. It is pointed out that good results cannot be expected from installations laid down by "marine superintendents," and it is recommended that "owners should engage an experienced electrician to test the circuits each voyage."

Chapter VII. consists of useful data and tables culled from various sources, and is succeeded by a brief vocabulary of phrases in English, German, and Russian used every day in the sea transport of Russian petroleum.

In future editions we would suggest that to the present index an alphabetical one should be added.

THE "AUDIO" TELEPHONE MOUTHPIECE.

THE particular advantage claimed by the inventors of this mouthpiece is that it is constructed in such a way as to intensify the sound waves, and thus render it possible to carry on conversations in an ordinary tone of voice. The mouthpiece is specially constructed for use in telephones of the Blake type, and the accompanying illustration shows how it is attached to the telephone.



The mouthpiece simply consists of a truncated cone which is clamped on to the telephone. By using an indiarubber ring between the mouthpiece and the telephone, any escape of sound is entirely prevented. The cone is double, the outer cone being perforated with holes, the idea being that the vibrations caused by the sound waves on the interior cone have full freedom and are entirely protected from contact with external substances. The Audio Telephone Mouthpiece Company, of 35, Ann Street, Glasgow, are the makers.

THE LANE FOX PATENTS.

WE have received a pamphlet containing reprints of reports by Sir William Thomson, Professor Perry, Mr. W. H. Preece, Mr. Latimer Clark, and Professor S. P. Thompson, on Mr. Lane Fox's Patent No. 3988 of 1878. Three of these reports are dated 1886, and the other two are not dated. They are supplemented by a statement signed by the patentee, dated April, 1890. These reports claim for Mr. Lane Fox the credit of the invention of the system of distribution of electric light by means of mains and branches to lamps arranged in parallel, and with secondary batteries. No one who has studied the history of the subject will contest this claim, but we think that it will be a surprise to many to learn that a patent of so wide a scope is in existence, and is still "alive." The question at once arises, Why has it been buried for these twelve years? Before the company which has been recently formed can claim a royalty this question must be answered. We understand that, with the assistance of Messrs. Drake and Gorham, Mr. Lane Fox has recently succeeded in regaining control of certain patents which have for several years been in the possession of the late Anglo-American Brush Co. That company never, as far as we are aware, ventured to claim any royalty for the parallel distribution of electricity. This does not prejudice the validity of the patent, but, if no such claim has ever been made, it seems somewhat doubtful if any retrospective action can be taken.

After making the first great strides in determining the true principles of high resistance, &c., which have made incandescent lamps practicable, and in suggesting the system of connecting them with the mains which has made their common use possible, it is to be regretted that the inventor's attention was turned to investigations of a very different character, for, whatever may be their value, the result has been that Mr. Lane Fox has received little credit and less reward for his brief but valuable work. An adequate remuneration for this invention, in the shape of royalties, either retrospective or prospective, would be an infliction to which the industry would not submit without a struggle, if for no other reason than that the claim has been made after so long a silence. The patent, if valid, has but two years and five months to run, and we hope that Mr. Lane Fox's company will lose no time in stating what course they intend to pursue. A modest fee, as claimed on far slighter grounds by the owners of the Jablochkoff patent for transformers, or that which is demanded for compound winding, is hardly worth resisting, though in both of these cases the inventors appear to have had little or no notion of the uses to which their inventions would ultimately be put; while Mr. Lane Fox was undoubtedly alive to the practicability of parallel distribution, in spite of the ridicule which he met from those who might be considered high authorities as to the value of his work at the time of his patent.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

At the meeting of this Institution on the 8th inst. a paper was read, "On Lightning Guards for Telegraphic Purposes and on the Protection of Cables from Lightning," by Dr. Oliver Lodge, F.R.S., of which the following is an abstract:—

The fact that the greater portion of a sudden flash prefers to jump an air space, rather than traverse a moderate length of wire, cannot be perfectly appreciated without recognising the rapid oscillatory character of sudden discharges, and the doctrine of impedance, or immense obstruction, which good conducting wires offer to currents of this character. This impedance may be of 100 or 1,000 ohms, whereas the resistance to steady currents may be but a ten-thousandth part of this amount. It is a matter of common experience that almost any lightning protector is better than none at all, and that the best of those in use are by no means inefficient instruments. They do not afford perfect security, but the occasions when they partially fail are perhaps not very numerous. It is therefore the practice to establish some sort of proportion between the elaborateness of the protector and the value of the apparatus to be guarded. In all except the very simplest and crudest form of protector, a perception of the true conditions may lead to more complete protection without necessarily much increase in cost. A number of obscure and unexplained faults develop themselves in the gutta-percha of submarine cables; it is possible that some of these are due to electric waves of high potential which have got into the core and punctured its dielectric at previously weak spots; and such faults are found occasionally to develop in the wake of a storm. I would also point out that the fact that a lightning switch is found damaged, or its wire perhaps fused by a flash, is no proof that it has entirely protected the cable from hostile influence. It shows that it has done the best it can; but since that best falls short of perfection, the damage to the protector, proving that there has been occasion for its activity, proves likewise that the cable has been in a position of danger, has received some proportion of the damaging current, and in all probability has suffered some amount of deterioration. The voltage which plays about in the very feeblest form of statical discharge is so enormously greater than anything ever developed by ordinary voltaic batteries that one cannot regard with equanimity the entrance of any portion of such electromotive forces into the delicate vitals of a cable. The assertion I have virtually made is that no conceivable form of single air gap, whether it be between knobs, or points, or plates, or wires, or between wire and tube, or coil and cylinder, or any other possible device, can possibly afford complete and adequate protection, and that no ordinary protector can switch the whole of a flash out of a coil.

The handiest method of working with Leyden jar discharges is to use a couple of jars, to connect their internal coatings with the terminals of an electrical machine, the distance apart of whose terminals regulates the energy of the discharge employed, and to connect the outer coats of the jars to the two ends of the rod, or to the two rods of the universal discharger, or to whatever the flash is wanted to pass through. Instead of a wire tangle or loop, which only typifies the coil of an instrument, and whose only advantage is that one has no compunction in spoiling it, I employ an actual galvanometer, and take it as representing anything requiring protection. A galvanometer serves pretty well, because it indicates whether any disturbing current passes round it or not. It only indicates, however,

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when the discharge really goes round the coil. If it jumps across insulation, and, still more, if it jumps from terminal to terminal, the needle indicates less or nothing. There are, in fact, two things to be aimed at and considered separately in the protection of instruments. First, the current has to be prevented from passing round the coil, and thus disturbing the magnetism of the needle; second, it has to be prevented from jumping across from layer to layer, and so damaging the insulation. The galvanometer I use is a simple reflecting instrument, of a pattern devised by Professor Stuart at Cambridge some time ago. I insert between the wires leading to the galvanometer a sort of lightning-guard—a pair of plates mounted parallel to each other on a sliding arrangement, so that their distance can be varied (Fig. 1). Directly the plates approach within sparking distance, the galvanometer is apparently protected, and its kicks cease, even though by extending the machine terminals further the energy of the discharges be increased. The non-deflection of the needle merely shows that no important quantity of electricity now finds its way round the coil. The galvanometer is by no means safe, for its insulation is in imminent danger, and if but moderately energetic flashes are employed we shall see sparks leaping across the coils or jumping from them to the metal work in a very pronounced manner. As this is rather rough on the galvanometer, I prefer not to use strong flashes, but to show the existence of the tendency with smaller ones by arranging a safety valve or supplementary minute air-gap between the galvanometer terminals; the safety valve being either a couple of pins brought close together (see Fig. 2), or a chink cut across a narrow strip of tinfoil pasted on glass.

An actual lightning-guard may, of course, be used, and its behaviour studied in detail. I take, as an excellent instance, a Saunders' protector, so much employed in connection with submarine cables. Its essential part is a fine wire, through which the useful currents have to pass, surrounded by an earth tube with points protruding towards the thin wire, which is stretched by a spring along its axis. The idea is that the tube will relieve the wire of dangerously high potential, while the wire itself will fuse if dangerously strong currents try to pass along it. A supplementary device is a short-circuiting contact, whereby a spring puts the cable to earth directly the wire is fused or in any other way broken. The diagram (Fig. 3) sufficiently represents the instrument. A Jamieson protector is a neat arrangement, involving a fine wire as well as an air-gap; there is also some wire coiled on a metal cylinder, but the metal deprives it of all appreciable self-induction. If I send very small discharges down the line wire towards a galvanometer protected by this Saunders' guard, they will, if small enough, escape it and pass through the galvanometer, either exciting its safety valve or disturbing its needle, or both. But if stronger flashes are sent, the protector begins to act, sparks are seen between the fine wire and the surrounding tube, and the galvanometer disturbances diminish; but those at the safety valve never wholly cease. One is not to suppose that the bigger the flash the less the effect; that would be a very desirable but somewhat impossible conjuncture. The smallest effect is got with the weakest flash which is just sufficient to spark to the protecting tube. Anything stronger or anything not greatly weaker than this gives larger effects. The fine-wire part of this guard is a good feature, and one that may be advantageously introduced into any protector, on the principle of a safety-fuse or cut-out, to eliminate steady or slowly varying currents of too great strength. But the short-circuiting of the protected terminal to earth by the terminal D as soon as the wire is destroyed, is perhaps not an unmixed good, for a subsequent earth-seeking disturbance has then two paths between which it may divide—if the connections are made as in Fig. 3—one along the intended earth wire, and the other through the instrument intended to be protected. We see how important it is to make the earth lead as short and direct as possible, and how it is better to connect the thing to be protected to the two binding screws C and D of the instrument as indicated by the dotted line rather than to make an independent earth.

I will now describe the principle of my own lightning-guard, and will then connect it to the circuit in place of Saunders', and show that it affords practically complete protection for both small and big flashes. The principle is to take the overflow from one protector and give it the chance of another, then to take the overflow from this and offer it another air-gap, and so on till nothing is left; at the same time diminishing the overflow from each protector as much as possible by the use of self-induction coils, which impede the violently varying or alternating rushes by their electromagnetic inertia. Thus, for instance, using a series of plate protectors, we may couple them up as shown in Fig. 4. Only a small fraction of a sudden shock will escape No. 1; say, a thousandth part, since it is offered the inertia or impedance of the coils as the only alternative. A thousandth of this again may escape No. 2; and a thousandth of this, or a thousand-millionth of the whole, is all that is left for the galvanometer. By adding to the series, if it were necessary, it is manifest that a disturbance may be diluted down to any desired extent, with the rapidity of a geometrical progression. I do not indeed propose to use plates commonly, but propose simple brass rods for the exposed air-gap, adjusted just far enough apart to exclude that disturbing thermo-electric or other effect caused by a spark occurring between their surfaces. The theoretically best place to tap off the useful current is from near the tips in contact, so as to tap off a minimum of impedance with a maximum. (See Fig. 5.) A, B are the exposed, or line and earth, terminals; C, D are the protected terminals.

Dr. Alex. Muirhead has kindly made me a highly-finished instrument on this plan, and I have also received from him a round and more compact form, illustrated in Figs. 15 and 16. My instrument is symmetrical—*i.e.*, there are just the same coils in its earth-connected as in its insulated portion. For alternating currents, at well as for rushes of uncertain direction, I think a symmetrical protector is best.

I insert in the so-called protected wire an arrangement of air-gaps and self-induction coils, after the fashion which constitutes my system of protection (Fig. 6). Then, inserting a fine wire, or a coil, or a galvanometer, or any other detector, in the interval, and connecting the far end of the wire to anything as before, it will be found that, although every trace of signalling current is able to affect the galvanometer, no appreciable trace of a violent disturbance is found there; it is now securely protected whichever way the disturbance comes. The electromagnetic inertia possessed by the coils cannot exert this protective influence alone, without successive air-gaps. The *combination* of air-gaps or escape valves along with obstructive inertia is essential to the device. The self-induction of my coils is quite small; a very small amount of wire thus distributed suffices. Three or four yards of No. 16 wire are all I need use.

The fact that cables are always coated with a stout metallic sheathing is a peculiar circumstance not found in the lines of land telegraphs, whether overhead or underground, and it is a circumstance which renders their complete protection from lightning peculiarly definite and easy. It is clear that risk is run, however, wherever a cable is connected to a land line. The land line to the station is often led to the same switch-board as the cable instruments are connected to; and whenever there is any sort of proximity of this kind a flash received by some distant part of the land line must be liable to spit across some of the terminals and flick off a bit of itself into the cable and its instruments. Two lightning switches, at least, ought to be employed in every such station: one, a coarse one, at the place where the land line enters the building, to eliminate the grosser violence; and another, a fine one, at the mouth of the cable, to filter out the last traces of dangerous disturbance. The mode of connecting one of my protectors to a cable is shown in Fig. 7. Here the outside sheath of the cable is used as sole earth. Another proper mode is to have a subsidiary or local earth, connection being made as in Fig. 8.

Its instruments can also be protected perfectly well by putting them all inside the sheath of the cable. The sheath would have to be enlarged; in fact, it might be made into an iron house, to contain the whole of the instruments and the operators. Reliance is commonly placed on the short-circuit of cable and sheath. If the short-circuit is very short indeed, the reliance is fairly justified; but if it be effected by a loop of any size (Fig. 9) then there is no absolute security, for a flash striking at A will bifurcate, and part of it rush into the cable. But if instead of a mere loop we put a thimble or hollow metal vessel over the end of the cable, connecting its sheathing to the walls, and connecting its core to the interior, then no sudden splashes can enter the cable at all; they will keep to the outside, and do no harm (Fig. 10). Such a magnified thimble is the proposed metallic or wire-netted cable station; and it is one that has the advantage of never needing to be removed—one which contains instruments and operators, and protects them all alike from dangerous disturbances (Fig. 11).

It may be asked whether a house thus made should depend for its earth entirely on the cable sheathing, or whether a local earth should be provided? It is not a vital point; but a local earth is to be recommended, in order that even the outer sheath of the cable shall not have to carry flashes of exceptional violence, which might unduly heat it. Again, gas pipes, water pipes, and everything else, may be permitted to enter the house, but only on the strict condition that they be effectively united to it at their point of entering, not at some other point. Since no insulated conductor must on this plan be allowed to penetrate the walls, it is manifest that no land line can be permitted to enter a cable station. The land signalling station must be a separate chamber. It need not be a distinct building; it may be under the same roof, but it must be wire-fenced off from the cable compartment, and the messages must be put through non-electrically.

It is customary to land the ends of cables in a cable hut on the beach, so as to be able to get testing instruments as close as possible to the real thing, undisturbed by insignificant shore leads. There is not the slightest difficulty or danger introduced by this practice, provided the hut or an enclosure inside it is made of iron, and both cable and shore-lead are well connected to its walls by their outer sheathing as they enter it. The cable hut need not be itself of iron; if it contains an iron box, as shown in Fig. 12, all requirements will be satisfied.

It is not to be supposed that any such cable houses afford any protection against earth currents, or any other steady or slowly varying effects. These will produce their full effect quite careless of the fact of metallic enclosure. Nothing but a *perfectly* conducting screen can entirely protect against them, and that is not a likely invention. Atmospheric disturbances also, and even discharges, *in so far as they are slow* or leave subsiding effects behind them, will be felt by the galvanometer; but then, although inconvenient to a reader of signals, slow disturbances are not dangerous. It is the violent and sudden rushes that are dangerous, and these are wholly excluded, occurring only in the outer metallic sheath. To exclude steady currents of too great strength a short length of very fine wire must be included in the circuit.

But now arises a very interesting question. The protection thus illustrated, is it theoretically perfect, or only perfect enough for all practical purposes? Does a metal cage protect a galvanometer absolutely from these sudden disturbances? Mr. Chattock and I obtained the following result a year or two ago, viz.: that between two wires wholly inside a wire-gauze house not a trace of spark can be obtained, whatever flashes pass along the outside. The only way we got sparks inside a metal enclosure was by allowing one of the wires to protrude a little through a hole in the walls without touching the sides of the hole. Thus, for instance, Fig. 13 gives no sparks inside, but Fig. 14 may give some very small ones.

But what about the conduction test? Insulation is safe enough, but will the signalling be interfered with during the continuance of a storm? If we try the experiment by putting a galvanometer inside a good conducting vessel and attaching its terminals to the walls—a small patch of gauze being, of course, provided for the ray of light to get in and out—nothing will be seen when ordinary flashes are given to the cage.

The protection of a galvanometer from these sudden discharges is not theoretically complete. No amount of covering-in can absolutely eliminate all disturbance. No matter how sudden a pulse may be, so long as there is an integral passage of electricity in one direction along a conductor, the central portions of that conductor will convey some trace of it. The integral passage of electricity along the axial wire is, in fact, that determined simply by its relative conductivity as compared with its surrounding sheath, irrespective of more complicated considerations. But whereas in the outermost layer of the sheath there are violent surgings, the current-strength being very great and alternating, nothing of the sort occurs in the central portions; the violence is all damped out, and there remains nothing there but a quiet and sluggish flow. The rush in the outer layer of a conductor induces currents in the layer next below, these again in the layer below that, and so on.

In the discussion which followed, Mr. Saunders said he got the idea of his lightning guard in 1864 from noticing that cables were generally connected to land lines through a fine wire enclosed in a glass tube. These wires were frequently fused and the tubes broken, so he replaced the glass tube by a brass one connected to earth. After this fusions were less frequent. In his practical experience of twenty-five years, he had never known a cable or instrument protected by his guard to be damaged, although the wires have been often fused. During a very sudden and violent storm on February 14th, 1888, the wire was fused, but nothing else damaged. Their length was 15in., diameter ·0027in., and resistance 45 ohms. These, Mr. Saunders said, were frequently fused. In his opinion Dr. Lodge over-estimated the chances of damage. Injuries due to lightning were of rare occurrence. As regards Dr. Lodge's guard, Mr. Saunders thought it very ingenious, but before it could be pronounced successful it must stand the test of practical use.

Sir W. Thomson thought a condenser with Saunders' fuse wire would be an efficient protection for cables, for the quantity of electricity required to make the difference of potentials between the plates considerable would probably be more than sufficient to fuse the wire. A sufficient length of fine wire would prove an efficient protection. He did not wish to express any adverse opinion on Dr. Lodge's guard, for he would like to see it tested in practice; at first, however, he would also insert a Saunders' protector between it and the cable as an extra precaution.

Mr. Preece said that it was quite unnecessary to assume that lightning flashes were oscillatory in order to understand that self-induction may be beneficial in causing a discharge to jump over a spark gap, for all admit the suddenness of the flashes, and this was the only essential point. Out of 600 valuable instruments not a single one had suffered damage from lightning in 1889. Only one case of damage had occurred to cables since 1879, and in this considerable doubt existed as to whether the injury was caused by lightning or not. From these facts he concluded that no want for a new protector exists, and that none can give greater efficiency. As regards economy, he said the ordinary protectors cost from 2s. 9d. to 3s. 6d., whilst those for cables were about £1.

Mr. Charles Bright directed attention to Sir Charles Bright's guard, and said it was particularly useful in cable huts, for if one wire was fused the remaining ones were available.

Captain Stiffe said that on the Persian Gulf cable he had used a protector, consisting of a Siemens plate guard and a fine platinum wire. Sometimes the wire was melted and the plates had been fused together, but no damage resulted to the instruments or cable.

Sir Henry Mance corroborated Captain Stiffe's statements, and said that since the Persian Gulf cable came under his charge he had modified the guard by winding the fine wire into a spiral and enclosing it in a glass tube to prevent mechanical injury. He admitted that obscure faults do sometimes occur, but did not think they were due to lightning.

Major Cardew thought Dr. Lodge's apparatus was not necessary for ordinary lines. If, as Dr. Lodge supposed, the line was struck outside the station, then, even at a comparatively short distance away, the impedance of the line would exceed that of Dr. Lodge's coils, and a kind of spark gap exists at each insulator.

Professor Hughes considered the communication under discussion very important, inasmuch as it recognised the value of impedance in lightning protectors. Many of the older protectors contained analogous arrangements, but their inventors failed to see their importance.

General Webber said that from his own observations on storms in Eastern countries, he was inclined to think that protection was due to the points of release at every insulator more than to anything else. As regards electric light circuits, he inquired whether bare or covered underground conductors were most likely to be damaged by lightning. Some time ago, in his own house, which was then lighted by 25-volt lamps, he noticed, or thought he noticed, the lamps go dark immediately after a vivid lightning flash, and again regain incandescence.

Professor Ayrton pointed out that the lightning protectors of Mr. Preece and Mr. Saunders could not be applied to electric light circuits, for it was admitted that plate protectors were insufficient, and the fine wire was inadmissible. He said he had known polarised relays to be frequently reversed by lightning. In one instance he saw a flash strike a line about a quarter of a mile from the station; every insulator between the point struck and the station was smashed, the relays fused, and all the instruments damaged.

Mr. Mordey said that it was not so much the lightning that is to be feared in electric light circuits as the current from the dynamo following the path of the discharge and forming an arc. Means must be devised for breaking up such arcs, and it was more in this direction that electric light engineers were working.

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Mr. Spagnoletti recalled an instance of lightning striking an aërial line, and completely demolishing all the insulators and arms on ten poles, as well as splitting the poles themselves into fragments. These and other cases seemed to show that the protection afforded at the poles referred to by Major Cardew and General Webber was quite insufficient.

Mr. Crompton made inquiries as to how electric light circuits were to be protected, and wished to know if it was necessary to put protectors into each house, or whether protectors at both ends of the leads would be sufficient.

Dr. Lodge said that, judging from the statements of several of the speakers, the ordinary protectors did their work well, but they were all open to the objection that they were frequently damaged. Whenever protectors were damaged he contended that something else had also been damaged, although the injury might not be visible. He could hardly accept the statements made by the men of experience who said that they never came across faults that could not be accounted for, and he maintained that any unexplained fault *may* be due to lightning. As regards the advantages of fine wire, he said its use was essential to safety. In his paper he had pointed out that two things had to be guarded against —viz., high potentials and strong currents. His apparatus reduced the high potential, and fine wire was a protection against strong currents. As pointed out by Sir W. Thomson, the fine wire should be at the protected terminals. In reply to Mr. Preece's statement that the self-induction of instruments was sufficient to cause the spark to jump across air spaces, he said that if the coils were wound on iron cores or metal reels their self-induction for flashes was negligeable, and in any case lightning would take no notice of silk or cotton insulation. Moreover, the shapes of the coils used were by no means such as would give maximum self-induction. He thought Sir W. Thomson's suggestion of a fine wire and a condenser a valuable one. If underground wires were entirely underground they would be more secure. In answer to Mr. Crompton's inquiries, Dr. Lodge thought the same principle as is used in protecting buildings from fire by means of fire-proof doors should be adopted, and protectors should be placed wherever underground wires leave the earth.

NOTES ON ALLOYS.

V.

At a meeting of the Society of Arts, held on Tuesday evening last, Professor W. C. Roberts-Austen gave a lecture on the "Art Metal Work of the Japanese, and the Alloys used by them." The lecturer has, for some years, made a special study of the constitution of these mysterious and remarkable alloys, and he has succeeded in reproducing all the colours and effects which are characteristic of Japanese art metal work. From the exhaustive analyses which he has made of a great variety of ornaments, plaques, &c., it appears that there are four chief alloys whose names and constitutions are given as follow:—

SHAKU-DO.

Copper	94·50
Silver	1·55
Gold	3·73
Lead	·11
Iron and arsenic	traces
	99·89

SHIBU-ISHI.

Copper	67·31
Silver	32·07
Lead	·52
Gold	traces
	99·90

KUROMI.

Copper	98·04
Antimony	1·96

BRONZE.

Copper	76·9 — 87
Tin	23·1 — 13

There is also a fifth alloy, viz., Japanese brass, which occurs in the various ornaments, but its constitution has not yet been published. The most striking feature of these alloys is that the precious metals take the place of tin and zinc in English alloys. Shaku-do is generally of a dark purple colour, but the slightest variation in the percentage of the gold in it makes a great difference in the colour. The class of alloys called Shibu-ishi are all of grey colour, and are both light and dark. Kuromi is mostly copper, and has from ·2 to 2 per cent. of an admixture of other metal, such as bismuth, nickel, iron, arsenic, and gold, and the colours vary between wide limits, from brown and red to purple-black. The colours of each alloy may be varied by the production of coats of oxides or salts of the metals. This is done chiefly by pickling solutions, by heat, and by atmospheric exposure. It has also been suggested that some of the effects may be obtained by exposing the surfaces to the action of certain fumes. It is hardly necessary here to go into the details of the artistic effects produced by the judicious blending of these alloys, or to discuss the fitness of embodying both colour and texture in a work of art; neither will our space allow of our quoting examples of the extraordinary beauty of some of the Japanese inlaid designs. Suffice it to say, that at the South Kensington Museum there is an admirable collection of specimens of this art.

There is also an alloy used largely by the Japanese, called Moku-me, resembling marble in its texture. It is formed by taking sheets of the above-named alloys and laying them one upon each other, and then twisting folding, punching, and welding them in all manner of ways. When the surface of such a mass is polished it presents the appearance of marble, with the different coloured streaks winding about like a maze. The effects produced by these operations are extremely delicate and beautiful. Though no Western artists have successfully reproduced any of the inlaid work of the Japanese, yet Christophele, of Paris, and Tiffany, of New York, have executed some admirable work in Moku-me. At the late Paris Exhibition a vase 29in. high was shown by Tiffany, and the price put upon it was £1,000. Messrs. Elkington have also been successful in manufacturing articles in this manner, but as they could buy them from Japan at a twentieth of the price at which they made them, they hardly felt encouraged to proceed.

PROTECTION OF TELEGRAPHS FROM LIGHTNING.

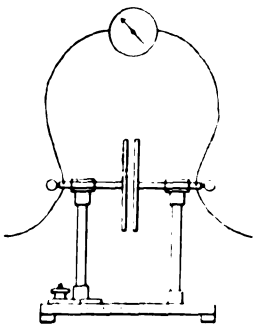


FIG. 1.

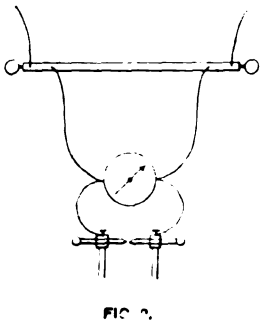


FIG. 2.

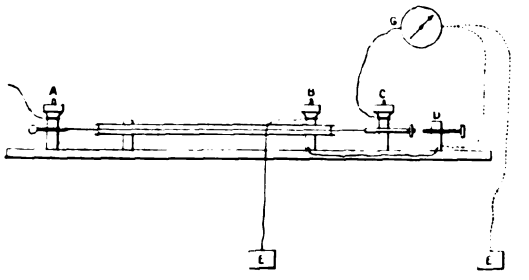


FIG. 3.

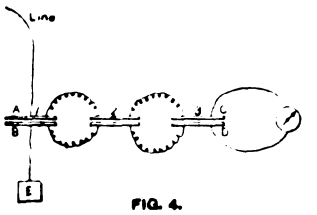


FIG. 4.

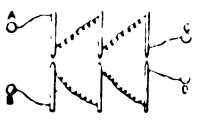


FIG. 5.

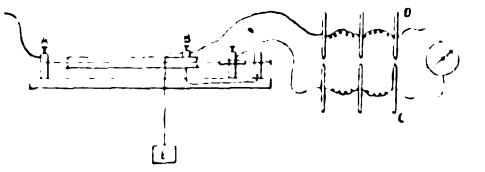


FIG. 6.

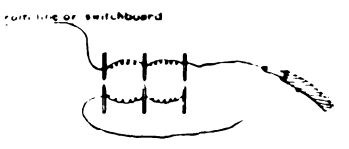


FIG. 7.

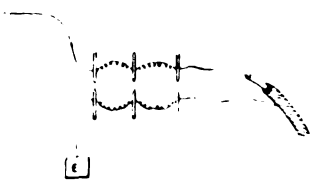


FIG. 8.



FIG. 9.



FIG. 10.

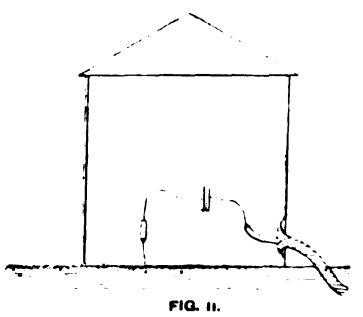


FIG. 11.

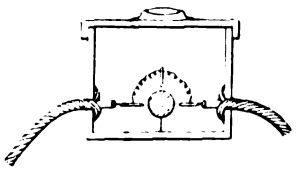


FIG. 12.

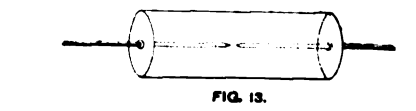


FIG. 13.

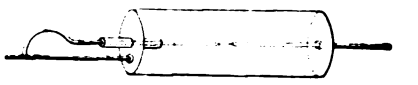


FIG. 14.

Industries

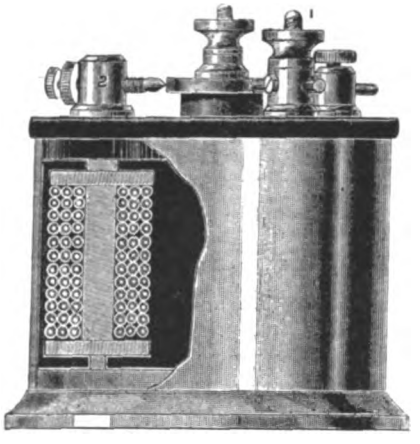
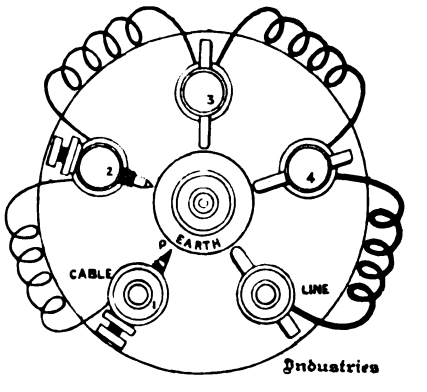


FIG. 15.



Industries

FIG 16.

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Little is known concerning the constitution or properties of the alloys containing three metals, as hitherto investigators have chiefly directed their attention to a study of the binary alloys. Dr. C. R. A. Wright and Mr Thompson have, however, in a recent paper communicated to the Royal Society, laid the foundation for future work on those complicated alloys which contain three metals. They chose as their first combination the metals tin, lead, and zinc, which were melted together and left at rest in a fused condition. When the percentage of tin exceeds a certain amount the mixture remains homogeneous, but when the amount is less than this the mixture separates into two layers, each layer containing the three metals. This limiting quantity of tin in the authors' experiments, which were conducted at a temperature of 600°–700° C., was found to be three-eighths of the total weight of the three metals. The heavier of the two layers which separate when the quantity of tin is lower than this consists of a saturated solution of zinc in lead containing tin, while the upper layer is a saturated solution of lead in zinc containing tin. The tin does not distribute itself equally in the two alloys, except when present in a particular proportion, which varies with the ratio of zinc to lead. With less tin than this, the lighter alloy takes up the excess of tin, and when the amount of tin is in excess of this amount, the lower alloy contains all this excess. They have, therefore, succeeded in obtaining a series of alloys in this way in which separation takes place on cooling, the lower alloy always having the same composition while the lighter one varies in composition, and a second series in which the upper alloy is uniform in composition and the heavier one varies with the amount of tin added. When no tin is added, they further find that lead is capable of dissolving zinc, forming an alloy containing 1·24 per cent. of zinc, and also that zinc dissolves lead to the extent of 1·14 per cent. In the Parkes process for the desilverising of lead by means of zinc a similar kind of separation takes place, which may be compared with this work of Dr. Wright and Mr. Thompson on the ternary alloys, and it will be in the recollection of our readers that it has recently been shown that there is a similar selective action when the attempt is made to form a ternary alloy containing lead and aluminium with a third metal (see *Industries*, Vol. VIII., page 236). A peculiar crystalline alloy, containing lead, tin, and copper, has recently been examined by Mr. A. French. It was found in a cavity at the bottom of a cupola furnace after being used for lead smelting. On analysis, however, it was found to contain, in addition to these three metals, nearly 4 per cent. of antimony, and traces of iron, silicon, and sulphur, and can, therefore, scarcely be regarded as a simple ternary alloy.

THE SOCIETY OF CHEMICAL INDUSTRY.

MANCHESTER SECTION.

On the 6th inst. Dr. Liebmann read a paper on "Pure Aniline and its Homologues." The commercial value of an aniline was based on determinations of the solubility, boiling point, and specific gravity of the liquid. As the literature on the subject gave different figures for the above, he had prepared pure specimens and carefully determined these constants, with the following results :—

Aniline, sp. gr. 1·007, boils 182° C.
Ortho-toluidine, sp. gr. 1·0037, boils 197° C.
Para-toluidine, melts 45° C., boils 198° C.

Sometimes sulphur compounds occurred as impurity in aniline, though, since the publication of Professor Victor Meyer's researches on thiophene, the quality of commercial benzenes had much improved. The best test for para-toluidine was the melting point, which was much lowered if any quantity of the ortho compound was present.

Mr. Carter Bell then read a paper on "The Liability of Certain Oils to Spontaneous Combustion," in which he pointed out that the determination of the heat produced by the reaction of chloride of sulphur on the oils was an important factor to determine, as he had found that the greater the rise the more liable was the oil to spontaneous combustion. By placing the oil in a flask containing oxygen connected with a water gauge, the amount of oxygen absorbed could be seen by the rise of water in the gauge —the most dangerous oils absorbed oxygen the quickest. The most reliable test consisted in putting a certain weight of wool saturated with the oil in a water-jacketed vessel open at both ends, having a thermometer in the water and in the wool; heat was then applied, and the temperature when the wool began to smoulder was noted. He gave the results of a large number of tests made with various wools and oils, some of the figures being widely different. A series of experiments were also made under conditions similar to those occurring in woollen mills, a larger quantity of wool—about 6lb.—being taken for the tests. Mr. Bell said it was the general opinion among manufacturers that white wools, when greased, were more liable to spontaneous combustion than dyed wools. He, however, had found exactly the reverse, by a series of tests which he had made to specially determine this point. In his experiments the wool had always smouldered away without actually bursting into flame; and in fact, with regard to flame, from inquiries which he had made, he did not think that such a thing as an outburst of flame ever occurred in mills. It was most important that all woollen mills should be kept thoroughly swept and clean.

In a short discussion which followed, Dr. Bailey, referring to the influence of mass upon experiment, suggested that tests should be made in which a large quantity and a small quantity of wool should be taken, and a Grinnell sprinkler imbedded in each, so as to see which produced the greatest heat first. With regard to the influence of water in the wool this would cause a reduction of temperature, owing to the loss of heat due to its conversion into steam. Mr. Thomson objected to the manner in which the tests were carried out, and thought that the results obtained were not of much scientific value, especially as the oils occurring in commerce were very rarely pure. Mr. Hurst said he had experimented on this subject, but had not obtained any satisfactory results. He regretted that Mr. Bell had not experimented with mineral oils, as these were now being much used in cloth manufacture. Mr. Bell, in reply, said that his figures were not put forward as scientifically accurate, but were intended to be of interest to millowners, as showing the difference between the various wools and oils with regard to liability to spontaneous combustion.

Notes.

BRIN'S OXYGEN PRÓCESS FOR GAS PURIFICATION.

The process of gas purification by means of oxygen gas, which was first attempted on a commercial scale at Ramsgate, and of which we gave a full description some time ago (see *Industries*, Vol. VII., page 574), has been adopted at Shrewsbury with success, and we understand that the Rochdale Town Council and the Montreal (Canada) Gas Company have also decided to adopt this system, and have given orders to Brin's Oxygen Company for the erection of the necessary plant.

THE ORDNANCE SURVEY.

From a Blue Book which has just been issued, we learn that, in connection with the Ordnance Survey, plans of twenty-three towns were published during the past year, and that these complete the plans of all the towns in England and Wales, all of which have now been published in accordance with the various Treasury minutes on the subject. All the counties have been published on the 6in. scale, with the exception of Devon, Salop, and Wilts; and the map of England and Wales, on a scale of four miles to an inch, is in the hands of the engravers, and the outline edition is in a forward state. The total expenditure on the Survey has been £1,697,678, and it is expected that £200,000 more will be required to complete it.

A MINIATURE STEAMSHIP.

A magnificent ship model, representing one of the three swift and powerful mail steamers now being built at Barrow for the Canadian Pacific Royal Mail Company, has just been completed by Messrs. Kelso & Co., model makers, of Glasgow, who have a high reputation in this line of business. The model is fully rigged, and is enclosed in a handsome glass case. It represents, on a scale of ¼in. per foot, a twin screw vessel, having a graceful clipper stem, lines exhibiting much fineness of entrance and run, and with a full sharp-bilged midship body—altogether a likely craft to attain the speed of 19 knots, for which she has been designed, and prove a comfortable sea boat. The full-size dimensions are—485ft. length, 51ft. beam, and 36ft. moulded depth, the tonnage being 5,700 gross. The engines will indicate 10,000 horse-power; and, as Mr. Bryce-Douglas now holds the reins in the Barrow establishment, it may safely be predicted that the required speed will be attained The destined station for the vessels is between Vancouver and Japan and China, and, to judge from the large number of lifeboats provided, the accommodation for passengers will be most extensive. The model shows the vessels to be armed with guns of the most approved type and calibre, for service as a reserve cruiser of H.M. Navy. The faithfulness with which the model makers have reproduced in miniature every item of deck fitting, masts, and rigging, down even to individual rivet heads and links of chain, reflects great credit on Messrs. Kelso & Co. The model, we understand, is to the order of the Barrow Shipbuilding Company, but is intended for the offices of the owners.

THE RESULTS OF THE "CHALLENGER" EXPEDITION.

Many developments of industry and commerce have been the results of investigations which have seemed to have no practical application. The work which has been done in connection with the "Challenger" expedition is, of course, of great interest to the pure scientist, but sooner or later it will be discovered to be of immense practical value. The reports which have been published in connection with it form a library of forty-seven quarto volumes, with nearly twenty-eight thousand pages of letter-press, more than two thousand five hundred lithographic and chromo-lithographic plates, four hundred maps, charts, and diagrams, together with a great many woodcuts. The preparation and publication of the reports have cost no less than £88,000, and the amount recovered by sales does not yet reach £18,000. The part of the report which is most interesting to us is that which gives information about harbours, tides, currents, and prevailing winds of out-of-the-way spots, which will be of use to those engaged in maritime and commercial pursuits.

A NEW QUARTERLY REVIEW.

The latest novelty in journalism is a quarterly review of current topics, entitled *Subjects of the Day*. It is "special" in a different sense from the ordinary journals, for instead of being devoted to a certain department of literature, science, art, or politics, each issue is to be entirely taken up with the discussion of a subject which is attracting attention, and will form a volume in itself. The first subject taken up is that of "State Education for the People." The articles are not by any means of a technical nature. The first is by Sir W. W. Hunter, President of the Indian Education Commission, and gives a most interesting account of the results of State education in India. Then follow accounts of the systems of education in England, Scotland, and Ireland, and a comparison of British and Continental and American systems. There is an article on "The Education and Status of Women.' Sir Philip Magnus dwells on the evils of payment on results in technical education. The new Codes which have been drawn out for the present year in the department of elementary education have practically abolished this system, and it is to be hoped that the subject will now be taken up in connection with the grants given by the Science and Art Department, where the effects are even worse than in elementary schools.

ECONOMIES IN STATE PRINTING.

We sometimes flatter ourselves on our generosity when a comparatively small sum is voted for purposes connected with education, science, or art, but we seldom or ever consider how much money is at present absolutely wasted. Attention, no doubt, is being directed to this matter in several departments, but as yet only a beginning has been made. In the Stationery Office, for instance, Mr. Pigot, the director, declares that he is well within the mark in saying that—going back at furthest to the year 1875 for a comparison of prices—the cost of a first-class battleship, complete in all its armaments, with an attendant flotilla of half-a-dozen gunboats, has during the last ten years been saved, without inconvenience to the public, on Government printing and stationery. This has been done mainly by cutting down the printing rates, and by reducing the number of copies of Parliamentary papers supplied to members. Instead of sending to each member a copy of every printed paper, only those are supplied which are asked for, a step which might have occurred to those in charge long before this, as few members have either time or inclination to read all the Parliamentary papers. Then, again, increased facilities have been given to the public for the purchase of papers, and the prices have been very much reduced compared with what they were a few years ago. No returns have yet been published showing how far the public has taken advantage of these opportunities, but we would imagine that in these days of political activity that many will avail themselves of them.

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Patent Record.

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

28th April, 1890.

6413. Junge, W. ..... Saws.
6415. Holding & Holding ... Looms.
6417. Lees, T. W. ..... Lubricating apparatus.
6422. Jones & Jones..... Cigar-making machines.
6424. Tschoepe, C. ..... Mechanical stoker.
6432. Stones & Stones ..... Lock nut.
6442. Pett, F. S. ..... Ship's logs and sounding apparatus.
6444. Darne, R. ..... Firearms.
6445. Smith, J. ..... Tension pulleys of spinning machines.
6452. Moore, A. W. M. ..... Wheels for road vehicles.
6453. Ramsey, H. E. ..... Circular boilers, &c.
6454. Penk & Krenner ..... Numbering presses.
6461. Pielsticker, C. M. ..... Metal sheets.
6469. Jones, C. ..... Street-watering apparatus.
6470. Horn, W. W. ..... Steam pumps (*Beatty*).
6472. Ainley & Oakes ..... Machinery for cutting square holes.
6474. Parratt, G. F. ..... Life rafts.
6477. Wells, C. ..... Steam engines.
6484. Fletcher, G. ..... Evaporating pans.
6485. Mellstrom & Bremberg Ordnance.
6487. English, T. ..... Raising gun platforms.
6488. English, T. ..... Carriages for quick-firing guns.
6489. Imray, O. ..... Low water alarm for steam boilers (*Wildman*).
6491. Reed, Sir E. J. ..... Connecting railways separated by rivers by submerged tubes.
6494. Carey, W. ..... Pipe couplings.
6498. Hoskins & Hoskins ..... Punching machine.
6499. Hoskins & Hoskins ..... Machine for caulking joints.
6500. Thompson, W. P. .. .. Feed-water heaters (*Stub*).
6502. Lake, H. H. ..... Burning hydrocarbon oil as fuel (*Sieft*).

29th April, 1890.

6508. Kelly & Dougherty ... Ordnance.
6509. Weston, G. H. ..... Rotary engines.
6510. Woodward, R. G. ..... Sewing machines.
6511. Musgrave, W. M. ..... Pistons.
6512. Brown, G. ..... Spinning machinery.
6513. Johnson, J. Y. ..... Friction catches (*Lewis*).
6514. Cook, W. ..... Multitubular boiler flues.
6523. Parker, J. ..... Barrel setting-up machines.
6525. Elliott, W. ..... Stitching machinery.
6526. Hammerton, C. ..... Tool holder.
6529. Bramwell, J. H. ..... Hardening steel.
6536. Fox & Williamson ..... Reversing valves for gas furnaces.
6541. Paley, G. ..... Sewing machines.
6552. Gimlinton, F. H. ..... Projectiles.
6557. Oertel, E. O. ..... Recording working of engines.
6558. Schott, A. J. ..... Sea calming apparatus.
6559. Lunkenheimer, E. ..... Straight way valves.
6562. Aiken, H. ..... Railway axles.
6571. Gobiet & Carrer ..... Corrugated metallic tubes.
6573. Jackson, J. ..... Pressure gauges.
6578. Thompson, W. P. ..... Construction of buildings (*Smead*).
6579. Thompson, W. P. ..... Desiccating apparatus (*Smead*).
6585. Lake, H. H. ..... Automatic guns (*Maxim*).
6588. Fombuena, V. S. ..... Cigarette machine.
6590. Churchill, J. D. ..... Governing steam engines.
6591. Lake, H. H. ..... Automatic guns (*Maxim*).
6593. Williamson, F. ..... Lubricators.

30th April, 1890.

6597. Terry, H. K. ..... Purification of middlings (*Pope*).
6600. Evans, W. L. ..... Weighing machine.
6602. Wild, J. ..... Joints for flexible hose.
6603. Thorp (of the Firm of J. & J. Hayes, Ld.) & Allen ..... Yarn guide traverse motions.
6617. Binns, J. P. ..... Gas engines.
6621. Brown, A. B. ..... Marine engines.
6622. Ross, Sir C. H. A. F. L.... Governing motors.
6625. Murrie, J. ..... Feed-water regulator.
6632. Ménard, R. ..... Gas engines.
6635. Thompson, W. P. ..... Valve rod packings (*Touceg*).
6641. Gillings, J. ..... Railway chair bolts.
6643. Gersant, J. ..... Ordnance.
6645. Lancaster & Couley ... Iron and steel.
6647. Hawks, N. S. ..... Furnaces.
6650. Leigh, H. H. ..... Multiple saw frames (*Jeansaume*).
6654. Davey, C. J. ..... Automatic brake.
6657. Bayly, J. P. ..... Locomotive (*Goulding*).
6660. Brophy, M. M. (of the Firm of James Slater & Co.) ..... Furnaces.
6661 Brophy, M. M. (of the Firm of James Slater & Co.) ..... Gas heated ovens.
6663. Taunton, R. A. P. ..... Spring gun.
6668. Vigers, E. ..... Tubulous boiler.
6669. Greenwood, H. ..... Machinery for shaping teeth of wheels.
6672. Lake, H. H. ..... Tool steel bars (*Garnier & Weil*).
6674. Kent, W. G. ..... Liquid meters.
6676. Shearer & McCutcheon Land grubbers.

1st May, 1890.

6677. Jerrard, E. P. ..... Multiplying hydraulic power.
6680. Taylor, P. ..... Bottle corking machines.
6684. Richardson, W. H. ..... Carding engines.
6686. Ashworth, Ashworth, & Ashworth ..... Driving gear of textile machinery.
6688. Partington, E. ..... Paper-making machines.
6692. Thornley, T. ..... Furnaces.
6694. Edwards, Davies, & Williams..... Casting ingots, &c.
6697. Birtwistle, W. ..... Loose reed looms.
6699. Simpson, H. J. ..... Ship's boat disengaging gear.
6702. Kay & Young..... Machinery for shearing pile fabrics.
6703. Jeffrey & Cockburn ... Stop valves.
6708. Hare, W. L. ..... Rollers for printing fabrics.
6709. Gehrling & Durran ... Eyeletting machines.
6718. Ashlin, H. C. ..... Furnaces.
6720. Clarke, G. T. F. ..... Implement for setting saws.
6722. Kirkby, J. ..... Drying kiln.
6725. Morris, R. ..... Projectiles.
6731. Collette, F. ..... Apparatus for preventing explosions in mines.
6732. Marsden, G. ..... Machinery for making hearth-rugs.
6736. Edwards, E. ..... Stop valve (*Adam*).

2nd May, 1890.

6745. Gatenby, H. E. ..... Spinning machinery.
6749. Cochrane, W. ..... Automatic shunter.
6750. Farran & Crawford ... Looms.
6759. Barnes, S. ..... Printing machines.
6761. Newton, J. E. ..... Hydraulic motors.
6764. Wilkinson, N. ..... Railway waggon or carriage.
6770. Scott, R. ..... Lace machinery.
6772. Morier, A. H. ..... Roaching machines.
6777. Crowley & Douglas ... Railway signalling.
6792. Simon, H. ..... Apparatus for cleansing wheat.
6794. Ohl, E. ..... Stretching machines.
6799. Human, E. ..... Flexible couplings for shafts.
6810. Smith, A. P. ..... Apparatus for tapping mains.
6813. Guy, C. W. ..... Crushing mills.
6815. Zimer, F. W. ..... Propelling boats.
6820. Lang, J. ..... Small arms.
6822. Penligen, W. H. ..... Ships' davits.

3rd May, 1890.

6827. Elliott, G. W. ..... Wheels and pulleys.
6828. Capone, F. ..... Aërial navigation.
6829. Adey, F. A. ..... Locating sunken ships.
6837. Bosshardt, F. ..... Drying and cleaning grain (*Perhees & Ferhaert*).
6839. Hoyer, F. ..... Metal for shipbuilding plates.
6840. Rigby, T. A. ..... Apparatus for purifying meal.
6842. Shabratt, A. ..... Furnaces.
6846. Dickinson, A. ..... Brake for tramcars.
6851. Southby & Blyth..... Refrigerating apparatus, &c.
6853. Poupard & Lewis..... Weighing machines.
6859. Carr, C. E. ..... Railway points and signals.
6865. Hartmann, E. ..... Pumps.
6870. Keefer, W. B. ..... Weaving carpets.
6872. Melhuish, A. G. ..... Gas motors.
6876. Ashworth & Kneen..... Furnaces.
6880. Hellinger, M. ..... Construction of walls.
6882. Coleman & Morton ..... Machines for road sweeping.
6885. Bayly, J. P. ..... Shaft coupling (*Capron*).
6894. Low, R. ..... Rolled forgings.
6896. Ambler, W. ..... Moulding cylindrical articles.

ELECTRICITY.

28th April, 1890.

6475. Lowrie & Hall ..... Safety device.
6476. Eagar & Milburn ..... Electrical batteries.
6490. Schweizer, E. ..... Electrical clockwork.
6492. Dewey, M. W. ..... Electric railways. (2nd November, 1889.)
6493. Dewey, M. W. ..... Electric refrigeration. (15th November, 1889.)
6495. Clark, A. M. ..... Telegraphs (*Shuckert & Co.*).

29th April, 1890.

6524. Ryland, W. ..... Electrical deposition.
6568-9. Lake, H. H. ..... Electrical measuring instruments (*Garver*).
6570. Dewey, M. W. ..... Electric refrigerating apparatus for railway vehicles.
6581. Lake, H. H. ..... Incandescence electric lamps (*La Société L'Incandescence Electrique*).

30th April, 1890.

6623. Warden & Smith ..... Switches for lamps.
6667. Frager, A. ..... Electric meter.

1st May, 1890.

6726. Von Hefner-Alteneck, F. ..... Electrical timepiece.

2nd May, 1890.

6793. Siemens Brothers & Co., Ld. ..... Combined electromagnetic coupling and brake apparatus (*Siemens & Halske*).
6795. Edmunds, H. ..... Storage batteries.
6801. Holmes, A. B. ..... Testing leakage and insulation of electrical conductors.
6811. Vogel & Calkins ..... Telephones.

3rd May, 1890.

6841. Smythe & Payne ..... Electrical fittings.
6878. Schmitz, R. ..... Electric alarm device for clocks
6893. Van der Poppenburg, J. Galvanic batteries.

CHEMISTRY.

28th April, 1890.

6416. Davis & Davis ..... Chlorine.
6433. Davis & Davis ..... Chemical furnace.
6462. Napier & Carr ..... Metallic alloys.
6463. Neave, E. ..... Oxygen from air.
6465–6. Pielsticker, C. M. ... Distillation of hydrocarbon oils.
6486. Imray, J. ..... Colouring matters (*La Société Anonymes des Matières Colorantes et Produits Chimiques de St. Denis*).

29th April, 1890.

6549. Plummer, J., Jun. ..... Hydrochloric acid and ammonia.
6553. Longsdon, A. ..... Oxygen from air (*Salomon*).
6575. Stringfellow, J. H. W. Manufacture of gas.
6584. Shedlock & Denny ..... Gas producers.
6587. Whiteman, W. T. ..... Distillation of alcohols (*Haeck*).

30th April, 1890.

6670. Cowper-Coles, S. O. ... Deposition of alloys.

1st May, 1890.

6698. Davis & Davis ..... Chlorine.
6729. Dreyfus, C. ..... Colouring matters.

2nd May, 1890.

6758. McEwen, J. ..... Generating carbonic acid.
6804. Andrews, W. C. ..... Purification of illuminating gas.
6821. Vivian, Sir H. H. ..... Copper.

3rd May, 1890.

6831. Davis & Davis..... Chlorine.
6834. Taylor, J. ..... Recovery of glycerine and salt from soapmakers' leys.
6850. Parry & Foskett ..... White pigment.
6864. Shedlock & Meldrum... Production of gases.
6874-5. Johnson, J. Y. ..... Colouring matters (*Badische Anilin & Soda Fabrik*).
6879. Lake, H. H. ..... Colouring matters (*Leonhardt & Co.*).

MISCELLANEOUS.

28th April, 1890.

6434. Wood & Bracewell ... Ventilating and moistening weaving sheds.
6439. White, C. H., Jun. ..... Wire-rope fencing.
6478. Efrem, J. ..... Dissolving boiler scale.
6497. Thompson, W. P. ..... Regenerative gas lamps (*Bucklin*).
6504. Wilby, J. H. ..... Driving belts.

29th April, 1890.

6517. Lóvold, J. M. ..... Distributing oil over waves.
6518. Lawrie, R. W. ..... Manufacture of tin boxes.
6555. Brewer, G. ..... Insulating composition (*Firth*).

30th April, 1890.

6612. Webb, R. T. ..... Bleaching yarns.
6644. Johnston & Johnston... Paper making.

1st May, 1890.

6706. Kimmins & Craig .... Separation of fatty matters from wool.
6711. Goodall, F. C. ..... Marine cement.
6715. Malmström, K. K. ..... Percussion fuses.
6730. Dreyfus, C. ..... Coloured rubber goods.

2nd May, 1890.

6819. Calmon, A. ..... Hose pipes.

3rd May, 1890.

6855. Higham, G. ..... Portland cement.
6867. Levita, C. B. ..... Percussion fuse.
6868. Turner, H. C. ..... Asbestos fuel.
6877. Hiertz & Garnett ..... Combustible coal brick.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form of such opposition.

Year 1889.

1676. Bamber.
7233. Thorp & Marsh.
7245. Hollinshead & Griffiths.
7429. De Haer & De Haer.
7627. Chalmers.
7185. Boult (*Page, Bird, & Bird*).
7256. Bour.
7287. Forrest & Sym.
7625. Rawson.
7747. Greene.

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7767. Smith.
7799. Needham, Needham, & Needham.
7978. Upward.
8169. Solvay & Co. (19th October, 1888.)
8667. Brun-Latrige.
8673. Willcox (*Farbenfabriken vormals Friedrich Bayer & Co.*).
8784. Witton.
8805. Clerk.
8970. Grimmett.
9028. Ramsden.
9033. Hyde (*Isaacs*).
9075. Foden.
9087. Lodge.
9182. Graham.
9219. Alexander MacDougall, Elizabeth Christie, & Alexander Watt (Executors of the late George Christie).
9407. Ker.
9640. Crisp.
9758. Prime & Lee.
9811. Anderson, Morrison, & Morrison.
9865. Simmons.
9972. Newnham.
10050. Casson.
10235. Birt.
10350. Pierce.
10379. Bankart.
10426. Greaves.
10437. Parker & Robinson.
10447. Fullford & Van Laun.
10453. Christie (*Simonds*).
10470. Johnson (*Serve*).
10478. Smith.
10490. Bickle.
10495. Sobnnecken.
10537. Street & Ellis.
10554. Parker & Robinson.
10566. Hawksley & Gowers.
10581. Johnson.
10612. Stephen (*Guilfoyle*).
10634. Bull.
10651. Duncan & Latta.
10664. Jacobs (*Jacobs*).
10669. Rowden.
10699. Siemens Brothers & Co., Ld. (*Siemens & Halske*).
10751. Morley & Lacey.
10764. Vogel.
10778. Heald.
10795. Wright, Wright, & Budd.
10895. Manier.
10904. Barber.
11030. Kaldenberg.
11049. Wood.
11152. Frost.
11251. Martin.
11518. Brown.
11722. Woodward.
11838. Thomas Ker.
12007. Martin.
12203. Heald.
13981. Hauberg.
14732. Brown.
14811. Malet.
15227. Sutter (*Jaeggli*).
15832. Wastell & Day.
16496. Monson.
17905. Snowdon.
17510. Everitt.
18848. Child & Emery.
19035. Spiegelberg.
20165. Snellenburg. (13th August, 1889).
7774. Sayer.
7920. Jones, Jones, & Jones.
7966. Snyder.
8082. Rogers.
8478. Walker & Walker.
8651. Wilders & Wilders.
8670. Thompson (*Caldwell*).
8749. Cowley & Lelen.
8750. Willcox (*Farbenfabriken vormals Friedrich Bayer & Co.*).
8945. Johnston.
9011. Downes.
9081. Baumgarten & Baumgarten.
9082. Firth & Robertshaw.
9158. King (*Connelly*).
9183. Sussmann.
9223. Mason.
9261. Midgley.
9276. Gough.
9294. Lake (*Bradley*).
9338. Ingleson.
9361. Newton (*Nobel*).
9501. Taylor.
9747. Balch.
9762. Bushell & Haydon.
9844. Till.
9855. Edwards (*Jansen*).
9869. Boult (*Eastman*).
10000. Deards.
10052. Cleminson.
10340. Clarke.
10352. Brinck & Rehnström.
10402. Schönheyder.
10436. Thomas Duff Pearson.
10440. Bayley.
10452. Otway.
10457. Ritchie.
10471. Johnson (*Serve*).
10482. Thompson (*Günzell*).
10491. Taylor.
10506. Neale.
10540. Cawley.
10556. Gray.
10571. Biebuyck.
10601. Holland.
10615. Brougham (*Spencer*).
10647. Sherrin & Sherrin.
10657. Jones.
10665. Dunsmuir.
10681. Gardner.
10701. Poehl.
10725. Platt.
10742. Hetherington.
10763. De Cou (*Allen & Co.*).
10768. Retzbach.
10781. Curtis & Wain.
10803. Norris.
10813. Pearce.
10898. Booth.
10981. Kennedy.
11038. White & Middleton.
11051. Lamplugh.
11183. Jacoby.
11481. Barbour.
11717. Dickson.
11726. Lawson.
11885. Macleod.
12050. Thompson (*Granger Foundry and Machine Company*).
14755. Watts.
15153. Eastwood & Ambler.
15277. Whitehead.
16369. Orchardson.
17034. Piat.
19129. Bonne (*Meinecke*).
18446. Wilmot.
18885. Gillam.
19654. Doublier.
20321. Green.

1890.

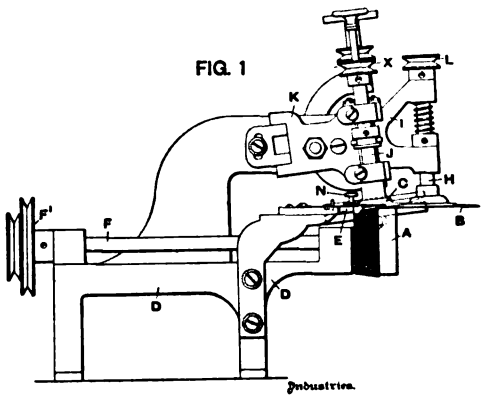
144. Bowdich.
1096. Watson, Gelston, & Weed.
1188. Huelser (*Ritter*).
1479. Thompson (*Crossette*).
1684. Boult (*Bibikov*).
2063. Holecek.
2449. Blakely.
2919. Grob, Schultze, & Niemczik.
3447. Caspar.
3964. Merritt.
4238. Etrich.
4243. Schückher.
4264. Lake (*Howell*).
4287. Guthrie.
4332. Harris.
4364. Bissmire.
4407. McGrew.
4436. Fisher & McLay.
4570. Leng & Leng.
4595. Mitchell.
4664. Clark (*Almond & Freligh*).
4783. Groff.
4820. Judson.
5028. Brown.
5085. Lake (*Green*).
5094. Johnson (*Eagle Pencil Company*).
304. Bishop & Cowan.
1153. Martin.
1185. Hunter.
1398. Phillips.
1594. Wilding.
1871. Fleshman.
2374. Boult (*Dunbar*).
2867. Gessner.
3006. McCants.
3033. Bush.
3466. Justice (*Thompson*).
4215. Westaway & Trelwing.
4261. Thompson (*Dannhorn*).
4274. Crawshaw.
4301. Torre.
4349. Ohmer.
4392. English.
4413. Grell.
4529. Leigh (*Dubault & Chicard*).
4652. Mewburn (*Peck*).
4768. Lundgren.
4772. Nield.
4799. Harrison.
4941. Hardy & Hewins.
5071. Boult (*Child*).
5086. Lake (*Hartford*).
5109. Millar.
5197. Gibbs.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

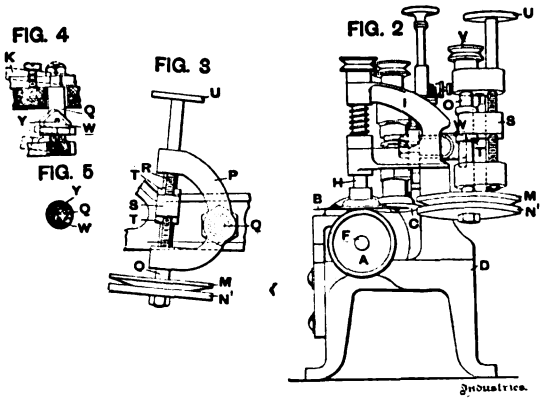
ENGINEERING.

Combined Treadle and Hand Driving Mechanism.—*F. W. Zimer, London.*—Improved means are here described for imparting a rotary motion to the wheels of bicycles, &c. The special object of the invention is to utilise the power of the bicyclist's arms as well as legs. The handle bar of the bicycle is made of the bent form, and so that it can be rotated at its point of attachment by lifting the handles. Below the handle and with one end pivoted to the bicycle frame is a lever. The other end of this lever is connected by a rod to a clutch upon the treadle shaft, whilst the centre part is coupled by a link to a loop secured to the handle bars. By lifting the handles the lever below it is raised, and the rod in connection with the clutch rotates the treadle shaft. The manner of coupling the lever to the handle bar above it is such as to permit the fork frame to be rotated in its bearings for the purpose of steering. This is effected by securing to the centre part of the handle bar a looped rod, part of which is concentric to the axis of the fork frame. The coupling link slides upon this loop, and so is not displaced by turning the frame. The gear may be used for other purposes such as propelling boats, &c. Five claims are made.—No. 7427A. May 3rd, 1889. 8*d*.

Leather-skiving Machines.—*C. E. Lewis, Boston, U.S.A.*—Means are here described for grinding the rotary skiving knives of these machines. The illustrations are:—Fig. 1, a side elevation; Fig. 2, a plan; and Figs. 3, 4, and 5, details of the improved



machine. The parts of the machine, such as the feed roll A, the feed disc B, and the revolving cutter C, are of the usual construction. The grinding mechanism consists of two abrasive discs M N¹, one of which has a feathered or chamfered edge, to present an annular groove or race for the cutter C. The discs are secured to a shaft O, having bearings in a frame P. The frame P is fast to a bolt or rod Q, to which the frame carrying the cutter C is also secured. The rod Q passes through a suitable bearing in the frame of the machine, and can be clamped in any position. By this construction it will be seen that the grinding disc or discs and the knife are simultaneously adjustable. As it is desirable to have the grinding discs act sometimes upon one and sometimes upon the other side of the cutter C, it is made vertically adjustable as shown. The means shown for accom-



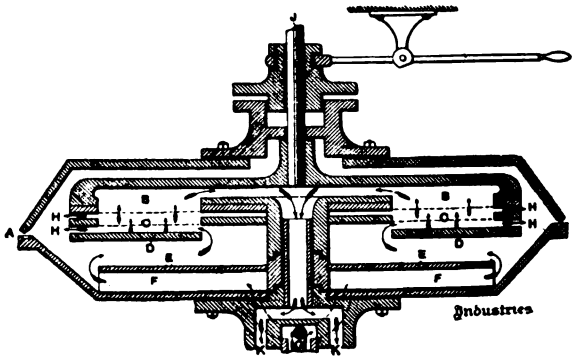
plishing such vertical adjustment consists of a screw R turning in the bracket P. The screw passes through a block S, which embraces the shaft O, so that by turning the screw R the block S will be raised and lowered. The shaft O is revolved by the pulley V. Seven claims are made.—No. 14,439. September 13th, 1889. 8*d*.

Blast Furnace Blocks and Tuyeres.—*J. McCann, Millom, Cumberland.*—The object of this invention is to prolong the operation of the blast in furnaces by a different construction of the blocks and tuyeres. The blocks and tuyeres are constructed so that the greatest flow of water passes round the belly part nearest to the furnace, that being the part subjected to the greatest heat. The tuyere is made in two or more parts. The first part consists of a number of coils of tubing passing round the belly pipe, and the second part of another coil of tubing arranged immediately over that portion of the first nearest to the furnace. The coils of both block and tuyere, in their separate parts, may be arranged to run side by side round the belly pipe until the last coil of the first pipe is reached, when the second part may be raised to overlap the remaining coils of the first. The two or more sets of coils of tubing in both blocks and tuyeres have separate connections with the water supply for cooling them, so that they work independently. Thus, when one set is injured by the heat, the others will continue to keep the belly pipe cool. Five claims are made.—No. 7443. May 4th, 1889. 8*d*.

Furnace Bridge for Boilers.—*B. Darbyshire & J. Entwistle, Bolton.*—The bridge is constructed in sections of terra-cotta or other fire-resisting materials, with an internal air chamber or cavity. Each side of the bridge is provided with openings of any convenient form for the passage of air from the ashpit to and from the internal chamber for the purpose of reducing the temperature of the bridge below that of the fire. The cooling of the bridge minimises the destructive action of the fire and the sticking of clinker. The upper portion of each section is loose to allow of removal to clear the chamber or cavity of dust, &c. Claim: Constructing furnace bridges for steam and other boilers of terra-cotta or other fire-resisting materials in sections, provided with a chamber or cavity and openings as and for the purpose described.—No. 8711. May 27th, 1889. 6*d*.

Lubricators.—*J. Decrance & G. H. Wall, London.*—The lubricator consists of a reservoir for the oil, fitted at its upper part with an oil trap, adapted to be worked intermittently by the attendant when oil is to be fed to the part lubricated. The oil trap is a cylinder, having communication to the working part to be lubricated, and also to the steam supply actuating the working part. A piston in this cylinder can be made by the attendant to close or open these two passages in the cylinder. By suitable connection with the steam supply, the reservoir is provided by condensation with water to take the place of the oil used. The water of condensation falls to the bottom of the reservoir, and forces the oil up to the top of the reservoir and into a part of the cylinder. The oil is thus always under the pressure of the steam in the boiler. By the attendant pushing in the piston the two passages in the cylinder are opened, and the oil in the cylinder trapped and blown out by the steam through the passage leading to the working part. By releasing the handle the parts resume their normal condition, and water of condensation commences to replace the oil just used. Claim: A lubricator having a slide valve mechanism that by a reciprocating movement traps a definite quantity of oil, and gives a flush of water and steam to drive the oil into the part to be lubricated as described.—No. 8715. May 27th, 1889. 8*d*.

Centrifugal Separators.—*W. Hucks, London.*—The separator is for the purpose of separating solids from liquids. The accompanying illustration shows a vertical section of the machine. The parts are enclosed in two circular pans, one inverted over the other, and having a water-tight joint at their circumferences A. Within the chamber formed by these pans is a hollow disc B with inlets and outlets as indicated by the arrows. The disc is secured to the shaft J, and is rotated upon the shaft independently of the chamber. The underside of the disc is covered by wire gauze as indicated by the dotted lines, and by



annular plates C D, C being also fitted with wire gauze. A circular plate E, having vertical radiating blades F, rests horizontally upon the bottom of the chamber. To discharge the accumulated thick matter from the chamber, a lever is provided to lift the top pan from off the lower one, and so form a space through which the matter may escape. The liquid enters the machine at G, passes under the plate E through the wire gauze into the disc, and from the disc is discharged through the passages K. By the rotation of the disc a rotary motion is imparted to the liquid, and through the liquid to the chamber. This centrifugal force keeps the gauze clear and causes the solid matters to collect at the circumference of the chamber. Nine claims are made.—No. 6391. April 15th, 1889. 6d.

Cylinders, &c., of Carding Engines.—*R. Tatham, Rochdale.*—This invention refers to the surfaces of the cylinders, taker-in rollers, doffers, and other rollers of carding engines. The rollers are made of a tube of steel or wrought iron, or of a sheet of metal bent into a cylinder and its adjacent edges secured to each other. The tube or cylinder is provided with arms of steel or wrought iron, by which it is mounted upon its axle; or discs of metal may be used in place of arms. On the surface of the tube or cylinder, strips of wood or lags are secured by bolts to constitute a surface for fastening the carding cloth to the roller. Claims: (1) For use in carding engines for carding cotton, wool, and other fibrous materials, cylinders, taker-in rollers, and other rollers formed of tubes of steel or wrought iron, or of sheets of steel or wrought iron formed into cylinders or tubes, and provided upon their outer surfaces with lags or strips of wood, or sheets, pieces, or strips of leather or other suitable material, and connected by means of arms of steel or wrought iron to bosses which are split or formed in halves or portions, and secured to the axles by bolts; (2) for use in the cylinders, taker-in rollers, and other rollers of carding engines for carding cotton, wool, and other fibrous materials, axles formed of tubes of steel for the purposes described.—No. 7888. May 11th, 1889. 8*d*.

Making Flexible Metallic Tubes.—*F. Walton, Sunbury-on-Thames.*—The apparatus described in this specification is for making the well-known flexible metallic tubes, which consist of a strip of metal wound helically; the strip of metal is corrugated in such a manner that the lips of the successive convolutions lock each other, having between them a strip of caoutchouc or other suitable packing material, to make the jointing sound as well as elastic. On a lathe head, having a revolving mandrel, is fixed a

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face-plate, having on its face three roller frames, the frames being at such an angle as to suit the pitch of the helical tube, and of such height from the face of the plate as to suit different parts of the circumference of the helix. Each frame carries a pressing roller, that can be adjusted to or from the mandrel. The axis of each roller has a pinion gearing with a pinion on the mandrel, the gearing being so proportioned that the circumference of the rollers have the same speed as the circumference of the formed tube. The mandrel and rollers are revolved, and the metal strip, after passing between corrugating rollers, is brought with a strip of the packing material, at the angle suitable to the helix, up to the mandrel, and the two are made to revolve with it, undergoing the pressure of the three oblique rollers by which the convolutions are pressed into shape and caused to interlock with each other. As the tube becomes formed, it is caused by the oblique action of the pressing rollers to be pushed continuously off the mandrel. Claims: (1) In apparatus for making flexible metallic tubes, the combination of a revolving mandrel, a face-plate carrying three adjustable pressing rollers inclined to and driven by the mandrel, a reel with guide eyes for the packing strip, and obliquely-set guide rollers for the corrugated metal strip as described; (2) for corrugating the metal strip above referred to, the combination of a plate slotted to guide the flat strip, a pair of corrugating rollers, and a die-plate formed to turn in the edges of the corrugated strip; (3) for supporting the formed flexible tube as it travels and revolves, a revolving pipe through which the tube passes, and in which it freely rolls.—No. 7906. May 11th, 1889.

PISTON RINGS.—*M. Husbands, Stapleford, Nottinghamshire.*—The piston A has two outer expanding rings B bevelled on their surfaces as shown. These rings are expanded by the action of two inner rings C sliding transversely in the recess of the piston, so that the bevelled surfaces of one pair of rings worked against the bevelled surfaces of the others and force them out. The rings C are forced apart by a spiral spring D. To give the expanding rings B more elasticity they are slotted as shown by E in

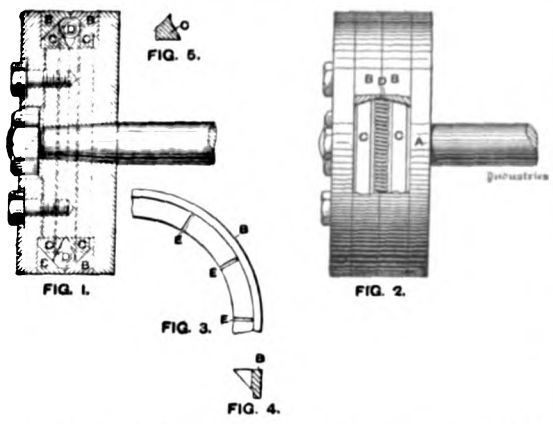
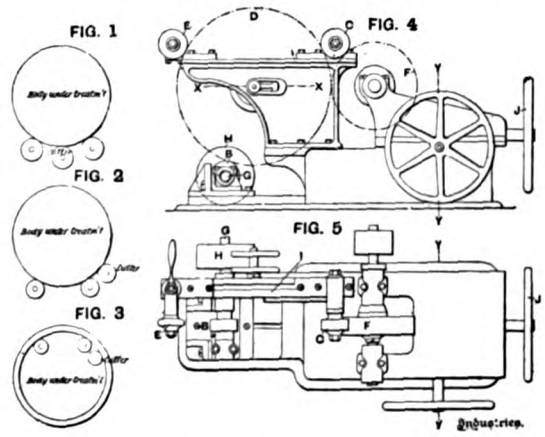


Fig. 3. Claims: (1) In a piston or the like the employment of a ring such as C having outer and inner bevelled surfaces as and for the purpose described; (2) in a piston or the like the combination with the outer expanding rings B of rings such as C provided with inner and outer bevelled surfaces as and for the purpose described; (3) in a piston or the like the combination with rings such as C provided with inner and outer bevelled surfaces of a spring such as D substantially as described and illustrated in the accompanying drawings; (4) in a piston ring having an inclined face such as described the employment of radial cuts or openings such as E as and for the purpose described and illustrated in Figs. 3 and 4; (5) the combination and arrangement of parts forming the complete packing for pistons and the like substantially as herein described and illustrated in Figs. 1 and 2.—No. 9340. June 5th, 1889. 6*d.*

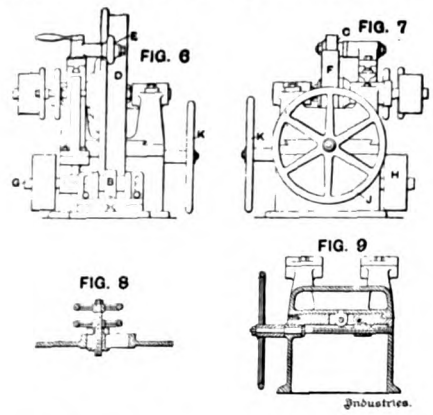
NAVIGABLE VESSELS.—*A. Clerk, London.*—The invention consists in providing the sides and bottom of the hull with longitudinal corrugations or ribs projecting from the surface of the hull so as to be acted on by the rising and falling motions of the waves in such manner that these opposite motions counteract each other. In the practical application of the invention the hull is plated or sheathed with corrugated sheets of metal, or by affixing to the sides and bottom longitudinal ribs of L or T iron, the corrugations or ribs being truly parallel with the line of flotation of the vessel. Claim: The application to ships' hulls of longitudinal ribs or longitudinal corrugated plates, substantially as specified, so as to roughen the outer surface of the hull in the circumferential direction, whilst leaving it smooth in the longitudinal direction, whereby to lessen rolling or rolling and pitching motions without opposing the progress of the hull through the water.—No. 9423. June 6th, 1889. 6*d.*

DIRECT-ACTING STEAM PUMPS.—*W. Holker, Liverpool.*—The class of steam engines here referred to is that in which the valve is worked by means of a rocking lever actuated by a tappet during the strokes of the engine. The engine is fitted with an ordinary slide valve actuated by a T-shaped lever. The lever is pivoted to the cross-head guides like a T reversed, and at the centre of its upright. At the end of the upright the valve rod is connected, and at each end of the cross-piece is a sliding pin. The pins slide in holes whose direction is downwards but towards a vertical line drawn through the centre of the lever; they are pressed downwards by springs, and protrude slightly from the lower surface of the cross-piece. The lower surface of the cross-piece inclines downwards from its centre to its ends, and its ends beyond the sliding pins are also turned slightly downwards. As the cross-head travels backwards and forwards, a pin in it works upon the lower surface of the lever, and, by reason of its inclined surface, rocks the lever and moves the valve. The pin, as it approaches the end of the rocking lever, presses in the sliding pin and at the end of its path comes under the turned-down end of the lever and opens the valve sufficiently to give a lead. The cross-head and its pin then travel backwards, but in passing over the sliding pin this time does not press it backwards by reason of its inclination, but causes the lever to be still further rocked and the valve to be opened full. The valve remains in this position until the cross-head passes the centre of its path; the pin then strikes the other inclined surface of the lever, and rocks it over until the valve is closed and similar operations recommence at the other end. Four claims are made.—No. 8089. May 15th, 1889. 8*d.*

REDUCING BODIES TO A CIRCULAR FORM.—*W. P. Thompson, Liverpool.* (*J. N. Barn, Milwaukee, U.S.A.*)—This invention is based upon the fact that a circle of certain diameter and no other will touch three points in given relation to each other. The machine involves the use of two or more rollers to serve as peripheral supports to the body under operation, and an abrading wheel or cutter located in such relations to the supports as to act on the periphery of the body revolved between them. Two of the rollers represent two of the points, and the abrading wheel the third point, which the body touches simultaneously when



reduced to the proper diameter. In the illustrations are shown Figs. 1, 2, and 3, diagrams of the different arrangement of the cutter and wheels, Fig. 4 a side elevation of a machine, Fig. 5 a plan, Fig. 6 an end elevation, Fig. 7 an opposite end elevation to Fig. 6, and Figs. 8 and 9 sectional details on the lines X X Y Y. Two rollers B C are mounted upon bearings of any suitable character, and support the approximately circular body D to be trued. An emery wheel F is mounted between the rollers to grind the body to the required state. The grinder F and the rollers B C occupy such position that their active surfaces touch a circle of the required size. By this arrangement it follows that the body revolved upon the supports will be reduced by the grinder until it acquires a true circular shape, when the action of the grinder ceases. The rolling support B consists simply of a wheel or pulley carried by a horizontal shaft G, which is driven by the belt pulley H. The rollers C and E have a horizontal adjustment upon the surface I to permit the variation of the

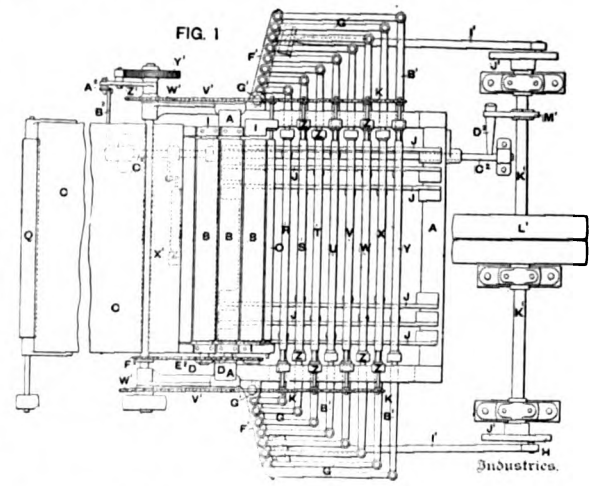


diameters of the bodies treated. The roller E keeps the body against the other rollers and the abrading tool. The tool F has a longitudinal and transverse horizontal sliding adjustment, and is manipulated by the hand-wheel J K. Seven claims are made.—No. 2629. February 18th, 1889. 8*d.*

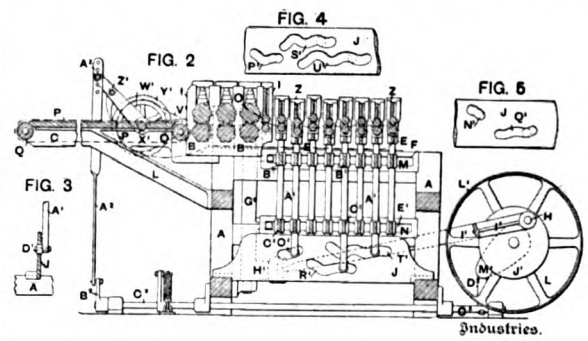
SLIDE VALVES.—*P. Brotherhood, London.*—The object of this invention is to simplify the construction and action of slide valves for steam and other fluid engines, and to obtain a large area of passage for the working fluid consistently with small clearance space in the passages to the cylinder. For these purposes the slide valve is subdivided into a number of separate valves, each in the form of a piston valve governing a circular hole close to the cylinder port. These piston valves are all connected to one operating rod which may be worked by an eccentric or other gear. The valves are arranged radially around the cylinder with their axes parallel to that of the cylinder. They are about the same length as the cylinder, and their ends constitute the valve faces. All the valves are enclosed in the same chamber, to which steam is supplied and surrounds the valves before escaping past their ends to the cylinder. The exhaust takes place through the valves which are made tubular with open ends. Claims: (1) Constructing the slide valve of a steam or other fluid pressure engine in several separate parts, each consisting of two connected pistons working through circular holes close to the cylinder ports, and all the rods of these pistons being connected to the main slide rod; (2) the construction of slide valves for a single cylinder in several separate parts attached to one main slide rod, each part consisting of two connected pistons working through circular holes close to the cylinder ports; (3) the construction of slide valves for a compound engine, the valve for the high-pressure cylinder in several parts, and the valve for the low-pressure cylinder in several other parts, each of these parts being in the form of connected pistons working through circular holes close to the cylinder ports and all these connected pistons being connected to one main slide rod; (4) the construction of slide valves for two cylinders side by side, the slide valve for each cylinder being divided into several parts and all the connected pistons for each cylinder being connected to one main slide rod as described.—No. 3485. March 4th, 1890. 8*d.*

GLASS-LINED TUBE FITTINGS.—*D. Rylands, J. Crowder, & R. Morant, Barnsley, Yorkshire.*—By this invention a T piece is constructed in a convenient and efficient manner with a continuous glass lining. The metal shell or casing of the T piece is composed of ordinary metal piping, the cross-piece being provided with a screwed hole midway between its ends for jointing up the stem piece. The casing so constructed, after being internally coated with glass, may be laid in a mould and metal cast around it to form a strong protecting coat. To line the piece with glass a glass tube of rather smaller external diameter than the internal diameter of the case is inserted in the cross-piece with its ends flush with the ends of the case. The ends of the glass tube are then stopped by corks, one cork having a hole for inserting a tube, and the other cork being pierced by a centre. The centre and tube thus inserted in the corks hold the glass tube and the casing horizontally in a fork-shaped frame. The T piece is now placed over a flame, so that the flame enters the unstopped hole and softens the glass at the joint. When the glass has become softened, air is blown into the glass tube through the tube penetrating the cork, and a hole is blown in the glass to accommodate the third opening. The glass thus blown forms a flange round the inner part of the stem of the T piece. A second piece of glass is now taken and inserted in the stem, and its inner end fused to the flange formed on the first tube. The space between the metal casing and the glass tubes is filled up with a cement or any suitable substance. Four claims are made for the method of constructing glass-lined tube fittings as described.—No. 6750. April 20th, 1889. 8*d.*

MACHINES FOR TREATING FLAX, &c.—*A. Spiegelberg, Dundee.*—The object of this invention is to substitute for the ordinary scutching process machinery that will act in a superior and more expeditious manner. The flax is passed through a series of



rollers, having, besides a rotary, a vertical and horizontal movement. Fig. 1 of the illustrations is a plan, and Fig. 2 a longitudinal sectional illustration of this machine. Figs. 3, 4, and 5 are details of the machine. Upon the upper part of the framing A are three pairs of preparatory pressing rollers B. Beyond the pressing rollers is a feed-table C, having an endless feed-apron P, which feeds the flax to the rollers B. The flax, after passing the rollers B, enters successively between eight pairs of breaking rollers, R to Y, which are horizontally and vertically reciprocated. Each pair of these breaking rollers is carried by a transverse bar, supported in spring bearings Z in the vertical rods A^1. The vertical rods A^1 give the breaking rollers their vertical motion, the ends of the rods carrying bowls which work in the slots of a cam-plate J. The ends of the rods supporting the breaking rollers are connected to horizontal rods G, which are pivoted to a lever F^1. The lever F^1 is fast to a spindle in the frame G^1, and receives an oscillating motion from the crank pin H of the plate J^1. The rollers are driven by endless chains V^1 and E^2, to which motion is transmitted from the driving shaft K^1, through the ratchet wheel Y^1 and the shaft X^1. By this arrangement



the breaking rollers, as they are moved longitudinally by the levers F^1, are also moved vertically by the bowls running in the slots of the plates J. From the nature of the connections it will be seen that the vertical and horizontal movements of the breaking rollers are of varying speeds. Claims: (1) The combination of parts constituting the improved machine for breaking or treating flax and similar textile materials as described; (2) for breaking or treating flax and similar textile materials, combining a number of pairs of nipping rollers, through which the materials are moved progressively with mechanism imparting to such pairs of rollers longitudinal and vertical reciprocations.—No. 7031. April 27th, 1889. 8*d.*

HOT WATER COILS.—*W. G. Cannon, London.*—In a previous specification the inventor has described a form of coil for heating purposes; the present invention is an improved form to facilitate the erecting and detaching of the parts. The coil or heater is composed of two longitudinal box-like vessels, one to form the top and the other the bottom of the heater. These vessels are

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provided with a series of holes or sockets upon their sides, arranged in a straight line, and those in the top chamber corresponding with those in the lower. Cast-iron tubular pieces connect these two chambers. They have cast upon the back of their upper and lower ends, and at right angles to their lengths, short tubular pieces, which fit the holes or sockets in the longitudinal box-like vessels. The short tubular pieces are surrounded by rubber rings or other packing material previously to being inserted, and they are held firmly in their sockets by a bolt passing through each end of the tubular chamber through the longitudinal vessel, and an opposite tubular chamber upon the other side of the vessel. Claims: (1) In steam and hot water coils or radiators of the above description, the improved construction of pipes whereby the junctions are made vertical for the purpose of facilitating the setting up, removal, or renewal of one or more vertical pipes, without disturbing the remainder; (2) in combination with steam and hot water coils or radiators of the above description, the improved air chambers, whereby fresh air is introduced to the apartment and warmed by contact with the heated pipes; (3) the general construction of the several and respective parts together constituting the improvements in the construction of steam and hot water coils or radiators, and in the utilisation of the same for warming and ventilating.—No. 7684. May 8th, 1889. 8*d*.

ELECTRICITY.

GALVANOMETERS.—*F. V. Andersen, Catford, Kent.*—This instrument has a comparatively long and consequently powerful magnetic needle which is suspended within the deflecting coils in such a manner that the coils intercept practically all the magnetic lines of the needle in whatever position it takes. A long indicating needle is mounted upon an axis making a small angle with the magnetic or longitudinal axis of the needle. The magnetic needle may be either a permanent magnet or magnetised by special coils. In the accompanying illustration, Fig. 1 is a vertical section of the instrument; Fig. 2, a plan; Fig. 3, a method of winding the deflecting coil when the instrument is used for measuring the differences of potential between points of electric circuits; Figs. 4 and 5, another method when used for measuring the resist-

FIG. 1

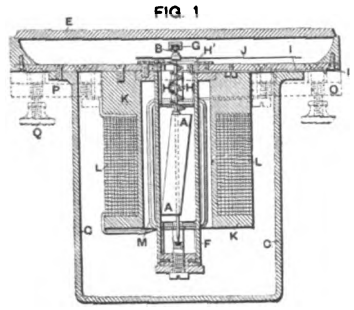


FIG. 4

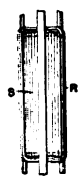


FIG. 5



FIG. 2

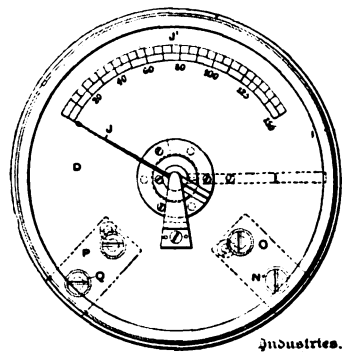


FIG. 3



ance of an electric circuit. The needle is composed of a thin blade A, of soft iron, to which is secured a non-magnetic spindle B, making a small angle with the direction of length of the needle. The instrument is enclosed in a metal case C, preferably of cast iron. In the centre of the case is attached to its cover D a tube F of non-magnetic metal. Within the tube F the magnet is pivoted. A spiral spring H is attached by its lower end to the magnet spindle, and at its upper end to a movable ring H¹. By a lever I the ring H¹ can be turned to adjust the indicating needle secured to the top end of the spindle. The coils for exciting the needle are wound upon an insulating reed K surrounding the needle. The deflecting coils M are wound upon the tube F. The circuit of the instrument is from the terminal N, through the plate O, deflecting coils M, exciting coils L, and plate P to the terminal Q. When the instrument is used to indicate difference of potential, the terminals N and O are connected to the points of the circuit, and the needle is deflected against the resistance of the spring H. The amount of deflection is indicated by the pointer J on the scale J¹, which is suitably graduated to read the difference of potential in volts. When the instrument is required to measure the resistance of a circuit or of a portion of a circuit the tube F is wound with two sets of coils R S arranged at right angles to one another as clearly shown in Figs. 4 and 5. One of these coils, say, R, is put in the circuit in series with the resistance to be measured, and the other coils S and the exciting coils L are arranged in series as a shunt to the resistance. In this arrangement the spring H is dispensed with. The deflection of the needle to either side of its symmetrical position with respect to the coils R S will be indicated on the scale J¹, which is then suitably graduated to read ohms. Four claims are made.—No. 5010. March 22nd, 1889. 8*d*.

ELECTRIC CUT-OUTS.—*W. J. S. Barber-Starkey, Bridgnorth, Shropshire.*—An automatic cut-out constructed according to these improvements is intended to open a circuit when the pressure on it exceeds or is in defect of a predetermined range of voltage. In carrying out the invention a small magneto or electro motor is included in a high resistance shunt from the dynamo or mains. By means of stops or equivalent devices the possible angular motion of the armature of the motor is limited, so that it does not rotate continuously when its circuit is closed. The spindle of the armature is geared or connected with a switch for opening and closing the main circuit. In the apparatus represented in Figs. 1 and 2 the electro field magnets and armatures should be wound

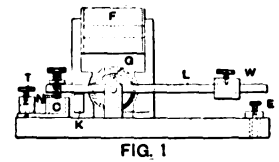


FIG. 1



FIG. 3

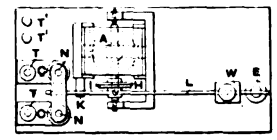


FIG. 2

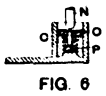


FIG. 6

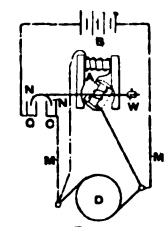


FIG. 4

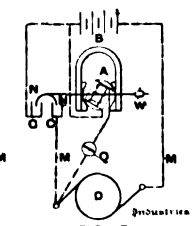


FIG. 5

in shunt with high resistance wire so as to employ only as much of the current as will be effective for the operation of the motor at the determined pressure. A lever L is connected with the spindle of the armature, and carries two prongs N N, which have adjustable screws as indicated. On the other end of the lever is a weight W which may be adjusted at any desired part of the lever between the motor and the end of the lever. The angular position of the armature relatively to that of the lever L may be adjusted by the screw G. The mercury cups O are insulated from each other, and are respectively electrically connected with the two terminals T T, which are in turn electrically connected with the two ends of the main cable or conductor which is to be opened or closed by the apparatus. Assuming that the terminals T T are connected with the main circuit and the terminals T¹ T¹ with the shunt and motor circuit, and that the lever rests with its weighted end on the stop E so that the prongs N N are out of the mercury cups C, when the e.m.f. in the dynamo circuit M M reaches a predetermined amount, the intensity of the magnetic field just suffices to enable the armature to rotate in opposition to the tendency of the weight W. The movement of the armature once commenced it increases rapidly, and the prongs N N are forced down into the cups, thus completing the main circuit. The apparatus may be joined up as represented diagrammatically in Figs. 4 and 5. In Fig. 4 it is joined in shunt to the dynamo terminals, and in this case the e.m.f. actuating the apparatus is that of the dynamo D. In Fig. 5 one of the terminals of the apparatus is joined to one of the poles of the dynamo D and

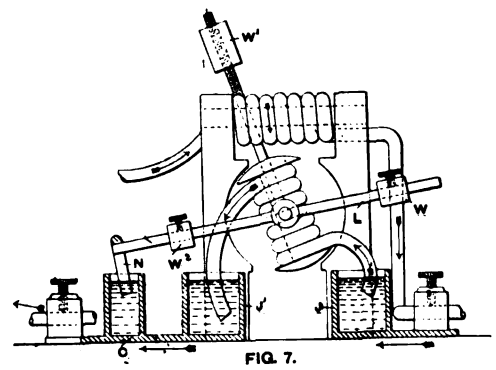


FIG. 7.

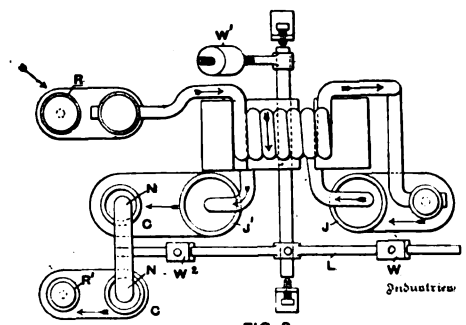


FIG. 8.

the other to the corresponding pole of the secondary battery or accumulator B which is being charged or is in circuit with the dynamo. When the apparatus is employed as a main circuit cut-out it is preferably constructed as shown in Figs. 7 and 8. The armature is wound with a conductor having a sufficient cross section to carry the main current safely. The current enters at the terminal R, traverses the field magnet coil, the mercury cup J, the armature coils, the mercury cup J¹, and the two mercury contact cups C C to the terminal R¹. The lever L, the prongs N N, and the mercury cups C C may be constructed and arranged as described with reference to Figs. 1 and 2. If the current exceeds a certain predetermined amount, the motion of the armature breaks the main circuit. Seven claims are made.—No. 8493. May 22nd, 1889. 8*d*.

FOG SIGNALS.—*F. A. Harvey & M. E. Brooke, London.*—Two metal lines are placed between and parallel to the rails. These lines are in connection with an electric bell and battery and a switch situated in the signal box. To the under part of the locomotive are secured two metal wheels or discs arranged to travel over in electrical contact with the two metal lines. The wheels are supported in brackets made to slide in cylinders, and are pressed downwards by coiled springs. The two wheels are electrically connected with an electric bell fixed in the cab of the engine. The electric circuit being connected by the switch in the signal box, the wheels as they travel over the metal lines complete the circuit, and the bells ring simultaneously in the engine cab and the signal box. Claims: (1) The combination with two lines of insulated metal in electrical connection with the signal box of wheels carried by the engine and bearing upon the insulated lines completing the electric circuit through the engine as described; (2) in apparatus such as referred to in claim (1) mounting the wheels upon pistons working in cylinders and pressed downwards by springs; (3) electric fog signalling apparatus for railways as described.—No. 9066. May 31st, 1889. 6*d*.

BEARINGS.—*H. J. Elliott, London.*—This specification describes a small appliance for giving warning of the over-heating of bearings, &c. In a small cylindrical box is arranged a short metal rod concentric with the axis of the box. The box is screwed to the bearing or part whose overheating it is to give warning of. One end of the rod is supported in an insulated socket at one end of the box, and the other end presses against an intercepting block of insulating material at the other end of the box. The insulating material is of such a nature as to liquefy when the part of the case enclosing it becomes heated to a certain extent. The wire is included in an electric circuit that works an alarum, and completes the circuit when the insulating material melts, by being pressed in contact with the metal case also included in the circuit. Claim: The combination of means as described, whereby a piece of shellac, gutta percha, sealing or paraffin wax, or some similar material or combination of two or more of them, liquefying by heat, or a disc of fusible alloy melting at a low temperature mounted in an insulating ring, so as not to touch the bottom or the sides of box, is interposed between the point of a spring wire and the metal box, and consequently with the battery, the softening or melting of which allows the completion of circuit with electric bell and indicator.—No. 9423. June 6th, 1889. 6*d*.

ELECTRO-MECHANICAL MOVEMENTS.—*S. E. Nutting, Chicago, U.S.A.*—The object of this invention is to construct an electro-mechanical movement that will be proportional at all times to the quantity of the electric current. In one form of this invention, where the motion to be regulated is the descent of a weight, the weight is suspended by a cord wound upon a sheave. Attached to one side of the sheave is a disc composed of beeswax, tallow, stearine, or other softenable substances. As the weight descends the sheave and disc of beeswax rotate. Through the disc a wire is passed at right angles to its face and close to its periphery. This wire prevents the disc rotating until the wire is sufficiently heated by the electric current to melt the wax. As the current increases the wax melts with greater rapidity, and the weight descends faster; upon a decrease in the current the action is reversed. In another form of apparatus the wire heated by the electric current is made to pass through the length of a stick of beeswax enclosed in a tube. The tube is slotted upon diametrically opposite sides for the wire to pass through.—No. 2234. February 11th, 1890. 8*d*.

CHEMISTRY.

ALLOYS OF ALUMINIUM—*G. Bamberg, London.*—The inventor obtains alloys of aluminium with iron or copper by first melting down the iron or copper, and acting upon it with an air blast in a similar manner to the Bessemer process, for the purpose both of removing impurities and raising the heat of the metal to a high degree by the combustion of the carbon and silicon contained therein. Vapours of chloride of aluminium or of double chloride of aluminium and sodium are then injected, or such materials in a fine state of division, which when exposed to the temperature of fused iron or copper shall produce vapours of chloride or double chloride. The molten iron or copper at a very high heat will decompose the chlorides of aluminium, producing chloride of iron or copper, which pass off as vapour, while the liberated aluminium, being in a nascent state, combines intimately with the fluid metal. Claim: Producing alloys of aluminium with iron or copper, by first melting down the iron or copper, and, after raising its temperature to a high degree by the injection of air blast, injecting into the same vapours of aluminic chloride or of the double chloride of aluminium and sodium, or of materials that will produce such chlorides when subjected to the heat of the molten iron or copper, substantially as herein described.—No. 7666. May 8th 1889. 4*d*.

MISCELLANEOUS.

HEMP ROPES.—*M. H. Tomkins, London.*—European hemp and Manilla hemp have different qualities. Thus the European hemp is as strong or stronger than the Manilla, whereas the Manilla is better able to resist friction. To make use of these qualities in the manufacture of rope, the inventor makes the core of European hemp and covers it with Manilla. In combining the yarns of these two hemps to form strands, a machine of the ordinary construction is used, and two guide plates are used set at five feet apart. The yarns are threaded through the plates on their way to be twisted into a strand. The two kinds of hemp yarns are threaded through these plates so that the one is covered by the other as the strand is formed. Claim: The manufacture of ropes from compound strands prepared from different qualities of hemp in the manner described.—No. 8951. May 22nd, 1889. 8*d*.

Copies of the British specifications may be obtained on application to H. READER LACK, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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IMPROVED SLOTTING MACHINE.

We illustrate herewith a powerful slotting machine made by Messrs. Crooks, Roberts, & Co., Argus Works, Sheffield, for Messrs. Joseph Ashforth & Co., Ld., Bruce Works, and designed by Mr. Thomas Peregrine Hill. The machine weighs about seven tons, and will take in a casting 8ft. diameter and 20in. deep. It has a 16in. stroke, and is fitted with a cast steel quick return arrangement. The ram is cast of a strong box-section shape, and planed out to take in 2in. round or square steel tools. It is driven by a four-speed cone capable of carrying a 3¾in. belt, and has double-geared cast steel back gear. A suitable fly-wheel is keyed to the main spindle, so that a good cut can be taken without the back gear being used. The body and bed of the machine are cast separately and jointed by planed surfaces. At each side, and also in front, heavy lugs are cast to receive strong iron hoops, which are shrunk on. The compound table is fitted up as usual, but is also supplied with extra deep and strong slides. The feed motion is obtained by an arrangement due to Mr. Wm. Wares, which feeds when the ram is at its highest point. All the wearing surfaces are case-hardened, and in every way the workmanship is good. Messrs. Ashforth have already tested the machine by using it for the blades and boss of a 10-ton propeller for a screw gunboat.

ON THE CRITICAL POINTS OF IRON AND STEEL.*

If iron and steel are submitted to a gradual heating or to a slow cooling between the ordinary temperature and that of fusion, and if the variations of some physical property in relation to the temperature are followed, it will be seen that these variations, besides being subject to a constant law, present remarkable phenomena at certain critical temperatures. In order to find in scientific literature the first reference to these anomalies it is necessary to go back to Gilbert, who discovered in 1600 that when a magnet is heated to redness it loses all traces of magnetism. It is, however, not my intention to refer here to the history of the question. This has been admirably summarised by Professor Roberts-Austen, in a lecture delivered at the Newcastle meeting of the British Association in 1889. I will merely give at the end of this paper a list of original memoirs which have been published, to my knowledge, during the last twenty years, and in which English science, represented by Gore, Barrett, Tait, Tomlinson, Hopkinson, and others, has taken a considerable part. When I commenced, in October, 1886, to study the critical points of iron, a certain number of important facts were already known. But as the first experimenters did not possess the means of accurately determining high temperatures, and as they did not, as a rule, make analyses of their samples, it was difficult to make a comparison of their results, and to decide what was the share of iron and of carbon respectively in the results observed. It was, therefore, necessary to collate the known facts rather than to discover new ones. This is what I propose to do in determining as accurately as possible the position of the critical points, their causes, and their relations to each other.

It was known at the commencement of the research that the phenomena to be studied were the results of either chemical reactions or allotropic changes, or both. But as all these phenomena are indicated by a liberation or absorption of heat, I thought that the classic method of cooling would be the most suitable for my purpose. A series of samples of suitable chemical composition were heated to a known temperature, and accurate measurements were made, during their cooling, of the time required for the temperature to be lowered an equal number of degrees. Every abnormal delay or acceleration in the fall of the thermometer should indicate a liberation or an absorption of heat, or, in other words, a critical point. The measurement of the time presented no difficulty. This was not the case with the measurement of the temperature. I was fortunate enough, however, to be able to employ the thermo-electric pyrometer, which has recently been devised by M. H. Le Chatelier, and which proved to be thoroughly well adapted for my researches. This apparatus is made by Carpentier, 20, Rue Delambre, Paris, and is described in the *Journal de Physique*, Vol. VI., January, 1887, and in the *Génie Civil*, 5th March, 1887. Le Chatelier's couple is formed of a wire of pure fused platinum and a wire of platinum alloyed with 10 per cent. of rhodium, fastened together at one end. The opposite ends, maintained at a constant temperature, are connected by means of copper conductors to the aperiodic mirror galvanometer of Messrs. Deprez and D'Arsonval. The apparatus is first calibrated by means of well-known melting and boiling points. The melting-point of potassium sulphate (1,015° C.) and the boiling-point of ammonium chloride (340° C.) are particularly well adapted for the purpose. It may be assumed that between these two points, and for higher temperatures up to 1,500° C., the temperature is proportional to the electromotive force of the couple, and to the deviation from zero of the spot of light from the mirror on the graduated scale of the galvanometer. This having been arranged, the experiment is conducted in the following manner.

The metals to be studied have the form of round or square bars, 5 to 7 millimetres (0·2in. to 0·28in.) in diameter or side, and at one of the ends of the bar F a small recess is filed or ground, according to the hardness of the metal, of a shape suitable for soldering the thermo-electric couple. (See Fig. 2, page 482.) A piece F′ of the same metal, 3 to 4 centimetres (1·18in. to 1·575in.) in length, and prepared in the same way, was brought over the couple, placed in position in such a way that the junction was squeezed between the rods F and F′, or the whole was firmly bound up with iron wire. (See Fig. 3.) Fig. 1 is a diagrammatic sketch of the complete installation shown in plan. The rod F is introduced into a porcelain tube in such a way that the connection may be placed in the centre of the furnace S. The platinum and platinum-rhodium wires are isolated by clay tubes. The porcelain tube is closed at both ends with cork, and through one the rod and the wires of the couple are passed. Air is thus prevented from freely circulating in the tube, and under these conditions the oxidation is very slight, so that the same rod may be submitted without appreciable alteration to a large number of successive heatings and coolings. The ends of the wires of the couples soldered to the copper conductors are placed in two test tubes filled with alcohol, and inserted in a water bath E, the temperature of which is that of the cold joint. G represents the galvanometer with its mirror *m*, L is the lamp, R the graduated scale with its reflector M. The dotted line LM*m* indicates the path of a ray of light sent by the lamp to M, reflected from M on to *m*, and thence on to the scale. In order to conduct an experiment, the furnace is heated to the desired temperature. When this temperature is obtained, the gas is extinguished, the whole system is allowed to cool spontaneously, and with the aid of a chronograph the moment at which the index passes across each of the divisions of the scale is noted. The error in reading amounts at most to one-twentieth of the time that elapses between two successive pointings. In order to represent the results graphically, I take the temperatures as abscissæ, and, as ordinates, the times included between the passages of the index over two consecutive divisions of the scale. These divisions are shown in the diagrams accompanying this paper by the ordinates of the corresponding temperatures, and the point representing the time occupied between two pointings is placed in the middle of the interval. A retardation or arrestation (*relentissement*) in the fall of temperature will thus be shown by a sharp point, and a delay in the cooling by a bulge in the curve—a bulge of which the area is proportional to the quantity of heat liberated.

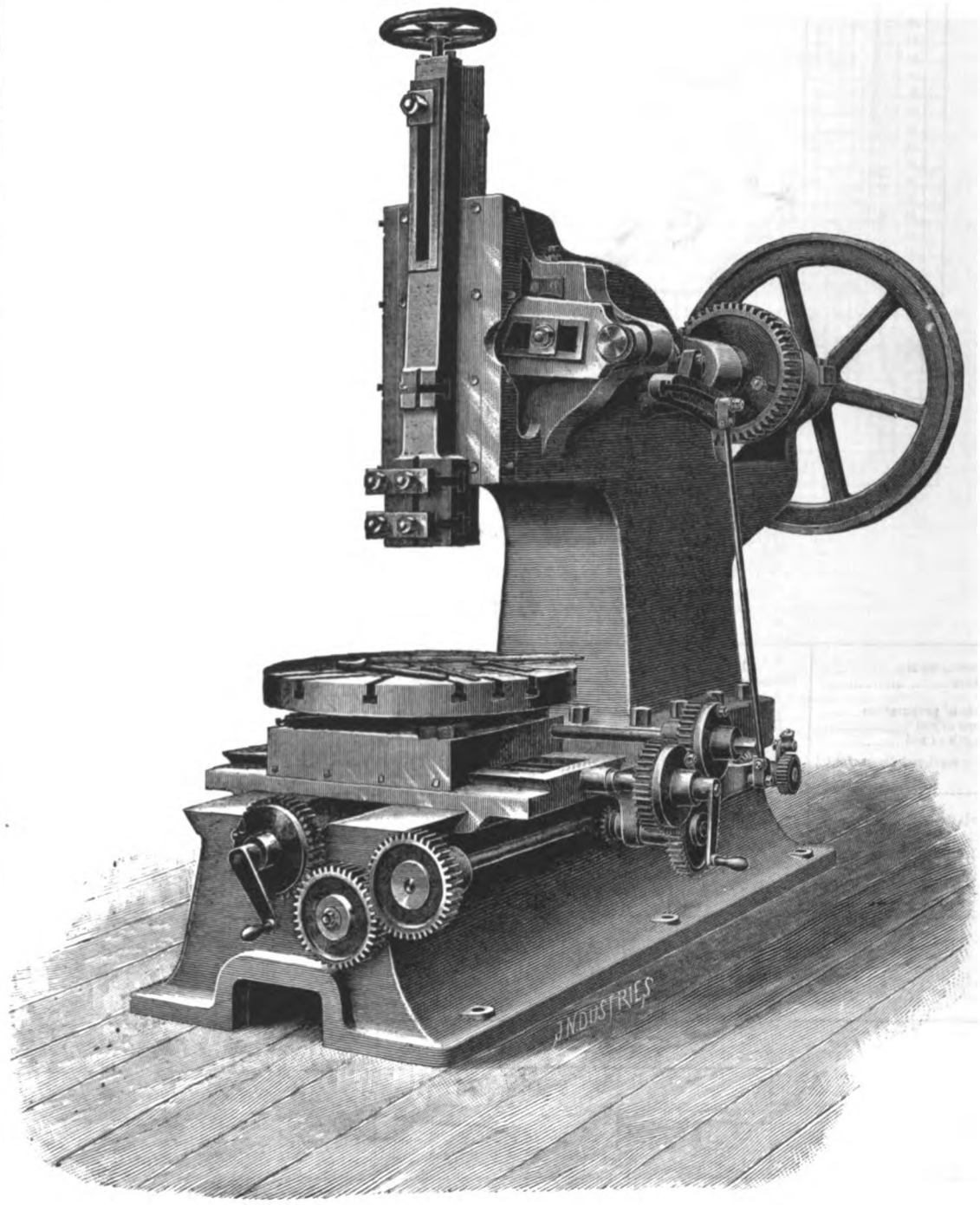
(A) Phenomena Observed during the Slow Cooling of Iron, Steel, and White Pig Iron between 1,100° C. and 600° C.—I shall first study a series of samples with an increasing proportion of carbon, the other constituents remaining, as far as possible, in low and but slightly varying proportions. Table I., on the next page, shows the results of analyses of the samples.

For convenience in describing and discussing the phenomena observed, I shall designate by the letter *a*, with Tchernoff, the critical points that are associated with the hardening of steel. But, as my experiments show that the point *a* of Tchernoff is not a single point, and that there may exist several adjacent critical points of different natures, I shall term these different points a_1, a_2, a_3, of which a_1 is applied to the perturbation produced at the lowest temperature. As, too, the same perturbation is not distinctly developed at the same temperature when the thermometer rises as when it falls, it will be necessary to distinguish a critical point, a_{r1} for example, observed during cooling (*refroidissement*), and the corresponding point a_{c1} observed during the heating (*chauffage*). In this notation *a* indicates the critical point; *r*, *refroidissement*; *c*, *chauffage*, and the numbers the positions in the thermometric scale. A symbol such as $a_{r(1\text{-}2)}$ will indicate that in the sample under consideration the two points a_{r1} and a_{r2} are combined into a single one. A symbol such as a_{r1}/m will indicate that the perturbation a_{r1} is incomplete. Besides the points *a*, there are in grey pig irons other critical points due to the successive solidification of different constituents. These points, perhaps, have their analogues, although very indistinctly marked, in steels. But even admitting that the existence of these small perturbations is certain, and although their theoretical and practical importance might be considerable, their true nature is hypothetical, and it seems to me preferable to neglect them for the present. Lastly.

* Paper read by Monsieur F. Osmond, of Paris, before the Iron and Steel Institute on the 8th inst.

IMPROVED SLOTTING MACHINE.

Constructed by Messrs Crooks, Roberts, & Co., Argus Works, Sheffield.



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THE CRITICAL POINTS OF IRON AND STEEL.

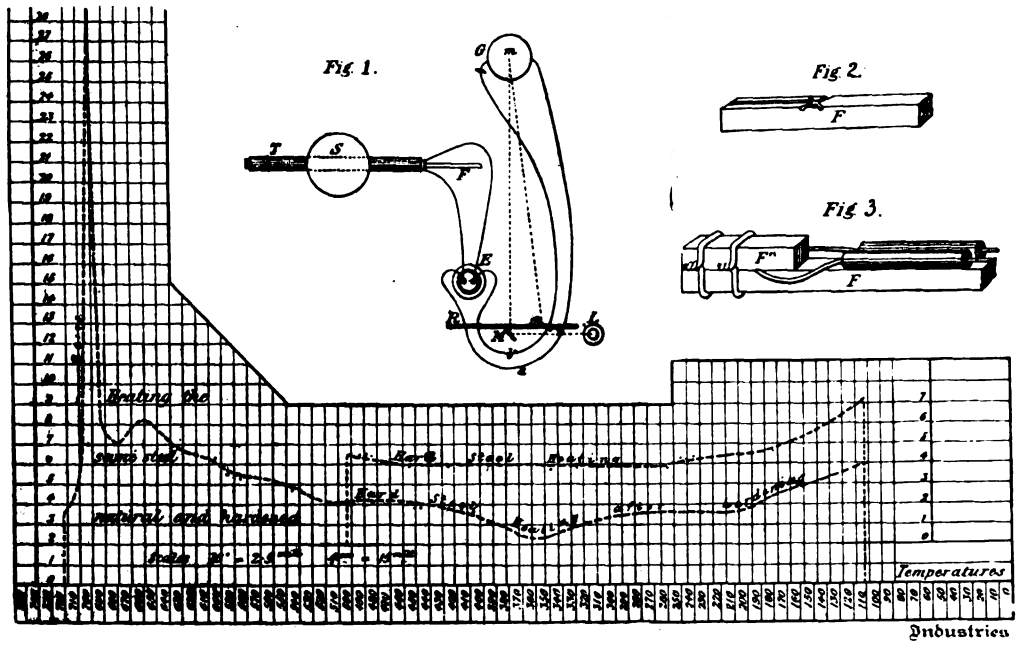


FIG. 4.

TABLE I.

Consecutive No. / Nature / Mode of preparation / Shape of rod / Length of rod / Cross sectional dimensions	1. Electrolytic iron. — Rectangular. 25 cm. (9·8 in.). 10×4 mm. (0·39×0·16 in.).	2 Extra mild steel, basic open-hearth. Forged. Circular. 60 cm. (23·6 in.). 6 mm. (0·24 in.).	3. Mild steel, basic Bessemer. Forged. Circular. 60 cm. (23·6 in.). 5 mm. (0·20 in.).	4. Medium steel, acid open-hearth. Forged. Circular. 60 cm. (23·6 in.). 6 mm. (0·24 in.).	5. Hard steel, crucible. Forged. Circular. 40 cm. (15·7 in). 6 mm. (0·24 in).	6. Swedish white pig iron. Cast. Square. 40 cm. (15·7 in.). 6½×6½ mm. (0·26×0·26 in.).
Carbon	0·08	0·160	0·290	0·570	1 250	4·100
Silicon	—	0·012	0·060	0·085	0·190	0·220
Sulphur	—	0·021	0·060	0·020	0·020	0·040
Phosphorus	—	0·029	0·052	0·050	0·021	0·018
Manganese	—	0·110	0·270	0·230	0·100	0·120

TABLE II.

Cooling.	Medium Steel. Duration of Cooling between 685° C. and 658° C.	Medium Steel. Recalescence a_{r1}. The Thermometer Stops at	Medium Steel. Recalescence a_{r1}. The Thermometer Rises at	Hard Steel. Duration of Cooling between 706° C. and 678° C.	Hard Steel. Recalescence $a_{r(3\text{-}2\text{-}1)}$. The Thermometer Stops at	Hard Steel. Recalescence $a_{r(3\text{-}2\text{-}1)}$. The Thermometer Rises at
	Seconds.			Seconds.		
Slow in tube	116·0	653° C.	656° C.	49	671° C.	675° C.
Ordinary in tube	24·5	648° C.	655° C.	20	670° C.	680° C.
Rapid in air	not determined	637° C.	640° C.	not determined	642° C.	651° C.
Very rapid in water	,,	absent	absent	,,	absent	absent

TABLE III.

—	a_3. Limit.	a_3. Maximum.	a_3. Limit.	a_2. Limit.	a_2. Maximum.	a_2. Limit.	a_1. Limit.	a_1. Maximum.	a_1. Limit.
Electrolytic iron: cooling	855°	855°	855°	750°	733°-705°	690°	Doubtful. Absent.		
,, ,, heating	900°	867°	840°	730°	720°	710°			
Extra mild steel: cooling	845°	822°	800°	755°	730°	710°	680°	668°	645°
,, ,, heating	92°	900°-864°	835°	755°	725°	?	—	590°?	—
Medium steel: cooling				750°	695°	united		661°	645°
,, ,, heating							720°	705°	690°
Hard steel: cooling							720°	674°	645°
,, ,, heating							720°	705°	700°

as certain terms may be interpreted differently, it is advisable to accurately define the sense in which I employ them. I apply the term *hardened steel* (*acier trempé*) to steel that has been rapidly cooled from a red heat. *Annealed steel* (*acier recuit*) is steel that has been heated to a red heat and cooled slowly. *Tempered steel* (*acier revenu*) is steel that, after hardening, has been softened, more or less, by reheating to a temperature far short of that to which it was raised before hardening. Having decided on the symbols to be adopted, I shall now pass to a description of the facts. (See Fig. 5.)

Sample No. 1, *Electrolytic Iron.*—Strip cut from a plate and annealed at a cherry-red heat in hydrogen before testing, in order to expel occluded hydrogen. Contrary to expectations, this electrolytic iron was found to contain a little carbon (0·08 per cent.), the presence of which has been verified by two different methods of analysis. Notwithstanding this, of all the metals examined, this iron approaches most closely to a state of absolute purity. During the cooling, the thermometer stops abruptly at 885° C., and makes a prolonged stay a_{r3} at this temperature. It then resumes, also abruptly, its downward course. A gradual arrest in the fall of temperature, commencing at 750° C., presents its first principal maximum between 737° C. and 730° C., its second subsidiary maximum between 708° C. and 702° C., and ends at about 690° C. Lastly, a final arrest a_{r1} is produced at about 660° C.; but it is almost imperceptible, and it might be confounded with experimental errors were it not found again, considerably amplified, in steel.

Sample No. 2, *Extra-Mild Steel.*—The course of the cooling presents three arrests, all of which are gradual, and their phases are as follows:—

	Commencement.	Maximum between.		Conclusion.
a_{r3}	845° C.	825°-819° C.	...	800° C.
a_{r2}	755° C.	736°-725° C.	...	710° C.
a_{r1}	680° C.	662°-655° C.	...	645° C.

Sample No. 3, *Mild Steel.*—There are two arrests in the fall of temperature:—

	Commencement.	Maximum between.		Conclusion.
$a_{r(3\text{-}2)}$	780° C.	721°-715° C.	...	690° C.
a_{r1}	680° C.	660° C.	...	640° C.

Sample No 4, *Medium Steel.*—There is one gradual arrest and one stay. The arrest $a_{r(3\text{-}2)}$ commences at about 750° C., reaches its maximum between 700° C. and 690° C., and before being completely terminated halts at the station a_{r1} at 661° C.

Sample No. 5, *Hard Steel.*—The slight arrest in the cooling a_{r3}/m, which is directly produced at about 860° C., in the curve given as example, is exceptional for the steel examined. It is an accidental fact which it was found advisable to note. The characteristic of hard steel is a single break of long duration $a_{r(3\text{-}2\text{-}1)}$, at 674° C. The stay is accompanied by an arrest in the fall of temperature which precedes and follows it, but uniting with it (commencement at 720° C., end at 645° C.).

Sample No. 6, *White Pig Iron.*—Solidification point 1,085° C. The critical points of steels are represented by a single stay, $a_{r(3\text{-}2\text{-}1)}/m$, which is exhibited at 695° C., and which unites in a continuous manner with an arrest commencing at about 710° C. and ending at about 660° C.

We are now enabled to discuss these results, which are all plotted in Fig. 5. A glance at the superimposed curves shows that the station a_{r1} goes on increasing from the electrolytic iron, where it is almost *nil*, up to the hardest steel, where it assumes enormous importance. Thus, a is a function of the proportion of carbon, and it may at once be identified with the phenomenon to which Barrett, who discovered it in 1873, applied the name of *recalescence*. Nevertheless, in the examples I have given the temperature remains nearly stationary, and does not rise as it did in Professor Barrett's experiments. This difference is unimportant. For the same steel it is possible to have indifferently recalescence, stay, or simple retard, according to the relative velocities of the cooling and of the reaction which liberates the heat, the reaction itself being more or less rapid according to whether it was more or less retarded. These phenomena are analogous to those of surfusion. The cause of the liberation of heat, which takes place at a_{r1}, may easily be determined. Indeed, Brinell's researches have shown that the carbon of steel is in the state of *hardening carbon* (*carbone de trempe*) below a_{r1}, and that it is in the state of *cement carbon* (*carbone de cémentation*) above that temperature. Thus, the recalescence a_{r1} represents the change of hardening carbon into cement carbon, and this change is effected with a violent evolution of heat. It is known, too, from the researches of Dr. Müller (*Zeitschrift des Vereines deutscher Ingenieure*, Vol. XXII., p. 385; *Stahl und Eisen*, Vol. VIII., p. 291) in Germany, of Sir Frederick Abel and Mr. Deering (*Institution of Mechanical Engineers' Proceedings*, 1885, p. 30) in England, and of Messrs. Osmond and Werth (*Annales des Mines*, 8th Series, 1885, Vol. VIII., pp. 5–84) in France, that cement carbon, termed also *carbide carbon* (*carbone de recuit*), is combined with the iron in the form of a compound probably having the definite composition Fe_3C. The true state of the hardening carbon is less accurately known, but it appears probable that it is that of free carbon simply dissolved in the iron, or perhaps that of hydrocarbon. Thus a new and more precise definition of recalescence may be given as follows:—*The liberation of heat which produces recalescence is the result of the chemical combination of the iron with the carbon; and conversely the absorption of heat during heating a_{r1} corresponds to the dissociation of the carbide Fe_3C, a compound which is stable at low temperatures.* It is in this way that carbonic anhydride and lime combine or separate, according as the temperature is lower or higher than the dissociation-point of calcium carbonate. This explanation, which I believe to be in accord with that of Sir Frederick Abel, merely brings the compounds of iron and carbon within the ordinary laws of chemistry. If, as is generally admitted with Caron, hardening carbon were more intimately combined with the iron than is cement carbon, the absorption of heat would prove the existence of carbide of iron stable at high temperatures. It would then be included within the class of explosive substances, and recalescence would not be, as it is, a reversible phenomenon. The *direct* combination of free iron with free carbon may appear somewhat paradoxical; but, in the state of hardening carbon, and at high temperatures, carbon is very different from the carbon in polymeric compounds with which we are accustomed to deal at ordinary temperatures. In this form it possesses a particular

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chemical activity, which enables it to combine *directly* not only with iron, but also with hydrogen and nitrogen. (Forquignon's experiments, *Annales de Chimie et de Physique*, 5th Series, Vol. XXIII.) It should be noted that the station a_{r1}, which increases from the extra mild steel up to the hardest steel, diminishes, on the other hand, on passing from hard steel to white pig iron. It follows, therefore, that in the latter the greatest portion of the carbon remains in the same state before and after recalescence. Is it hardening carbon that exists in the cooled pig iron, or does the cement carbon remain combined at a red heat? The latter alternative is the true one. This is proved by the experiments of my friend M. Werth, who has found that the residue, isolated by Weyl's method from the identical white pig iron employed in my researches, contained but a minute proportion of iron—that is to say, of iron carbide. Besides this, a portion of the hardening carbon easily assumes the form of graphite in very pure and highly carburised pig irons. To effect this, it is merely necessary to heat the white pig iron slightly above its melting point, and to allow it to cool slowly. Even in steel, carbon never assumes one of its two forms, hardening carbon or carbide carbon, to the complete exclusion of the other. This may depend on the fact that the rate of cooling is never infinitely rapid nor infinitely slow, and also on the nature of the medium in which the reactions are effected. In fact, it is assumed that in a solid, where the molecular movements are very limited, all the atoms of carbon are not able to reach the atoms of iron necessary to combine with them. The temperature at which this combination is effected tends to slowly rise, under the conditions employed in my experiments, in proportion to the increase in the amount of carbon contained in the metal. The position of the maximum of a_{r1} is as follows:—

1. Electrolytic iron	660°
2. Extra mild steel	662–655°
3. Mild steel	660°
4. Medium steel	661°
5. Hard steel	674°
6. White pig iron	695°

The two samples 3 and 4 containing a little more manganese than the rest, the point a_{r1} is comparatively a little lower, as will subsequently be seen. It is, however, probable that the temperature of combination is theoretically constant; but the reaction is retarded in practice by the comparative scarcity of the carbon.

Let us now examine the critical points of iron. In electrolytic iron, during cooling, two abnormal evolutions of heat occur. One, a_{r3}, commences and ends abruptly, and causes at 855° C. a fairly prolonged stay of the thermometer; the other, a_{r2}, is less distinct, and has no precise limits. It extends from about 750° C. to 690° C., passing through two unequal maxima. The same critical points are found in extra-mild steel; a_{r2} preserves its position and character, but the station a_{r3} is converted into a gradual slackening between about 845° and 800° C., with a maximum at about 820°C. In mild steel a_{r3} is still lower, and becomes confounded with a_{r2} into a single gradual slackening, $a_{r(3\text{-}2)}$. It is easy to show, by measuring the areas of the bulges in the curves, that the quantity of heat liberated at $a_{r(3\text{-}2)}$ by mild steel is practically equal to the sum of the quantities of heat $a_{r3} + a_{r2}$ liberated at two points by the preceding sample. In medium steel, the double point $a_{r(3\text{-}2)}$ continues to descend. Its maximum, between 700° C. and 690° C., is still distinctly separated from a_{r1}, but the end of the arrestation coincides with recalescence. Lastly, in hard steel, all the critical points are united into a single one, $a_{r(3\text{-}2\text{-}1)}$ at 674° C.

To sum up, in proportion to the increase in the amount of carbon, a_{r3} is rapidly lowered (excepting occasionally a small residue which remains in the original position) and first joins a_{r2}; then the double point $a_{r(3\text{-}2)}$ descends in its turn, and finally coincides with a_{r1}. The superimposed curves in Fig. 5 clearly show this progress of the phenomena. Since the point a_{r3} is the more individualised the nearer the iron approaches to purity, it is evident that this point corresponds with a molecular modification of iron. *Iron is a polymorphous element*, like sulphur, silicon, &c. In the present state of our knowledge, it is difficult to say whether a_{r2} is a second distinct molecular modification of a_{r3}, or whether it is simply the end of a_{r3} retarded by the presence of a little carbon. In support of the second opinion, which appears to me the more probable, it may be urged:—1. That the best-known molecular changes are effected at a well-defined temperature, which is not the case with a_{r2}. 2. That as the presence of a sufficient quantity of carbon causes a_{r3} to descend as a whole, it is natural that a slighter quantity of carbon partially produces the same effect. 3. That carbon is not uniformly distributed throughout the mass of the metal, and that a very mild steel may be considered as a mixture of pure iron and harder steel. 4. That the curve of the thermo-electric powers of iron, compared with that of carbon, does not exhibit any distinctly marked point at a_2 ("Transformations du Fer et du Carbone," by F. Osmond). None of these arguments, however, is decisive, and it is merely *probable* that a_{r2} is the retarded end of a_{r3}. I therefore accept this view provisionally and until it is disproved, and shall assert that iron below a_{r2} possesses the molecular form α, and assumes above a_{r2} the allotropic form β. Between a_{r2} and a_{r3}, when these two points are distinct, the metal is a mixture of the two varieties α and β.

The action of carbon on iron in steels and white pig irons may now be summarised in a few words. Carbon, in the state of hardening carbon, maintains iron in the β condition, during slow cooling, up to a temperature which is in inverse proportion to the amount of carbon contained in the metal.

It is evident that the sudden variations observed by different investigators in the physical properties of iron and steel may be referred to one of the points a_1, a_2, or a_3. The following are a few selected examples:—1. Gore's phenomenon and Barrett's recalescence are at once identified with a_{r1}, or more generally with the triple point $a_{r\,3\text{-}2\text{-}1}$. 2. Pionchon, in his researches on specific heat, found the two points a_{r2} and a_{r3} in commercial iron and in iron reduced by hydrogen; but he placed his point a_3 between 1,000° and 1,050°—that is to say, at a temperature a little too high. 3. Hopkinson's experiments on the magnetic properties of iron and steel identify, in a highly satisfactory manner, the appearance and disappearance of magnetism with the point a_3 if it is isolated, and with the multiple point containing a_3 if the latter is not independent. 4. Le Chatelier has shown the coincidence of a_3 with the abrupt variation occurring in the law of the dilatations of soft iron. 5. The same observer found two remarkable points in the curves expressing the electrical resistance of steels as a function of the temperature. One of these points corresponds to a_3, and the second appears to refer to a_1. 6. I myself have found, on repeating Tait's experiments on my samples, that the thermo-electric power of iron passes through a singular point at a_3 for soft iron, and at $a_{3\text{-}2\text{-}1}$ for hard steel. It is thus evident that the greater number of the experiments made before or after mine are in accord with them. If, among the observations published, there are any others that appear to be discordant, it may be hoped that all difficulties will soon disappear, either when the numerous causes capable of displacing the critical points are better known, or when the temperatures have been determined by processes that admit of comparison.

THE CRITICAL POINTS OF IRON AND STEEL.

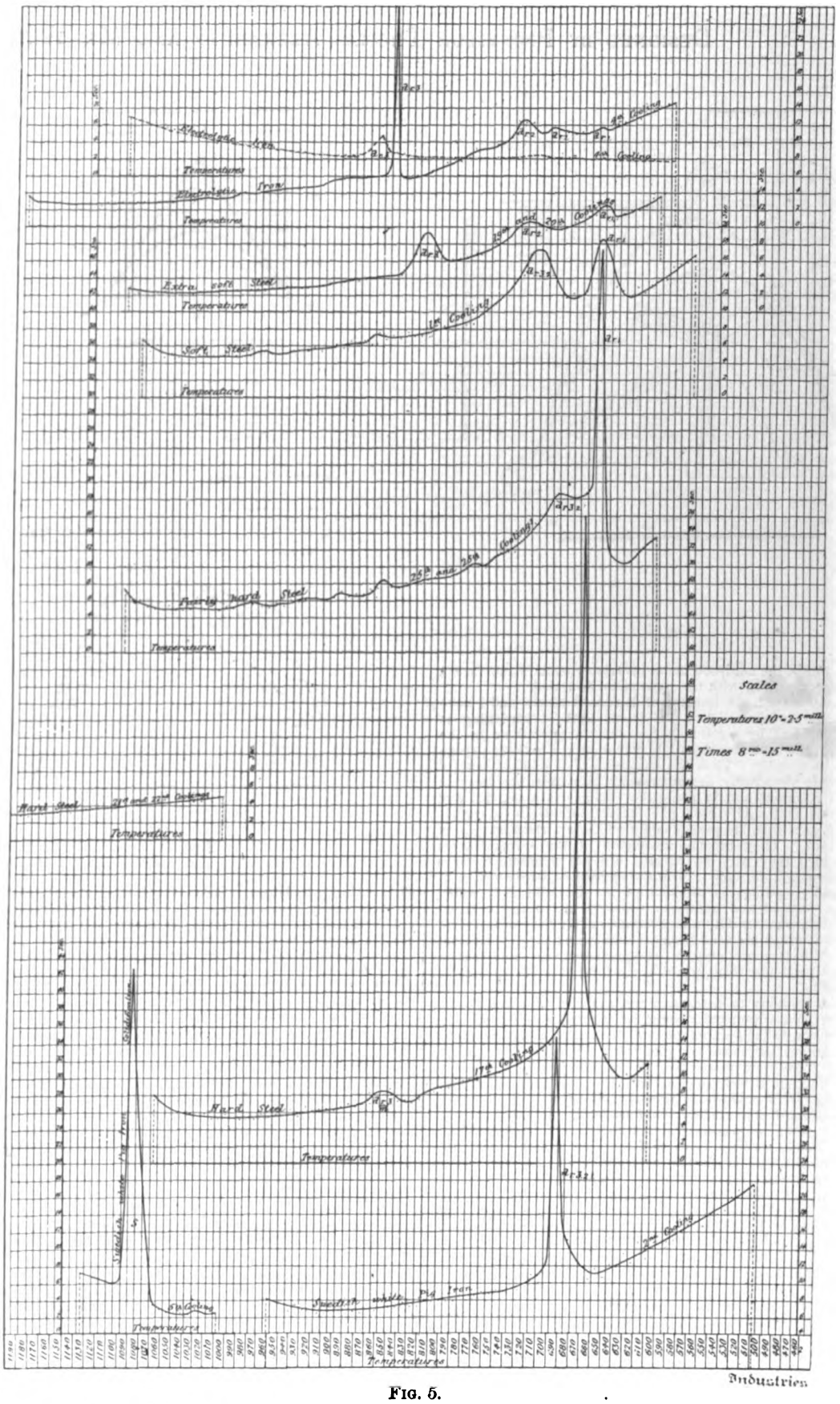


FIG. 5.

(B) INFLUENCE OF THE INITIAL TEMPERATURE AND OF THE RATE OF COOLING ON THE POSITION OF THE CRITICAL PERIODS. THEORY OF HARDENING.—If the same samples are submitted to a series of successive heatings and coolings in which the maximum temperature of heating is gradually increased, it is found that the recalescence is lowered, fairly rapidly at first, then very slowly when the cooling starts from a higher initial temperature. The position of recalescence is similarly lowered when the cooling is accelerated, as is shown in Table II., page 482.

During the hardening in water, an arrest in the fall of temperature is no longer noticed. Thus, when the rate of cooling is fairly considerable, the changes produced during slow cooling are not produced, at least integrally. Hardened steel is a steel in which the iron and carbon have preserved more or less completely in the cold the condition which they possessed at high temperatures. The heat of the change that has not been effected remains disposable in the metal, and may be termed the latent heat of hardening.

As it is difficult to observe, during cooling in water, an even comparatively lengthy arrestation of the thermometer, the preceding conclusions might appear very slight. They are, however, confirmed by two other methods.

1. I dissolved in equal volumes (500 cubic centimetres) of a saturated solution of the double chloride of copper and ammonium, equal weights (1·5 gramme) of different steels, successively annealed and hardened, and I measured the quantity of heat liberated in each case by the reaction ($2\,CuCl_2 + Fe = 2\,CuCl + FeCl_2$). The rises in temperature, after all corrections were made, were found to be as follows:—

	Annealed.	Hardened.
Medium steel	2·866° C.	2·477° C.
Hard steel	2·148° C.	2·309° C.
White pig iron	1·665° C.	1·678° C.

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A BENDING MOMENT DELINEATOR.

DESIGNED BY PROFESSOR THOMAS ALEXANDER AND MR. ARTHUR W. THOMSON, GLASGOW.

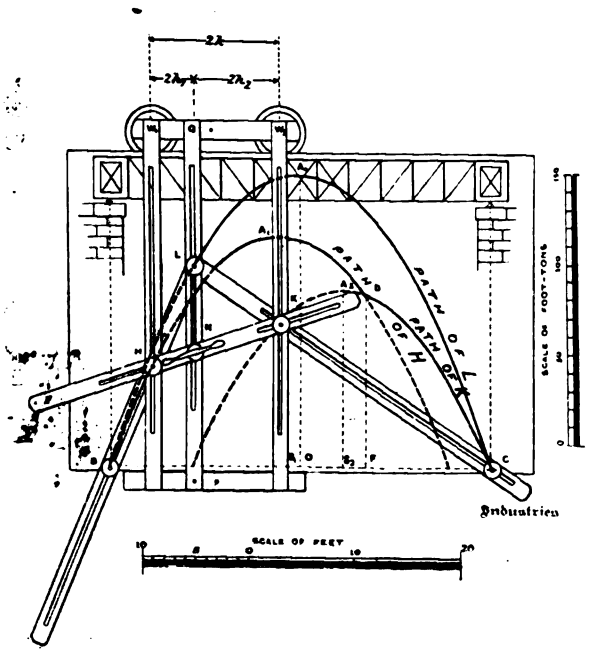


FIG. 1.

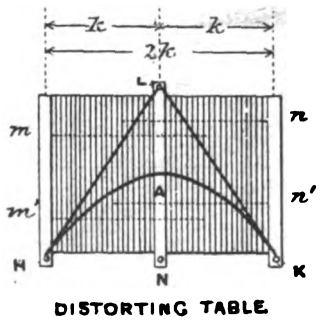


FIG. 2.

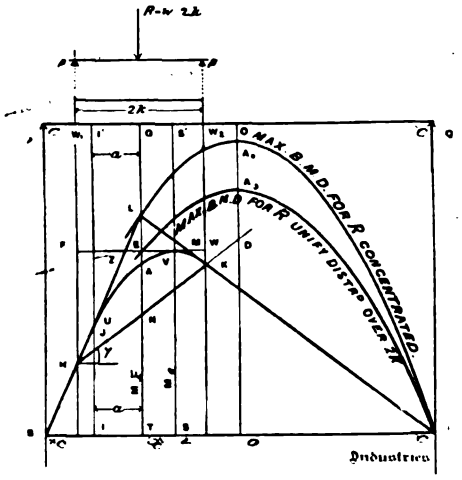


FIG. 3.

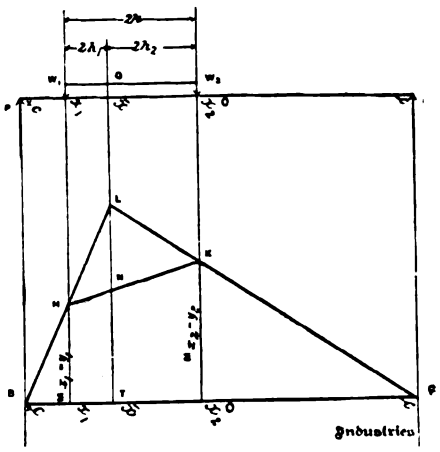


FIG. 4.

In other words, the hardened metal invariably contains an excess of heat in comparison with the same metal annealed.

2. I have traced the heating of hardened steels, and I have shown that the liberation of the latent heat of hardening is rendered evident by certain characteristic accelerations in the progress of the heating. I shall, however, return to these experiments subsequently. Thus the existence of the latent heat of hardening is abundantly demonstrated. Moreover, the delay in chemical reactions and in molecular changes is a general and well-known fact. All these phenomena necessitate a certain time, and, as a rule, are possible only within a certain interval of temperature. They become incomplete if the circumstances under which they may be effected are not maintained for a sufficient length of time. In this way Sainte-Claire Deville, by very rapidly cooling the products of the dissociation of water, kept the oxygen and hydrogen separate up to the ordinary temperature, whereas with a less abrupt cooling they recombined. In this way sulphur cooled from a suitable temperature assumes the condition of plastic sulphur, and preserves, for some time at least, this particular form, which is the form of stable equilibrium above 260° C.

It now remains to determine the share of iron and that of carbon in the new properties communicated to steel by hardening. In opposition to the opinion generally accepted, I believe that it is not carbon, but the allotropic β-iron which is the principal cause of these new properties. This theory would be placed beyond doubt if it were proved that (1) a steel containing much hardening carbon could be soft; and that (2) a steel containing very little hardening carbon could be hard. In order to establish the first proposition, I hardened my medium steel (sample No. 4) between $a_{r(3\text{-}2)}$ and a_{r1}, that is to say, when the change of the iron is already well advanced, although that of the carbon has not yet commenced. Under these conditions the metal was soft under the file, and when treated with nitric acid gave the reaction for hardening carbon. This experiment, however, has been criticised, not without reason, by Mr. Howe. It is indeed possible that the steel thus hardened, although less hard than the file, had acquired a certain amount of hardness; and, on the other hand, the nitric acid reaction, as applied, is simply qualitative. I admit, therefore, that this test is not conclusive, although it appears to me to agree with those of M. Nouel, engineer of the Compagnie de Chatillon et Commentry, in his researches on dilatation. The second proposition, however, lends itself to a more satisfactory demonstration, and it is easy to prove by figures that very mild steel may be considerably hardened in the absence of notable proportions of hardening carbon. For this it is merely necessary to harden from a higher temperature at a_{r3}, and to render the cooling extremely rapid by plunging a bar of slight thickness into a freezing mixture. Under these conditions the tensile strength may increase from 42 kilogrammes per square millimetre (26·6 tons per square inch) of the original section (annealed metal) to 97 kilogrammes (61·5 tons per square inch, hardened metal), whilst the elongation decreases from 30 to 4 per cent. We have thus to deal with a steel containing 0·22 per cent. of carbon, only a small fraction of which has retained the form of hardening carbon. It follows that the hardening carbon is not responsible for the enormous diminution in the malleability that has just been shown. Moreover, electrolytic iron clearly shows that iron, in the absence of carbon, may acquire the hardness of hardened steel. I conclude that *hardened steel owes its properties principally to the presence of β-iron*, which is hard and brittle by itself at the ordinary temperature. The influence of carbon is of the same character as that of the rate of cooling, and both combine to produce the final result. The rate of cooling alone is not sufficient under the ordinary conditions in which hardening is effected to maintain an appreciable fraction of the iron in the β-condition. But as, under the same conditions, it is easy to maintain the carbon in the state of hardening carbon, and as the hardening carbon imparts stability to β-iron, it is evident in what manner β-iron may be successfully preserved up to the ordinary temperature by the aid of carbon. The more rapid the cooling the more incomplete are the changes and the harder is the hardened metal.

(C) PHENOMENA OBSERVED ON HEATING THE SAME SAMPLES BETWEEN 600° C. AND 1,100° C.—I append a comparative table (Table III., page 482) of the critical points in cooling and heating. I may, however, remark, that the determination of these critical points is not as sure during heating as during cooling on account of the irregularities in the pressure of gas and of water that supplies the blast. It is thus evident that all the critical points studied are reversible, as might have been expected, since they are reproduced identically by a series of successive coolings of the same sample. a_2 alone is situated in the same interval of temperatures on heating as on cooling. For the other critical points, their temperature is higher during heating than during cooling. It is true that the temperature of steel rods when heated or cooled is never quite the same at the surface and in the interior, whence it follows that the temperatures indicated by the couple are somewhat low during the cooling, and somewhat high during the heating. But the normal error which results from this fact is very much smaller than that which is observed in the majority of cases, and which has been also noted by other authors (Norris, Brinell, Newall, &c.). It is probable, however, that the theoretical temperature of the critical points should be the same in both cases; but as the chemical reactions, as well as the dimorphous changes, acquire a certain velocity only when the system is sufficiently distant from its conditions of equilibrium, it is constantly found in practice in the shape of more or less lengthy delays due to the rate of heating and of cooling. In the special case of steels, these delays may still be exaggerated for the combination of iron with carbon, by the solid condition of the medium, and for the change of the iron by the presence of carbon. The loss between a_{r3} and a_{c3} is at a minimum for electrolytic iron. These experiments confirm and explain an important fact observed by Brinell, namely, that the temperature to which a steel must be heated to enable it to acquire hardness, and that at which it suffices to plunge it into water for hardening it during its cooling, are not identical.

(D) HEATING AND COOLING BELOW 600° C. THEORY OF TEMPERING.—Iron and steel previously annealed do not present critical points in this region. This is, however, not the case with hardened steel. It is known that hardened steel, reheated at increasing temperatures, loses by degrees the hardness and brittleness imparted to it by hardening. From this it may be concluded that the latent heat of hardening is liberated during tempering, and should produce characteristic accelerations in the rate of heating. These suppositions are completely confirmed by experiment. Fig. 4, page 482, shows a comparison of the curves of reheating of the same steel annealed and hardened. The liberation of the heat of hardening begins to be exhibited at about 200° C. under the conditions of the test; it presents its maximum at about 350° C., and appears to cease at about 520° C. A final liberation of heat is exhibited between 660° and 680° C., quite near to the station marked $a_{c(3\text{-}2\text{-}1)}$. Hence, it follows that iron and carbon which in hardened steel were not in equilibrium, just like plastic sulphur, tend to resume, as far as circumstances will allow them, their state of equilibrium, which is normal at the temperature under consideration. Thus, *during tempering, the β-iron returns to the α-condition, and the hardening carbon to the condition of iron carbide.* In the present state of our knowledge, however, it is not yet known whether the changes of iron and carbon are successive or simultaneous, nor is it known what interpretation to give to the different accelerations observed during heating. Does the iron assume the α-condition when the hardening carbon which maintains it in the β-condition has combined with the iron? Or can the β-iron, on the other hand, left to itself, subsist up to a higher temperature? This is difficult to decide, in spite of the important researches made on tempering, notably by Barus and Strouhal. (*Bulletin of the U.S. Geological Survey*, No. 14, 1885, and No. 35, 1886; *American Journal of Science*, Vols. XXXII., December, 1886, XXXIII., January, 1887, XXXIV., July, 1887; *Washington Laboratory Bulletin*, No. 27.) These physicists have shown that, at the melting point of lead, steel previously hardened recovered, almost but not completely, the electrical resistance and thermo-electric constants of annealed steel. The melting point of lead coincides, moreover, with the maximum of acceleration observed by me during the reheating after hardening (about 350° C.). On the other hand, the specific magnetism of steel tempered at 330° C. is very different from that of the same metal annealed; and the second acceleration shown by my curve between 660° C. and 680° C. (an acceleration which is, moreover, confined to very hard steels) proves that the effects of hardening are not completely destroyed at this temperature. The question is in reality very complicated. M. Werth and myself have clearly shown, on a steel of medium hardness, that tempering in a bath of lead at about 400° brings back the carbon to the state of iron carbide as completely as annealing at redness. If, however, the chemical state was the same in the two cases, it was not so with the physiological state of the carbon. Although Weyl's method isolates the carbide from annealed steel in the form of brilliant metallic spangles, the carbide from tempered steel, with the same percentage composition, appears in the form of a dull amorphous powder. The carbide is formed *in situ*, and remains in a state of infinitely fine division. Like the hardening carbon which has produced it, it cannot, at the comparatively low temperature of 400° C., be collected into scales, as it is at a red heat. Hence there is a great difference in structure, which appears to have a considerable influence on certain physical properties, and above all, on the comparative mechanical properties of annealed steel and of tempered steel. It is a noteworthy fact that the change of the carbon is gradual. This fact is in complete accord with daily practice, which shows that the effect of tempering is proportional to the temperature attained. It is rendered evident by the shape of the curve of reheating; and Barus and Strouhal have proved that, for a given temperature, steel previously hardened tends towards a state of equilibrium which depends only on the temperature, and which is attained the more rapidly the higher this temperature is. The reaction being possible, it would appear to be complete, as any tendency to the inverse reaction does not limit it to the temperature under consideration. If this is not the case the solid nature of the medium does not permit, at the desired moment, as a liquid or gaseous medium does, the contact of all the atoms that ought to combine. Perhaps the tardy liberation of heat between 660° C. and 680° C. should be attributed to the same cause. It is evident that before the broad principles of the theory of tempering are developed, the details must be worked out. The more affirmative theory I formerly enunciated now appears to me, after much investigation and reflection, to have been premature.

(To be continued.)

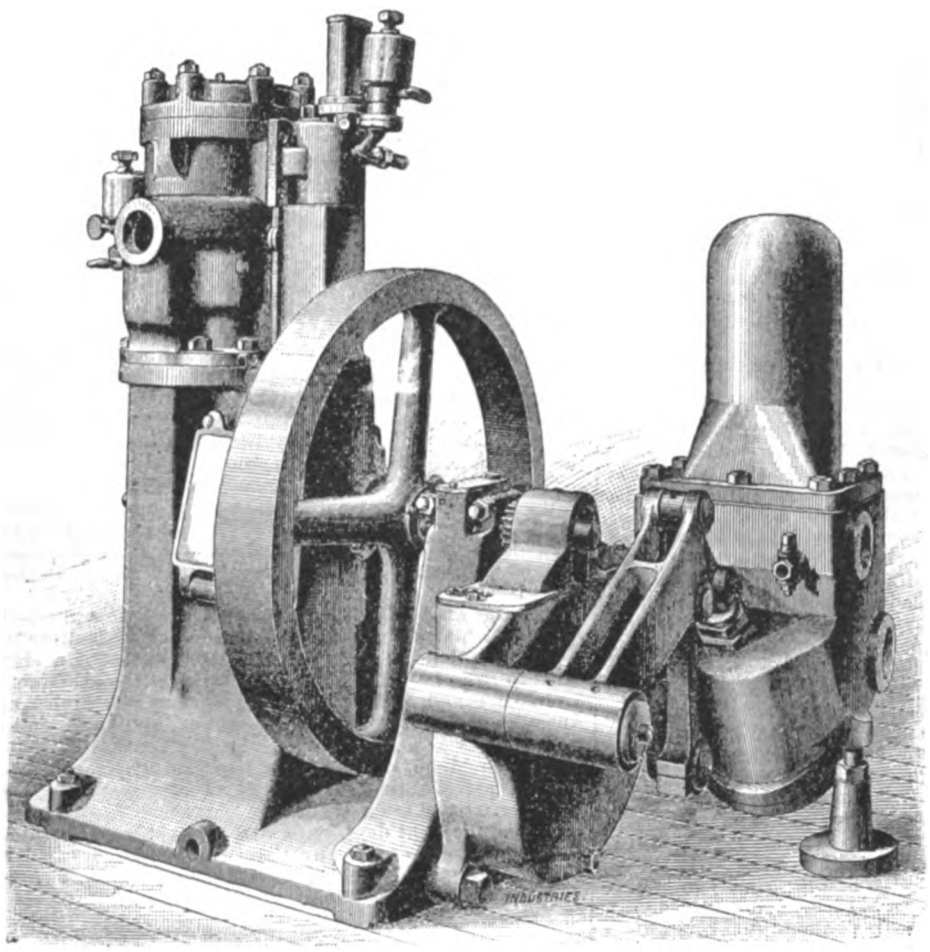
A BENDING MOMENT DELINEATOR.

A SHORT time ago Professor Thos. Alexander and Mr. A. W. Thomson read a paper before the Institution of Engineers and Shipbuilders in Scotland, on their "Bending Moment Delineator, and its application to maximum bending moments due to moving loads." As this instrument has been proved to be capable of correctly indicating the bending moments in structures, we give

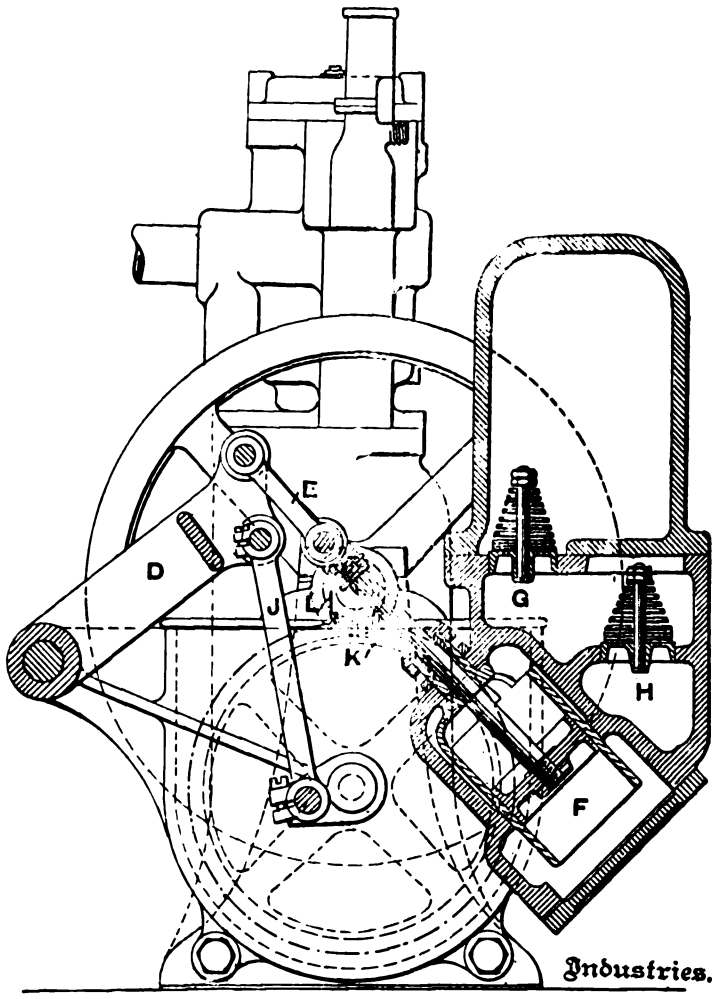
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GAS ENGINE AND PUMP.

CONSTRUCTED BY THE NATIONAL METER COMPANY, NEW YORK, U.S.A.



GENERAL VIEW OF ENGINE AND PUMP.



VERTICAL SECTION THROUGH PUMP.

herewith a short description of it. On page 484 Fig. 1 gives a general view of the instrument, Fig. 2 shows the distorting table used in connection with it, Fig. 3 is a diagram of the curves drawn, and Fig. 4 is a skeleton outline.

It is in the form of a working model. Bending moment curves and scales are drawn on the face of the board. The frame consists of slotted vertical bars W_1, G, W_2, fixed at the top and bottom to cross pieces. The middle vertical bar can be fixed in two positions—one midway between the two outer bars, the other as in Fig. 1, nearer the left. The frame can move along the face of the board, this motion being facilitated by the use of friction rollers. The compass bars L B and L C are hinged at L, and by means of slots pass over bolts B and C. Another bolt forms the hinge L, and slides in the slot of the middle bar of the slot frame. The transverse bar H K is also slotted, and near its centre carries a handle for moving the whole arrangement into any desired position. The bar H K can rotate on a bolt N, which passes through the slot in the middle vertical bar. The bolts H and K pass through the slots of the compass bars, of the two outer vertical bars, and of the transverse bar. The distance between the two points L and N is kept constant by means of the distance piece L N, which slides in the middle vertical slot, and whose ends pass over the bolts L and N. The distorting table (Fig. 2) is composed of about 90 wooden laths, 9in. by ⅛in. by ⅛in. thick. The middle and two outer laths are heavier, as they have to guide the others and keep them in position; their ends H, K, L, N are strengthened with pieces of sheet brass, and can slip over the corresponding bolts of the slot frame, arranged so that the inner vertical bar is midway between the other two. On the under sides of laths H and K guiding pieces are fastened, which slide in the slots of the slot frame. Wires hinged at m, m^1, n, n^1 pass through small holes in the middle lath L N, and remain parallel to the centre line of the slot H N K while the table is distorted; on these wires the intermediate laths are threaded. On the face of the table, when rectangular, a parabola H A K and two tangents H L and K L are drawn. (See Fig. 3.)

When the slot frame is clamped in any position (Fig. 1) the model is rigid. For suppose the compass bar lifted off the bolts B and C, and the four points H L N K moved upwards in the slots any short distances and so as to keep the bars B L, L C parallel to their original directions; also that the points L and N are fixed in their new positions, and that the compass bars are again put over the bolts B and C; then the two points H and K must move downwards in the slots, and the line H N K will be no longer straight; but in the model H N K is a rigid bar, and therefore, for any given position of the slot frame, there can be only one triangle H L K, and it can have only one position.

As the slot frame moves across the face of the board, the points H, L, K, and N describe portions of the same parabola in different positions, as illustrated in Figs. 1 and 3. The co-ordinates of the point D, the intersection of the paths H and K, can be found, and it can be proved that, for every position of the delineator, the centre line of the transverse bar produced, if necessary, passes through the point D (see Fig. 4). Taking advantage of this latter fact, the authors have devised a modified form of the moment delineator. In this modified form the distance piece L N is no longer necessary, and may be removed; a pin is fixed into the board at the point D, and projects slightly from its face; and the transverse bar is placed next the board with its slot passing over this pin. The authors show that the locus of the tops of the maximum ordinates for the bending moments is a parabola.

The delineator is a decidedly interesting piece of apparatus, and it will have a place in engineering classrooms and laboratories.

GAS ENGINE AND PUMP.

THE accompanying illustrations show a combined gas engine and pump made by the National Meter Company, of New York. Mounted on the engine shaft is the pinion L, which engages with the wheel K. As the wheel is enclosed in a box containing oil, thorough lubrication is provided, and the wear of the only quick-moving part of the pumping portion of the machine is reduced to a minimum. The shaft of the wheel K carries a crank connected by the rod J with the rocking lever D, which, by the rod E, is connected with the rod of the plunger F. The water enters through the valve H and is discharged through the valve G. This arrangement of the several parts of the pump in relation to the engine permits of the placing of the entire machine on one base, thereby obtaining all the advantages to be derived from rigidity and compactness. It is stated that at the price for which gas is sold in New York this engine will raise 1,000 gallons of water to a height of 75ft. for 2½ cents. We are indebted to our contemporary, *The Iron Age*, for our illustration.

THE POSTAL JUBILEE.

THE Post Office is such an important institution for the promotion of industry and commerce that the jubilee anniversary of the introduction of inland uniform penny postage, which was celebrated last Friday evening in the Guildhall, as a joint affair of the Corporation of the City of London and the Post Office authorities, demands notice. Arrangements were made for the display of apparatus connected with the Post Office, and the illustration of their use, as for example the stamping, sorting, and preparation of letters, and the making up receipt, and despatch of mails. Specimens were shown of telegraphic apparatus, and communication was maintained direct from the office in the Guildhall to several Continental cities, and special arrangements were made for transmitting direct to various journals an account of the proceedings. The chief speech was delivered by Mr. Raikes, the Postmaster-General, and, after paying a graceful compliment to the memory of Sir Rowland Hill, he gave a sketch of the changes which had taken place since 1840 in consequence of the establishment of the penny post. In the year immediately preceding 1840 the number of letters delivered in the United Kingdom amounted to 76,000,000, whereas last year they amounted to 1,600,000,000, or twenty times the number of letters which passed through the post fifty years ago. In addition to the letters there were 652,000,000 postcards and other communications by the halfpenny post, and an enormous number of newspapers.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 20th May, 1890.

IRON.—The French iron markets, in spite of the weak tendencies abroad and the slack demand at home, show increasing firmness. Thus here in Paris, though consumers buy only sufficient for present needs—and those needs are small—the merchants are seeking to re-establish the price of 160s. for bars and joists. News to a similar effect comes to us from the provinces. The manufacturers of the Ardennes maintain the price of 160s. a ton for bars, and the manufacturers of the North refuse to make any concession on 156s. Seeing that the demand is nowhere brisk, this firmness must be attributed to the prospect of dear coal. This is, however, an artificially formed situation, which cannot last long. Already English iron, Middlesbrough No. 3 pig, is being offered to the forgemasters of the Champagne group at 67s. to 68s. a ton delivered in the neighbourhood of Saint-Dizier, and Belgian iron, both crude and finished, is beginning to find its way over the frontier.

METALS.—The metal market is more animated than it has been for some time past; but its renewed life proceeds from speculative operations rather than genuine business. The holders of copper warrants find it necessary to give a fillip to the market every two or three weeks to keep it up to the point desired. Consumers have, however, nothing to lose by limiting their purchases to what is strictly necessary for the moment. The recently published statistics of the stocks in hand have deceived no one. Tin is a little weaker. Lead has recovered a little; but spelter has given way a point in the course of the week.

THE BREWING INDUSTRY.—The consumption of beer in France is constantly increasing, and the brewing industry is steadily developing itself. The development is, however, not sufficiently rapid to meet the growth in the consumption of the beverage. Evidence of these facts is to be found in the statistics of production and the Customs returns for the year 1889. The production of beer last year amounted to 8,700,000 hectolitres, against 8,400,000 hectolitres in 1888. The quantity of foreign beer imported in the same time amounted to 224,321 hectolitres, against 188,306 hectolitres in the previous year. Of this quantity Germany supplied 172,736 hectolitres, England 20,539 hectolitres, Austria 766 hectolitres, and other countries 30,280 hectolitres. The imports of German beer have greatly fallen off in the last few years.

THE WOOLLEN INDUSTRY IN FRANCE.—The official report of the trade of France for 1888 allows a comparison between the volume of the woollen industry and the general movement of foreign trade. The figures are as follow:—

	Imports. Frs.	Exports. Frs.
Raw wools of all kinds	341,252,000 ...	131,284,000
Woollen yarn and goat's hair....	14,086,000 ...	37,160,000
Tissues of wool, pure and mixed	65,176,000 ...	323,375,000
Total for wool and its products	420,514,000 ...	491,819,000
Total general of merchandise ...	4,107,007,000 ...	3,246,749,000
Total of manufactured products	578,807,000 ...	1,706,583,000
Total of raw materials.....	2,021,164,000 ...	813,443,000

FRENCH SEAPORTS.—From recent statistics it appears that the order of French seaports in commercial importance and the tonnage of the vessels in each during the past year are:—Marseilles, 4,623,650 tons; Havre, 2,653,685; Bordeaux, 2,489,512; Dunkirk, 2,020,848; Rouen, 1,721,710; Cette, 980,151; St. Nazaire, 915,930; Dieppe, 517,703; Boulogne, 476,116; Bayonne, 465,788; Nantes, 374,315; Caen, 351,608; La Rochelle, 335,883; Calais, 273,706.

BERLIN, 19th May, 1890.

IRON.—The iron market here is moderately active and steady, the demand being chiefly for building iron. Silesian bars have not recovered in price, but are still quoted 205s. a ton. From Breslau the market is reported active, both for crude iron and for finished iron and steel. Grey pig finds ready purchasers at 83s. to 85s. a ton. The demand is brisk for joists and steel plates on export account. Ships' plates are being sent in large quantities to Kiel. Founders and machine makers are very busy. W. Fitzner's works at Laurahütte turned out their three-thousandth boiler last week. Since the year 1874 the number made at these works exceeds 2,000.

METALS.—The revival noticed in the metal markets report last week has made further progress. There is, however, no visible expansion in the volume of trade transacted, consumers still limiting their purchases to what is strictly necessary for the requirements of the moment; but a stronger tone prevails, and prices have risen all round. Mansfeld refined copper is quoted £60; English brands from £57 10s. to £59. Banca tin has advanced to £103. The Silesian market for spelter is steadily improving. The W.H. brand is quoted £25 to £25 10s. Clausthal refined lead is very firm at £15 to £15 10s. a ton.

COAL.—A Breslau correspondent writes: "The altered state of the coal market is becoming significantly visible in the rapid accumulation of stocks about the pits. To check this accumulation some of the colliery proprietors have resolved to work one shift a week less from the 17th of the present month. Hence it is evident that the production is not to be maintained at the high level reached in the first quarter of the year. There is no diminution of activity in the coke-making industry." The production of the Lower Silesian coal mining district in the first quarter of the current year amounted to 615,088 tons, against 591,879 tons in the corresponding portion of 1889.

THE YARN INDUSTRY.—Flax spinners have work enough in hand to keep them fully occupied for some time to come. The yarn market is somewhat less active, consumers having bought well forward, but the situation is such that prices must remain firm. The Association of German Jute Manufacturers has under consideration a proposal to further advance the prices of jute yarns and woven fabrics.

THE TEXTILE INDUSTRY OF SAXONY.—The state of the textile industry in Saxony at the present time is the subject of much complaining on the part of the manufacturers. Business is slack, and as the near prospect is without any encouraging feature many have begun to restrict production. In the Chemnitz district a considerable number of operatives are either out of employment or have gone into some other industry as labourers. Wages have dropped considerably within the last three or four months. The tapestry branch of the textile industry is the only one in which there is anything like activity. But even in that branch prices are depressed.

ELECTRICAL CONGRESS.—The Electro-Technical Society of Frankfort-on-the-Main has decided to hold an international electrical, or, more correctly, an electro-technical, congress in that city next year, during the time of the Electro-Technical Exhibition. The invitations will be issued immediately.

DEATH OF AN ELECTRICAL ENGINEER.—The death took place on the 8th inst. of Mr. Carl Fritchen, of Messrs. Siemens & Halske. He entered the service of the Hanoverian Government in 1850, and in spite of his youth was entrusted with the superintendence of the erection of railway telegraphs, and shortly afterwards he was appointed chief of the Hanoverian telegraphs. In 1856 he invented electro-magnetical duplex telegraphy simultaneously with Dr. Werner Siemens. In 1867 he entered the telegraph service of the North German Confederation. In 1870 he accepted an offer of Messrs. Siemens & Halske to enter their service as chief engineer. His inventive capacity, combined with his practical turn of mind, found full scope in the large and diversified works of the firm extending to all branches of electricity.

THE VULCAN SHIPBUILDING YARD AT STETTIN.—It has been announced that this company, which in 1888 paid a dividend of 6 per cent. on the preference and ordinary shares, will this time only pay a dividend of 5 per cent. on the preference shares, whilst the ordinary shareholders will receive nothing. In the report the explanation afforded is that only merchant vessels came into account last year, some of which were undertaken at a loss simply to provide employment for the workmen in the winter of 1888-9.

GERMAN TELEGRAPH AND TELEPHONE SYSTEMS.—A further extension in the telegraph and telephone network of the German Empire is shortly to be undertaken. Nearly 8,000,000 marks are to be devoted to the purpose in the current year. According to the plan, 3,099,500 marks will be applied to enlarging the town telephone installations and to the telephonic connection between different towns; 1,928,000 marks are provided for new telegraph offices, especially in the country; 761,900 marks will be applied to the improvement of telegraph wires, the erection of double poles, the transformation of overhead wires to underground wires; and lastly, 87,000 marks is intended for extending the pneumatic post installations in Berlin and Hamburg. The work has already been commenced at a number of points, and, as the weather is favourable, great progress is being made.

VIENNA, 19th May, 1890.

THE IRON MARKET.—The situation of the iron market does not change. The prices of bar iron, foundry goods, and sheets are kept high at the syndicate level, but there is no animation and no inclination to buy. The decrease of prices in the German markets up to the present time has not influenced the Austro-Hungarian markets, but some reserve in buying was the consequence. Bohemian sheet-makers are very busy. The Austro-Hungarian iron market for the year 1889 shows an increase of the production of pig iron of about 15 per cent., and of bar iron about 10 per cent.; the quantities of rails did not reach half the possible maximum production. A large order has been received by Messrs. Nicholson & Co., of Budapest, from the Hungarian Ministry of Communications, for two steamers with 600 h.p. triple-expansion engines and two steamers with 300 h.p. compound engines, both with a short term of delivery. Further, Messrs. Nicholson & Co. have received orders for two petroleum ships and thirty-five steam tugs.

THE COAL MARKET.—In the Austro-Hungarian coal and coke market there is still a very animated business. The amount sent away from the Bohemian districts steadily increases, and, as the traffic on the Elbe is easy at present, the export is very animated. The stability of the increase is assured, for markets for Bohemian coals are extending very much. The home consumption is a satisfactory one, as may be seen from the excellent financial state of the works in the Falkenau territory, which deliver most of their production to home customers.

THE AGRICULTURAL EXHIBITION.—Last week the Vienna Agricultural Exhibition was opened by its patron, the Emperor, in the company of all the Court and the ambassadors. Since 1867 there has been no agricultural exhibition in Vienna, and therefore great importance is attached to the present one, as it will show the progress made during the last twenty-three years in this branch of our national economy.

BRUSSELS, 20th May, 1890.

THE IRON MARKET.—The iron trade only exists with the greatest difficulty. New business is very scarce, and the buyers are trying to cut prices even below their present low level. Merchant bars may be quoted at 16fr., but 15fr. has been accepted by many. Pig iron has become weaker, and 65fr. is the basis price now. In the Liége district the outlook is particularly dark, and the buyers are all eagerly awaiting further concessions in the prices. The official figures for the export of iron and steel during the first quarter of the year show an increase in the shipments of rails and steel generally. Otherwise, with a few unimportant exceptions, there has been a general decrease, the most noticeable being in the products of rolling mills.

THE COAL MARKET.—The state of the coal market is undecided. Larger sizes and pit coal maintain their price, but there is a good deal of weakness in the smaller sorts. The price of coke is nominally 32fr. at present, though no sales are reported above 30fr. The buying is all from hand to mouth, as there is absolutely no confidence in the future. At most of the pits the coal-getting is all done on order, and there is none brought up for stocking at pit's mouth. At the meeting of coalmasters last week no anxiety was expressed as to the state of the market, for it was universally supposed that the depression was only temporary, and only caused by the want of briskness in the iron trade.

THE GLASS TRADE.—The demand for window glass this spring is better than ever before, and the strikes only prevent it from being better still. The question of the eight hours day is being discussed, and it is expected that the employés will strike in order to gain this point. In the meantime, there is no change in prices

THE CANAL TO BRUSSELS.—Some time since a grant of 4,000,000fr. was promised by the Minister of Agriculture to the municipal deputation for the construction of a ship canal to Brussels. The proposal has created considerable excitement and dissatisfaction in commercial circles at Antwerp, as it is alleged that the opening of navigation to inland towns is unnecessary in a small country like ours, which should be satisfied with one great seaport. The opinion prevails that it would have been better if the Government had reduced the port charges at Antwerp and abolished the light dues, steps which would have benefited the country more generally than the proposed canal is likely to do. The canal is estimated to cost from 12,000,000fr. to 16,000,000fr.

DÜSSELDORF, 20th May, 1890.

IRON.—Some disappointment is felt over the continued stillness of the iron market. For a time it seemed that the recent heavy reductions in price would bring about a revival of business, but consumers are still chary of entering into fresh engagements. The demand for pig iron is very slack, but nothing is offered below the syndicate maximum. The quotations are:—Ordinary spiegel pig, 102s.; Rhenish-Westphalian best forge, 78s.; Siegen forge, 80s.; Thomas pig, 68s.; Bessemer, 82s.; and foundry No. 1, 82s. a ton. The finished iron and steel market is gradually losing strength. The demand for bar iron for home consumption is very slack, and for export almost extinct. Hoops, too, are neglected. For plates there is a moderately active market, and for joists the demand is brisk. Wire is but little inquired for. The railway authorities have decided to adopt the 86lb. rail, and the prospect has infused life into the rail market. Manufacturers express, however, disappointment that the "Goliath" rail of 105lb. per yard was not chosen.

COAL.—The prices of household coal have dropped 1s. to 1s. 6d. a ton in the course of the last week. Business is now very slack in the coal market, not only for the household sorts, but for steam and metallurgical coal. Consumers are holding back in the hope of something like a collapse in prices. Such an event is, however, improbable. The colliery owners, who have sufficient orders already booked to keep them going several months to come, have agreed to reduce the production by dismissing the additional hands lately taken on rather than, to use an American expression, to allow the bottom to fall out of the market. Some interesting statistics, just published, concerning the coal mining industry of this district show that these additional hands number some 10,000. With this augmentation, amounting to 9 per cent., the output of coal was increased only about 3 per cent. Compared with the last quarter of 1889, the increase in the number of hands employed in and about the pits was 3,246; and with these additional hands and a considerably higher rate of wages the production fell off to the extent of about 300,000 tons. As all the pits have been worked full time since the beginning of the year, it is obvious that the cost of getting coal has been notably increased.

FLAG-STONES.—At a meeting of the flag-stone quarry owners in the district of Neuwied, held the other day, it was recommended, in view of the constant accumulation of stocks, to push the export trade more vigorously. With this intention it was agreed to freight collectively a vessel, and to despatch immediately a cargo of flags to England, where there is a prospect of some trade being done in them.

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LILLE, 20th May, 1890.

Iron.—The situation seems to have improved in the course of the last week. There is no increase of business, and consumers appear to be as reluctant as ever to enter into fresh engagements, but the manufacturers have expressed themselves satisfied, and have assumed a firmer attitude in the matter of prices. At a general meeting of the Northern group, held the other day, it was shown that all the members had work enough in hand to keep them going at least two months longer. What, however, is equally true is that the fresh orders coming to hand are far from sufficient to keep things going. If the present situation is satisfactory, the near future leaves much to be desired.

Textile Manufactures.—The current of business in linen goods is a little more brisk this week, and the volume compares very favourably with that of the average for this time of the year. Orders continue to be received in sufficient abundance, and the prospect is encouraging. From Roubaix business is reported dull—paralysed, in fact, by the recent senseless strike. A good deal of the trade for the time being has been driven to Germany. A very unfavourable report concerning the tulle industry at Calais has come to hand. From this it appears that the trade in tulle is practically at a standstill in that locality, and that the near prospect offers no cheering feature.

Flax and Yarns.—The flax market continues active. Walloons are scarce and dearer. Russian flax has been less largely dealt in. Tows are not so much inquired for. For linen yarns the market is active. The demand is equal to the supply and stocks in hand are small. Prices, consequently, remain firm. Jute yarns sell readily at full prices. In the markets of Belgium the demand has slackened somewhat of late.

Rail-testing Apparatus.—Some very interesting experiments have recently been made at the Northern Railway Company's depôt at Ermont with the electro-mechanical apparatus called the "schiscophone," the invention of Captain de Place, for testing the soundness of rails. This apparatus consists of a microphone and telephone combined with a mechanical "striker" and an induction audiometer. It is said that the instrument may be relied on to reveal any latent defect in the metal, and certainly the experiments made at Ermont go far to prove the statement. Wherever a fault was indicated the rail was broken, and invariably the fault was found to exist. The Minister of Marine sent an engineer to be present at these experiments with a view to ascertain whether the instrument could be effectively applied to the detection of defects in screw shafts.

AMSTERDAM, 19th May, 1890.

Steam Communication with Mexico.—The Consul-General of Holland in Mexico has addressed a report to the Minister of Foreign Affairs, drawing his Excellency's attention to the advantages of a new and direct line of steamers between a Dutch port and a Mexican one. When established, the Consul-General thinks the existing English service of steamboats (Liverpool to Galveston, for Mexico) will not be able to compete with it. The English company, he admits, is moderate in its freights, but its service is bad, because so irregular. Moreover, goods get damaged or lost very often between Galveston and Mexico, and experience shows that the senders are without a remedy, as their complaints are disregarded or ignored. It is for this reason that importers prefer the Vera Cruz service, albeit much more expensive than the Galveston route. The Dutch Consul-General thinks that a line of steamers between Rotterdam or Antwerp and Tampico, *viâ* Cuba and New Orleans, would probably show good results. Such a line would command a large export trade, not only from Holland and Belgium, but also from Germany, Austria, and Italy. The Consul-General believes in the future of Tampico. As a competitor with Vera Cruz it is rapidly rising. The new railway to St. Louis Potosi, is completed, and it will open up a new district; whilst the Mexican Government is anxious to improve the harbour accommodation of Tampico, whose situation is much more favourable than that of Vera Cruz.

The Deli Railway.—This railway in Sumatra, which chiefly serves the rich tobacco lands in Deli and Langkat, where several English companies are also at work, has made a net profit of 246,935 guilders in the past year, and an 8 per cent. dividend will be paid. The number of passengers transported was 743,619, and the aggregate of goods forwarded amounted to 123,339 tons. The cost of working was 44 per cent., against 47 per cent. in 1888. The company is constructing several new branch lines.

Dutch Trade in Africa.—The report of the African Company at Rotterdam, the oldest and the largest European trading company on the Congo, shows that 1889 was a prosperous year. The total net profit reached 400,000 guilders, allowing of a distribution of 13 per cent. on the share capital.

The Reafforestation of the Dunes.—The Dutch Government is examining the very interesting question as to whether trees can be made to grow on the sand hills or dunes of the West Coast, thus increasing their resisting power by preventing the wind continually blowing away the sand. At present nothing will grow upon these dunes but a kind of thin long grass, which affords very little protection against strong winds.

United States Geological Survey.—The United States Geological Survey is asking Congress for an appropriation of $800,000 for the ensuing year. Nearly all of this is to be used in surveys for irrigation purposes, the average being about $40,000 for each of the far Western States, except California and Texas, for which $60,000 is asked for each. The maps for the surveys of 1888, for Montana, Colorado, New Mexico, Idaho, Utah, Arizona, Nevada, and California, will be ready for the engravers by the 1st of July. They will cost $50,000.

Petroleum in the Dutch East Indies.—The prospectus of an important new company has made its appearance. It is that of the Royal Netherland Company for the Working of Petroleum Wells in Insuland, established with a capital of 1,300,000 guilders, or a little more than £100,000. Petroleum wells have been discovered, after much prospecting, in Sumatra, and this company has been formed to acquire the concession obtained by the civil engineer, Mr. A. J. Zylker, from the Ameer of Langkat (Eastern Sumatra). The new petroleum field measures about one hundred square miles, and the concession is a monopoly during seventy-five years from 1883, within the dominions of the Ameer, who is a vassal of Holland. The concessionaire is to pay no dues whatever, but the Ameer will levy a royalty of 3d. a hundred litres of exported crude petroleum, and of 6d. a hundred litres of refined petroleum, which royalty cannot, however, exceed 5,475 guilders a year. The borings in this territory have already given very good results. Petroleum is found in large quantities and of good quality at a depth of 120 metres. It is proposed to export it, in the first instance, to Singapore and Penang; afterwards to British India, in competition with Russian. Samples will be sent to London, where, no doubt, much interest will be felt for these efforts to open up a large petroleum field in a part of the world where its existence was probably least expected. The Dutch-Indian Government mining engineers have reported very encouragingly on these new wells.

COPENHAGEN, 17th May, 1890.

The Swedish-Norwegian Railway Company.—Both the Chambers of the Swedish Parliament have, with large majorities, voted in favour of the proposed grant of 7,000,000kr. for the purchase by the State of this railway. One would therefore imagine that the transfer could soon be effected; the sooner the purchase is concluded the better. The company is constantly getting into fresh trouble, and a couple of new summonses have now been brought against it in Sweden. One is for interest on debentures due on the 15th of July last year and on the 15th of January this year. The other summons is by a labourer for damages on account of injuries received while in the service of the company.

The Viksuas Copper Works.—These works are to be discontinued; and the hands have all received notice to leave on the 1st of August. Since this notice has been given the best pit in the mines has fallen in, and it is now feared that the working will be stopped at an earlier date. The works have existed for about twenty-five years, and the number of hands employed at present amounts to about four hundred, but it has been considerably larger in former years. The production once reached 48,000 tons, but of late years it has only been about 30,000 tons of ore annually.

Fishing in Norway.—The Finmark fishing is not so good this year as last. Up to the middle of May there were caught 8,745,500 fish, of which 5,771,800 have been hung for drying. For the same period last year the quantity was 12,600,000 fish. This year's yield of liver amounts to 25,791 hectolitres, and of cod liver oil 939 hectolitres. Prices have been advancing of late.

The Telephone in Iceland.—The telephone has found its way to Iceland. A merchant at Isafjord has had one installed, and it is proposed to connect Reykjavik and Havulfjord with the telephone. It has several times been on the *tapis* to bring Iceland in telegraphic communication with the outer world, but the plan has never been realised.

Strikes in Denmark.—A very serious strike has broken out in Copenhagen, all the bricklayers having struck for nine hours instead of ten, and a minimum pay of 6¾d. per hour. Their average pay for piecework, which is almost the only mode used, is considerably in excess of this demand, so the struggle refers really to the hours. On account of the strike some 2,500 men are out of work. The struggle is likely to be a long one, as both the masters and the men are determined not to give in.

Wood Pulp in Norway.—The Norwegian wood pulp manufactories are not doing particularly well at present, and the prices on the principal markets are very low. In consequence, the rate of production is being reduced.

MADRID, 19th May, 1890.

Labour Troubles.—The labour question has begun to show very disagreeable signs in this country. At the Bilbao mining district about 6,000 men have struck work for shorter hours and higher pay. They came from the iron works to the San Francisco works and the shipbuilding yard, and made the workmen there join them. Thus reinforced, they went to the establishment of La Vizcaya, where they attempted to stop the works, but were prevented by the civil guard. Several shots were fired in order to disperse the mob, and several workmen were killed or wounded. There is also a strike of the coal miners of Asturias, who claim higher wages. It must be admitted that they have really some reason to complain, as their pay is very small indeed. Their situation is peculiar. Most of the men work in mines quite near to their homes, and they cultivate the land for themselves in addition to mining. They are comparatively independent as a class, as they do not depend entirely upon the mines for their living. It is probable that the managers of the mines will have to yield this time, and prepare to use more machinery and fewer hands for the future. The workmen of the coal district of Belmez are also on strike. But little sympathy can be shown to the companies. They sell their coal at extravagant prices, and pay as little as they can to the men.

NEW YORK, 10th May, 1890.

The Iron and Steel Trades.—The desire to secure more business has been so great that it is hard to even maintain the low prices now ruling. While the trade is still confidently expecting better times, there is nothing to show that the expected improvement is near at hand. In pig iron the market is very dull. Prices are slightly better than they were a month ago, and there are indications that the lowest point has probably been passed. The supply of iron is abundant, and it will require a very heavy consumption to raise the prices to what they were at the beginning of the year.

The Coal Market.—There has been no further improvement in the anthracite trade. While there has been an increase in manufacturing sizes, it was not as great as was expected, and this is now offset by a decrease in domestic sales. Business is almost at a standstill.

The Labour Situation.—The strikes among the labouring classes are slowly extending. The numbers on strike are not very large in any one city, but they are spread over the entire country. There are now about 12,000 carpenters out, Chicago leading the list with 3,000, New York city having 2,500, and Philadelphia 1,650. Of these nearly 11,000 ask a reduction in hours, and 8,000 an increase in pay. The number of mill hands on strike is about 5,000, all of whom want a reduction in hours. There are about 7,500 iron workers and others in addition to the above, one-half asking for higher wages and about two-thirds asking for fewer hours. This number is constantly increasing, and in many cases the strikers have been successful and are returning to work.

Subsidising Mail Steamers.—The Frye Bill to provide for ocean mail services between the United States and foreign ports is about ready to be reported back to the Senate from committee. It provides for a ten year contract with American-built vessels owned and officered and partly manned by Americans. The steamers are to be divided into four classes, 8,000 ton gross register, and 20 knots an hour between the United States and Great Britain; 5,000 tons, and 16 knots; 2,500 tons, and 14 knots; and 1,500 tons, and 12 knots. Those of the first three classes are to be easily converted into auxiliary cruisers.

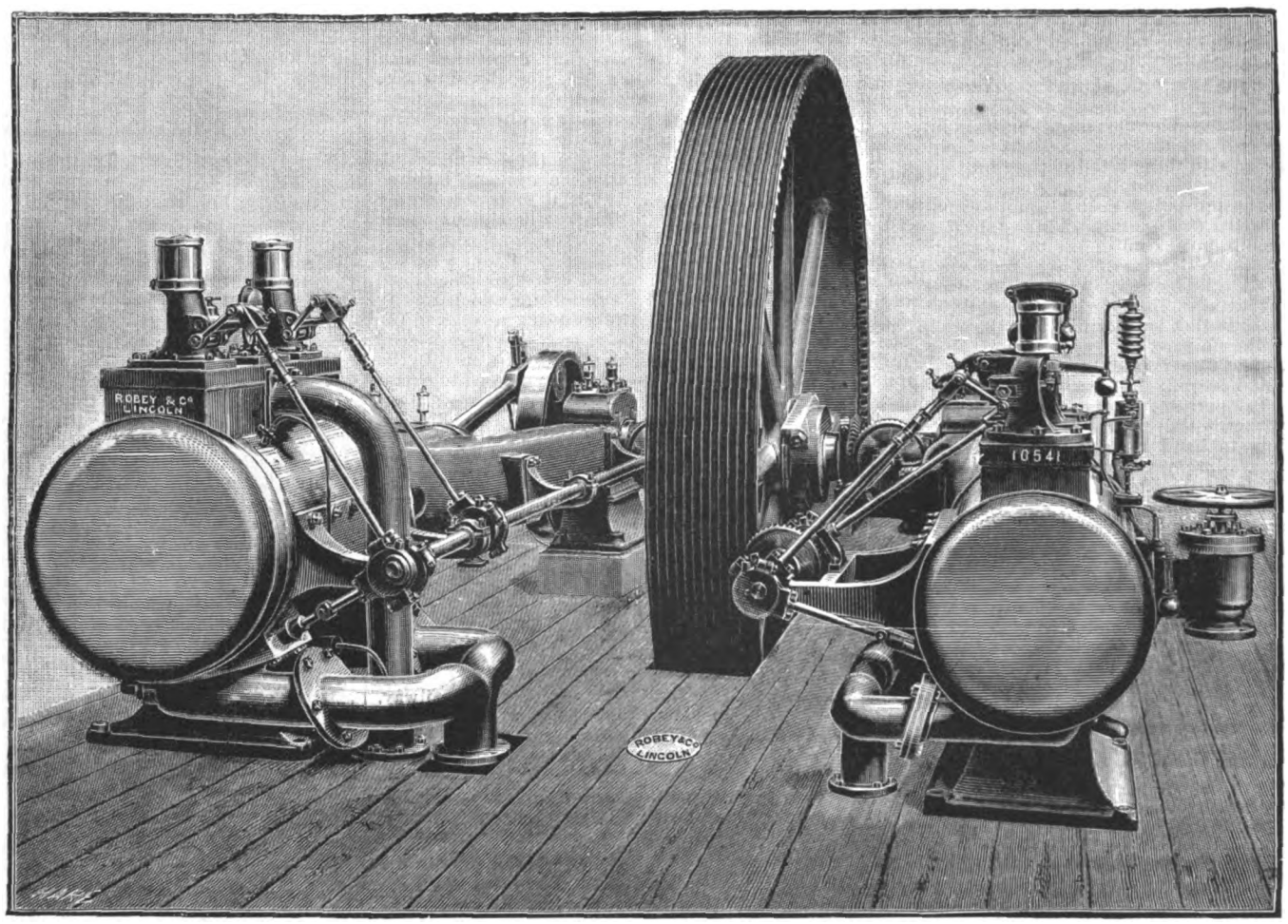
The "Cushing."—The new torpedo boat "Cushing" ran between Newport and New York in 6 hours and 57 minutes, an average of 19¼ knots per hour for the whole distance. She did this with hard coal, an inexperienced crew, and in the face of a brisk breeze and a choppy sea. On her trial run two months ago she made 22½ knots for three hours, and her commander says he has seen the boat travel at the rate of 24·32 knots, or 28 miles per hour. The "Cushing" is 138ft. long, 15ft. beam, 10ft. deep, and with 10 tons of coal aboard her displacement is 117 tons. She can carry 39 tons of coal, and with this can steam 4,000 miles at 10 knots per hour. The "Cushing" has also made the run from New York to Washington in 28¼ hours, with an average speed of 15 knots per hour.

Gold and Silver Production.—The gold production of the United States was 1,587,000oz. of the value of $32,800,000, against $33,000,000 in the preceding year. Of this $31,959,047 was deposited at the mints for coinage and manufacture into bars. The silver product for the year 1889 was approximately 50,000,000oz., of the commercial value of $46,750,000, and of the coinage value of $64,646,464, against an estimated product for the year 1888 of 45,783,632 fine ounces, of the commercial value of $43,020,000, and of the coinage value of $59,195,000. In addition to the silver product of our mines, about 7,000,000oz. of silver were extracted from lead ores imported into the United States and smelted in this country, and over 5,000,000oz. from base silver bars imported, principally from Mexico, making the total product of our mines, smelters, and refineries, about 62,000,000 fine ounces of silver. Of this amount the Government purchased for coinage 27,125,357oz.; there were used in the arts about 6,000,000oz.; there were exported to Hong Kong, Japan, and the East Indies about 9,000,000oz.; and there were shipped to London for sale about 20,000,000oz. Colorado still maintains first rank among producing States with an aggregate product of gold and silver of over $24,000,000. Montana stands next with a product of $22,894,000. California produced $14,034,000, of which $13,000,000 were gold, being about two-fifths of the total gold product of the United States. Utah shows a largely increased product, notably in silver. Idaho and New Mexico report an increased product, and Arizona and Nevada a reduced product for 1889. The gold product of Dakota (South) increased from $2,600,000 in 1888 to $2,900,000 in 1889. Oregon and Washington both report increased products, the former having produced $1,200,000 in gold. The States of the Appalachian range show a slightly increased product of gold over 1888.

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THE EDINBURGH EXHIBITION.

MESSRS. ROBEY'S 400 I.H.P. COMPOUND ENGINE AS USED FOR ELECTRIC LIGHTING PURPOSES.



THE EDINBURGH EXHIBITION.

PRIME MOVERS.—I.

THE prime movers in the Edinburgh Exhibition may for convenience be divided into two categories—(1) those employed for electrical and (2) those employed for mechanical purposes generally—otherwise than locomotives. The leading railway companies have enriched the Exhibition by sending a number of locomotives, some of antiquarian interest merely, and others up to the most recent practice in this department, and the importance of these exhibits demands treatment apart from other examples of engine exhibits. The department of marine engineering is very sparsely represented, though the models which have been sent are of much interest.

The largest exhibit of steam engines is that of Messrs. Robey & Co., of Lincoln. The plant put down by Messrs. Robey, entirely for electric lighting, consists of nine separate engines, two of these being of coupled sets, developing in all upwards of 1,000 i.h.p. The most important is an 80 h.p. nominal coupled compound horizontal fixed engine, shown above. This engine is fitted with Richardson & Rowland's patent automatic trip expansion gear. The cylinders are both steam jacketed, and are respectively 18¼in. and 30in diameter, the stroke being 40in. The trip valve gear is fitted to each cylinder. The cut-off on the high-pressure cylinder is capable of being varied from 0 to ¾th of the stroke, and the cut-off on the low-pressure cylinder can be altered by hand without stopping the engine. The working pressure is 100lb. per square inch. The normal speed is sixty-five revolutions per minute. The driving in this case is done by rope gearing, twelve 1¾in. ropes being used on a fly-wheel 15ft. diameter. The maximum indicated horse-power is 400. The steam inlet and exhaust valves on each of the cylinders are independent. On the high-pressure cylinders double-beat Cornish equilibrium inlet valves are fitted on each end of the cylinders with the object of minimising the length of the steam passages, in order to maintain an initial pressure in the engine approximating, as nearly as possible, to that of the boiler. The exhaust valves are a special arrangement of slide-valve, giving a rapid and ample opening to the exhaust with a minimum of travel.

The exhaust valves are placed under the cylinders in order that the interior may be properly drained, and they are worked by eccentrics upon the same shaft which works the steam inlet valve gear. The engine frames are of an exceedingly substantial character, and these, like all the other parts of the engine, are excellently finished. The bearings are well lined with Babbitt metal, and are made in three adjustable parts, and fitted with lubricators. The peculiarity of this type of engine, of which Messrs. Robey & Co. are the sole makers, lies in the appliance for treating the steam after it leaves the high-pressure cylinder and before it enters the low-pressure cylinder. On its passage from one cylinder to the other the steam enters a receiver, where it is superheated by high-pressure steam from the boiler. The superheating steam circulates through a coil of tubing placed inside the receiver, which is externally lagged with wood and sheet iron. This arrangement secures that the steam enters the low-pressure cylinder at a higher temperature and drier than would otherwise be the case. The trip expansion gear is adapted both to single and coupled non-condensing and condensing engines. The makers claim that in the case of condensing engines the consumption of steam can be reduced by means of this gear to 15lb. per horse-power per hour. The above engine, while driving six Brush dynamos, each supplying current to 35 arc lamps, develops 400 i.h.p. The engine next in size is a 65 h.p nominal horizontal fixed engine capable of indicating 320 h.p. This engine is also fitted with Richardson & Rowland's patent automatic trip expansion gear and special slide exhaust valves, the low-pressure cylinder being, however, fitted with an ordinary rectangular slide having a variable travel. The diameters of the cylinders are 15in. and 26in. respectively; the stroke is 28in. The working speed is 86 revolutions per minute. The driving gear consists of nine 1¼in. ropes, which are carried on a 12ft. fly-wheel. The cylinders are jacketed as in the engine formerly described; the working pressure is 100lb. per square inch. The crankshaft is made of forged steel, and is carried by three bearings cast on the engine-bed, and a fourth bearing beyond the fly-wheel which overhangs the bed-plate. The bearings are lined with Babbitt metal. Six 35-light Brush dynamos are supplied with power by this engine.

The third engine is a 25 h.p. nominal compound "Robey" horizontal fixed engine. This engine is fitted with automatic valve gear of the slot link, block, and radius rod type, controlled by a Richardson patent spring governor. In this arrangement the cut-off valve of the high-pressure cylinder is part of an automatic expansion gear, by means of which the cut-off can be regulated from ⅛th to ⅝th of the stroke, the variations in speed being very slight. The diameters of the cylinders are respectively 9½in. and 16½in., the speed being 143 revolutions per minute. Like the second engine, the end of the crank-shaft is carried on an outer bearing. This engine is employed for incandescent lighting, its load being one of Messrs. King, Brown, & Co.'s 350-light incandescent dynamos. The fourth item in Messrs. Robey's extensive installation is a pair of coupled non-condensing vertical engines, cylinders 9½in. diameter, 12in. stroke. Here, also, the slot link automatic valve gear just described is fitted. The fly-wheel is keyed upon the crank-shaft between the two engines; the speed is 155 revolutions per minute. The fifth item is a high-speed compound engine specially designed for driving dynamos either from the fly-wheel or by being coupled to them direct. The speed is 300 revolutions per minute. The moving parts of the engine are kept as few in number as possible, the piston and rod, for example, being in one piece. The bearings are of gun-metal. The working parts are all protected by hinged cones, which prevent alike injury to the bearings from grit falling from the surroundings and injury to the surroundings from the scattering of oil by the engine. Lubrication is effected entirely inside the protecting cone, a licker on the end of the connecting-rod taking up oil at each stroke and lubricating the whole of the moving parts by throwing the oil upon them. The oil finds its way back to the well by means of a channel, and thus a continuous circulation of oil is maintained. The high-pressure cylinder valve is of the piston type. These engines are similar to those exhibited by Messrs. Robey & Co. at the Glasgow Exhibition two years ago. We favourably commented upon them at the time. For compactness and finish they occupy already a prominent place among engines adapted for electrical installations of moderate size. The protection of their working parts from external interference is of great importance, where, as is often the case in small installations, the labour available is not the most skilled. The engine

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shown drives a 15-light Brush arc dynamo. The sixth item is a high-speed single-cylinder vertical engine. The speed of this engine is 285 revolutions per minute. It has been designed with the special object of meeting the demand for compact engines for ship lighting. All the wearing parts have large surfaces, the lubrication is automatic, the engine is well balanced, and the speed can be varied to suit requirements. A No. 7 Brush dynamo, supplying current for fifteen arc lights, is actuated by this engine. The above-mentioned plant, consisting of six engines, two of these being twin engines, is situated in the dynamo court.

Messrs. Robey have, however, in addition, three engines at the stand of Messrs. Ernest Scott & Co.—viz., one vertical high-speed single cylinder engine, cylinders 6½in. diameter, stroke 6in., speed 300 revolutions, coupled direct to a compound-wound "Tyne" dynamo; a similar engine of rather smaller size, doing similar work; and a third, still smaller. The nominal power of these engines is respectively 9, 7, and 5 horses. The whole of Messrs. Robey's work exhibited is admirable alike in design and workmanship.

(To be continued.)

Notices of Meetings.

NEXT WEEK.

ROYAL INSTITUTION OF GREAT BRITAIN.—Friday, May 30th, at 9 p.m. Paper to be read: "On Astronomical Telescopes," by Mr. A. A. Common, F.R.S.

PRICES CURRENT, 21st MAY, 1890.

Quotations at per ton, unless otherwise specified.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	6 0 0	.....	6 10 0	f.o.t. wks.
„ Angles	5 15 0	.....	6 5 0	„
„ Plates	5 17 6	.....	6 7 6	„
Staffordshire Bars (cheaper makes)	7 15 0	.....	8 5 0	London.
„ Angles	7 15 0	.....	8 5 0	„
Crown Sheets	7 5 0	.....	7 15 0	„
„ Hoops	7 0 0	.....	7 10 0	„
"Siemens-Martin" Steel Boiler Plates			8 10 0	„
„ Ship and Girder			7 10 0	„

Market dull.

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	69/-	59/-

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

METALS.

Spelter:	Ordinary	£24	0	0	to	£24	5	0
Copper:	British Cakes and Ingots	58	0	0	„	59	0	0
„	Chili Bars, G.O.B.'s	52	15	0	„	53	0	0
„	Other sorts, G.M.B.'s (equal to Chili Bars)	52	15	0	„	53	0	0
„	Manufactured (strong)	66	0	0	„	.....		
Lead:	Common Pig	13	12	6	„	13	15	0
„	English Sheet	14	7	6	„	14	10	0
Tin:	Straits	94	10	0	„	94	15	0
„	Australian	.....			„	.....		
„	English Ingots	99	0	0	„	.....		

Messrs. Carrick & Brockbank, Manchester, report as follows:—

COPPER has maintained its firm position during the week, and large quantities of raw have changed hands. The speculative buying is said to have been mainly on American account for shipment to the United States, where values are at present ruling high. Stocks are steadily decreasing, owing to a better all round demand from smelters, sulphate makers, and consumers generally. The statistics show that stocks were reduced about 3,300 tons during the first fortnight in May. Should the French warrant holders continue to keep their copper off the market, probably higher rates may rule, as stocks in the hands of consumers are small, and there is a largely increased demand. Chili bars to-day are £52 15s. to £53 cash, and manufactured £66 sheets, £69 bottoms.

TIN firm, with good business doing. The small supplies from the Straits and the improved demand have helped to strengthen prices.

LEAD quiet, but with more inquiry, and prices a shade firmer.

SPELTER is a little easier, as prices had been advanced too rapidly. The stocks are small everywhere, and consequently values must continue to rule high.

PIG IRON.

Middlesbro' Warrants, No. 3.	40/3	Cash
Scotch Warrants, m/n	44/3	„
Hematite Warrants, m/n	53/1½	„

Stocks in Stores	Scotch	761,363—Dec. for week	10,211	Tons.
	Middlesbro'	118,896—Dec. „	8,434	„
	Hematite	324,689—Dec. „	3,836	„

	No. 1.		No. 3.		
Coltness	65/-	.....	58/-	f.o.b.	Glasgow.
Gartsherrie	61/3	.....	57/-	„	„
Langloan	65/-	.....	58/-	„	„
Eglinton	49/-	.....	48/6	„	„
Glengarnock	65/6	.....	58/6	„	„
G.M.B. ex Store	44/9	.....	44/6	„	„

CHEMICALS.

		£ s. d.		£ s. d.
Acid: Carbolic Crystals	lb.	0 0 8½	to	0 0 10
„ „ Liquid	gal.	0 1 2	—	.....
„ Citric	lb.	0 1 7	—	.....
„ Oxalic	„	0 0 4	—	.....
„ Sulphuric	ton	1 12 0	—	.....
„ Tartaric	lb.	0 1 4	—	.....
Alum: Lump (powder 10/- ex.)	ton	4 17 6	—	.....
Ammonia: Carbonate	lb.	0 0 3½	—	.....
„ Muriate (Grey)	ton	22 15 0	—	.....
„ „ (White)	„	26 10 0	—	.....
„ Sulphate	„	11 10 0	—	.....
„ Liquor	lb.	0 0 3½	—	.....
Antimony	ton	.....	—	.....
Bleaching Powder	„	5 0 0	—	5 2 6
Bisulphide of Carbon	„	13 10 0	—	.....
Borax	„	30 0 0	—	.....
Benzole (90 %)	gal.	0 3 10	—	.....
„ (50/90 %)	„	0 2 10	—	.....
Copper Sulphate	ton	26 0 0	—	.....
Copperas	„	2 0 0	—	.....
Kieserit	„	.....	—	.....
Lead: Nitrate	„	22 10 0	—	.....
„ White Sugar	„	24 0 0	—	.....
„ Brown	„	19 0 0	—	.....
Potash: Bichromate	lb.	0 0 4	—	.....
„ Caustic	ton	22 0 0	—	.....
„ Carbonate	„	19 10 0	—	.....
„ Chlorate	lb.	0 0 5	—	.....
„ Prussiate (Yellow)	„	0 0 9½	—	.....
„ Sulphate (Basis 90 %)	ton	9 10 0	—	.....
Precipitate: Red	lb.	0 3 1	—	.....
„ White	„	0 3 2	—	.....
Salts: Epsom Bags	ton	3 0 0	—	.....
Salts: Epsom Casks	„	3 15 0	—	.....
„ Glauber	„	1 10 0	—	.....
Sulphur: Sublimed Flowers	„	9 0 0	—	.....
„ Recovered	„	4 10 0	—	.....
Soda: Ash	deg.	0 0 1½	—	.....
„ Caustic (White 70%)	ton	7 10 0	—	7 12 6
„ „ „ 60%)	„	6 12 6	—	6 15 0
„ „ (Cream 60%)	„	6 7 6	—	6 12 6
„ Crystals	„	3 2 6	—	3 5 0
„ Bicarbonate	„	6 5 0	—	.....
„ Hyposulphite	„	6 5 0	—	.....
Solvent Naphtha	gal.	0 4 0	—	.....
Tartar, Cream of	cwt.	5 12 6	—	.....
Zinc Sulphate	ton	7 10 0	—	.....

Messrs. S. W. Royse & Co., Manchester, report as follows:—

CHEMICALS: Prices of caustic soda are again lower, the demand being very slow. Soda ash is also having less inquiry, but manufacturers are well engaged. In bleaching powder a moderate business is being done at steady prices. Sulphate of copper is very scarce on spot, and there is a good inquiry for June-July and for contract to the end of the year. Crystal carbolic is unchanged. Crude carbolic is receiving more attention, but holders are not disposed to accept buyers' ideas of value. Sulphate of ammonia has secured a good advance. Oxalic acid is also dearer.

OILS.

			£ s. d.
Cocoanut: Cochin	per ton		29 10 0
„ Ceylon	„		25 5 0
Cottonseed	„		22 10 0
Cod	„		21 0 0
Lard	„		36 0 0
Linseed	„		23 15 0
Palm, Lagos	„		25 10 0
Rapeseed: English	„		32 10 0
Seal: Pale	„		27 0 0
„ Brown	„		22 0 0
Sperm	„		45 0 0
Whale	„		24 0 0
Turpentine	per cwt.		1 9 8
Coal	per gal.		
Petroleum (Refined)	„		0 0 5 7/12
„ Spirit	„		0 0 7

SHIPBUILDING NOTES.

ON the 8th inst. there was launched from the shipbuilding yard of Messrs. MacIlwaine & McColl, Belfast, a steel screw steamer named the "Strait Fisher," built to the order of Mr. James Fisher, Barrow-in-Furness. Her dimensions are:—Length, 174ft.; breadth, 26ft.; depth, 14ft.; gross register tonnage, 500. The engines will be of the triple expansion type, and she will be fitted with steam winches and windlass.

ON the 14th inst. the s.s. "Ingleby" was taken on her trial trip in the Tees Bay. She has been built by Messrs. R. Craggs & Sons, Middlesbrough, for Messrs. Ed. Harris & Co., of the same town. The principal dimensions are:—Length, 260ft.; breadth, 36ft. beam; and depth, moulded, 19ft. The vessel sailed immediately afterwards for Alexandria. The speed developed was 10 knots, at an indicated horse-power of 920. The engines and boilers have been made by Messrs. Westgarth, English, & Co., of Middlesbrough. The cylinders are 20in., 33in., and 54in. diameter, by 36in. stroke, and the boiler pressure is 160lb.

ON the 17th inst. the "Teucer," a steel screw steamer of 2,800 tons gross register, was launched by Messrs. Scott & Co., Greenock. The "Teucer," which has been built for the Ocean Steamship Company, Liverpool, is of the following dimensions:—Length, 335ft.; breadth, 38ft, 6in.; depth, 27ft. The vessel is intended for the London and China trade.

ON the 17th inst. Messrs. Osbourne, Graham, & Co., Sunderland, launched a steel screw steamer, built to the order of the Cardiff Steamship Company, Limited, for their line of steamers trading between Cardiff and Bordeaux. The dimensions are:—Length, 200ft.; breadth, 29ft 3in.; and depth, 15ft. 3in. She is built with long full poop, open topgallant forecastle, water ballast, web frames, and she will be fitted with triple-expansion engines by the North-Eastern Marine Engineering Company, Limited, Sunderland. The vessel was named the "Taff."

ON the 17th inst. Messrs. Wigham Richardson & Co. launched from their Neptune Shipyard, Newcastle-on-Tyne, a steel screw steamer built to the order of the Compagnie Anonyme de Navigation Mixte, of Marseilles. She is 260ft. long, 32ft. beam, and 25ft. deep, and is fitted up with accommodation for passengers in the service between Marseilles and Algiers. The engines are on the triple-expansion principle, and are also being supplied by Messrs. Wigham Richardson & Co. The vessel was named the "Tafna."

ON the 17th inst. Messrs. Robert Stephenson & Co. Limited, launched from their shipyard at Hebburn-on-Tyne a large spar-deck screw steamer of the following dimensions:—Length, 361ft.; breadth, 41½ft.; depth, 29ft. This is the fourth vessel built and engined by the builders for Messrs. F. Stumore & Co., of London. She has a large poop, long bridge, and topgallant forecastle. All the mechanical appliances on board are of the latest and most improved type. The engines are of the triple-expansion type, and indicate 1,800 h.p.; they have been constructed at the engine works of Messrs. R. Stephenson & Co., Limited, South Street, Newcastle. The steamer was named the "Glen Caladh Tower."

ON the 17th inst. Messrs. Ropner & Son launched from their shipyard at Stockton a steel steamer built to the order of Messrs. G. R. Sanderson & Co., of Hull. Her dimensions are as follows:—Length over all, 282ft. 6in.; breadth, 38ft. 10in.; depth, moulded, 21ft. 11in.; and deadweight capacity, 3,350 tons. She has a short full poop, containing a handsome saloon, with accommodation for captain and officers, raised quarter-deck, long bridge extending to foremast, and short well with side stringers continued to the topgallant forecastle, cellular bottom for water ballast, four steam winches, patent windlass, steam steering gear, and stockless anchors. She is built on the web frame principle, and her holds are quite clear, and will give large stowage for cargo. She will be fitted with triple-expansion engines by Messrs. Blair & Co., Ld., and two large steel boilers. As she left the ways she was christened "Inverness."

ON the 17th inst. the s.s. "Lomas," built by Messrs. Raylton Dixon & Co., Middlesbrough, proceeded from the Tees on her trial trip. This vessel has been built to the order of Messrs. Arthur Holland & Co., London, and is on the web frame principle, having poop, raised quarter-deck, and topgallant forecastle. Her chief dimensions are:—Length over all, 287ft.; breadth, 39ft.; depth, moulded, 21ft. 3in.; and deadweight capacity about 3,300 tons. Her engines have been built and fitted by the North-Eastern Marine Engineering Company, Ld., Sunderland. The cylinders are 21in., 35in., and 57in. diameter, by 39in. stroke. They proved very satisfactory on the trial run, and gave a speed of 11 knots.

ON the 17th inst. there was launched from the east yard of Messrs. C. S. Swan & Hunter, shipbuilders, Wallsend, a steel screw steamer of the following dimensions:—Length, 228ft.; breadth, 34ft. 6in.; and depth, moulded, 21ft. 6in. She is built on the spar-deck rule with bridge-house amidships. Her water ballast arrangement is on the cellular bottom principle, extending to the fore and after peaks. The deck machinery is of the latest and most improved type, including steam winches, steam steering gear, &c. The engines, which are of the triple-expansion type, have been supplied by Messrs. Black, Hawthorn, & Co., Gateshead, and are capable of indicating 750 h.p. The vessel, which is the eighth built by Messrs. Swan & Hunter for the same owner, Mr. T. Rodenacker, Danzic, was named the "Julia."

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HOME INDUSTRIES.

LONDON, 22nd May, 1890.

The Money Market.—Money is abundant and cheap, and there is no immediate prospect of a change in these conditions. In spite of the continued lowness of the Paris and Berlin rates of exchange, discount rates are easy. There has been no marked alteration in the position of silver this week, but the Indian exchange is firm. The stock markets, though active at the beginning of the week, have failed to maintain that activity, and prices have been inclined to droop. The stocks of the "heavy" home railways were in strong request at improving prices on expectations of an extension of the stock-splitting policy among the companies, but the sphinx-like attitude of the Parliamentary Committee who are considering the three stock-splitting bills put forward by the Great Northern, the London and South-Western, and the Caledonian Railways, has rather damped the ardour of the market. American railways, though still fairly supported, are not so brisk as they have been, and in sympathy Canadian and Mexican railway securities have experienced a check in the recent steady advance. Foreign stocks have been in request, notably Turkish issues. South American bonds have been freely bought, Brazilian and Uruguayan stocks in particular. Copper mining shares have not quite maintained the higher prices reached at the beginning of the week, and gold shares have shown a dull disposition. There has been a fall in the shares of the Eastern telegraph companies. Little movement has occurred in industrial and miscellaneous securities, and the nitrate group has shown no feature of interest.

Companies.—The following companies have been registered since our last report:—Dunedin Suburban Gas Co., Ld., with a capital of £40,000; Sunderland Cycle Co., with a capital of £5,000; San Cabrian, Ld., with a capital of £140,000, to take over the San Cabrian Railway and Collieries; Mason's Paper Mill Co., Ld., with a capital of £25,000; Flax Growers' Association, Ld., with a capital of £602, to carry on the business of cotton spinners, &c.; Blackwood Gas and Water Co., Ld., with a capital of £5,000; Penrhys Rhondda Colliery Co., Ld., with a capital of £5,000; Mackie's, Ld., to carry on the business of engineers; H. & M. Southwell, Ld., with a capital of £100,000, to acquire a carpet manufacturing business; South Atlantic (African) Land and Exploration Co., Ld., with a capital of £150,000; Leon Cobalt and Copper Mining Co., Ld., with a capital of £75,000; African Petroleum Syndicate, Ld., with a capital of £10,000; Carbonate Mountain Development Co., Ld, with a capital of £65,000; Elm Spinning Co., Ld., with a capital of £70,000, to carry on the business of spinners in cotton, &c.; British and Foreign Refrigerating Co., Ld., with a capital of £50,000; Kingston Machinists' Co., Ld., with a capital of £30,000; Metropolitan Cement and Brick Works, Ld., with a capital of £10,000; Climax Patent Carbonising Co., Ld., with a capital of £1,000, to acquire certain patents.

Speculation in Pig Iron Warrants.—The Board of Management of the British Iron Trade Association have under consideration the question of the legality of dealings in pig iron warrants for speculative purposes, on which counsel's opinion is being taken. It is probable that a Bill will be introduced into Parliament for the purpose of controlling the present system of dealing in warrants.

Railways.—The gross receipts of the twenty-three principal railways in the United Kingdom for the week ending the 11th inst. amounted, on 16,159¼ miles, to £1,348,743, and for the corresponding period of 1889, on 16,031 miles, to £1,301,380, an increase of 128¼ miles, or 0·8 per cent., and an increase of £47,363, or 3·6 per cent.

The Skilled Labour Market.—During the month of April there was no falling off in the number of labour disputes which caused stoppages of work, no less than 91 being reported, many of which were of considerable importance. In the cotton trade there were nine strikes, in the woollen trade five, in the linen trade five, in the tailoring trade twelve, in the coal trade ten, in the building trades fifteen, in the iron trade five, in the shipbuilding trade five, in the engineering trade two, in the quarrying trade three, and nine among dock labourers, the remainder being among miscellaneous trades. The returns of trade societies show a slight falling off in the demand for some kinds of skilled labour, although in a few others the figures show an improvement. Reports have been sent in by 21 trade unions, showing a total membership of 219,228, of which number 4,297 are out of work, being a proportion of 1·96 per cent. The returns of the previous month gave a total for the same societies of 3,823 unemployed, a proportion of 1·7 per cent., while the proportion for March was 1·4 per cent. This falling off is chiefly visible in the shipbuilding trade and in the allied industries depending thereon. The building and house furnishing trades continue to improve, cabinetmakers being remarkably well employed. There has been some falling off in the manufactured iron trades, but steel workers are well employed. The textile trades are somewhat dull, and there is rather more labour unemployed than is usual at this time of the year. The boot and shoe trade is fairly well employed, except in the hand-sewn branch, which is rather dull. The general observations made by the reports show that ten trades are considered "very good," seven "good," and four "moderate." The falling off here indicated is only slight, but the figures for the month seem to show conclusively that in some of our most important industries the full tide of prosperity is beginning to run slack.

The Sanitary Institute.—At a meeting of the Council held on the 14th inst., Sir Douglas Galton, K.C.B., F.R.S., in the chair, a scheme was adopted for periodical examinations for inspectors of nuisances at various centres throughout England.

Electrical Engineering.—Messrs. Appleton, Burbey, & Williamson have purchased the whole of the manufacturing business of Mr. F. Geere Howard, of Cleveland Street, Fitzroy Square, W., and have transferred the plant to their works at Hatton Garden, E.C., which have been enlarged to meet the growing demand for their electrical supplies.

The Lane Fox Patents.—We hear that the Lane Fox Company are in negotiation with several electric supply companies for the payment of a royalty of 1d. per Board of Trade unit supplied and sold to the consumers. This may be taken as 12½ per cent. on the revenue for the next two years.

The Bermudas and Halifax Cable.—The s.s. "Westmeath" is about to start from the Thames with 2,000 tons, or 874 knots, of submarine cable, to be laid between Halifax and the Bermudas.

"On Principle" Strikes.—A short time ago Mr. J. Stafford Ransome, A.M.Inst.C.E., wrote a series of articles on "Strikes" for the *Globe*, more especially with the object of showing some of the disadvantages of the existence of trades unions. Some of these articles were distributed as pamphlets among the men during the late gas strikes, and the demand for copies from employers of labour throughout the country became so great that Mr. Ransome has determined to issue all four articles together in pamphlet form under the name of "'On Principle' Strikes."

The Great Tower in London.—The site of the Watkin Tower has been fixed in the neighbourhood of St. John's Wood, in immediate contiguity to the Metropolitan Railway. The other day, by the invitation of the directors of the Metropolitan Railway, a party of gentlemen proceeded by special train to inspect the spot. It is intended to begin building operations as soon as possible, in the hope that early next year the tower may be opened to the public.

Protective Paints for Ships.—We have received a catalogue of Hartmann's Rahtjen's Composition Company, Limited, 18, Billiter Street, London, E.C. It appears that the Peninsular and Oriental Steamship Company have used this excellent anti-fouling paint for the whole of their fleet for fifteen years. A large number of the cruiser class of the Navy are painted with it, as also are such notable vessels as the "Majestic," "City of Paris," &c. The first cost of this composition is greater than that of the majority of such like paints, but its lasting powers and small skin friction more than compensate.

Diving Apparatus.—Mr. Alfred E. Stone, submarine engineer, 5, Mansion House Chambers, E.C., has lately brought out a new diving helmet, which possesses many advantages. A circular metallic ring forms the collar of the breastplate, and a groove is formed in the breastplate to receive the fillet on the collar of the dress. The metallic ring is screw-threaded in sections, and the flange on the helmet is screw-threaded in sections alternate to those on the breastplate. By this arrangement the helmet can be attached to the breastplate and diving dress with great ease; there is only one watertight joint, and no screws, nuts, or loose pieces, &c., are required, neither are there any holes punched in the collar. Those who have used this apparatus express satisfaction with it.

MANCHESTER, 22nd May, 1890.

The Manchester Ship Canal.—The policy of interesting traders of various kinds in this undertaking has been steadily pursued by the directors. About a week ago a party of the principal fruit merchants in Manchester and Liverpool were conducted over the works from end to end. The import trade in fruit and vegetables is a very large one in Manchester, and has during the last few years grown so largely that the market buildings have been twice extended, and a further extension is at present projected. The Mayor of Manchester and a Committee of the Corporation visited the Deptford Foreign Cattle Market on the 20th inst., and witnessed the disembarkation of 565 beasts from the "Egyptian Monarch." The visit was paid in order to see the arrangements with a view of establishing a similar market on the banks of the Canal.

Weavers' Wages.—The difficulty as to the formation of a standard list of prices, to which we referred last week, has been rendered acute by the action of the General Council of the Weavers' Association at a meeting held in Burnley on the 17th inst. The Council determined to insist on the formation of a uniform list within fourteen days, and, failing that, to take separate action. Since the meeting, strenuous efforts have been made to agree upon a list, as it is felt that unless this course is adopted a strike of large dimensions is inevitable. Both sides are agreed as to the desirability of the step, and there appears to be no reason why it should not be taken.

Another Cotton Corner.—Rumours of an intention on the part of speculators to create another corner in cotton are rife, but there does not appear to be much ground for them. It is well known that early in the season spinners bought very freely, and there is no doubt that many of them are well supplied. Further, it is not believed that the brokers are not selling as freely as they can, or are keeping cotton locked up, and the present strong position is apparently the outcome of the free buying earlier in the season. The demand for cotton continues to be large, and new spindles are gradually getting to work. Also several large concerns are being floated which will further increase the productive capacity of the county.

The Linen and Jute Trades.—There has been a decided falling off in the amount of business put through of late, and agents for manufacturers are constantly receiving requests from the wholesale distributors to defer delivery of goods on order until advice is received to the contrary. The houses are curtailing fresh supplies to immediate and pressing wants, and it is not expected that much will be doing until three or four weeks hence, after the holidays are over and stock has been taken. In the general home trade, however, a satisfactory turnover has been effected, and even certain sections of the linen departments have been fairly active. Such articles as blinds, for instance, have been inquired for, this being the period of spring cleaning. With regard to prices, it is not thought that any advance will take place for some time to come, although unfavourable reports with regard to the Irish and Continental flax crops have appeared of late. The shipping demand is quiet, and prospects all round will not brighten up this side of Whitsuntide. The jute trade displays no special feature of interest.

GLASGOW, 22nd May, 1890.

Pig Iron.—There is no change of any consequence in the pig iron market. Large deliveries from store are still going on, and shipments are good. Many merchants report that they are daily doing a good trade with the Continent, Canada, and the Colonies. Cleveland warrants have passed out of the hands of the late large holders, and are now being offered freely at about 4s. per ton below Scotch warrants, but on these terms they readily find buyers. Hematites have been kept up by large deliveries ex store and by labour disturbances at the mines in the North of Spain.

Scotch Railways.—The Scotch railway companies are still *en evidence* in London. The practical settlement, so far as the House of Commons is concerned, of the amalgamation scheme of the North British and Glasgow and South-Western Railways has, of course, involved the defeat of the Caledonian counter-scheme. The Caledonian Railway (Conversion of Stocks) Bill has been before a committee presided over by Mr. Campbell-Bannerman, and a Bill of limited range, for the construction of some minor branch lines in Lanarkshire and Midlothian, was passed. A larger Bill seeking for running powers over the existing joint lines in connection with the Lanarkshire and Ayrshire Railway, which is at present being constructed, was debated before Sir John Dorrington's committee in the early part of this week. On Tuesday afternoon the preamble was found not proved. The Caledonian Railway have already suffered rather heavily this session in their Parliamentary contests. In consequence of the likelihood of the Conversion Bills passing the House of Commons in the course of the week, there has been a considerable all round advance in railway shares, although last week, on receipt of the news of the defeat of the Caledonian Railway Amalgamation Bill, there was a sharp fall in the stock of that company.

Cross-river Traffic at Finnieston.—There was launched on Saturday from the yard of Messrs. Wm. Simons & Co., Renfrew, a new patent elevating ferry steamer for cross-river service at Finnieston. The dimensions of the vessel are: Length, 80ft.; breadth, 43ft.; and depth amidships, 12ft. The hull is chiefly of steel, and the main deck iron. The vessel is subdivided into thirteen water-tight compartments by longitudinal and transverse iron bulkheads. An important feature in this steamer is its being able to embark or land passengers on the quay or landing places irrespective of the rise or fall of the tide. This is managed by an elevating platform, which extends the whole length of the vessel and occupies two-thirds of its width. The platform is supported by six steel columns of box-section, and by means of screws placed inside the upright columns it can be raised to a height of 15ft. The vessel has accommodation for 300 passengers, besides eight loaded carts and horses. The propelling and elevating machinery is placed amidships, and consists of two independent sets of surface-condensing three-cylinder engines, each set coupled with its own propeller shafting, and each shaft carries two propellers. Steam steering gear is supplied by Messrs. Alley & McLellan, and Brown's patent steam and hydraulic starting and reversing gear is fitted to the propelling engines. Two horizontal boilers of Siemens-Martin steel, with patent ribbed furnaces, at a working pressure of 150lb., supply the steam. The engines for raising and lowering the platform are separate, and the gear for working the elevating screws is so constructed that any variation of speed may be obtained according to the nature and extent of the load.

(From our own Correspondents.)

LIVERPOOL, 21st May, 1890.

The American Passenger Trade.—The passenger traffic across the Atlantic is now very heavy, and the season has commenced in earnest; last Saturday was an exceedingly busy day at the landing stage, for while three of the largest steamers, the "City of Rome," the "Alaska,"

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and the "Aurania," left for New York with a full complement of passengers, six large steamers arrived from New York and the Canadian ports, the "Umbria" alone landing 520 passengers, of whom 450 were saloon passengers. The leading hotels are full, and special trains were despatched by the London and North-Western Railway Company and the Midland Railway Company to the metropolis.

THE NORTH WALES STEAMBOAT SERVICE.—Visitors to North Wales will have ample steamboat service this season, for, in addition to the new company mentioned last week running the "St. Tudno"—formerly the "Cobra"—another company has started with the steamer "Victoria." For a time the public will have the benefit of the competition in the shape of reduced fares; but eventually the weakest will go to the wall, and the fares will return to the normal rate. There is, however, a prospect of an improved service, both as regards speed and accommodation, being maintained, for the new boats are a decided improvement upon the old ones.

LEEDS, 21st May, 1890.

THE IRON AND STEEL TRADES.—There is no new feature to notice in the iron and steel trades of this district, except it be that at present things are a little quieter than a fortnight ago, owing to the decline in the market. A hopeful feeling, however, exists with regard to the immediate future, the belief being that when prices get more settled home and foreign orders, which have purposely been withheld, will be given out. Meanwhile, the absence of inquiry is being felt. Less is doing at the forges and steel works, though the foundries are fully employed on old orders. The engineering trade remains unchanged. The chief locomotive building shops have plenty of work, chiefly on old account, while in some shops difficulty is experienced in giving full time to the hands. Makers of hydraulic machinery keep busy. One or two trade disputes have arisen in the town within the past fortnight. As indicated in a former letter, the workmen employed in the engineering, tool, and machine trades of the district have had under consideration the advisability of asking their employers for an advance of wages. The heads of the Amalgamated Society of Engineers, Steam Engine Makers, and others have now taken a practical step in the way of trying to get additional pay for both union and non-union men engaged in the engineering trade. By means of circulars the masters are requested to consider the propriety of increasing the present rate of wages, and thus enable the "workmen to take their proper position as skilled workmen with the other large centres of industry." The men suggest that an equitable adjustment would be an advance of 2s. per week to pattern-makers, smiths, fitters, millwrights, turners, and machinists. Leeds, according to the view put forward on behalf of the men, is the only centre of the engineering trade where the workmen generally have not reaped the benefit of prosperity prevailing. The answer of the masters to the demand made is looked forward to with interest outside the trade.

THE LEEDS EXHIBITION.—This Exhibition was opened to-day in the presence of a large number of spectators. Although the arrangement of the exhibits was not quite complete, yet it was possible to obtain a good idea of the merits of the show.

SHEFFIELD, 21st May, 1890.

THE STATE OF TRADE.—No orders of importance have been placed here during the past week. There is a decided falling off in orders from marine sources. Engineers still find plenty to do in attending to local requirements for new machinery and alterations to existing plant. The Manchester tool makers find Sheffield a good market. Some excellent tools have recently been delivered, including a standard type of rifling machine. Messrs. Howell & Co., of steel tube fame, are extending their works, to enable them to deal with some heavy orders. The agricultural implement makers are very busy, and most of them are working double shifts. On the whole, trade is fairly good.

NORTH STAFFORDSHIRE, 21st May, 1890.

THE IRON TRADE.—There is no real improvement to report in the iron trade of this district. Inquiries are rather more numerous, but little actual business is being done. Many of the mills are only working half time, and some are altogether at a standstill for want of working specifications. The Midland Coal, Iron, and Coke Company have given their blast furnacemen fourteen days' notice. The company find that their stocks are increasing, and that, with the present high cost of production, it is practically impossible to make a profit. Prices rule at about £7 10s. for bars and 52s. 6d. for pig iron. Puddle mine is being sold at 15s. to 16s. per ton, and furnace mine at 9s. 6d. to 10s. 6d.

THE COAL TRADE.—As might be expected at this season of the year, the demand for house coal is falling off, and prices tend downwards. There is also a great diminution in the consumption of manufacturing fuel. This industry is being seriously crippled through the heavy cost of production. It is apparent to all but the miners themselves that the rapid rises in wages have had the effect of "killing the trade."

DERBY, 21st May, 1889.

ELECTRIC SIGNALLING.—A special monthly meeting of the Midland Counties branch of the National Association of Colliery Managers was recently held at Messrs. John Davis & Sons' All Saints' Works, Derby, where, in the large hall, a most complete and effective collection of apparatus for every kind of electrical signalling applicable to collieries was exhibited. Mr. Davis, in a preliminary address, said that electrical engineering was beginning to be very much appreciated by colliery managers, and, without venturing into the regions of prophecy, he thought it was safe to predict that in time certificates of colliery managers would include the study of electrical engineering. It is proposed that the other branches of electricity for collieries be similarly treated, for which purpose the Messrs. Davis will again generously place their works at the service of the association.

TECHNICAL INSTRUCTION.—The Derby School Board have decided to join with the School of Art and the Chambers of Commerce, in presenting a memorial to the Town Council, requesting them to put in operation the Technical Instruction Act, 1870, with the view of assisting and developing a more perfect system of science and art teaching and manual instruction, more especially for the artisan classes, than has hitherto been practical.

CARDIFF, 21st May, 1890.

IRON AND STEEL.—The output of pig iron has not yet been appreciably reduced, and there is less increase in stocks at makers' works than would have been expected. Prices are dull, and where makers have been forced to sell buyers have been able to secure bargains. Hematite iron is quoted at 55s. Steel tinplate bars are quoted nominally £5 10s., but some makers prefer to stock or turn their attention to rails rather than accept a figure which cannot leave them any profit. For steel rails there is rather a better inquiry, but for iron ore the market is flat. The strike at Bilbao means the reduction of shipments by 100,000 tons, which has caused mine-owners to advance their quotations. Rubio ore is now quoted at 15s. 3d. per ton c.i.f. Cardiff and Newport, 16s. Port Talbot, 16s. Middlesbrough, 15s. 9d. Tyne.

COAL AND COKE.—The advance of 13½ per cent. in colliers' wages seems to have given satisfaction to the men, and masters know that, on its present basis, the results of the sliding scale are often a surprise to those not fully informed as to the course of the markets. Wages have now gone up, while prices are going down, and undoubtedly the position will be reversed when wages may be reduced on a rising market. This the men should remember, as the large contracts running for periods of twelve months and more rule the average price. This week shipments have been good, especially at Penarth Dock—so much so that Taff Vale Railway stock has taken a decided step upward. Prices of steam coal are fairly steady, best steam being quoted at 15s. to 15s. 6d.; second, 13s. 6d. to 14s. 6d.; and third, 12s. 6d. to 13s.

BARROW-IN-FURNESS, 21st May, 1890.

HEMATITE IRON.—There is a somewhat slow business being done in the hematite pig iron trade, and although prices are firm at about late rates—54s. for hematite warrants—the weight of pig iron changing hands is inconsiderable. Old contracts continue to engage attention, and in some cases, where these are running out, makers are disposed to transact new business at warrant prices, although the normal values quoted by makers range from 57s. 6d. to 60s. net f.o.b. for parcels of mixed numbers of Bessemer iron. They are all the better enabled to do this, because they are now getting cheaper labour and cheaper iron ore and coke. There is again a reduction to note in stocks to the extent of 6,876 tons, making the total reduction this year 59,678 tons, and leaving the aggregate stocks at 320,964 tons.

STEEL.—A rather better feeling is reported in the steel trade, which is fairly well supplied with orders. Rails are in better inquiry, and it seems likely that some good orders will be placed while prices are down at the low figure of £5 per ton for heavy sections net f.o.b. There is also a good outlook in the Siemens-Martin department, and there are prospects of good orders. Blooms, billets, tinplate bars, hoops, slabs, and general merchant qualities are quiet.

MIDDLESBROUGH, 21st May, 1890.

PIG IRON.—There was rather a small attendance at the weekly market held on 'Change yesterday, and business was duller than ever. No. 3 G.M.B. was quoted at 41s. 6d. per ton, and small lots were sold as low as 41s. 3d. Merchants are not selling, and prefer to wait. Makers are handicapped with high wages and the large prices for coke. In warrants, Cleveland No. 3 is quoted at 40s. 7d. per ton, and West Coast hematites at 53s. 5d. per ton cash. East Coast brands are nominally 60s. per ton f.o.b. for mixed numbers makers' iron, but they may be had at less. The stock in Connal's store on Monday amounted to 118,219 tons, being 8,024 tons less that a week ago. However, whilst Connal's stores are decreasing, makers are increasing in greater proportion.

SHIPMENTS OF PIG IRON.—The shipments, though rather more favourable last week, are far behind those of last year. The difference between Scotch and Cleveland has not yet reacted upon the shipments, and indeed it is questionable if the Scotch trade is desirable to the makers with the price so unremunerative. Up to the 19th the shipments amounted to 41,008 tons, against 51,993 tons to a similar date last year. Germany and Holland have taken more, but other foreign countries have taken less.

MANUFACTURED IRON AND STEEL.—These trades are very dull, and specifications are hard to get. Iron ship plates may be had for £5 15s.; angles, £5 12s. 6d.; and bars for £5 17s. 6d. per ton; steel ship plates, £6 17s. 6d.; angles, £6 10s.; heavy rails, £4 17s. 6d. per ton, all less the usual discount free on trucks at works. Some works are running short time.

SUNDERLAND, 21st May, 1890.

SHIPBUILDING.—During the last few days there have been three steamers launched at this port—the s.s. "Taff," built by Messrs. Osbourne, Graham, & Co., North Hylton, for the Cardiff Steam Shipping Company, Ld.; the s.s. "Queensland," from the yard of Messrs. Jos. L. Thompson & Sons, North Sands, built to the order of Wm. Kish, Esq., of this town; and the s.s. "Lyell," built by Messrs. Bartram, Haswell, & Co., for Messrs. Wilkie & Turnbull, North Shields. The second vessel is the largest yet owned and registered in the port, having a displacement of 8,100 tons. Shipbuilders are reported to be in receipt of inquiries, but most of these appear to be tentative. Doubtless some shipowners may be tempted to place orders at present as material has fallen considerably in cost, but they would be acting wisely to wait a little longer.

SHIPPING.—Outward freights have continued to rule low. Generally the outlook has not improved, and there is a considerable degree of uncertainty as to the future. The local import and export trade has not been so satisfactory during the last two weeks.

NEWCASTLE, 21st May, 1890.

THE ENGINEERING TRADE.—In the marine engineering establishments business continues extremely active, in spite of the fact that very few new orders are being booked. In the boiler shops there is also a good deal of work in progress, Messrs. Eltringham's establishment, South Shields, being particularly busy. The locomotive engineering works in the district are, in most cases, pretty busy, a large part of the work in hand being ordered on foreign account. Makers of steering gears and other deck accessories for steamships have still plenty of work in hand, but inquiries have fallen off, and when the orders now in progress are completed it is but too probable that a serious slackness will be felt. Efforts are now being made to give practical effect to a suggestion recently made by the employers that a Board of Arbitration and Conciliation should be formed in connection with the engineering trade of the district. Meetings of the employers and the workmen's representatives will shortly be held in reference to the matter, and it is probable that the outcome will be the early formation of a properly constituted Board, before which in future all wages disputes may be brought for settlement.

THE LABOUR QUESTION.—At a meeting of the employers and men's representatives of the North of England Iron and Steel Trade, held at Newcastle, yesterday, Mr. Jenkins, Consett, in the chair, a reduction of 10 per cent. in steel smelters' wages was accepted by the representatives for the men.

CONSETT STEEL WORKS.—Two sections of the operatives at the Consett Steel Works, numbering in all about 300, have come out on strike because the company declined to comply with their request for the dismissal of two men who had refused to join the Steel Smelters' Association. Four of the plate mills have in consequence been laid idle, and about 1,200 men, exclusive of those directly connected with the strike, are thrown out of work. Should the dispute not be speedily settled the restricted production caused thereby must seriously inconvenience Tyneside shipbuilders, whose supplies of steel plates and angles are mainly obtained from the Consett Works.

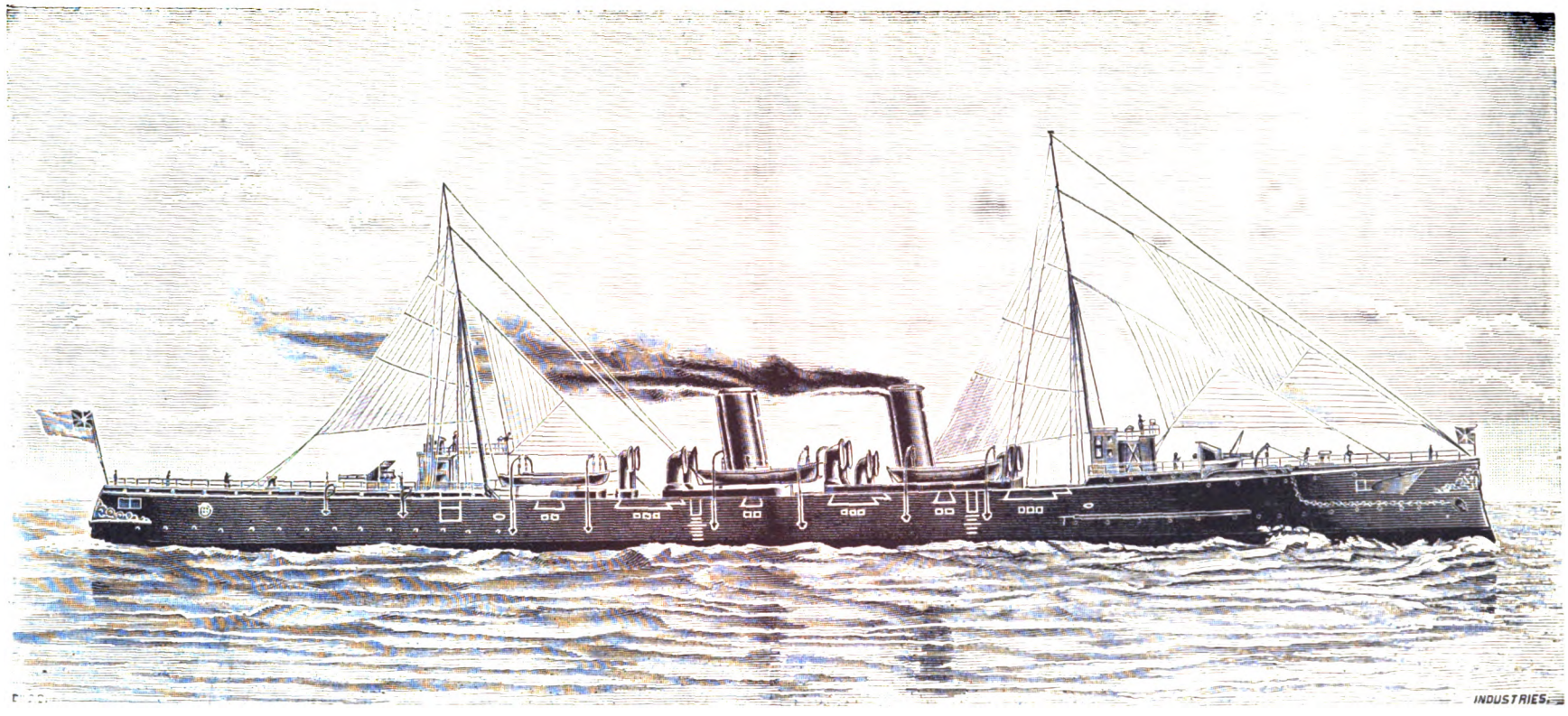
DUNDEE, 21st May, 1890.

JUTE AND FLAX TRADES.—The jute branch of the trade is again brisk, and there is a steady demand for yarns and cloth. Prices have advanced, and burlaps, 40in. 10½oz., are now quoted in New York at 5⅛c. per yard. The advance is to some extent causing hesitancy on the part of buyers here, who are only operating for the present so as to cover actual requirements. Makers are, however, well foresold, and there is a prospect of prices being maintained. There is an active demand for raw jute at advancing rates. A large business, both on spot and to arrive, has been concluded during the fortnight. Fine first marks have been quoted as high as £16. Jute yarns are sold at higher prices, but buyers are now less inclined to operate. There are rumours that some importing houses at Buenos Ayres are in difficulties, and that some orders from Dundee exporters have been cancelled. Flax spinners are well stocked, and there is little or no business doing on spot or contract. Flax and tow yarns are quiet. Manufacturers are now, however, showing more inclination to operate, and spinners of finer qualities expect that they will be able to get better prices than have ruled of late. Linen is in fairly good request, but the demand is not animated.

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HER MAJESTY'S CRUISER "LATONA."

BUILT BY THE NAVAL CONSTRUCTION AND ARMAMENTS COMPANY, LIMITED, BARROW-IN-FURNESS.



LAUNCH OF H.M.S. "LATONA."

THERE was launched yesterday, from the works of the Naval Construction and Armaments Company, Limited, Barrow-in-Furness, a steel-protected cruiser for Her Majesty's Government, called the "Latona," and which we illustrate above. Unusual interest is attached to the event, as the "Latona" is the first practical outcome of the Naval Defence Act of last year. This Bill provided for the construction of twenty-nine vessels of the "Latona" class, and it was decided to build twelve of the vessels in the Royal Dockyards, while the remaining seventeen were placed with the principal shipbuilding firms in the country. Orders for three of the seventeen vessels were placed with the Naval Construction and Armaments Company, and the "Latona" is the first of these vessels to be launched, and has been put in the water in exactly nine months from the day on which the first keelplate was laid.

The "Latona," which is one of the new type of protected cruisers, is of the following dimensions:—Length, 300ft.; beam, 43ft.; and depth of hold, moulded, 22ft. 9in. Her displacement represents 3,400 tons on a mean draught of 16ft. 6in. The hull throughout is built of steel, the stern, stern-post, propeller brackets, rudder, &c., being of cast steel. The engines embrace two sets of the triple-expansion type, with cylinders 33½in., 49in., and 74in. diameter, by 36in. stroke, and are capable of developing over 9,000 i.h.p., with the boilers worked under moderate forced draught. The engines are of the light type adopted in modern war vessels, cast and wrought steel being largely introduced into their construction. The boilers have an aggregate of 16,000 square feet of heating surface. The "closed stokehold system" of forced draught has been adopted, each stokehold being fitted with two powerful fans, worked by independent engines, for the supply of air. A steel protective deck is one of the distinctive features of this cruiser; it extends fore and aft, the forward part running down with a long sweep to the ram of the vessel, of which it forms part. The transverse section of this deck is in the form of a flat arch, the crown of which rises about 1ft. above the water line at the centre of the vessel, and slopes down towards the sides to a point about 4ft. below the load-line. On the sloping part the average thickness is 2in., with a thickness of 1in. on the crown. Under the protective deck are placed the engines and boilers, magazines, steering gear, and other vital parts of the ship. As, however, in the "Latona," vertical engines have been adopted instead of horizontal, as fitted in some of the former vessels of this type, the necessary protection for the parts of the engines projecting above the protective deck is obtained by fitting a belt of 5in. of steel armour with 7in. of teak backing round the engine hatchway between the protective and upper decks. The subdivision into numerous water-tight compartments has been, as usual in warships, fully carried out in the "Latona." For the full extent of the engine and boiler space a complete inner bottom is fitted, the continuity of which is carried forward and aft by the water-tight flats forming the magazines and store-rooms of the ship. Alongside the engines and boilers amidship, coal bunkers are also fitted, formed by longitudinal bulkheads extending to the upper deck, thereby affording additional protection to the machinery. Moreover, numerous transverse bulkheads are fitted, the hull under the upper deck being thus divided into about a hundred water-tight compartments. The greater part of the hull amidships under the protective deck is occupied by the machinery, there being two separate engine and boiler rooms. Aft of the engine-rooms are situated the magazines for the supply of the after guns, as well as the steering gear, both hand and steam, fitted in two separate compartments. Forward of the machinery spaces are the magazines for the forward guns and the various store-rooms required for the ship. Above the protective deck aft are the cabins for the ship's officers, the part amidships being occupied by the coal bunkers, artificers' workshop, wash-places, &c., while the part forward is entirely devoted to the crew. Under the poop are placed the cabins of the commander and principal officers, ward-room, &c., the forecastle being taken up by the crew. The armaments of the ship consist of two 6in. breechloading central-pivot guns, one mounted on poop and the other on the forecastle; six quick-firing 4·7in. central-pivot guns, three on each broadside; eight quick-firing 6-pounder guns, four on each broadside; besides one 3-pounder Hotchkiss, and four five-barrel Nordenfelt guns mounted at suitable stations along the sides of the vessel. A 9-pounder gun for boat and field purposes is also secured on deck. In addition to these, four torpedo tubes are fitted—one forward, one aft, and one on each broadside in front of the poop. For controlling the ship in action, a conning tower of steel is fitted on the after end of the forecastle, inside of which all the gear for manipulating the engines, steering gear, guns, &c., is placed. As regards the pumping arrangements, an elaborate system of piping is fitted, extending to every compartment, while the fire service and sanitary arrangements are on the same elaborate scale. A complete installation of electric lighting is also fitted, including three powerful search lights. The steam cable gear has been supplied by Messrs. S. Baxter & Co., Sandiacre, Nottingham, and this firm are also supplying similar gear to the sister vessels now being built.

The crew numbers 252 hands, all told, for whose accommodation and comfort every care has been taken in the way of utilising the living quarters to the best advantage. Externally the "Latona," as will be seen from the illustration, has a smart appearance, having two funnels and two pole masts, with a light fore and aft rig. The Naval Construction and Armaments Company are proceeding with the building of two similar cruisers, which are to be named "Naiad" and "Melampus," and which are now in a forward state.

INSTITUTE OF MARINE ENGINEERS.

A MEETING of the Institute of Marine Engineers was held on Tuesday evening, the 13th inst., when Mr. David Phillips read a paper on the "Comparative Corrosion of Iron and Steel under Various Conditions." The Chairman introduced the author of the paper as well known to many present, but he mentioned that Mr. Phillips had given considerable attention to the subject on which the paper treated. The diagrams, casts, and experimental plates which were exhibited were exceedingly interesting, and served to show practically the course of reasoning followed in the paper. In the introductory part of his paper, the author referred to the more important papers which had been read on the subject of the corrosion in iron and steel within the last nine or ten years, and referred to a former paper he had read in 1881, before the Institution of Civil Engineers, and the subsequent discussion on that paper. He pointed out that being far from satisfied with the results, both in respect to the discussions and the subsequent papers on the subject, he had decided to undertake a series of experiments extending over a lengthened period, with a view of testing the relative merits of several kinds of iron and steel under various conditions. The results of these experiments, and his own observations upon them, he dealt with in the paper. The length of the paper did not admit of time for more than a brief discussion, in which the following members and others took part:—Messrs. G. W. Manuel, W. W. Wilson, A. W. Robertson, and G. E. Wilkinson. The usual votes of thanks to the author of the paper and the chairman were accorded, and briefly responded to.

On Saturday evening, the 17th inst., several experiments were made with Scotch anthracite coal by means of the coal-testing machine, and on Tuesday, the 20th inst., a second paper on "Electrical Engineering" was read by Mr. R. E. Crompton.

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

Contents.

	PAGE
Improved Slotting Machine (*Illus.*)	481
On the Critical Points of Iron and Steel (*Illus.*)	481
A Bending Moment Delineator (*Illus.*)	484
Gas Engine and Pump (*Illus.*)	485
The Postal Jubilee	485
Institute of Marine Engineers	485
Foreign Industries (Corres.)	486-487
The Edinburgh Exhibition (*Illus.*)	488
Notices of Meetings	489
Prices Current	489
Shipbuilding Notes	489
Home Industries (Corres.)	490-491
Launch of H.M.S. "Latona" (*Illus.*)	492
Institute of Marine Engineers	492
The Critical Points of Iron and Steel	493
British Railways and British Traders	494
The Carlisle Railway Accident	494
Letters to the Editor:— Piece Work	495
The Recent Meeting of the Iron and Steel Institute	495
The Carlisle Accident	495
Biggs' Tubular Block (*Illus.*)	496
The Institution of Civil Engineers	496
Reviews	496
The French Exhibition	497
Dutton's Oil-Measuring Pump (*Illus.*)	497
The Institution of Electrical Engineers	497
The Arc Lamp on Alternating Circuits	498
Electricity as a Hastener in the Tanning of Hides	498
The Manufacture of Aluminium by the "Heroult" Process (*Illus.*)	499
The Society of Chemical Industry	500
Notes	500
"Industries" Patent Record:— Applications and Acceptances	501-502
Illustrated Abridgments	502-504

To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

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FRIDAY, 23RD MAY, 1890.

THE CRITICAL POINTS OF IRON AND STEEL.

M. OSMOND'S paper on the "Critical Points of Iron and Steel," the first part of which we publish in our present issue, was undoubtedly the most important contribution communicated to the Iron and Steel Institute at their recent meeting. We gave an outline of the paper in our issue of the 9th inst., and in that of the previous week a *résumé* of the paper which M. F. Osmond had previously communicated to the Académie des Sciences on the same subject. The great variation in the physical properties of iron and steel, and the industrial importance of these variations, have not only stimulated manufacturers in their endeavours to improve the quality of their products in some special manner, but has led many investigators to give their time and attention to unravelling the causes which produce these modifications of the mechanical constants in the commercial metal. In studying the mass of literature which has accumulated in recent years on the influence of foreign elements, such as carbon and silicon, on the properties of steel, we are struck with the enormous amount of data which have been tabulated without any explanation of the causes which produce these well-known variations in mechanical qualities and physical properties of the steel or iron to which such elements have been added. It is, of course, necessary in all progress that, before any satisfactory generalisation can be established, facts must be accumulated; but in this department of knowledge facts have been accumulated at an ever-increasing rate without any corresponding development of the theories which are formulated to explain the causes which produce these results. Faraday, for example, years ago established the fact that iron loses its magnetism at a high temperature and recovers it at a certain point as the temperature cools; and Gore, Barrett, Tomlinson, Hopkinson, and many others have recorded additional facts on the amount of magnetism present in iron of varying quality and at varying temperatures, all of which information we are pleased to call contributions to our knowledge as to the influence of magnetisation on the molecular structure of iron. But although these investigators have been indefatigable in their labours, and their respective researches have certainly contributed to our knowledge so far as the establishment of facts are concerned, we still know nothing of the causes of these phenomena, and we are still groping in the dark for an explanation which may lead to a generalisation which shall at once raise the work of the metallurgist and iron and steel master to the same level as that of the electrician and the engineer. As Dr. Gore pointed out, in his recent letter to the Secretary of the Iron and Steel Institute, since 1869—when he first drew attention to the changes in the physical properties which take place when a bar of iron is heated to redness—other investigators have demonstrated more fully the variations which occur in the physical constants of the iron; and the mere qualitative fact established by Gore has been the starting point of a series of investigations which have determined in a great measure the exact magnitude of these changes, so that his statement that "simply by heating a bar of iron to redness a whole series of changes occur in its molecular structure, its magnitude, its dimensions, its exhaustive power, its specific heat, its thermo-electric capacity, and its electric conducting power," has been verified and amplified by several sets of quantitative experiments. In the same letter he points out that, as iron is magnetic and possesses one set of properties at one temperature, and is non-magnetic and has a more or less different set of properties at another temperature, it is a conspicuous example of the general truth that "every substance becomes more or less a different substance at every different temperature." The information which chemists have been able to offer towards the elucidation of these problems is still more meagre; and although within the last few years the chemical analysis of iron and steel has been regarded as a necessary adjunct to a statement of their respective physical properties, the chemist is unable to indicate why the presence of this or that element in the steel should produce so marked a variation in the mechanical tests. It is true that chemists distinguish between combined carbon and free carbon, and theorise about the alloys of iron formed by the additive elements, but little is known beyond the empirical facts of certain properties accompanying steels of a known composition. Osmond's elaborate pyrometric study of steels of known composition, and his successful determination of critical points in the molecular condition of the metal, is a step towards the generalisation which is needed from a physical point of view, and as these results fully confirm the hypothesis of Professor Roberts-Austen based on the periodic law, and therefore derived from our present chemical theories, there seems no doubt for believing that we are at last obtaining an explanation of the causes of these phenomena, which is in accord with our knowledge of the constitution of matter arrived at by independent reasoning and experiment.

M. Osmond, in the introduction to his paper, points out that his work has been that of arranging the known facts rather than that of discovering new ones, and his success seems to be mainly due to his careful re-statement of our knowledge in a way which shows the changes in physical properties which accompany alteration in chemical composition. That the molecules of iron were capable of undergoing allotropic change so that two or more varieties of the metal are possible was a fact which most chemists and metallurgists were willing to admit, and, indeed, there was abundant evidence from what is known of other elements, and their readiness to undergo molecular change, to warrant a belief in the possibility of such a change taking place in iron during a cooling or heating extending over a long range of temperature. The importance of this work appears to us to lie in the fact that the foreign elements when added have the power to alter the temperature at which these changes in the iron take place. In the case of carbon, M. Osmond admits that a third change takes place which marks the change from the combined to the graphitoidal condition and corresponds to the recalescence point of Barrett. This critical point is, therefore, one which marks the temperature at which the dissociation of the iron carbide makes itself felt to the maximum extent, and as in all dissociation phenomena the change is a gradual one, depending on the temperature and other circumstances, it is easy to see that the presence of other elements may modify the temperature at which the alteration of molecular state takes place. As Dr. Ball, in his paper on the changes

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in iron produced by thermal treatment, says: "It is evident that the molecular changes which take place when iron is heated to high temperatures resemble in their nature the dissociation of chemical compounds," in the sense that in both cases the process is gradual and not abrupt, beginning at one temperature and reaching a maximum at another. When this maximum temperature has been exceeded, the products of the first dissociation may again be subject to a similar change. Further, if a mixture of several chemical compounds is treated in this manner, each compound, apart from other influences, will have its own maximum temperature of dissociation, and a curve representing the general result would show a series of maxima in accordance with the number of compounds present. Whether the critical points other than that of recalescence are due to an allotropic change in the molecules of iron, or due to the dissociation of alloys at these temperatures, will obviously not affect the value of these results. The fact that M. Osmond has obtained one of these critical points in examining specimens of the purest electrolytic iron tends to support the view advanced by the author, but in this case the change at this temperature will then be a dissociation of the molecules of α iron into the simpler molecules of β iron as the temperature increases, and the halt in the change of temperature would indicate that the supply of external heat, instead of raising the temperature of the mass, is being expended in raising the internal molecular energy of the system, the smaller β iron molecules having a greater potential energy than the more condensed α. If the view of M. Osmond be correct as to these allotropic forms of iron the alteration in temperature at which the changes take place when a foreign element is present are comparable to the alteration in the melting points and boiling points of bodies when foreign substances are introduced. Raolt's method for determining the molecular weight of bodies by noting the amount by which the solidifying point of the solvent is lowered may be cited as an illustration of the same class of phenomena, and it may be advanced as a proof that the addition of small quantities of foreign bodies which apparently do not form any chemical compound with the solvent alter the temperature at which the solvent changes from one state to another. As Raolt's method gives such promising results as to the molecular weight of bodies in the liquid condition, it may be that the researches of M. Osmond will eventually throw some light on the size of the molecules of solids, and thus be of value to the physicist as well as to the iron and steel manufacturer. Raolt's method in the hands of Heycock and Neville has contributed to our knowledge of the molecular weights of metals when in solution in another metal, and thus in Osmond's method we should have a means of determining changes in the molecular weight of metals in the solid condition.

The confirmation of Professor Roberts-Austen's law by these results of M. Osmond must not be overlooked in reviewing this work. As Mr. Snelus stated at the meeting, one point was perfectly clear—viz., that the law of Roberts-Austen seemed destined to place metallurgy on a scientific basis, a position that it had hitherto failed to occupy, and will be of itself an immense step towards furthering additional research in this direction. The changes then, in the physical properties of iron and steel are thus demonstrated to be caused partly by alterations in the molecular state of the iron and partly by the dissociation of iron compounds at definite temperatures which are determined by the chemical composition of the metal. Barus has quite recently endeavoured to ascertain how these molecular changes are brought about, and in a recent paper on the hydro-electric effect of stretching metals shows that besides β iron being produced spontaneously out of α iron above a certain temperature, as in M. Osmond's experiments, β iron may also be produced in small quantity by straining α iron at ordinary temperatures, and Carus Wilson in *Nature* has also shown that his experiments on the viscosity of strained steel support Osmond's view as to the constitution of iron. Professor J. J. Thomson, and Giese in Germany, have also recently been advancing the theory for electrical conduction in metals analogous to that of the migration of ions in an electrolyte, which further point to the metals consisting of molecules of great instability, and thus supporting the points which M. Osmond advanced in his paper before the Iron and Steel Institute.

BRITISH RAILWAYS AND BRITISH TRADERS.

The inquiry ordered by Parliament into the deposited schedules of maximum rates and charges submitted by the railway companies to the Board of Trade came to a formal end on Wednesday. The inquiry was in every way one of the most important, as it certainly was the most lengthy, that has ever taken place into the circumstances of transport in relation to the trade and commerce of the United Kingdom. If it has no other substantial result, it has brought together and crystallised a great mass of evidence and data as to the powers of the railway companies, their systems of working, their methods of dealing with trade and traders, and the missing links of railway enactment that are likely, for all time, to exercise a powerful and, it may be, a controlling influence on the relations of English railways and the population which they serve. Much money, much care, and not a little forensic and administrative ability have been expended over the inquiry. The railway companies, feeling that they were fighting, if not for bare life, at any rate for principles and demands upon which their future greatly depended, did not hesitate to employ the best skill at the Bar. The traders have mainly been represented by Mr. Balfour Browne, who, although a host in himself, has had a heavier burden and responsibility cast upon him than ought in fairness to be placed on any one man. The traders, in some cases, appeared without any counsel at all. Nevertheless, both sides have fought a good fight, and now that the battle is over it remains for the Board of Trade to determine the issues, which will, in the course of a few weeks, at the most, be presented for the consideration of Parliament.

One of the most remarkable circumstances that have been brought to light in the course of this inquiry is the fact that no common basis of railway rates and charges at present exists, after nearly seventy years' experience of railway transport, that has any claim to be regarded as exact and scientific. Railway rates are levied in the most haphazard and unsatisfactory way. In one case the exigencies of competition, in another the amount of charge that the traffic is believed to be capable of bearing, in a third the statutory maximum powers, and in a fourth the cost of the services rendered, are made the main, if not the controlling, factors in the fixing of rates. Each of these factors, again, appears to have an "infinite variety" of applications and interpretations. The statutory maximum powers of railway companies are, to the uninitiated, a puzzle compared with which the great Asian mystery would be simplicity itself. Companies like the Great Western and the London and North-Western, that have been built up out of a vast congeries of small and independent lines under Amalgamation Acts obtained at many different times, have generally a large number of Acts applying to isolated parts of their system, and under which they are entitled to levy many varying rates of charge. No ordinary trader can hope, without infinite pains and trouble, to master the intricacies of these different Acts, so that railway companies have been left to do much as it suited them, without let or hindrance, and the marvel is that traders have been content to allow matters to go on as they have done for so long. The Acts of the various companies should have been codified and their classification made uniform a very long time ago, but this undertaking, although several times attempted, has until now defied the powers of Parliament. Vested interests were too strongly arrayed against each other until the Railway and Canal Traffic Act of 1888 called forth the present inquiry.

Many grave questions, however, still remain to be decided. There is, first of all, the question of what shall be the the maxima of the companies generally, having regard to their statutory powers. The schedules deposited with the Board of Trade generally propose to have maximum powers on a high scale, the highest scale, in many cases, allowed under any one of the numerous existing Acts of the different companies. This means a process of levelling up to which the traders will never consent. It would be monstrous if, for example, the London and North-Western Railway Company, because they have powers to levy a charge of 3d. per ton per mile under some local Act, applying to a very limited part of their system, were to have powers now given them to levy that rate on their system as a whole under any particular head of the classification. And yet, according to the railway companies, it would be equally monstrous if that company were required to forego the powers granted by Parliament on that particular section, and on the faith of which the capital required to carry out the railway in question was subscribed. Obviously, if a uniform schedule of rates and charges, applicable to the whole system, is to be adopted, there must be a certain amount of give-and-take on all sides. Some powers must be sacrificed in order that others may be obtained, and Parliament may fairly be expected to take care that the powers of the future shall be fixed, not so much with reference to existing statutory maxima, as in view of the necessities and reasonable requirements of the traders on the one hand, and of the railways on the other. One example will show how deep a gulf has to be bridged over in this endeavour. The railway companies say that they should have, up to twenty miles, an average maximum mileage rate of 1d. to 1½d. for the transport of mineral traffic. The traders, or, at any rate, a very important body of them, say that the average cost of transporting mineral traffic, in full train loads, is not more than a farthing per ton per mile, and that if the maxima is fixed by Parliament at a halfpenny, it would leave 100 per cent. profit on the cost of the service. Here, then, there is a difference of from 100 to 150 per cent. between the parties, which Parliament, in the long run, must undertake to adjust. It is the cost of the service, plus a reasonable profit, on the one hand, against the statutory powers already granted by Parliament on the other. It is impossible that both parties can be satisfied, and it will be well if they can be brought so close together as to make apparently hopeless differences less prominent a feature of the negotiations than they appear to be at present. The same observations apply, *mutatis mutandis*, to the vexed question of terminal charges, which is still under consideration. The companies claim to make an arbitrary charge—(*a*) for the use of stations, and (*b*) for terminal services rendered, varying according to the position of the article in the classification, from 9d. up to 5s. 6d. per ton. The traders, for the most part, resist the first charge entirely, and demand that, if railway services are to be paid for, they must in each case be distinctly specified and charged for accordingly. There is much confusion as to the existing powers and practice of the railway companies in reference to making terminal charges, and the present inquiry will have done much to get over that difficulty, if it does nothing else.

THE CARLISLE RAILWAY ACCIDENT.

The report by Colonel Rich on the Carlisle railway accident is likely to lead to a great amount of unsettled opinion on the special circumstances connected with the accident. After a careful perusal of the evidence, we feel compelled to agree with the verdict of the coroner's jury, rather than with the opinion of Colonel Rich, notwithstanding the weight which we naturally attach to such an opinion. The jury found that the deceased were accidentally killed owing to the train in which they were travelling overshooting the platform and coming into collision with an engine belonging to the Caledonian Railway Company, and that such collision was entirely due to the failure of the brake with which the train was fitted, and they acquitted the driver of all blame. They further stated that they thought that the London and North-Western Railway Company were incurring great responsibility in using a brake of such an uncertain and unreliable character. In direct contrast to this, Colonel Rich states that, in his opinion, the collision was caused by the mismanagement of the engine-driver and consequent want of brake power to stop the train, which ran down the incline from Shap Summit at a speed of about sixty miles an hour, and approached Carlisle Station at a high speed. He evidently has taken great pains to arrive at a knowledge of the facts, and among other things he ran an experimental train from Carlisle to Penrith and back, and endeavoured to make the conditions as nearly as possible the same as those of the train with which the accident occurred, and from his observations of the driver's methods of working his brakes and the appliances connected with them, he came to the conclusion that the accident was caused by the wrong action of the engine-driver.

The statement of Colonel Rich shows how apt it *might* be for a driver to make a mistake in the management of his brakes, and such a complicated arrangement as existed in this case should never have been used. Colonel Rich recommends the London and North-Western Railway Company to put a stop to the confusion by doing away with the simple vacuum as fast as possible, and to work only with the automatic vacuum brake, and to use with it a proper amount of vacuum. The company indeed seems to have determined on this some time ago, and it is unfortunate that they did not

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act at once on their decision. We admit that Colonel Rich's explanation of the cause of the accident may be the correct one, but to think so we must set aside the greater part of the evidence given before the coroner and in connection with the Board of Trade investigation. We cannot now enter into the details of that evidence, but those who read it will see at once that something apart from the action of the driver interfered with the working of the brakes. On the way from Euston to Tring the train was stopped by a message from a signalman to "stop and examine train." When the train stopped at Tring the wheels of the Gourock van were found to be red hot and jammed to the brake blocks, which could not be got off, so it was arranged to leave the van in the siding at Tring. As soon as the vacuum pipe at both ends was detached from the train, the brake blocks came off. Colonel Rich says that this would happen if the van were worked by simple vacuum while the rest of the train was worked by automatic vacuum, and he was of opinion that this was the cause of the mischief. But what was observed at Tring and at Carlisle pointed most distinctly to another cause, in the shape of an obstruction in the pipes, which might be quite sufficient to account for the accident, without putting aside the greater part of the evidence of the men who were responsible for the working of the engine. At Carlisle, when the automatic vacuum brake machinery was examined, it was found to be in good order, but half a pint of water was found in the belly of the pipe between the engine and the tender. Colonel Rich says that this quantity of water, if frozen, would not be sufficient to plug the pipe and stop the air way. Possibly not, although if there were a sharp bend it probably would. Supposing, however, that the pipe was only partially blocked by ice, the air would only pass with difficulty, which would of course increase as the obstruction increased, and would account for all that afterwards occurred. In our opinion, therefore, there is no need for the starting of a theory which *might* explain actual occurrences when we have certain facts which also account for these, and which are, moreover, supported by the evidence of the men concerned.

Letters to the Editor.

PIECE WORK.

To the Editor of "Industries."

Sir,—In your leading article, "Can an Improved Education Prevent Strikes?" a question to which I would undoubtedly answer "Yes," you deal with the subject of piece work. You state: "Officially the trade unions are generally very strongly opposed to it. To the uninitiated it may seem strange that a system which, on the face of it, is the fairest that could be devised, and by which, as a matter of fact, the highest wages are earned, should be regarded by artisans, as a body, with aversion." This is quite correct, but in your theories as to the causes I think you have omitted one. Trade unions, as trade unions, do object to piece work, but the individuals composing the unions, I believe, do not. This sounds a paradox, but I shall try and explain. The unions look on the matter in the same light as they see the eight hours day. They have to contribute money to their members who are out of work, and a shorter day will, as you point out, cause fewer members to be unemployed. In the same way, piece work causes more to be unemployed. The whole subject is looked upon in a selfish light. The union, as a body, looks after itself with a view to pay as little out of its coffers as possible; but take, on the other hand, a time work member of the union, and offer him the chance of making more money by going on piece work, and there will not be many so unselfish as to decline.

Yours &c.,
J. D. W.

London, 20th May, 1890.

THE RECENT MEETING OF THE IRON AND STEEL INSTITUTE.

To the Editor of "Industries."

Sir,—The recent meeting of the Iron and Steel Institute, although a very quiet one, and apparently not producing anything absolutely startling or progressive, seems, nevertheless, to have cleared the atmosphere, and to have placed before us the results of some painstaking investigations on the causes affecting the quality of steel. These investigations cannot fail in the future to yield results on matters which a short time back were exclusively in the domain of abstract science, but now have been placed, in a measure, in the hands of the practical manufacturer, who may now possibly be able to classify the working of metals in accordance with natural laws.

The combined researches of M. Osmond, Roberts-Austen, and others have evidently influenced the members of the Institute, and, from the tone of the discussion thereon, they appear fully to comprehend, and to be fully alive to, the importance of the papers read. It appears to me that an immense stride has been taken. The great importance of such statements that iron may—indeed, must—exist in different molecular forms, and that thus its quality is affected by such molecular variations, cannot be gainsaid.

Further, the law of atomic volumes here so clearly enunciated by Professor Roberts-Austen deserves the utmost attention, and, together with the part which initial temperature and cooling plays in determining the quality, or, in fact, the chemical modifications of the metal which seem to occur, places the chemistry of steel on a firmer basis. Probably we may soon be in a position to give a rational explanation of much which, up to the present, we have been profoundly ignorant. Hence the past necessity of coining words meaning nothing, and practically amounting to a confession of hopeless mental confusion, will therefore in the future be avoided.

The important paper by M. Osmond on "Some Critical Points in Iron and Steel" deserves the attention of those engaged in the manufacture. I find in this paper an explanation of many before to me unaccountable variations in the behaviour of steel. And it is probable that the following out of this line of research, with further experiments, combined with careful observation, will bear fruit. Indeed, I venture to suggest that our ideas as regards the chemical composition of steel may be completely revolutionised. One seems even now to realise that in lieu of the old fashioned doctrine that, with so much S, P, &c., corresponding variations must of necessity follow, has received a severe below. It follows that we cannot draw correct conclusions unless we attach due weight to the influence exerted by changes, which M. Osmond so clearly shows may occur by, roughly speaking, what may be termed mere variations in heating, cooling, and general manipulation.

The consideration of the atomic volume of the elements usually present in iron and steel will also have to be considered. For, as I understand it, it is quite possible that, of two elements, equal weights of both may be present in steel, yet the actual volume of these in combination may vary greatly, or, on the other hand, the weights may vary, but the atomic volumes may be equal. In other words, the mere percentage composition of an alloy affords only partial information, likely to mislead, unless coupled with the knowledge of the relative atomic volumes of the constituents.

M. Osmond tells us, in addition, that, in the case of iron, the metal assumes the molecular form in accordance with the higher or lower atomic volumes of the elements added. Elements of lower atomic volume than iron, preserving or increasing the proportion of β, or hardening iron; elements of higher atomic volume having the reverse action, increasing the proportion of α, or the soft modification of iron. Further, it is asserted that several of the elements, or their compounds, in Group 2, of higher atomic volume than iron, may communicate their properties to the metal. This, we may fairly infer, indeed, we already know, does occur. It therefore follows that a further study of such alloys formed with iron free from carbon, say, electrolytic iron, or, preferably, purified iron oxide reduced with hydrogen, might lead to useful practical results. In the present state of our knowledge, it seems somewhat difficult to trace the *direct* influence of the ordinary foreign elements present in steel and iron containing varying proportions of carbon. M. Osmond has, however, in some degree, explained their effect in modifying the constitution of the ordinary carbonaceous metal.

It is worthy of note that Sir Lowthian Bell asserts that when plates of iron of dissimilar composition, as regards carbon, are heated, even at the low temperature of a hot-air stove, a transfer of carbon occurs. Carbon really appears to be slowly soluble in iron; the ratio of solubility being a function of the temperature. Or, more clearly, carbon apparently is soluble in iron, obeying the same law applicable to most salts difficultly soluble in water. This seems, at first sight, somewhat outside the circuits of the phenomena discussed by M. Osmond, but it is clear that a heterogeneous mixture of pure iron must, on sufficiently prolonged heating, become homogeneous. Similarly a cast steel ingot may be a heterogeneous mixture of pure iron and carbonaceous iron, which, after repeated heating, may become, practically, homogeneous. Hence it follows that, in the heating of steel bars, as described by M. Osmond, a diffusion of carbon must occur. It is not so clear that this diffused carbon returns to its normal state on cooling.

I quite agree with Mr. Galbraith as regards the important influence which the presence of iron oxide has on iron and steel. Further, I have repeatedly urged the importance of constantly determining the amount of the oxide in iron and steel, which in my experience I have found to vary considerably. The younger generation of metallurgists appear, however, to have completely forgotten that the late Mr. Mushet at once attributed the red shortness of bloom Bessemer metal to its true cause—viz., the presence of an excess of iron oxide, and promptly suggested the addition of spiegeleisen as the only remedy. Unfortunately, owing to the influence of what may be termed mass, it appears that oxide of iron can only be completely removed by the addition, in many instances, of an injurious excess of carbon and manganese. Hence, it may be reasonably presumed that soft steels contain more iron oxide than the harder varieties, and for the same reason are more liable to boil and splutter in the moulds during casting. Probably the addition of some element of nearly the same atomic volume as iron, and of greater affinity for oxygen, might be beneficial if added just previous to casting.

Yours, &c.,
Metallurgist.

South Wales, 19th May, 1890.

THE CARLISLE ACCIDENT.

To the Editor of "Industries."

Sir,—I propose, with your permission, to offer some few remarks on the Carlisle accident, and the lessons to be learnt therefrom.

Unfortunately there is not complete unanimity between the report of the Board of Trade Inspector and the verdict and remarks of the coroner's jury. The former states that the collision was caused by the mismanagement of the engine driver, and consequent want of brake power to stop the train, that the engine driver got thoroughly confused, and omitted to do what he should have done, and did what he ought not to have done, by altering his engine to work the simple in place of the automatic vacuum brake. Colonel Rich considered that great allowance should be made for the mistakes that he made, as it must be a most confusing thing to have both the simple vacuum and the automatic vacuum brake to deal with.

The jury, in their unanimous verdict, say they acquit the driver, Rumney, of all blame, and are of opinion that he used all available means at his hand to stop the train, and that the London and North-Western Railway Company are incurring a very grave responsibility in using a brake of such an uncertain and unreliable character. This is rather strong language for a jury to make use of to a great railway company like the London and North-Western, and following, as it does, the third experiment in continuous brakes on this line. It would appear from the result that the question of brakes has not been studied by the mechanical advisers of the company with unbiassed attention.

The history of the unfortunate train on its fatal journey is most remarkable, chronicling a series of brake failures from the very start. The train at Euston consisted of 11½ vehicles, a large vehicle being counted as 1½ ordinary ones. This number was increased from time to time until at Preston the train consisted of 13 vehicles, equal to 15 ordinary vehicles. These were all fitted with the automatic vacuum brake for use as far north as Carlisle, beyond which place the Westinghouse or compressed-air brake was to be used. Before starting from Euston the van the fourth from the end failed to show the proper amount of vacuum, and, upon examination, it was found that some part of the mechanism on this vehicle was frozen. To remedy this defect the remarkable proceeding of lighting a fire of oiled waste under the brake cylinder was resorted to. It was not quite clear whether the piston had been frozen in the cylinder or whether the valve between the train pipe and the cylinder had been frozen in its passage. This valve is simply a brass ball about ⅛in. diameter, and in cold weather is quite likely to condense any moisture in its neighbourhood which may be in the train pipe. If this moisture freezes, the ball is either fastened to its seat or off its seat, as the case may be, and the brake for the time being is inoperative, although it may be all right before it is frozen and after it is thawed. The next incident to the train was at Tring, where it was stopped by signal, a signalman having noticed that the train was apparently on fire. Upon examination it was found that the vacuum brake was on, and the tyres red hot. Every effort was made to release the brake, but without success. The van was therefore unloaded and left at Tring, after causing a delay of twenty-seven minutes. A change was made here in the method of working the brake, as the automatic method had failed twice on the journey. This change to the simple vacuum system violated one of the Board of Trade safeguards. The principle of automacity having been abandoned, any failure of a coupling henceforth makes the brake useless throughout the train.

At Bletchley preparations had been made to change the method of working the brake back from simple to automatic vacuum, but upon the train arriving at Bletchley the change is deferred in order that further time should not be wasted. At Rugby the change is made and a new engine attached to the train; from Rugby forward to Crewe, Wigan, and Preston the automatic vacuum system worked satisfactorily, but when the train should have been slowed down preparatory to stopping at Carlisle it was found that the brake refused to act, both the engine-driver and the guards attempting to put on the brakes without success. Resort was had to the hand-brakes, but the brake power being insufficient to stop the train in the distance of 1½ miles it rushed through the station at the rate of from 25 to 30 miles per hour and collided with a Caledonian engine at a distance of 100 yards from the north end of the station.

The engine-driver gave it as his opinion that the failure of the brake to act was due to frost. Colonel Rich did not consider this conclusively proved, but it is quite clear that twice before on its journey the brake failed to act in consequence of its being frozen, and it is reasonable to suppose, failing any other explanation, that it was frozen on the third time when it refused to act. I think with the jury that the company using such a brake incur grave responsibilities. One of the peculiarities of the vacuum brake is its liability to be frozen, so that railway companies cannot plead ignorance on this score. From the Board of Trade Returns on brakes it is seen that from December 1st, 1886, to March, 1889, the vacuum brake has been found frozen no fewer than 106 times. Even on the day of the Carlisle accident, there was another case of failure on the London and North-Western Railway at Northampton, where the train overran the platform 100 yards, which was assigned by one of the officials to be caused by frost preventing the vacuum brake from acting.

The question naturally arises, whether the railway companies, using a vacuum for brake action, have not adopted a wrong principle altogether. The tendency of a vacuum is to produce intense cold, and hence the vacuum brake becomes a refrigerating machine. The plan adopted by the London and North-Western Railway for feeding water into their tenders by a trough between the rails is attended by a certain amount of splashing of the water under the carriages, and thus gives rise to a favourable condition for obtaining unlimited quantities of water at every leaky point. The Vacuum Brake Company, knowing the liability of their brake to take in moisture, have sundry drip pipes at intervals on their brake apparatus, but if the temperature is sufficient to freeze this water the drip pipes become inoperative.

The safety of the travelling public being of vital importance, it appears to me that it is the duty of the Board of Trade to declare themselves in no measured terms and to insist that their requirements should be carried out on every railway. It is quite clear that the companies are not to be trusted alone. Thus, after thirteen years, the London and North-Western Railway are only able to equip their trains with a brake which fails whenever the temperature is reduced a few degrees, and which, on this unfortunate occasion, killed four passengers and injured sixteen others. Surely the time has now come, Sir, when some authoritative tribunal, above the various interests of the various railway companies, should declare which is the best brake and thus prevent further human slaughter.

Colonel Rich, in his report of this accident, appears to me to favour the railway company at the expense of the driver, although he cannot at the same time avoid condemning the brake as it is now made. Of course, if the vacuum brake is improved, and improved first by the adoption of an air-pump, then by increase of vacuum, why not carry it one step further and improve the vacuum out of existence? This would then make it a compressed-air brake. I think the verdict of the jury is decidedly the more common-sense view of the accident, and that it is the railway company and their mechanical advisers who should be blamed for the slaughter of the passengers and the injury to property, and not the engine-driver who had the misfortune to handle so wretched a brake.

Yours &c.,
London, 19th May, 1890. Pressure.

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BIGGS' TUBULAR LOCK.

We illustrate below a new tubular reversible mortice lock, the invention of Mr. F. J. Biggs, and manufactured by the Tubular Lock Syndicate, Limited, Leadenhall Buildings, London, E.C. The ordinary fitting of locks into doors is still a laborious operation. The oblong cavity necessary for the insertion of a mortice lock also weakens the door, and leaves very little wood for out-

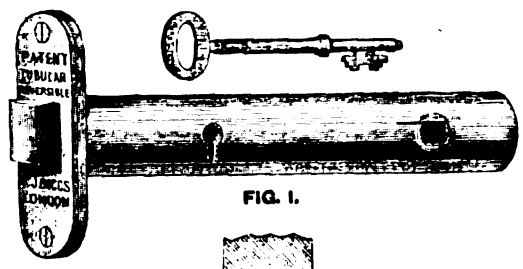


FIG. 1.

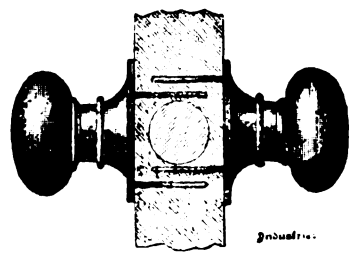


FIG. 2.

side screws to penetrate in securing the outer furniture. Fig. 1 gives a general view of the lock and key, and Fig. 2 shows a sectional view of the door in front of the knobs. It will be seen from Fig. 2 that long screws—equal in length to the thickness of the door—may be used for securing the knob plates to the door. The lock and fittings are exceedingly well made by specially designed machinery, and should command a wide sale.

THE INSTITUTION OF CIVIL ENGINEERS

At the concluding ordinary meeting of the Session, on Tuesday, the 20th inst., Sir John Coode, K.C.M.G., President, in the chair, the paper read was on "The Keswick Water Power Electric Light Station," by Messrs. W. P. James Fawcus and Edw. W. Cowan, Assoc.MM.Inst.C.E.

This was believed to be the first attempt to utilise available water power in this country for the purposes of a public supply of electric light. Early in last year the directors of the Keswick Electric Light Company instructed the authors to prepare plans and to procure tenders for the erection of a central supply station in or near Keswick. As the area proposed to be lighted was large and sparsely populated, it was seen that the only feasible system to adopt was an overhead high tension one. The alternating current transformers system was finally selected, and a site on the River Greta, about three-quarters of a mile from Keswick, was chosen for the erection of the station, the river being here available at 20 feet head. The saving effected in using this water power was considerable. The rent paid for the water was 10s. per h.p. per annum. Taking the number of h.p. hours required per annum as 100,000 for the present output of the station from a 50 h.p. turbine, the cost per h.p. came out as 0·06d. On the other hand, taking the price of steam coal at 15s. per ton, and the quantity burnt per h.p. per hour as 6lb., the cost per h.p. hour came to 0·48d., or eight times the cost of the water power. In addition to this, the attendance required for a turbine was, of course, less than that necessary for a steam engine and boiler; the first cost, maintenance, and depreciation were also considerably less, and the chances of a breakdown much less likely. As there was a possibility of partial failure of the water supply during extreme drought in summer, it was decided to provide steam in addition to water power. The turbine was of American design, and was called the "Victor." It was of a "mixed flow" type, the wheel being 20in. in diameter. Its speed was 273 revolutions per minute; this was at least 70 per cent. greater than the speed of an "inward," an "outward," or a "parallel flow" turbine would have been, working under a similar head. Its design was exceedingly compact, and the regulation, which was effected by opening and closing a cylindrical sluice working between the guide-passages and the wheel, was all that could be desired. As the turbine was 16ft. above the level of the tail race, a draught-tube was necessary to give full effect to the head of 20ft. This draught tube was of wrought iron, 14ft. long and 3ft. in diameter. The maximum velocity of water flowing through it was a little over 4ft. per second. The engine was a Westinghouse of simple type, having two single-acting cylinders 10in. in diameter by 9in. stroke; it gave with 80lb. of steam, at 350 revolutions per minute, 50·11 brake h.p. The floor space taken up by the engine was 7ft. by 4ft. The boiler was a 20 nominal h.p. Hyde duplex, 4ft. 6in. in diameter and 11ft. 6in. in height. Its working pressure was 120lb. to the square inch. The alternator, which was designed by Mr. Gisbert Kapp, and manufactured by Messrs. Johnson & Phillips, the contractors for the electrical plant, was a 30-kilowatt separately-excited machine, giving an output of 15 amperes at 2,000 volts. Its speed was 750 revolutions per minute, and the frequency 75. The armature had a cast-iron supporting-ring 28in. in diameter and 2½in. wide, provided with six arms. The armature-core was of charcoal-iron strip, 2¼in. wide, wound with paper insulation to a depth of 8in. There were nineteen coils, each containing 100 turns of 0·072in. wire, covered to 0·092in. in two layers. The resistance of the armature, after working some hours, was found to be 7 ohms. The magnetic field consisted of twelve magnets on each side of the armature. The cores and pole-pieces were of wrought iron, the yoke-rings of cast iron. The former were cylindrical, 3¾in. in diameter. The latter were 4in. by 7¼in. Each core was wound with six layers of 58 turns per layer, with 0·102in. wire covered to 0·117in. The total resistance of the field after working some hours was 11·2 ohms. At full load the energy of the field was 3 per cent. of the output of the machine. The framework was of substantial construction, and the machine when running was remarkably free from vibration. Its open design admitted of the free passage of air to the armature, which would carry 20 amperes without overheating. The magnets could be racked aside for access to the armature. The exciting dynamo was a 1-kilowatt machine of the Gramme type, giving 10 amperes at 100 volts. Regulation was effected by varying by hand the resistance in the field-magnet circuit. Two circuits left the station, both of which were double-pole fused, and provided with double-pole switches and lightning-arresters. There were some special features in the method of carrying out the overhead mains. If wire of high insulation had been used the expenditure would have been considerable, and it did not appear that any great advantage, other than increased durability of the mains, would have resulted. It was, therefore, determined to use a lower insulation for the mains, and to rely upon the points of support for insulation, also to use special arrangements for cutting off all surface leakage where the wires entered the consumer's premises. The authors were not aware that attention had been paid to this point before, yet it would seem that in wet weather, upon a long line of overhead mains, even with the best insulation, the surface leakage, when high tension currents were employed, would be considerable; and if devices were not adopted for cutting this off where the wires entered buildings, leakage to earth must result, which might be a source of danger as well as of loss. The mains at Keswick were being insulated from earth, and from each other, by oil throughout the system. The house leading-in wires were insulated with vulcanised india-rubber of the highest quality, and were threaded through a shackle oil insulator, the wire being cemented in with Chatterton's compound. Such an arrangement should effectually cut off surface-leakage from the mains. The leading-in wires entered the roof through a stone-ware pipe, provided with a covering piece to keep out rain and cover a reservoir of oil in the mouth of the pipe. The sizes of the mains were fixed for a current density of 500 amperes to the square inch. The fall of potential, between the generating-station and the town, was only slightly above 1 per cent. at full load. Steel suspension strand was used for supporting the mains for all circuits, consisting of three strands, each strand being 14 B.W.G., and galvanised. One short run of underground mains was being tried, the Brooks fluid-system being used. This system had much to recommend it; it was simple, cheap, and durable, and did not take long to lay down. The transformers were Kapp's patent, and they transformed the high-tension current of 2,000 volts to 100 volts. A double-pole, quick-make and quick-break switch, with double-pole fuse and lightning-arrester, was used in the high-tension circuit with each transformer. Both the transformers and the switches were enclosed in cast-iron water-tight cases. A series of experiments had been made to test the efficiency of the machinery, with the result that the total efficiency of the generating-plant at the station came out at about 40 per cent. at ¼ full load, and over 70 per cent. at full load. In connection with the arrangement of this central station scheme, the authors had occasion to make a comparison between the illuminating power of the glow lamp and gas; the results showed that the relative values usually given were misleading, as they almost invariably dealt with a standard London argand, a burner seldom used for ordinary lighting. This burner was generally taken as giving from 15 to 16 candle-power for 5 cubic feet of gas consumed per hour; whereas, out of a large number of ordinary burners taken haphazard, and tested where they were in use, in Chester, Manchester, and Keswick, at various times, it was found that the light given by 5 cubic feet of gas per hour was more frequently equal to 8 candles or less. This would show that, in practice, one 16 candle-power glow lamp gave approximately the same degree of light as two ordinary burners each consuming 5 cubic feet of gas per hour. This conclusion seemed to be borne out by the result obtained by Dr. Hopkinson, who, experimenting upon some ordinary burners, found the average candle-power to be 1·76 per cubic foot of gas. As regarded glow lamps, Sir David Salomons found that 100-volt 16 candle-power Edison Swan lamps averaged 17 candle-power at 100 volts. The light had been received with great favour at Keswick, and already the demand was equal to the supply of the present plant. Supply was commenced at the beginning of the year, and the station had run without hitch up to the present time—a man and a boy being found sufficient for tending the machinery.

Reviews.

Alternative Elementary Physics; being a Course of Lessons, adapted to the requirements of the new Syllabus of Physics recently instituted by the Science and Art Department. By John Mills. London: Chapman & Hall, Limited. 1890.

This is a type of book which has been produced to meet the requirements of the Science and Art Department Examinations, and contains just sufficient to cover the syllabus of the Department in the alternative subjects of Physics. It is a type to which we strongly object, as in the nature of things it must be very much a cram book. As such no doubt the author has done his best to make the book suitable for the examination, and he has succeeded in making it both readable and fairly accurate. The subjects of sound, light, heat, magnetism, frictional electricity, and voltaic electricity are dealt with, about 25 pages being given to each. On page 27 there is a misprint for hole, and Fig. 14 on page 29 seems to be altogether wrong and unintelligible, unless for "rod" we read "sphere." If the circle to which the tangents are drawn is intended as an end view of the rod then the shadow shown is impossible. In experiment 19, page 32, something is wanting, and the description may be made much clearer in a future edition. On page 41 it is stated that: "When light passes from one medium to another it is bent out of its straight course." This is too general, for it is not so in the case of perpendicular incidence. On page 46 "plain" has been written for "plane." A specimen examination paper is given at the end of the book, which is fairly adapted to the examination for which it is intended.

Transactions of the Institution of Engineers and Shipbuilders in Scotland. Vol. XXXII. Session 1888–89. Edited by the Secretary. Glasgow. 1889.

In the absence of the President, Dr. Kirk, the thirty-second session of the Institution of Engineers and Shipbuilders in Scotland was opened by one of the Vice-Presidents, Mr. Dyer, with a paper on the "Horse Power of Marine Engines." Mr. Dyer's remarks were founded on a report on the subject which had been issued by the North-East Coast Institution of Engineers on the subject, and the paper was written chiefly for the purpose of obtaining an expression of opinion from the Scotch engineers. Mr. Dyer himself did not think the proposed formula of the North-East Coast Institution would serve any useful purpose, and he proposed that, till some satisfactory method of measuring brake horse-power has been devised, that the indicated power should be adhered to, as the most generally satisfactory measure which could be adopted. In the discussion which followed a considerable number of opinions were expressed. The proposal of the North-East Coast Institution was defended by Mr. Weighton, who had a good deal to do with its origin, and who, as a former Clyde engineer, was also acquainted with Clyde practice. The general drift of the discussion was shown by the concluding remarks of the President, Dr. Kirk, who expressed the opinion that a formula such as that proposed by the North-East Coast was of no use, and that the ordinary rational formula not only covered present practice, but was also sufficient for all calculations which were necessary to meet the changes which took place in practice. He, moreover, thought that nominal horse-power was fast passing into disuse and was dying a natural death, and he thought it was best to let it so die out. No formal resolution was therefore come to on the subject by the Institution.

Mr. Andrew S. Biggart continues his series of papers on the Forth Bridge, which, when complete, will form a valuable permanent record of the progress, methods of construction, and design of that great undertaking.

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Professor Jamieson has a paper on the designing of continuous current dynamo machines, which should be of great use in drawing office work, as the formulæ are all put into a shape which allows them to be directly applied. Mr. Dyer's "Notes on Some Recent Steam Engine Trials" give a digest of some recent experiments, and show the lesson to be drawn from them. In connection with marine engine efficiency, the paper by Mr. Kemp on his "Compound Marine Boiler" will be read with interest, as it marks a new departure in steam boiler design. Professor Jenkins, of Glasgow University, has an important paper "On the Stability, &c., of Oil Carrying Steamers," and in view of the importance which such steamers are now attaining it comes at a very opportune time. The other papers in the volume are two by Mr. George Thomson and Mr. F. I. Rowan, "On Smoke Prevention," "Forced Combustion," and allied subjects; one by Mr. Ivy, on his "Valve Gear and its Results"; "On a Special Apparatus for Working Sails," by Mr. John Hastie"; "On Dredging and Dredging Appliances," by Mr. Andrew Brown"; and "On Evaporation," by Mr. Charles Lang. Altogether, the contents of the volume are varied and valuable. We are glad to observe that the Institution continues to prosper financially and as regards the number of its members.

THE FRENCH EXHIBITION.

Want of preparation is one of the usual faults of exhibitions, the Military Exhibition at Chelsea having been one of the few exceptions to the rule. The French Exhibition at Earl's Court, which was opened on Saturday last by the Lord Mayor, forms a conspicuous example of backwardness, and on the doors being opened it was found that the industrial portion consisted mainly, not of the Shakespearian "beggarly array of empty boxes," but of unpacked boxes, and as no catalogue was available it is impossible even to say what was supposed to be there.

The classification includes vegetable products, textiles, minerals, metallurgy, machinery, electricity, chemicals, and pottery. There is no steam power except for the electric light, and the sole mechanical exhibits in place were a Swiss embroidery machine and a small aërated water plant. The art section and grounds were in good order, and the Executive has arranged for a varied series of amusements.

The electric lighting machinery was in good form. The lighting of the Exhibition has been carried out by the Gülcher New Electric Light Company, of Battersea, the laying out of the work having been executed by Mr. Guy Fricker. The same firm were entrusted last year with the lighting of the Spanish Exhibition, held at the same place, but the present installation is on a different plan. The driving power consists of the following:—A Davey Paxman compound horizontal fixed engine of 70 n.h.p., and indicating up to 200 h.p. It works at 120lb. pressure and 100 revolutions. There is another Davey Paxman engine, girder type, of 40 n.h.p., indicating up to 130 h.p. and running at 110 revolutions. It was intended to have a third Davey Paxman fixed engine, but owing to pressure of time a 30 n.h.p. double cylinder high-pressure portable engine, by Ruston, Proctor, & Co., was employed. This indicates about 80 h.p. Steam is supplied from three Davey Paxman boilers, each of 40 n.h.p. The total production of steam is 10,000lb. per hour.

The power from the engines is transmitted to a countershaft supported on seven standards and running at 230 revolutions. In all there are ten dynamos, the e.m.f. of each being 70 volts at the terminals. They consist of four 40-unit Batterseа compound-wound dynamos, four 20-unit Battersea dynamos, one 2-pole 20-unit machine, and one 4-pole 30-unit machine. The machines, most of which have been specially made for the present job, are well turned out mechanically. They are fixed on sliding rails to take up the slack of the belt.

The ordinary type of switches common for temporary arc installations—one switch being arranged for each group of five or six lamps—is employed. Above the switches is erected a very large resistance frame, consisting of a considerable number of coils, one resistance coil being provided for each arc lamp. A sliding contact is arranged on alternate coils to regulate the resistance as desired. Thus the current from the dynamos passes to the switches, and through the resistance coils, which are so arranged that the pressure at the terminals of each arc lamp is about 50 volts.

The low-tension Gülcher system is used, and each arc lamp is fed from a separate lead. The object has been to avoid the use of a heavy cable, which would be injured by the attachment of feeders, as the installation is of course only of a temporary character, and the present cables can be taken down and used again, as they will not be materially damaged.

There are in all 200 arc lamps installed in the buildings and grounds, 110 being of 3,000 c.p. and 90 of 2,000 c.p. In addition there are, in the "Welcome Club," theatre, and elsewhere, some 300 incandescent lamps.

IMPROVED OIL-MEASURING PUMP.

Constructed by Messrs. Dutton & Co., Worcester.

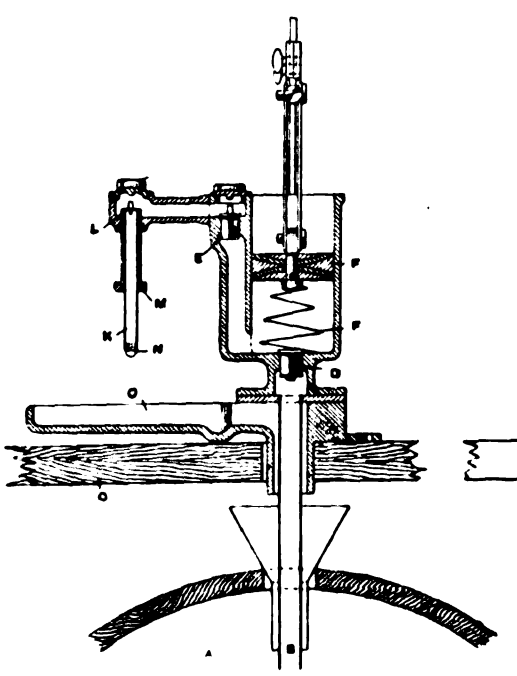


Fig. 1.—Vertical Section.

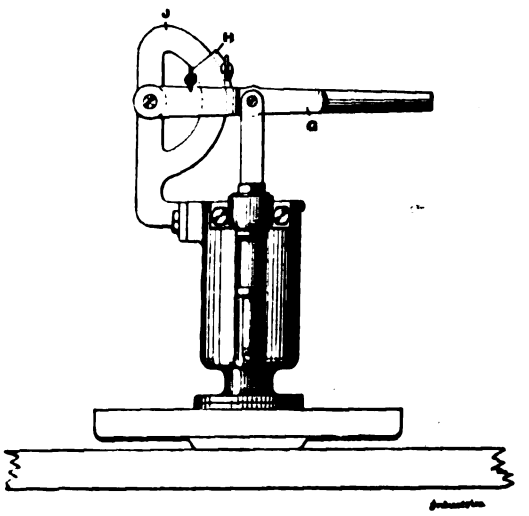


Fig. 2.—Elevation.

DUTTON'S OIL-MEASURING PUMP.

The apparatus we illustrate above was specially designed to charge the oil cisterns of railway signal, carriage, ship, and other lamps, and to exactly measure the quantity supplied. In Fig. 1 A represents the oil barrel out of which the supply is drawn; into this descends the suction pipe B, the pump itself being mounted upon some suitable bench C; the top of the suction pipe is provided with a valve D, and the delivery pipe with a valve E. The piston F is packed with leather as shown, and is worked by the lever G. An adjustable stop H is placed upon the sector J, by which the travel of the piston is regulated so as to deliver an exact measured quantity for each stroke of the lever after a few preliminary strokes have been given to fill the pipes. The piston is provided with a coiled spring P, which causes it to rise after having been made to descend by the lever G. The delivery pipe ends in a sliding tube K, which is shaped as a valve at the top L, and slides easily through the packed gland M under the valve L. The tube is perforated with several holes, and at the end N it is formed as a strainer. When it is required to fill a lamp the tube is inserted, and the lamp lifted, until the bottom of the cistern strikes the soft button and lifts the tube K and valve L off its seat; the oil is then free to pass down the tube into the lamp, the required number of strokes are given, and the valve is allowed to drop back on its seating. The tray O catches any overflow and returns it to the barrel. The pump is manufactured by Messrs. Dutton & Co., of Worcester.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

At the meeting of this Institution on the 15th inst. Major Cardew read a paper on "The Treatment, Regulation, and Control of the Electric Supply by the Legislature and the Board of Trade." The paper, which was of some length, was a new departure, both as regards the discussion before a scientific society of questions which are even more remote from their usual subjects than the commercial matters which are occasionally introduced, and as regards the still more unprecedented appearance of one of the chief officers of a Government Department to explain before a public body, not only some of the recent results of legislation, but the principles and method of treatment which they embody. "Ignorance of the law," says Selden, "excuses no man. Every man must be taken to know the law; to hold the contrary would be to confer a premium on ignorance, which would afford a defence to every possible transgression of the law." The electrical trade is, we think, greatly indebted to Major Cardew for the exposition of the recent Acts and Model Orders, and his paper, although the author disclaimed that it was in any sense official, will be studied with interest by those who have no time to wade through the wordy documents which formed its subject.

The author begged that questions of policy might not be discussed, but this request could not be taken to mean more than that he deprecated being placed in a defensive attitude. The tone of the discussion, of which a brief abstract will be found below, showed that strong views are held on the subject of over-legislation. This over-legislation is an instance of the socialistic meddling which was discussed in the House of Lords on Monday night. The Prime Minister then observed that no irremediable evil will be the result, though a certain amount of legislative goose-step will be performed, and that we may trust the nature of things to show that the State must not undertake work which can be done by anybody else, and that legislation must not undermine private rights or destroy confidence, upon which alone the machinery of capital and industry depends.

In the discussion which followed the reading of the paper,

Mr. R. E. Crompton expressed his opinion that the electric lighting industries had suffered considerably from over-legislation, and he disagreed *in toto* with Major Cardew's statement that the Act of 1882 did not do the amount of harm generally attributed to it. He admitted that over-speculation in electric light patents had a depressing effect, but he himself could vouch for the fact that the Act of 1882 prevented one large central station from being proceeded with. Otherwise the experience for which we had now to go to America would have been gained first hand. Under present circumstances it was necessary to keep the positions of sites for stations a secret, and this necessity caused hurried designs and workmanship, as well as increased cost. He firmly believed that the old method of obtaining private Bills as for gas works, would have been far more satisfactory to everybody than the present system of Provisional Orders, and he felt quite sure that the gas works clauses could have been easily modified to make them applicable to electric lighting stations. Whilst fully admitting that the Board of Trade had done all in its power to make the Acts workable, and that the thanks of all interested were due to the officials for the great efforts they had made, he could not help thinking that the tendency of modern legislation was to interfere too much and to show people how to do their

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own work. The case quoted by Major Cardew as to consumers being entitled to the choice of two pressures, one about half the other, was, in his opinion, one of undue interference, for it was quite as much a pure commercial question as whether a grocer should make up his tea in pound or half-pound packages. Another case of injustice occurred where the supplier is required to provide larger terminals when a greater supply was needed by a consumer than he originally estimated.

Mr. G. Offor endorsed Mr. Crompton's remarks about the Board of Trade officials being always anxious and ready to deal practically with the questions which arose. He also thought that we suffered from over-legislation. One serious defect of the present system was the inordinate length of time required to obtain a provisional order, for the preliminary order must be applied for in July, whilst the confirmation of the order cannot be granted until August in the following year. Should an unexpected dissolution of Parliament occur in the interval, the consequences would be very serious to the applicants. He submitted that a great improvement might be effected by materially shortening the time between the application for, and confirmation of, provisional orders, or, better still, by avoiding the necessity of obtaining confirmation Bills. As this confirmation was not required for licences, he thought that orders might be treated similarly. As to the position of local authorities being more favourable than that of private companies under the Acts, he thought this a distinct advantage, for it would facilitate procuration of capital for carrying out lighting schemes, whilst private manufacturing companies would obtain the contracts without incurring all the risk.

Mr. J. Shoolbred thanked Major Cardew for the concise account of provisional orders which he had given to the Institution, and referred to the necessity for bye-laws and the question of overhead wires.

The discussion was then adjourned until the 22nd inst.

THE ARC LAMP ON ALTERNATING CIRCUITS.

The whole subject of the arc lamp on alternating circuits wants thrashing out. Many authorities hold that alternating arc lamps should be avoided because of their inefficiency. The power is distributed over two craters, so that the light is, roughly speaking, only equal to that of two direct-current arcs, each taking half the power. In addition to this, one crater is on the lower carbon, and wastes most of its light by dispersing it upwards into space. Special direct-current circuits are sometimes run for the sake of the arc lamps, as, for instance, in Chelmsford. The efficiency may be lower, though we do not remember having seen any tests; but still it is advisable to run arc lamps from alternating circuits, as any inefficiency is more than balanced by saving the cost of extra direct-current plant.

Alternating arc lamps may be run from 100 volt circuits two in series, or from 50 volt circuits in parallel, or in series circuits. The latter plan has been adopted by the Westinghouse Company, who have worked out a complete alternating arc system, beginning with the dynamo and ending with the lamp. An arc system worked out by the engineers of the Westinghouse Company is sure to have received the greatest attention in every detail, and to be good practically; but many of the points in it seem so curious that they awaken discussion.

The arcs are in series, on transformers; where convenient there are three or five lamps to a transformer, in other cases there is a transformer for each lamp. In a series system the transformers merely prevent the dangerous pressures from coming into the houses; they have no other effect of importance, and may therefore be left out of the discussion. There is, of course, a slight loss by resistance, which has some inappreciable regulating tendency. It may also be remarked that the loss of power in the iron does not go on when the lamp is not in use, as short-circuiting the secondary of a series transformer reduces the induction to very small values. The extraordinary thing is that the Westinghouse Company should work out a series system when they have, in most of the towns where they will instal arcs, a parallel system already running. The series dynamo is specially designed to give a "drooping" curve, but this result can be very easily obtained in parallel work by means of a choking coil, and the choking coil allows single arcs to be run off 100 volt circuits with steadiness and economy, an advantage, of course, unattainable on direct circuits. We can only hazard a guess that arc lamps have been tried two in parallel on a 100 volt circuit and did not work well, and that choking coils with closed iron circuits were also tried without success. It does not seem to be generally realised that a choking coil should always have an open iron circuit.

The need of a drooping curve for the satisfactory working of the lamps used is shown by the design of the dynamo, whose armature current reacts powerfully on the field; or, as it is commonly put, has a large coefficient of self-induction. This reaction is said to be so great that the armature current does not increase above the normal even on short circuit. This is, of course, impossible; still the armature reaction is very great. Now this reaction has an effect very similar indeed to that of a choking coil in the circuit; why then, should the lamps not be run off the parallel circuits with open iron circuit choking coils?

Another innovation is the change from 130 to 62 periods per second. Of course the pitch of the objectionable hum is thus lowered an octave, from tenor C to bass C in fact. There is also less trouble in making electromagnets. A given electromagnet which, with a frequency of 130, gives, with a certain pull, a back pressure of, say, 20 volts, gives the same pull with only 10 volts with a frequency of 62, or, in other words, it chokes less. Apart from these small matters we cannot see any reason for altering the frequency. The whole subject is so important that it is earnestly to be hoped that the Westinghouse Company will put the public in fuller possession of the considerations that have led to their latest departure.

ELECTRICITY AS A HASTENER IN THE TANNING OF HIDES.

It is somewhat remarkable that so little application has been made of electricity to industrial processes in which chemical operations are involved. If the metallurgical operations of electro-depositing and electric smelting be excepted, the Cassel gold chlorination, Hermite's bleaching, Webster's sewage, and Figgé's unsavoury process for "de-gumming" rhea fibre have alone been tried on any large scale. Regarding an electric current as a mode of conveying energy, it has to compete with heat and the various forms of chemical energy, the applications of which entail generally a comparatively small outlay for plant; but where a distinct local effect, or where the action of so-called nascent elements is required, it would seem that electricity might frequently be employed with economy.

Many of the most important chemical processes of the day have been worked out in the laboratory by the patient applications of chemical principles at the hands of skilled chemists, and in this respect the electric method of tanning is singular, since we have not been able to hear of even the existence of a chemical hypothesis to account for its results. The British Tanning Company have recently started at Rothesay Street, Bermondsey, London, S.E., a practical method of tanning "by electricity." The company was formed about a year ago to work in this country the patents of Worms and Ball, who, after many experiments, managed in Paris to successfully overcome the difficulties which Goulard and the earlier investigators in this direction had met with. It will be within the recollection of many of our readers that at the Paris Exhibition several specimens of leather tanned in France by this process were shown in the saddlery department. The English company at first started with a small plant of French manufacture, but they have recently erected a new series of drums, which have been at work for some weeks past, yielding very satisfactory results. In the present process, the hides, after the usual liming and depilating process, are transferred to large wooden drums, nearly 12ft. in diameter, and as many feet in length. These are mounted on a horizontal axis so arranged as to permit of being slowly rotated by steam power. Each drum is then charged with about 500 gallons of ordinary tanning liquor of about 20° strength, made from either oak bark or chestnut, and, after the addition of a small quantity of turpentine, is hermetically sealed. Thus far, the method differs but little from the various processes which have been tried with small success to substitute for the hand labour involved in daily turning the hides a mechanical movement to the tanning extract and suspended hides. In the electrical process which we had an opportunity of seeing at work last week a few feet of copper wire, forming the electrodes for a current which enters at one end and leaves at the other, are fastened within the flat sides of the rotating drums. The copper electrodes are provided on the shafts outside with rubbing contacts, consisting of ordinary dynamo brushes, to which the leads from a small dynamo are attached. At the Bermondsey works there are five such drums, and a current of 12 amperes at a pressure of 70 volts is used, or about 14 volts for each drum. The joint effect of this mechanical agitation of the pelts and liquor and the passage of this low density current is stated to reduce the time required to successfully tan half a ton of hides per drum from several months to four or five days. After working for some little time a slight heating of the liquor is noticed, and the electrolytic gases produced exert a small pressure within the drum, which is controlled by a spring valve, but no data seem to be forthcoming as to what influence this increase of temperature and pressure have upon the result. The former effect might of course be obtained more economically, while the latter is in this case small, and has been applied much more elaborately in the hydraulic process of Spilsbury in 1823, and the vacuum process of Knowles and Duesbury, both of which failed many years ago.

We are informed that the simple mechanical agitation has been found to reduce the time necessary for tanning to one half, the rest of the great economy being attained by the inexplicable electric action. It is obvious that it is extremely difficult even to devise experiments which would be successful in differentiating the part played by the various forms of energy which apparently influence the result, but until this is done a full explanation of the increased rapidity of the tannage is impossible.

A considerable stock of finished butts and skins were on view at the time of our visit; and in the opinion of experts the tanning process was stated to be fairly complete and well struck through, but the butts were generally more supple than is considered advisable for boot soles. The continual mechanical agitation in bulk would naturally open the pores of the hide; and it is suggested, somewhat vaguely, that the electric current has a similar effect, presumably in a manner akin to the action of a current on osmosis and dialysis, though in this case there is no definite direction, as the hides are being continually churned in the liquor. Turnbull, in 1845, patented a process in which endosmosis of the liquor through the pelts was hastened by forming them into bags, into which the ground tanning material was placed, together with water, and then immersed in a strong extract of catechu, but the method has not found favour with manufacturers generally. It is difficult to see what useful electrolytic action can take place, for it is not claimed, as in the bleaching process, that any chemical changes are produced, nor would such action favour any ferment of the liquor or dehydrating action.

The chemistry of the tanning process is still very obscure, and, as we have already pointed out, there is a great deal of systematic scientific research required before a satisfactory explanation of the new method can be given. Although the electric current does undoubtedly do a small amount of electrolytic work within the drum, it is probably confined to the water and inorganic salts present, as it has yet to be shown that complex molecules of the gallic and tannic acid type can be decomposed in this way. It must not, however, be forgotten that all tannins are characterised by a great avidity for oxygen, and it may be that a temporary oxidation of the active tanning principle renders it in a position to enter more readily into condensation with the gelatine of the pelt. It has been suggested that the action may be analogous of that of a mordant in dyeing, the ions liberated by the electric current determining the motion of the tannin molecules in the solution towards the gelatine. It is difficult to imagine that the electric current has any direct effect on the condensation of the gelatine and tannic acid in the production of leather, as there is no extraneous evidence to warrant the assumption that the electric current is capable of acting as a dehydrating agent. In the production of leather from the simpler molecules one would imagine that heat would be evolved, and that, therefore, it would be unnecessary to furnish additional energy to bring about the change.

The system at work at the British Tanning Company's place does not stand alone, but the results, unintelligible though they be, are confirmed in a highly satisfactory manner by a different application of electricity under the Groth patents, which have recently been tried on a less extensive scale by Messrs. Tebbitt Bros., also of Bermondsey. Here a circular vat (of somewhat smaller dimensions than the drums of the British Tanning Company) is provided, with a central shaft and eight strong arms of wood, four at the top and four at the bottom. On these the hides are firmly fastened, and the whole revolves like a huge paddle, the vat being stationary, like a brewer's mash tun. At opposite ends of a diameter, two vertical strips of copper are placed against the sides of the vat, and a current of about 12 amperes is passed. Here there is no appreciable heating, and, of course, no pressure. The hides, so far from being continually churned together, are not even subject to the ordinary daily handling, but remain strained flat during the whole operation. In stiffness and thorough tanning the resulting butts are admirable, and apparently are better adapted for boot soles and other purposes requiring a hard leather than that now being produced in the rival process. The copper electrodes waste away, as might be expected, but the British Tanning Company can discover no injurious result, nor can they detect its presence in the leather. Messrs. Tebbitt Bros., on the other hand, partly attribute the colour of their leather to the presence of copper, and propose to use an alloy in its place, though we should imagine that carbon electrodes

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would overcome this difficulty. In specimens of the leather manufactured by this latter process, which we have inspected, the colour was much darker than that of the former, but we understand that the butts were tanned by a prepared extract, which is well known gives a darker colour than when a bark liquor is employed. One would imagine that in the Groth process the stretching of the pelts upon the wooden frames would facilitate a regular and uniform tannage, while in the alternative process the beating and flapping of the loose hides against one another and the sides of the revolving drum would have a tendency to soften the leather.

It seems a pity to ask too much of so promising a system. To reduce the time at one bound from many months to a few days is to spur a willing horse. Messrs. Tebbitt Bros. prefer to feed the hides with a weak liquor first, and are satisfied if the tanning is complete in two or three weeks. A strong liquor acts at once on the outer surfaces, and prevents the process from extending to the middle of the hide, and though we did not observe that this was the case at the British Company's place, we think that another fortnight in an ordinary pit would give greater firmness to their butts. The whole economy is one of time—there are no complications of new or cheaper chemicals, or utilisation of waste products; indeed, there is the introduction of motive power and electric machinery; but the advantage consists in the reduction of the large idle capital which lies in the tanner's yard in the form of costly liquor and half-tanned leather, besides the possibility of a rapid turnover and economy of space. The amount of energy expended in electricity is very small: the British Tanning Company use the current for twelve hours out of forty-eight, and its cost for the half-ton of hides tanned per drum at 8d. per Board of Trade unit would be only 3s. 4d.

More than forty years ago Peter Barlow wrote:—"Of late years considerable changes have taken place in the modes of tanning, so that this operation, which a few years ago took several months to complete, can now be done in as many days;" but he goes on to say, "the leather, however, made by this hastened process is considered to be less perfect than by the old method, an opinion which is supported by many eminent tanners and scientific men, among whom may be mentioned Sir Humphry Davy." While the former part of this quotation exactly expresses the result of the electric methods of tanning, we hope that history will not repeat itself, but that we have in these processes the beginning of a new and important industry. In the application of electricity to any industry, considerable time must necessarily elapse before "the trade" will give way its prejudices against a new process, and when, as in this case, there are alternative schemes before the public, the delay is likely to be prolonged by litigation. We believe that both processes are capable of yielding a valuable commercial leather, and that the manufacturers who adopt the new method will find that there are many advantages both in time, labour, and space over the older methods of tanning.

THE MANUFACTURE OF ALUMINIUM BY THE "HEROULT" PROCESS.

Some time ago (see *Industries*, Vol. V., page 406) we gave an illustrated description of the works of the Swiss Metallurgical Company at Neuhausen, where the Heroult process for the production of aluminium was first carried out on a large scale. The same process is now successfully established at Froges (Isère), near Grenoble, where it has been developed by the Société Electro-Metallurgique Française. At Froges, as at Neuhausen, hydraulic power is employed for driving the dynamos. The available supply is equal to 800 h.p., and is partly utilised by two turbines of 300 h.p. each, and a smaller one of 100 h.p. The dynamos are four in number, each yielding 6,000 amperes of 15 volts, and are worked by the two large turbines. The small turbine furnishes a current of 500 amperes, with a voltage of 65, which is employed for the lighting of the works and the motive power required for ventilating the foundry and working the smaller machinery.

In the illustrations, for which we are indebted to *Le Génie Civil*, Fig. 1 gives a general view of the crucibles in which the fusion and electrolysis of the alumina takes place. Fig. 2 shows the apparatus which is employed for the preparation of pure aluminium. The crucible is raised on isolating supports, and is lined entirely with charcoal. The negative electrode is made of metal, and fixed at the bottom of the crucible, while the positive electrode of carbon is introduced from the top and is capable of being raised or lowered into the molten alumina. The crucible is first charged with a small quantity of cryolite, which soon fuses and allows the current to pass, when electrolysis at once commences,

MANUFACTURE OF ALUMINIUM

By the "Heroult" Process at Froges, near Grenoble, France.

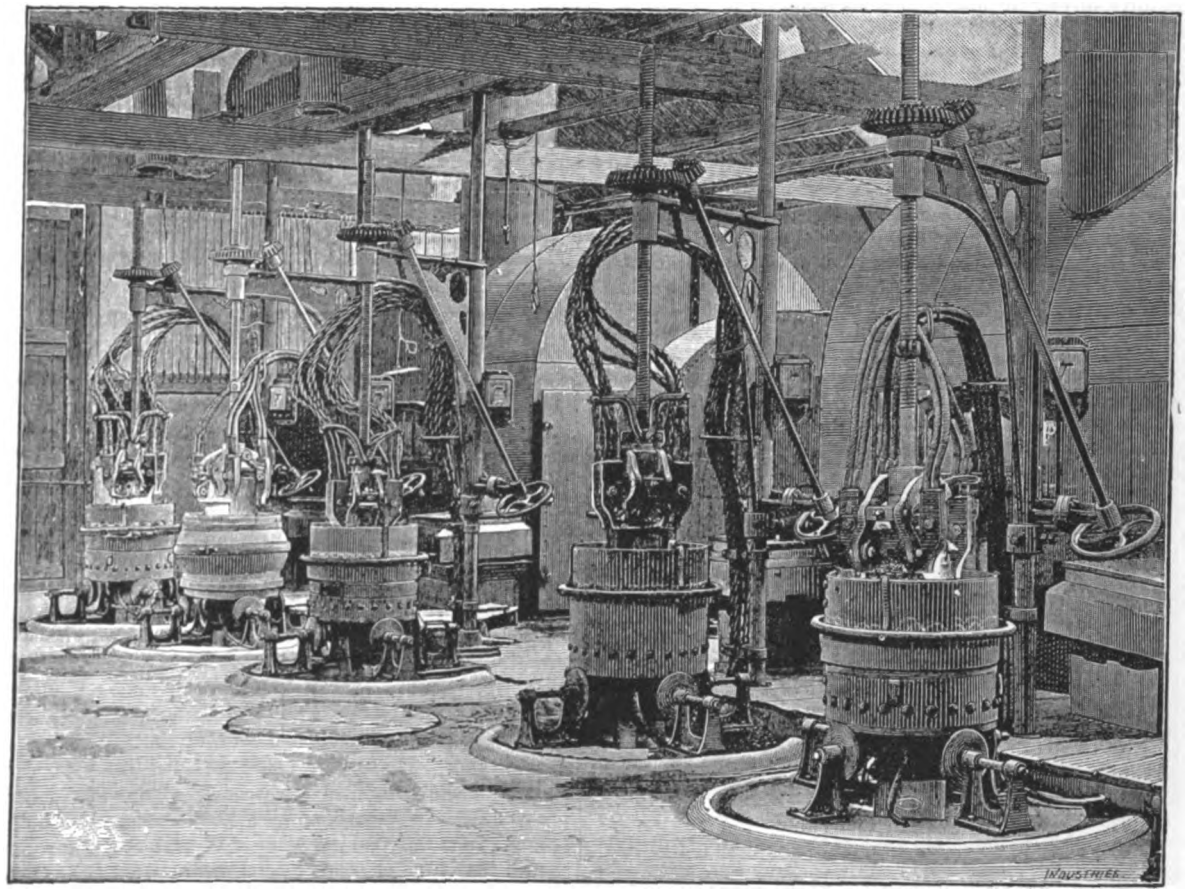


Fig. 1.—General View.

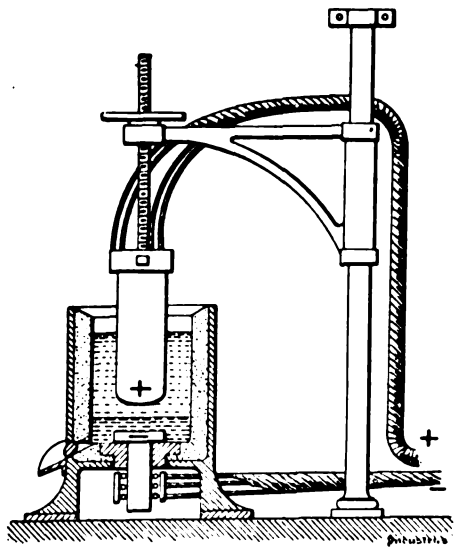


Fig. 2.

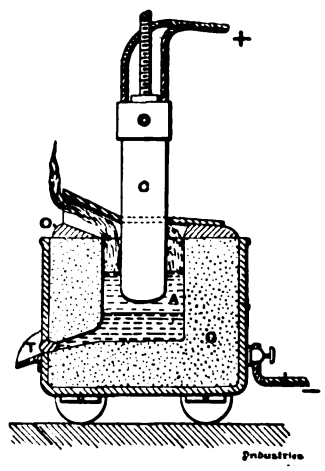


Fig. 3.

and the alumina can then be added from time to time. The metal accumulates at the bottom of the crucible, and is run off every twenty-four hours. When pure materials are used, the product is chemically pure, but in practice the percentage of aluminium in the casting varies from 97·5 to 99 per cent. For the preparation of ferro-aluminium and aluminium bronze a somewhat different arrangement is employed, which is shown in Fig. 3. Here, as in the other apparatus, the positive reducing anode is made of charcoal, and is movable. It consists of a series of plates of carbon bound together by copper bands so as to form a solid block about 1 metre in length, with a square base of ·25 by ·25 m. At C is shown the bottom of the crucible which contains the iron or copper A, which is gradually converted into alloy by the aluminium as it is produced. The opening in the side of the crucible at O serves to introduce the alumina from time to time and the metal to be alloyed. From it also issues the carbonic acid found in the reaction. At T is a plug of charcoal, closing an opening from which the molten alloy is run at the end of the operation. In working with this plant the current passes from the electrode C to the iron or copper, and is thus compelled to pass through the layer of alumina. This offers considerable resistance to the passage of the current, resulting in such an elevation of temperature that the alumina is fused to a perfectly fluid liquid, and is then capable of behaving as a simple electrolyte. The aluminium liberated alloys with the copper or iron, forming the negative electrode, and the oxygen disengaged at C rapidly burns up the carbon, forming carbonic acid, which issues from the opening O. This rapid burning away of the carbon electrode necessitates its frequent renewal, but the temperature at A is so high that all other materials are at once melted and thereby rendered unsuitable. The alloys obtained in this way contain from 8–30 per cent. of aluminium, and the yield of aluminium is approximately equal to 16 grammes per horse-power per hour. By substituting silica for alumina, the same plant can be employed for the preparation of a copper rich in silicon, from which the different silicon bronzes can be subsequently manufactured.

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THE SOCIETY OF CHEMICAL INDUSTRY.

GLASGOW AND SCOTTISH SECTION.

On the 6th inst. Mr. George McRoberts contributed a paper on "Blasting Gelatine and some other Explosive Mixtures." Blasting gelatine contains 92 to 93 per cent. of nitro-glycerine and 7 or 8 per cent. of nitro-cotton, and has a similar composition to the smokeless powder patented by Sir Frederick Abel and Professor Dewar, and named "cordite." This smokeless powder had been adopted by Her Majesty's Government for use in the British army and navy. Several advantages were claimed for it. It gives an initial velocity in rifled muskets of about 2,000ft. per second, while the pressure within the barrel of the gun was less than that produced by ordinary black powder, and it is unacted upon by water. If these results were borne out there could be little doubt that a great future was in store for it, and that it would entirely supersede black powder both for the purposes of war and sport.

Dr. J. B. Readman continued his paper on "The Manufacture of Phosphorus," in which he pointed out that the present process was open to many objections, and was one which resulted in much loss of material. With these and other disadvantageous facts before him, he initiated some years ago a series of experiments to ascertain if a simpler and cheaper process of producing phosphorus could be found, dispensing with the use of sulphuric acid and also with the employment of retorts.

Notes.

TURKISH ARTILLERY.

A number of steel breechloading rifled cannons made from steel manufactured in the Turkish Arsenal have lately been put to severe tests at the proof ground on the plains of Hademkieu, which is a two hours' run from Constantinople on the Roumelian Railway. The guns consisted of a number of B. L. mountain guns on the Broadwell principle, an 8-centimetre B. L. Broadwell system, an 8-centimetre built up B. L. on the Krupp system. The mountain guns were shown to be quite satisfactory. 1,000 rounds were fired from the 8-centimetre Broadwell system, with full charges, and 1,025 rounds were fired from the 8-centimetre on the Krupp system. After firing, they were returned to the factories for examination and to be gauged. The Commission now report that after these severe tests there is no appreciable enlargement or any scoring in the bores or powder chambers, and they are considered excellent samples of modern artillery. A 12-centimetre B. L., built up on the Krupp system, is now approaching completion, and will be ready for proof in a few days. The guns have been finished and built up in the Imperial Ottoman Gun Factories with the Turkish military labour, under the personal and able superintendence of Colonel William V. Shelton and Colonel B. Atkinson.

TERCENTENARY OF THE MICROSCOPE.

The magnifying power of lenses was known from a very early date. Layard found a convex lens among the ruins of the palace of Nimrod, and there can be little doubt that the delicate carving on ancient gems owes much of its perfection to the use of magnifiers. Roger Bacon described the magnifying power of spherical segments of glass, and shortly afterwards spectacles are said to have been invented by an Italian optician. But it was not till the year 1590 that the idea of combining lenses and forming a microscope was carried out. This was done in that year by Hans Zansz or Jansen, and his son Zacharias, spectacle makers, at Middelburg, in Holland. The present year, therefore, brings us to the tercentary of the discovery, and the people of Antwerp have determined to celebrate the occasion with an International Microscopical Exhibition, in which the history and development and present condition of the instrument will be fully illustrated. The occasion will, no doubt, bring together a remarkable collection of instruments which are very interesting from a historical point of view, and others which represent the highest pitch of perfection in design and workmanship.

MINING ACCIDENTS IN 1889.

From advance summaries of the Reports of her Majesty's Inspectors of Mines we learn that the death roll for last year was longer than it has been for some years, containing as it does 1,128 names. The figures for 1888 were 960; for 1887, 1,051; and for 1886, 1,018. During last year there were ten fatal explosions of firedamp, involving the loss of 128 lives. In the previous year the deaths from the same cause only numbered 43, which accounts for an increase of 85, and the remainder must be attributed to minor casualties. These figures refer to all the mines in the kingdom, and when we examine the details of the figures we find that the increase was due entirely to accidents in coal mines, the fatalities in metalliferous mines being rather under the average. The increase is no doubt accounted for by the exceptionally busy year, and possibly a want of due care in consequence thereof. In the coal mines there were 848 fatal accidents and 1,064 deaths during last year, the number of accidents being 27 more, and the number of deaths 176 more than in the preceding year. One death occurred for every 530 persons employed, or, to put it another way, one life was sacrificed for every 178,227 tons of coal brought to the surface, as compared with one life for every 205,698 tons during 1888.

ANOTHER PROPOSED LABOUR CONFERENCE.

The Emperor of Germany seems determined to upset all preconceived notions regarding Imperial or Governmental ways of doing work. The recent Labour Conference at Berlin was an altogether novel step, but now it is reported that the Emperor proposes to summon delegates from all the trades of Germany, and that from among them he will choose the ablest to form an Operatives' Privy Council. Each member of that council, which will advise his Majesty on trade questions and assist him in controlling the working classes, will receive £100 a year and the title of Arbeitsrath. We give the Emperor credit for good intentions, but we are afraid that he is inclined to push matters too hurriedly, and we very much doubt whether such a council would have much weight with the working classes, who in their present temper would be very much inclined to look with suspicion on men who had become practically Government officials. We further doubt whether the best men, and those who were likely to do any good, would accept the position. We are of opinion that more good is likely to come from the free association of employers and employed than from any such official organisation as has been proposed.

PATERSON'S ELECTRIC TARGETS.

A new electric target system is being introduced by the Electric and Self-Indicating Target Company, of 9, Bucklersbury. The system consists essentially of two parts, one being the electric target, and the other the electric registering apparatus. The principle of the invention is as follows:—On a bullet striking the target, which is built up in sections having springs at their back, the particular section hit is forced back, together with its corresponding spring, by the force of the impact. The spring strikes a vertical lever, and causes it to fall into a horizontal position. By this means electrical communication is established through contacts and a battery with the registering apparatus placed at the firing end of the range. The registering apparatus has pointers or plates which are caused to appear behind a vertical slot, and according as one section of the target is struck by the bullet its corresponding indicator is caused to travel behind the slot, thus showing to the marksman where his bullet has taken effect. An electric bell is simultaneously rung. To interrupt the circuit and stop the bell a cord is pulled, a brush rises over the face of the target, removing the bullet splashes, and the lever is restored to its original position. A mechanical target on the spring system is also made by the firm.

BRASS WORK AND ARMS.

Although the City Companies occasionally receive a good deal of abuse, they frequently do some service to the industries they represent. The Armourers and Braziers' Company, for instance, lately offered prizes for armour and articles in brass bronze, and metals combined with brass, with a view to encourage artisans to turn out ornamental work. The Company used to exercise something like absolute powers over the production and sale, within five miles of the City, of arms, armour, and hammered brass and copper work. This control has, of course, ceased, but the Company has always been in touch with its trades. The articles submitted to the Company in connection with the competition were placed on view at the Hall of the Company in Coleman Street, E.C., on Tuesday last, and the Exhibition will close to-morrow. Most of the work is of excellent design and workmanship. It is well worth inspection, and electric light engineers will find some exceptionally tasteful electroliers, among which one in nickel and brass for five glow lamps carries off the palm. It has been designed by Mr. C. H. Mason, and carried out by Messrs. J. Longstaff and H. Ross, in the employment of Messrs. Strode & Co. The articles shown are of a very diversified nature, and include fire screens, clock cases, gas and oil brackets, *repoussé* work, a large picture frame in copper (by Mr. Holman Hunt), swords, hunting knives, and so on. It was intended to ask for exhibits from India, but time did not allow thereof. Instead, the South Kensington Exhibition authorities send a large collection of Indian work. The Company desire to exert an influence towards procuring better arms for our soldiers, and to bring about a more artistic and useful treatment of the brass and copper work, which is again becoming popular. In this they appear to be succeeding.

NAPHTHALENE AS A CAMPHOR SUBSTITUTE.

The *Oil, Paint, and Drug Reporter* points out that the extreme scarcity and high price of camphor in America has induced two or three American firms to place on the market a highly refined naphthalene suitable for the preservation of woollens, furs, and other articles from the destructiveness of insects. The naphthalene is produced in several forms, the more saleable being balls, tablets, scales, and granulated. As American coal is not so rich in naphthalene as the English varieties, our manufacturers will still supply the bulk of the crude article.

IMPROVEMENT OF THE PORT OF HOLYHEAD.

At a recent meeting of the Holyhead Local Board the offer of the London and North-Western Railway to the Board of Trade, to undertake the removal of the Platters Rocks, was considered. These rocks occupy an acre in extent, and are in a most dangerous position, depriving large vessels of the advantages of the shelter of the inner harbour. The London and North-Western Railway Company, which is very desirous of developing Holyhead, offered to remove the rocks to a depth of 25ft. at low water at a cost of half a million of money if the Board of Trade will permit the company to construct a deep water quay in another portion of the harbour, and extend their lease of their present works. The projected improvements would enable Holyhead to become a port of call for American liners, and prove a great advantage to the shipping trade. The Board of Trade, however, for reasons which were not known, had declined the offer of the railway company, but it was resolved to bring the matter before Parliament and to urge the Government to reconsider the matter.

THE LONDON POLYTECHNICS.

The Education Department has approved the scheme of the Charity Commissioners for dealing with the City of London Parochial Charities under the Act of 1883. The Commissioners propose to establish a City parochial foundation, to be administered by a central governing body of twenty-one members. The property is divided into two funds—the first to be devoted to the establishment of parks and open spaces and polytechnics, and the second to ecclesiastical purposes. The grants to institutions are:—Bishopsgate Institution, £40,000; Cripplegate Institution, £40,000; Regent Street Polytechnic, building grant, £4,000; ditto, by taking over the West London School of Art, £1,000; ditto, temporary maintenance grant, £6,750; People's Palace, £6,750; City Polytechnic (including the Northampton Institute, the Birkbeck Institute, and the City of London College), £51,000; Victoria Hall and Morley College, £6,000. The following annual payments are also proposed to be made:—Bishopsgate Institute, such a sum as, in conjunction with the residuary income of the Bishopsgate charities, will make up £2,000 a year; Regent Street Polytechnic, £3,500; People's Palace, £3,500; City Polytechnic, £5,350; Victoria Hall and Morley College, £1,000; Borough Road or Ironmongers' Institute, £2,500; Battersea Polytechnic, £2,500; South-Western Polytechnic, Chelsea, £1,500; the Joint Committee of the Working Men's College, Great Ormond Street, and the College for Men and Women, Queen's Square, Bloomsbury, £400; Bow and Bromley Institute, £150; Aldenham Institute, £150; and various other smaller sums to other Institutes, which are left to the discretion of the governing body.

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Patent Record.

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

5th May, 1890.

6899. Walker, W. ..... Expansion gear.
6903. London, J. A. ..... Machine for opening peat fibres.
6906. Dewar, W. ..... Guard for tramcars.
6908. Scholes & Walkden ... Looms.
6909. Riley, J. ..... Sleepers for railways.
6910. Dorrington & Coates... Gas engines.
6911. Hooper, H. W. ..... Iron and steel horse roughs.
6912. Fielding, J. ..... Gas engines.
6914. Fawcett, T. C. ..... Machinery for making bricks.
6915. Furnival & Clarke ... Book-backing machines.
6919. Holborow, H. G. ..... Engines for compressing fluids.
6928. Martyn, S. E. ..... Air compressors.
6938. Woodroffe, F. K. ..... Mills for grinding grain.
6941. Haddan, H. J. ..... Delivering condensed water free from surface scum (*Bison*).

6th May, 1890.

6951. Kellner, C. ..... Paper pulp boilers.
6955. Draper, Holmgren, Mount, & Barnes ... Removing and preventing incrustations in steam boilers.
6960. Neill, J. ..... Steel plated ingots.
6962. Ashberry & Barnes ... Mechanical clippers for sheep.
6963. Davage & Taylor ..... Manufacture of projectiles.
6972. Rouchetti & Cross ..... Fire-extinguishing apparatus.
6976. Pullen, T. M. ..... Looms for piled fabrics.
6978. Willcox & Whitehead Feeding printing presses.
6983. Bosshardt, F. ..... Cigarette making machines (*Enghien*).
6987. Tolladay, R. ..... Force pumps.
6990. Butler, E. ..... Petroleum engines.
6991. Dunn, Paterson, Riley, & Wilding ..... Cotton opening machines.
7000. Schmidt, L. ..... Drill grinding apparatus.
7001. Longsdon, A. ..... Hydraulic brakes for ordnance (*Krupp*).
7004. Nevius, J. H. ..... Hot-air furnaces.
7007. Henderson, C. ..... Boat disengaging gear.
7008. Askham & Wilson ..... Machines for making moulds.
7009. Askham & Wilson ..... Disintegrating apparatus.
7011. Fitzpatrick, H. D. ..... Grinding machines (*Lawles*).
7013. Jörgensen, J. ..... Lubrication of shafting.
7014. Wardle, W. W. ..... Rotary pump.
7015. Hill, J. ..... Automatic fire extinguishers.
7020. Fraser, Tavernier, & Casper ..... Indicator for steam engines.
7021. Lich, M. L. H. ..... Grinding machinery.
7026. Thompson, W. P. ..... Split pulleys (*Reeves Pulley Company*).
7029. Thompson, W. P. ..... Spinning machinery (*Jones*).
7031. Weiss, R. ..... Embroidery machines.
7034. Ermold, E. ..... Bottle-corking machines.
7035. Hayton, J. ..... Converting reciprocating into rotary motion.
7037. Stern, E. ..... Dynamite projectiles.
7041. Campbell, J. H. ..... Ammonia engines.
7042. Price, J. M. ..... Street railways.
7043. Lake, H. H. ..... Firearms (*Bofors Gullspang Company, Ld.*).
7046. Pogson, J. ..... Safety guards for tramcars.
7047. Speicher, J. ..... Railway joints.
7048. Whieldon, J. H. ..... Rotary measuring apparatus.
7049. Schulder, C. ..... Looms.
7050. Pitt, S. ..... Fish plates and chairs (*Weber*).
7051. Morris, H. B. ..... Looms.
7052. Kiddier, Kiddier, & Kiddier ..... Warp knitting machines.

7th May, 1890.

7061. Middleton, H. ..... War vessels.
7062. Wild, J. ..... Friction clutches.
7065. Blamires & Blamires ... Sounding and signalling apparatus.
7067. White, T. W. ..... Reducing the pitching of ships at sea.
7068. Foster, F. ..... Bottling apparatus.
7070. Heaton & Holden ..... Steel and iron.
7074. Wilson, A. ..... Self-locking safety bolt.
7083. Fairbairn, C. ..... Forging projectiles, &c.
7095. Westley, W. ..... Ring spinning machines.
7099. McTear, B. F. ..... Kilns for burning bricks.
7100. Lodge & Littlewood ... Looms.
7101. Gregory & Gregory ... Machinery for lasting boots.
7102. Pogson, J. ..... Sole plate for rail joints.
7105. Lord, W. T. ..... Steam engines.
7108. Bayly, J. P. ..... Nut lock (*Conway*).
7110. Bayly, J. P. ..... Harrow (*Mack*).
7114. Bayly, J. P. ..... Spring-actuated motor (*Dillon*).
7115. Astbury, J. ..... Ordnance.
7116. Astbury, J. ..... Breechloading guns.
7121. Ruffles, R. G. ..... Steam generators.
7129. Danton, J. D. ..... Iron.
7135. Thomson & Haigh ..... Carding engines.
7136. Henn, E. ..... Heating apparatus.
7141. Marshall & Wigram ... Slide valves.
7143. Moss & Hunt ..... Sewing machines.

8th May, 1890.

7145. Rylands, D. ..... Machinery for the manufacture of bottles.
7146. Stuart & Binney ..... Hydrocarbon engines.
7147. Bradbury, W. ..... Mules.
7149. Braithwaite, C. C. ..... Fluid pressure engines.
7151. Tucker, J. ..... Grain elevators.
7154. Wilkinson & Wilkinson Jacquard mechanism for looms.
7157. Wilson, J. ..... Appliances for shafting hammers.
7162. Hardie, T. G. ..... Boiler furnaces.
7163. Partington, E. ..... Paper refining engines.
7164. Mackay, F. N. ..... Grain conveyors.
7165. Mackay, F. N. ..... Apparatus for drying sludge.
7167. Morison, D. B. ..... Feed heaters.
7169. Duggleby, S. ..... Sifting machines.
7171. Schmidt, F. T. ..... Parallel vice.
7172. Carruthers, J. H. ..... Pumps.
7176. Greaves, W. McG. ..... Furnaces.
7177. Mewburn, J. C. ..... Combined gas and compressed air motors (*Proell, Kummer, & Fischinger*).
7179. Coram, J. C. ..... Machines for finishing tubes.
7187. Church, W. C. ..... Slide valves.
7192. Pringle, T. ..... Ships.
7197. Younghusband, S. S. ... Slide valve.
7201. Lorrain, J. G. ..... Forging metals.
7210. Pitt, S. ..... Steam heating apparatus (*Kieley*).

9th May, 1890.

7212. Newcome, H. J. ..... Elevator.
7214. Popplewell, T. ..... Rag-breaking machines.
7226. Thompson, W. ..... Prevention of collisions at sea.
7233. Parkinson, G. S. ..... Pneumatic propulsion of trains.
7234. Lea, E. C. ..... Sewing machines.
7241. Mossop, J. A. ..... Clipping machines.
7245. Haddon & Slade ..... Firearms.
7253. Hodge, W. ..... Converting iron into steel.

10th May, 1890.

7262. Tarbet & McDonald ... Sewing machines.
7263. Thomas, F. ..... Railway carriage coupling.
7264. Stones & Stones ..... Expansion valve.
7265. Edge, J. ..... Middlings purifiers.
7266. Kohl, A. ..... Alarm indicator for boilers.
7273. Hingelberg, G. R. ..... Diminution of air resistance of trains.
7274. Rivret & Colson ..... Carding machines.
7275. O'Donnell, Smith, & Timmis ..... Railway signalling apparatus.
7279. Shorrock, Hacking, & Feilden ..... Looms.
7282. Ambler, W. ..... Moulding tubular articles from molten metal.
7285. Lake, H. H. ..... Railway joints (*Continuous Rail-joint Company*).
7288. Downing, G. C. ..... Bench vice (*Sonty*).
7291. Paterson, J. M. ..... Marine boilers.
7294. Thompson, W. P. ..... Mortising and boring machines (*Young*).
7297. Frances, D. ..... Continuous brake.
7300. Bradford, T. ..... Ironing machines.
7303. Wanner & Rebmann ... Lubricating apparatus.
7304. Imray, O. ..... Machine gearing and couplings (*Mannesmann*).
7308. Robinson, J. ..... Steam boilers.
7312. Baudry-Diot, E. ..... Bridges.
7318. Bayly, J. P. ..... Drainage and sewerage system (*Hallock*).
7319-20-21. Bayly, J. P. ..... Buoyant propeller and water locomotive (*Pond*).
7324. Rivett, T. ..... Winding yarns.

ELECTRICITY.

5th May, 1890.

6924. Eagar & Milburn ..... Batteries.
6933. Von Peichl, J. ..... Mariners' compasses.
6939. Crawcour, W. H. ..... Telegraph and telephone wires
6943. Fischinger, E. ..... Arc lamps.
6945. Appleton, J. ..... Electric switch.

6th May, 1890.

7003. Duncan & Carpenter... Electric motors.
7044. Lake, H. H. ..... Conduits for electric conductors (*Brooks*).

7th May, 1890.

7125. Romanze, Weise, & White ..... Electricity meters and clocks.
7132. Lake, H. H. ..... Carbon electrodes (*Lacombe & Cie.*).

8th May, 1890.

7185-6. Thompson, W. P. ..... Electric welding (*Coffin*).
7196. Grefen, H. ..... Electric door lock.
7209. Saunderson, L. ..... Arc lighting. (4th December, 1889.)

9th May, 1890.

7219. Perry, J. ..... Electric supply meter.
7225. Baker, T. J. ..... Electric bell pushes.
7239. Woolley & Hunnex..... Electric switch.

CHEMISTRY.

5th May, 1890.

6931-2. Abel, C. D. ..... Colouring matters.
6936. Bamberg, G. ..... Extraction of gold.
6946. Pitt, S. ..... Colouring matters (*Cassella & Co.*).

6th May, 1890.

7018. Cole, W. ..... Indigo.
7019. Serre, C. A. ..... Soap.
7055. Sinclair, A. ..... Copper ores.
7058. John, J. Y. ..... Chlorine (*Marx & Weller*).

7th May, 1890.

7063. Fourness, H. ..... Water gas.
7117. Scott, H. ..... Soap.

9th May, 1890.

7247. Baudouin & Escarpit... Ammonia.
7252. Lindsay, R. C. ..... Illuminating gas.

10th May, 1890.

7260. D'Andria, M. N. ..... Oxide of iron pigments.
7277. Cruikshank, G. M. ..... Manufacture of gas (*Reissig, Landin, & Maccallum*).
7301. Lundholm & Hosie ..... Explosives.

MISCELLANEOUS.

5th May, 1890.

6905. Moore, F. W. ..... Non-conducting covering for steam pipes.
6940. Wood, E. T. ..... Hollow balls of celluloid. (9th November, 1889.)

6th May, 1890.

6952. Kellner, C. ..... Coating iron with Portland cement.
6982. Fleming, F. ..... Carding fibres.
6993. Kellner, C. ..... Manufacture of paper pulp.
6998. Taylor, I. F. ..... Fog signalling apparatus.
6999. Lancaster, W. J. ..... Levels.
7038. Lake, H. H. ..... Mechanical telephones (*Knight*).

7th May, 1890.

7075. Hunt & Mackey ..... Filtering apparatus.
7076. Morris, R. ..... Cartridges.
7138. Lawrence, W. ..... Softening water.
7142. Stern, H. ..... Decolorising oils.

8th May, 1890.

7198. Spencer, W. H. ..... Bleaching textile fibres.
7202. Cavailles, P. ..... Dyeing wool.

9th May, 1890.

7238. De Liebhaler, L. E. A E. D. ..... Removing rust from iron.

10th May, 1890.

7270. Challinor, C. ..... Fog signalling.
7314. Benners, E. H. ..... Grease cups.
7327. Thompson, F. O. ..... Pots for melting glass.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form of such opposition.

Year 1889.

1115. Chapman.
7488. Harrison.
7758. Peyman.
7894. Atkinson.
8097. Hart & Baynes.
8296. Wall.
8600. White & Carson.
8676. Wasserman.
8916. Milne.
9203. Butler & Butler's Patent Petrol-Cycle Syndicate, Ld.
9359. Oliver.
9386. Thompson (*Pool*).
9418. Adam.
9530. Dick.
9797. Smith.
9891. Hawksley.
10131. Greene & Evans.
10225. Powell & Johnson.
10312. Lundholm.
10386. Kerr.
10449. Carrington.
10488. Dinsmore.
10541. Rose.
10695. Lake (*Hussey & Brown*).
10735. Bethell.
10798. Rudge.
10810. Reynolds & Reynolds.
10830. Mitchell.
10835. Hydes.
10850. Wastfield.
10876. Newnham.
10887. Chapman.
10906. Cornely & Cornely.
10911. Thame & Sanguinetti.
10934. The Clayton Aniline Company, Ld., & Dreyfus.
10945. Vicars, Vicars, & Vicars, Jun.
10957. Ried.
5948. Cox & Gordon.
7695. Erskine.
7808. Julian.
7895. Atkinson.
8147. Edwards.
8498. Wilke.
8604. MacIlwaine.
8773. Godsál.
9134. Brown.
9243. Hitchon.
9258. Rawson & Rawson.
9302. Oldfield, Head, & Mark.
9411. Brigg.
9420. Andrews & Wallace.
9577. Kendall, Gee, & Thornton.
10031. Swinburn.
10168. Northrop (*Cooper*).
10237. Deeley.
10376. Lundholm & Sayers.
10425. Clarke.
10463. Douglin.
10524. Fisher.
10596. Scott.
10696. Lake (*Hussey & Brown*).
10797. Woodhead.
10800. Davis.
10818. Beecroft & Clark.
10832. Collins & Frazer.
10836. Hydes.
10868. Thompson (*Schaaf*).
10884. Jones & Gleason.
10900. Richardson.
10907. Thompson (*Notkin & Marix*).
10941. Gwinnett.
10942. Moore, Sen., Stamps, & Moore, Jun.
10946. Vicars, Vicars, & Vicars, Jun.
10959. Thoms.

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10984. Robert Edwards.
11005. Wilson.
11023. Mallett.
11032. A. Oulton & Edmondson. (9th July, 1889.)
11087. Dawson.
11112. Whitaker.
11125. Sanders.
11134. Bond.
11162. Williams.
11179. Siemens, Bros. & Co., Ld. (*Siemens & Halske*).
11229. Timmins.
11295. Willis.
11657. Thompson (*Junquera*).
11851. Lane.
11929. Lockwood.
12093. Eiffläender.
12392. Trigg.
12782. Berkley.
12999. Wells.
13360. Ashberry.
14487. Zehren & Zehren.
15096. Rattray & Lowdon.
15176. Imray (*Farbwerke vorm. Meister, Lucius & Brüning*).
15746. Redmayne.
16181. Henderson & Simonett.
17820. Bermel.
18416. Smith.
18877. Weatherill.
19156. Richards.
19524. Empsall & Fish.
20556. Fairbairn, Jones, & Briggs.
20959. Gibson.

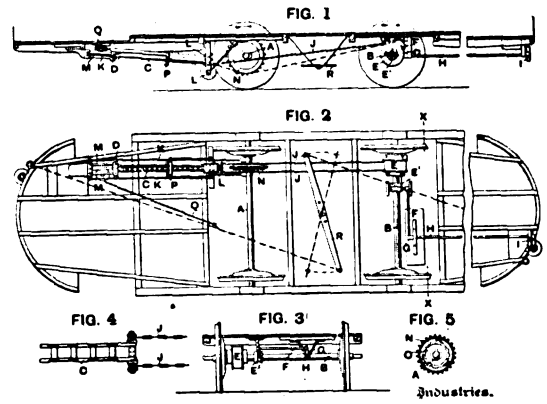
1890.

80. Biddles.
255. Miles.
1702. Craven. (22nd July, 1889.)
2497. Bruce. (17th July, 1889.)
2856. Bragge & The English Watch Company, Ld.
3363. Heucken.
3589. Steffen.
3831. Thompson (*Hörenz*).
4172. Boult (*Reiche*).
4241. Searles.
4386. Von Ehrenwerth.
4654. Justice (*Swift & Davenport*).
4689. Potts.
4926. Mefford.
4962. Gardiner, Collingwood, Fulton, & The New Halfpenny Letter Company, Ld.
5077. Newton (*Howard*).
5088. Lake (*Worsley*).
5204. Laird.
5267. Chapman & Vickers.
5323. Burkhardt & Jackson.
5326. Haddan (*Weigel*).
5344. Lake (*Garver*).
5356. Algar.
5396. Nittinger & Rotter.
5397. Whitfield.
5412. Thompson (*Wynkoop*).
5421. Fennell (*Fennell*).
5464. Hawkins & Barton.
10998. Willcox (*Farbenfabriken vormals Friedr. Bayer & Co.*).
11064. Cousins (*Olsen*).
11070. Johnson (*Riker*).
11099. Parker & Robinson.
11120. Thomerson.
11129. Milner.
11156. Cochrane.
11165. Cochrane.
11191. Benson.
11193. Reilly.
11291. Von Nagy.
11421. Barrow & Guest.
11690. Poumaréde.
11867. Platt & Thorp.
12065. Powles.
12225. Hall (*Storer*).
12448. Renaut.
12808. Heys (*Buxstorf*).
13003. Ellis.
14141. Johnson.
14751. Smith.
15175. Imray (*Farbwerke vorm. Meister, Lucius & Brüning*).
15304. Hargreaves.
15822. Jackson & Jackson. (29th March, 1889.)
18157. Peacock.
18485. Thompson (*Ambery & Wilbur*).
19324. Green.
20289. Johnson (*Mitchell*).
20660. Winckler.
20929. Rosentweg.
215. Wallbank.
350. Epstein.
1889. Edie, Koppas, & Koppas.
2631. Thompson (*Bourgain*).
2719. Behringer.
2963. Sayer.
3089. Seckendorf (*Reuland*).
3440. Sebenius.
3776. Ingram.
4143. Boyes.
4229. Melendy.
4323. Hanneborg.
4556. Rainforth, Sen., Rainforth, Jun., & Rainforth.
4814. Auras & Wilke.
4948. Smith.
5027. Allison (*Hotchkiss*).
5406. Luce.
5047. Wrightson & Holt.
5057. Bernstein.
5064. Towne.
5087. Lake (*Barrett*).
5154. Thomson.
5238. Hersey.
5315. Jones & Jones.
5325. Grill.
5333. Green.
5347. Thompson (*Nelson*).
5365. Imray (*The Irrigation Pump Company*).
5411. Boult (*Jahn*).
5414. Mayes.
5423. Wenstrom.
5480. Wendt & Wendt.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

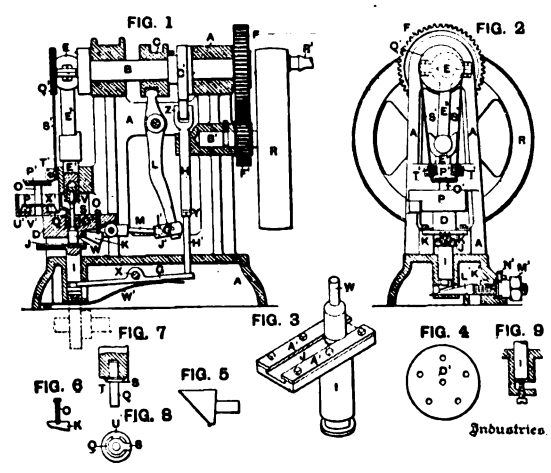
Restarting Tramcars, &c.—*E. Dredge, London.*—In this class of mechanism the power exerted to stop the tramcar is utilised for the purpose of restarting it. Combined with the starting mechanism in this invention is a brake which is pressed against the wheels by the impetus of the car. In the accompanying illustrations Fig. 1 is a longitudinal section of the tramcar, Fig. 2 an underside plan, Fig. 3 a transverse section on X X, and Figs. 4 and 5 details. On the axle B is a clutch E E¹, worked by means of the connections F G H and I, which are under the control of the driver. Connected to the drum of the clutch by the chains J is an open link chain C. The other end of the link chain C is secured to a crosshead D sliding upon the guide rods K. The chain also passes between two guide pulleys L. To the back of the crosshead D are attached rubber springs M. Upon the second axle A is a loose chain wheel N, having a ratchet wheel O upon one side as illustrated in Fig. 5. The ratchet wheel O is keyed to the shaft. The driver, when desiring to stop the car, throws the clutch E E¹ into gear, and causes the drum to wind up the chains J under the influence of the momentum of the car. The link chain C is thus drawn out, and the springs M distended. As the chain C is drawn out it engages with the teeth of the wheel N, and revolves it upon the shaft until it ultimately assumes the position shown by the dotted lines. To start the car the driver releases the clutch E E¹, and the springs will pull back the chain C. This will cause the wheel N, with which the chain is in gear, to rotate in the direction in which the car is to proceed, and, by reason of the pawl and ratchet arrangement, it will also drive the axle A in the same direction, and so propel the car. In pulling out the chain C during the stopping of the car, the crosshead D will strike against and push forward another crosshead P, which may also slide on the guide rods K, and is attached by a chain Q to the chain of the ordinary brake lever R. Thus it will be seen that the act of storing the power during the stopping of the car will also put on the brakes, and as the power is produced by the impetus of the car the action of the brakes will be more powerful than when worked by the driver. Claims: (1) In car-starting apparatus the combination of a friction clutch on one axle, with an open



link chain which is drawn out (against the tension of a spring or otherwise) by a drum on the said clutch, and a silent clutch or pawl and ratchet coupling on the other axle, as and for the purpose set forth; (2) the arrangement of car-starting apparatus, as herein shown and described; (3) the combination with a car-starting apparatus of a brake mechanism, whereby the momentum of the vehicle which is used to set the starting mechanism serves also to actuate the brake mechanism as set forth; (4) the arrangement of car-starting apparatus herein shown and described in combination with the ordinary brake mechanism of tramcars.—No. 14,986. September 23rd, 1889. 8*d*.

Steam Traps.—*J. Coulong, Hollin Bank, Blackburn.*—In a closed vessel provided with inlet for condensed steam and outlet for discharge of water is pivoted a bell-crank lever. To one arm is attached a ball float and to the other an adjustable weight. On the ball float arm and at a short distance from its pivot is attached a valve of the double beat type, the seatings being equal in diameter top and bottom. The arm carrying the weight is set vertically and the arm carrying the float horizontally when in the position ready for discharging water. When the steam and water enters the vessel the ball float rises, and, by lifting the double beat valve, opens it, permitting the water to escape. When the water again sinks to the normal level the lever and valve assume their previous positions The weight upon the arm keeps the valve tightly closed. Three claims are made.—No. 8561. May 23rd, 1889. 8*d*.

Compressing Machines.—*J. A. McFerran, Philadelphia, U.S.A.*—The machine is for compressing pulverised materials into the form of pills or tablets. Fig. 1 is a sectional side elevation of the machine, Fig. 2 an end elevation, and the remaining figures represent details. The die carrier D is oscillated by a cam C on the driving shaft B through the medium of the lever L. The compression die Q is carried by a plunger E¹ which is given a vertical reciprocating motion by the crank E. Adapted to the lower die is an ejector W operated by the eccentric C¹, lever G, and rod H. The hopper P is fitted with a stirrer U¹ which is revolved by the endless band S¹ driven by the pulley Q¹ fixed to

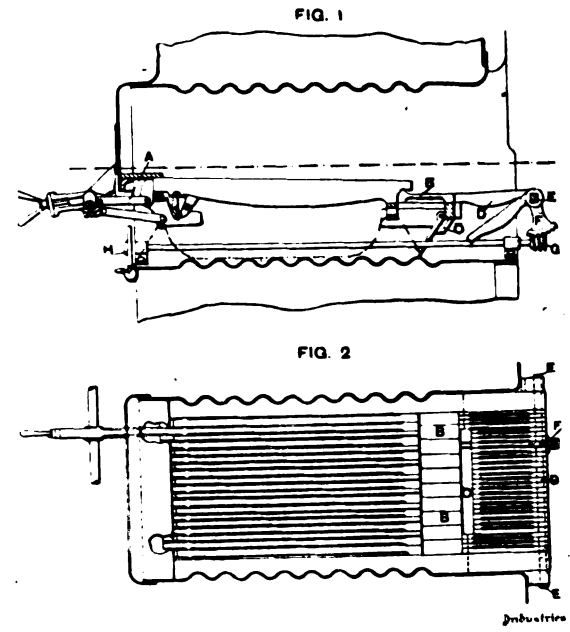


the pin of the crank E. Beneath the post I is a wedge-shaped adjustable block N by which the machine may be regulated for quantity. The cycle of operations is as follows:—As the driving shaft is revolved, the die carrier passes under the opening in the hopper P, thereby taking in a charge of material. The die carrier now returns to the position shown, and the compressing die Q descends, forcing the part W down until the post I rests upon its seating and the charge is properly compressed. When the top die commences to reascend the ejector comes into action and the pill formed is thrown out of the mould. Seven claims are made for the improved machine described and illustrated.—No. 5861. January 5th, 1889. (Application April 5th, 1889.) 8*d*.

Double-lift Jacquards for Looms—*W. J. Cheetham & S. Sutcliffe, Kirkstall, Leeds.*—Above both sets of knives is pivoted a clearing bar. To each clearing bar is attached a pivoted vertical lever connected to a spring hammer, having double inclined bearing surfaces working against a fixed roller. The uprights have a projection about half way of their length. These projections, when the uprights are lifted, engage with a fixed knife, which holds them up until they are required to drop. When the uprights are going down the projections are held off the knife, which is coming up by the clearing bar until they get past the centre. By this arrangement only one neck cord is required where two have been used before, and as there is no jerking of the cords they last longer. Three claims are made.—No. 9548. June 8th, 1889. 6*d*.

Bridges for Boiler Furnaces.—*T. Plant, Huntingdon.*—The bridge is constructed of several pieces, so as to permit free expansion and contraction of the parts, and at the same time provide means for the more perfect combustion of the fuel. The bridge up to the level of the fire-bars is solid, but it has pipes in it for supplying air to the upper structure. Above the level of the fire-bars the bridge is hollow. The front and back are formed of suitable bars of iron bolted upon the brick sides, so as to form together a chamber with open top. Into this chamber the pipes in the solid bottom lead and supply it with air and steam. On the top of the chamber is an adjustable plate inclined from the front to back of the furnace. In operation the flames strike the front of the chamber, and then rise and pass over the inclined plate and mouth of the chamber. The steam and air rising from the latter meets the flames and smoke, and thorough combustion ensues. Claims: (1) A fire-bridge formed of bars capable of yielding to expansion and contraction as set forth; (2) a fire-bridge having a hollow chamber surmounted by an adjustable inclined plate, into which chamber air and steam are conducted, so as to commingle and become heated therein, and meeting the gases from the flames above the chamber promote combustion of the fuel, all as described.—No. 10,994. July 8th, 1889. 6*d*.

Furnace Fire-Bars.—*T. Henderson, Liverpool.*—In former patent specifications the inventor has described forms of self-cleaning fire-bars. The present invention is an improvement upon them. The figures show respectively a longitudinal section through an elevation of the furnace, and a plan of the same. In



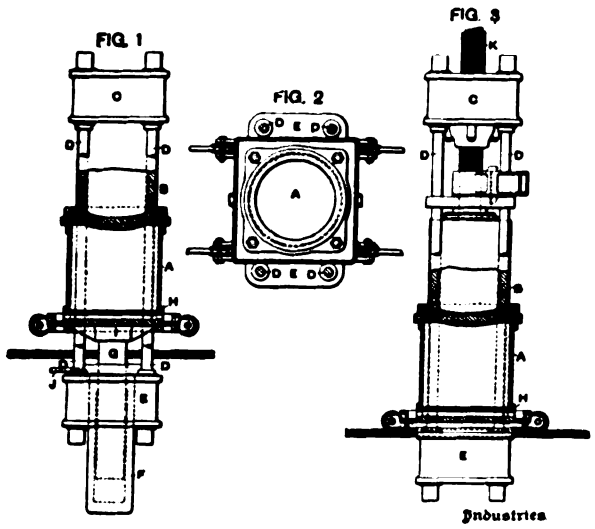
the front part of the furnace is a well-known mechanical method A of agitating the fire-bars, and causing the fuel to travel towards and over the dead-plate B, until it falls over into the ashpit at C. The present invention consists briefly in providing at the end of the furnace to which the clinkers travel a movable dead-plate, having small or no air passages. This device, termed the "clinker-plate," is mounted and arranged so that it may be tilted from time to time as desired. It is represented in the figures by D, its upper surface being a continuation of the dead-plate B. In this instance the clinker-plate is a series of fire-bars, and occupies about two-thirds of the width of the furnace. It turns about its rear end upon a shaft E, made to revolve by the toothed sector F and worm G, controlled by the hand-wheel H. Several modifications are made in the manner of working this clinker-plate. This improvement forms a ready means of discharging the clinkers from the furnace into the ashpit. Claims: (1) The arrangement within a boiler or other furnace of a tipping clinker-plate, forming a continuation of the fire-bars at either end of the furnace, and adapted to receive the clinker from the said bars, and also to discharge such clinker into the space below the bars each time it is tipped by means of suitable mechanism, operated or released from the front end of the furnace or from other convenient point, substantially as described; (2) the arrangement within a steam boiler or other furnace of a system of self-cleaning fire-bars, similar to that illustrated, only adapted to feed the fuel and clinker from the rear portion of the furnace towards the front, in combination with arrangements for quickly discharging or removing said clinker after it has reached the tail end of the fire-bars.—No. 8539. May 22nd, 1889. 8*d*.

Slide Valve Gear.—*E. M. Galloway & J. H. Beckwith, Manchester.*—The slide valve is operated by a cam fixed to the piston rod of the engine. In the groove of this cam runs a bowl mounted upon one end of a bell-crank lever, the other end of the lever being pivoted to the piston rod and the angular part of the bell-crank lever pivoted to the framing of the engine. As the piston makes its strokes the cam travels backwards and forwards, and the bowl working in the cam oscillates the bell-crank lever, and consequently works the valve. As the path of the bowl is in the shape of a rhomboid the bowl is kept against the proper face of the cam by a spring secured to a third arm of the bell-crank lever and to the reciprocating cam. This spring, as the cam reciprocates, pulls the bowl first against the top of the cam and then against the bottom, causing it to travel forward in the groove continually. Other means are shown and described for causing the bowl to travel correctly in its groove, and in a modification the cam is detached from the piston rod, but made to oscillate upon a stud by connecting it to the piston rod by a

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rod or link. Claims: (1) For working the slide valve of an engine or pump, the combination of a part reciprocating along with the piston and having a cam groove acting on a roller mounted on the arm of a lever linked to the slide rod as described; (2) in combination with the slide rod lever and cam groove referred to in the preceding claim, a spring or a roller pressed by the piston of a subsidiary cylinder and acting on the lever as the cam groove approaches each end of its stroke, so as to insure the complete movement of the lever as determined by the cam groove; (3) in combination with the slide rod lever and cam groove above referred to, a subsidiary cylinder having its piston connected to the slide valve of the main cylinder, and having its own slide valve worked by the reciprocating part as described.—No. 3659. March 7th, 1890. *6d.*

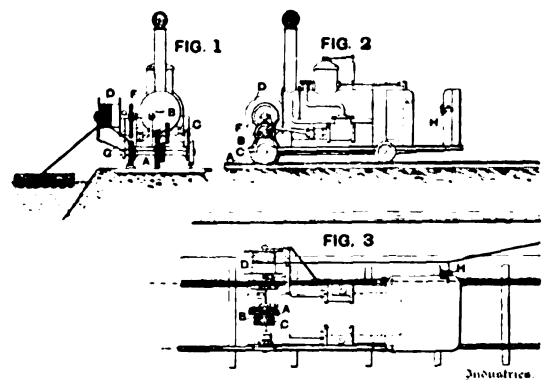
PRESSES FOR FRUIT, &c.—*R. Heaton, Malaga, Spain.*—The press described in this specification consists of a perforated vessel for the reception of the fruit, and provided with a piston or presser, which, entering the vessel, compresses the fruit. Fig. 1 is a sectional elevation of a press constructed according to the invention and adapted to be worked by hydraulic power, Fig. 2 is a plan of the same, and Fig. 3 is a sectional elevation of a similar press worked by manual instead of by hydraulic power. A is the receptacle of circular shape, whose walls and bottom are perforated. B is the piston or pressure adapted to enter the receptacle. The piston is secured to a crosshead C supported upon the standards D which are fast at their lower ends to the bed-plate E. A hydraulic cylinder F is connected to the bed-plate E, and its plunger G terminates in a head I designed to enter the recess of a carriage H. In the modification shown in Fig. 3 the presser is lowered into the receptacle by the screw K in the manner of a screw press. The operation of the apparatus is as follows:—After the receptacle is filled with the material to be pressed or squeezed, the carriage is pushed into the apparatus beneath the presser B, water under pressure is then introduced through the pipe J into the hydraulic cylinder F, whereby the plunger G is raised so as to press against the underside of the carriage and lift



the same with the receptacle towards the presser B, the upward movement being continued until the presser has entered the receptacle to a sufficient extent to produce the desired pressure. Claims: (1) Apparatus for pressing fruit, pulp, and other substances, comprising a perforated receiver which is mounted upon a carriage, a piston or presser adapted to enter the said receiver to press the materials therein, and means for moving the said receiver and the piston or presser relatively to each other; (2) the manufacture and use of the improved apparatus for pressing fruit, pulp, and other substances.—No. 3840. March 4th, 1890. *6d.*

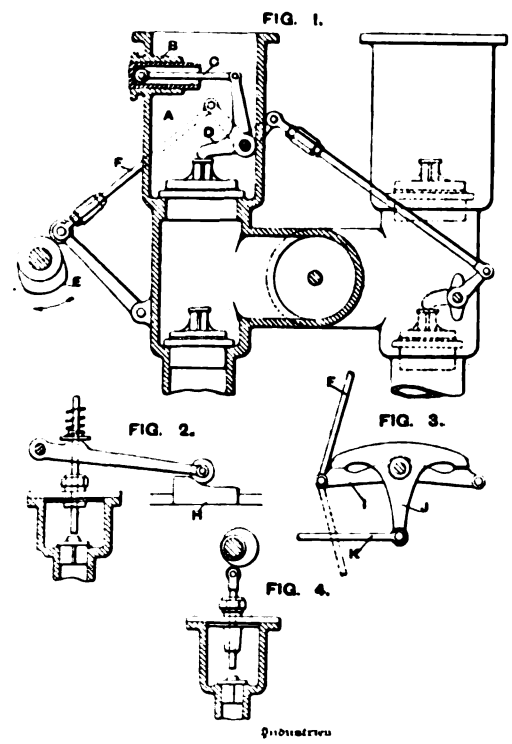
PURIFYING WATER.—*L. A. Cheralet, Paris.*—The process is one in which the salts contained in the water is precipitated by heat. It is based upon the fact that if calcareous water be brought to boiling point the carbonic acid it contains (which acid keeps in solution the salts of lime and magnesia) is set at liberty with the steam, and the salts are thus precipitated. To entirely clear the water of calcareous matter it is necessary to keep the water at boiling point some length of time. The apparatus used for this purpose is composed of a series of vessels arranged one above the other and provided with overflow pipes leading from the upper vessel to the one immediately below it. The water to be purified is supplied to the top vessel, and descends by the overflow pipes from one vessel to the other. For heating the water to boiling point, steam is admitted to the bottom vessel, and, after percolating the water it contains, passes on up and through the water in the other vessel. The steam passes into each vessel from below through a central upright pipe whose top edge is slightly higher than the overflow pipe. Over the top of this pipe is a circular deflecting hood with serrated edges, the edges being turned downwards and submerged in the water. Thus the steam, as it passes in by the upright pipe, is deflected by the hood, and has to pass under its edges and through the water before escaping to the vessel above. When the appliance is thoroughly at work the water is kept at the boiling point in all the vessels, and the calcareous matter precipitate in them. Claims: (1) The bubbling of steam from engines in water to be purified, such bubbling to take place successively in the distilling column, modified to suit the deposition of calcareous matter; (2) the application of a box for scouring the steam by the shock of the latter against a plate without holes, in order to obtain water free from grease for the boiler; (3) the application of Mariotte's vessel to the purifying apparatus, in order to introduce the solution of carbonate of soda required when the water contains plaster; (4) the arrangement of a horizontal purifier and its application to steamboats, &c.; (5) its adaptation for heating water for steam boilers, such adaptation being intimately connected with the process of purifying water when waste steam is used for the purpose.—No. 8271. May 18th, 1889. 8d.

LOCOMOTIVES FOR TOWING PURPOSES.—*F. Koernig, Bromberg, Germany.*—The locomotive is designed for towing rafts and other vessels on rivers and canals. Fig. 1 is a front elevation, Fig. 2 a side elevation, and Fig. 3 a plan of the engine. The boiler and firebox and the steam cylinders are attached to the frame of the locomotive in the usual manner. The frame rests on two axles, each of which is provided with a toothed wheel and a plain wheel with double flanges. On the front axle there is, at the centre, a spur wheel A, into which gears a pinion B fixed on to the crank



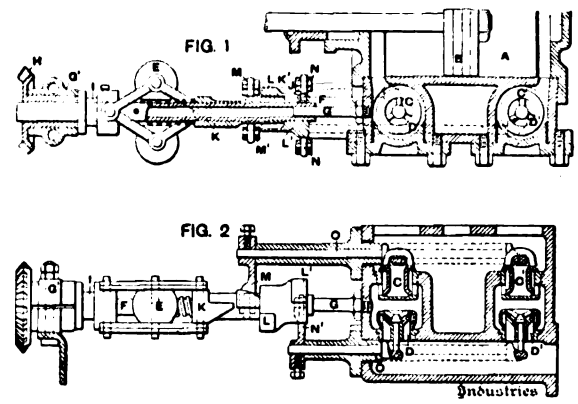
shaft C, which is driven by the pistons. There is also a second pair of wheels, as shown, by which the crank shaft and the driving axle can be geared together to run at about the same speed. The four wheels thus constitute slow and fast speed gears. At one side of the locomotive there is journalled a rope drum D on the shaft of which is keyed a toothed wheel F which gears into a toothed wheel G mounted on the crank-shaft. The wheels F and G can be put out of gear with each other at will. The position of the drum D is such that the pull of the tow rope will not bring any appreciable lateral pressure on the toothed rail. Connected to the drum D there is a contrivance such as a calendar or mangle wheel for effecting regular winding up of the rope, as is well understood. On the rear part of the locomotive is fitted a hand crank and winch H by which the towing rope can be tightened or slackened. By this means, in cases of bends in the stream, it is possible from the locomotive to supplement the action of the rudder or entirely to effect the steering of the vessel which is being towed. Claims: (1) For towing rafts, ships, and other floating bodies, a locomotive having gearing interposed between the crank shaft and the driving axle such that the speed of the locomotive may be decreased when it is towing and increased when running light, the said locomotive running on the tow-path on a permanent way comprising a toothed rail next the waterway and a plain rail at the opposite side; (2) in a locomotive for towing rafts, ships, and other floating bodies, the combination with a driving axle having a plain double-flanged wheel running on a plain rail and a toothed wheel running on a toothed rail (the said axle being driven by fast or slow gearing from the crank-shaft), of a rope drum, driven from the engine, and designed by hauling in or paying out the rope to aid the steering of the floating body which is being towed; (3) in a locomotive of the kind referred to in claim 2 arranging the rope drum in such a position that the pull of the tow rope will not bring any appreciable lateral pressure on the toothed rail, and providing the said drum with an application such as the well-known calendar or mangle wheel for ensuring the regular winding up of the rope.—No. 5915. April 6th, 1889. 8*d.*

VALVE GEAR.—*A. Riedler, Berlin, Germany.*—The valves referred to are those used for pumps, compressers, and the like. They are operated by the motion of the piston and by the pres-



sure of liqnid in the valve chamber. In operating the valve gear of a double-acting pump as shown in Fig. 1 the constant liquid pressure within the valve chambers is utilised to weight down the valves. The piston B is, for this purpose, connected by the rod C to a bell-cranked lever D whose lower arm rests upon the top of the valve A. It will be seen that by this arrangement the force of the liquid against the inner surface of the piston B tends to keep the valve closed. This pressure is removed the instant before the valve is automatically opened. To release the pressure upon the valve a rotating cam E presses against the rod F and revolves the lever G about its spindle, to which is secured the lever D, and so the latter is raised from off the valve. The levers of two valves are coupled together as shown. A modification of the gear as described is illustrated by Fig. 2. In this case the pressure upon the valve is released by a reciprocating cam H. Fig. 3 shows a method of actuating the gears of a double-acting pump such as shown in Fig. 1. The rods F of the two sets of valves are connected to the arms of a lever I. An oscillating motion is imparted to the lever I by a T-shaped lever J whose upper arms strike the arms of the lever I as they are moved upwards and downwards by an eccentric rod K. Fig. 4 shows a form of value acted upon directly by a rotating cam. Six claims are made.—No. 14,021. September 5th, 1889. 8*d.*

ENGINE VALVE GEAR.—*S. Eddington & J. E. Stevenson, Chelmsford.*—The valves are of the double or equilibrium type, and are actuated by cams upon a shaft, to which the governor is also mounted. The cams for the admission valves are double (one for each direction of the engine); they are of a spiral form, and connected to the governors. The motion of the governors controls the extent to which the valves act. The figures show respectively a sectional plan and elevation of the gear. A is the cylinder, B the piston of an ordinary engine. C C^1 are the steam admission valves, and D D^1 the exhaust valves. E E are the governors carried on the hollow shaft F. The hollow shaft F is mounted in bearings G at right angles to and is driven by the crank-shaft through mitre gear H. The end of the governor nearest the crank-shaft is formed with a groove I, in which a fork engages from an ordinary reversing lever, by means of which the governors and cams can be moved with the shaft F. Attached to the opposite ends of the governors are the cams K K^1 for actuating the admission valves; these double cams are formed in one hollow block or piece sliding on the hollow shaft F. The cams L L^1 actuating the exhaust valves are, in the arrangement shown, fixed on the hollow shaft F by means of a set screw J or other device. The cams K K^1 and L L^1 actuate the admission and



exhaust valves by means of levers M M^1 and N N^1 and cranked spindles O. The cams K^1 and L^1 are shown in gear, and in order to reverse the engine the shaft having the governors and cams mounted upon it is pushed forward by means of the reversing lever or the like, so bringing the cams K and L into gear. Claims: (1) In self-acting expansion engines constructed with equilibrium double beat or similar valves worked by cams mounting the governors and the cams actuating the admission and exhaust valves on the same shaft; (2) in engines constructed with equilibrium double beat or similar valves worked by cams arranging such cams and governors in the manner described in the foregoing specification and as illustrated for the purpose of reversing the engines; (3) the general arrangement of valve and reversing gear for engines substantially as described and illustrated.—No. 8565. May 23rd, 1889. 8*d.*

LIFTING JACK.—*J. P. Cito, Petange, & P. Funck, Luxemburg.*—This appliance is for raising railway rails and such like purposes. In a metal shoe or frame constructed with a flat bottom plate and two side plates, in shape sectors of a circle, is pivoted the raising lever. The lever is pivoted in the side plates near the apex of the sectors, and the circular portions of the sectors are made with ratchet teeth. In the long end of the raising lever is a cross-pin which engages in the teeth of the sectors as that end is lowered and holds it in the lowered position. To lower the long end of the raising lever, and consequently raise the shorter or loaded end, a loose hand lever is used provided with a circular cam head. In this head are secured eccentrically two small pins. When raising the load the pins are placed in the teeth immediately above those in which the pin of the raising lever engages. The cam face of the hand lever then rests upon the long end of the raising lever, and by pulling the hand lever over the eccentric cam face forces down the end of the raising lever until it engages in a fresh pair of teeth. The hand lever is then removed to the next pair of teeth, and the action repeated until the load is raised to the required height. Claim: An apparatus for lifting weights characterised by a lifting lever pivoted in a bottom frame upon its free end acting the eccentric cam of a hand lever to be placed in different notches of the frame in accordance with the height to which the weight is raised, whilst with the lifting lever is connected a link which in every case keeps the weight raised by means of its pin placed between the bent locking arm pivoted to the frame and arranged eccentrically to the pivot of the said lifting lever, the said link preventing the back movement of the arm and of the lifting lever.—No. 2704. February 19th, 1890. *6d.*

FURNACES.—*E. F. Paddon, London.*—All kinds of furnaces are referred to, the novelty in construction being the use of a perforated plate at the charging end of the furnace. The plate is a prolongation of the dead-plate, and is slightly inclined downwards towards the fire-bars. Under the perforated plate in the ashpit is a deflecting plate to cause air entering the ashpit to be directed upwards through the perforations into the furnace and over the fuel, thus forming a complete combustion. Claim: In furnaces the combination of a perforated plate with a plate or feather inclining downwards into the ashpit to divert the draught up through the perforations into the furnace as described.—No. 3591. March 6th, 1890. *6d.*

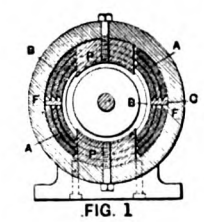
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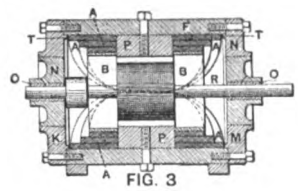
WATER HEATERS.—*E. Werdenberg, Bâle, Switzerland.*—According to the invention two concentric tubes, each formed with hollow walls and communicating with each other at the top and bottom, are placed vertically. The outer tube is curved over at its upper part to form a cap, and its lower end is enlarged so as to contain a greater body of water than the other parts. A space is left between the two tubes, and inside the smaller one is a flue pipe leading out at the top. Gas burners are placed on the lower part of the apparatus, and the heated products from these pass upwards between the two tubes, and then downwards within the smaller tube, and, finally, up again through the flue pipe away. The gas burners are Bunsen burners, and are arranged in a ring, and so that the flames strike the enlarged part of the outer tube, where is the largest body of water. Three claims are made.—No. 8864. May 28th, 1889. 8*d*.

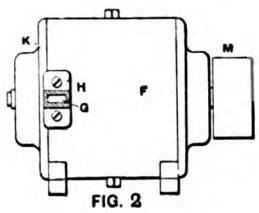
ELECTRICITY.

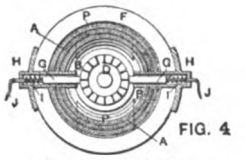
COLLECTORS FOR DYNAMOS, &C.—*E. Holt, Manchester.*—The improved collector consists of a pair of wheels which rotate in contact with the commutator. The wheels are supported on the arms of a T-shaped frame mounted upon the spindle of the commutator, so that the centre of the wheels and the commutator shaft are in a straight line. The T-shaped frame can be rotated about the commutator shaft, so that the collector wheels may be placed at any angle. To permit the wheels being pressed against the commutator the wheels are flexibly connected to the frame, and a spring holds them against the commutator. The bearing blocks of the wheels are insulated from the frame, and are made elastic in order to take up the wear and form a good electrical connection. Claims: (1) The arrangement of rocker and current collector or conductor for dynamo and other electric machines as described; (2) in dynamo and other electric machines, the arrangement of two rollers pressed against the commutator by spring pressure, and rotated by contact with the bosses, or of said rollers for collecting and conducting the current from the commutator to the field magnet coils as described.—No. 19529. December 5th, 1889. 6*d*.

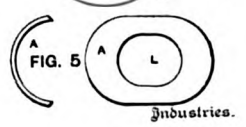
DYNAMO ELECTRIC GENERATORS AND MOTORS.—*G. E. Dorman, Stafford.*—A wrought or cast iron tube encloses the armature, field magnets, and other parts of the machine. The illustrations show Fig. 1 a transverse sectional view through the centre of a dynamo or motor, Fig. 2 a side view, Fig. 3 a central longitudinal section, Fig. 4 an end view with the commutator end bracket removed, and Fig. 5 views of a sectional coil of the field magnet coils. The tubular case F is closed at its ends by two covers K M, which also support the armature shaft. Around the pole pieces P are the field coils A, made for convenience in two or


FIG. 1


FIG. 3


FIG. 2


FIG. 4


FIG. 5

Industries.

more sections. The coils are first wound and taped, and then bent to the required curvature in a mould or die. The coils fill as nearly as possible the annular space between the armature and case, so as to bring them into proximity with the armature. D is the commutator, and G the brushes of the machine. The brushes G are supported in tubular cases H, having an insulating fibre sheath. In large machines an air propeller is arranged within the casing to draw in air through perforations in the pulley end cover for the purpose of cooling the interior of the machine. Claims: (1) In a dynamo electric generator or motor an iron tube, or equivalent structure, containing two interior pole pieces with field or exciting coils arranged around the said pole pieces, the coils being bent or shaped to conform with or fit the interior curvature of the said tube or equivalent structure; (2) in a dynamo electric generator or motor an iron tube, or equivalent structure, containing two interior pole pieces, with sectional field or exciting coils arranged around the said pole pieces, the said coils being bent into proximity to or to embrace the armature; (3) in a dynamo electric generator or motor an iron tube, or equivalent structure, containing two interior pole pieces, with field or exciting coils arranged around the said pole pieces, the coils being bent; (4) in a dynamo electric generator or motor an iron tube, or equivalent structure, containing two interior pole pieces, and bent exciting or field coils, with end plates or brackets completely enclosing one or both ends of the said tube.—No. 6568. April 17th, 1889. 8*d*.

ELECTRIC SWITCHES.—*F. B. Nicholson, London.*—The switch consists of a centre contact piece, turned taper and working in suitably constructed contact pieces after the manner of an ordinary gas or water taper plug tap. The contact pieces are so arranged that when the centre contact piece or plug is turned to one position the electric circuit is completed, whilst in another position it is broken. The plug is held down by a coil spring in contact with the contact pieces, and it is turned about its axis by a handle or key. Claims: (1) The construction, combination, and arrangement of the parts of a switch as described; (2) the constructing of switches with the contacts tapered and so arranged that by horizontal movement or rotation of either the central portion or the contact blocks the circuit shall be made or broken.—No. 9917. June 17th, 1889. 6*d*.

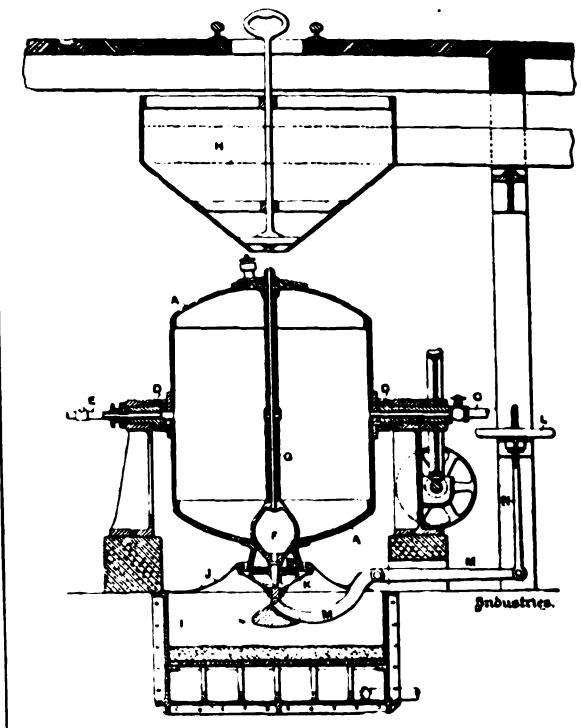
INCANDESCENT LAMPS.—*A. A. Goldston, Middlesbrough.*—The object of the invention is to provide incandescent lamps with improved cut-outs adapted to operate automatically when the carbons become destroyed. Each leading wire within the lamp has a contact piece attached to it, and between the two contact pieces is arranged a cone or wedge of insulating material. To the lower part of the insulating material is secured a metal piece which is adapted to complete the circuit between the contact pieces on the leading wires at the required moment. To the upper part of the insulating material, and to the upper inner part of the lamp is secured a helical spring, which thus has a tendency to lift the insulating cone or wedge, and complete the circuit between the contact pieces or the leading wires. The upward motion, however, of the cone or wedge is prevented by its shape, which tends to force apart the contact pieces, and so the ends of the carbon filament, by the motion upwards. The carbon filament is at first of sufficient strength to resist the action of the spring upon the cone, but as it gets weaker from wear its ends are forced apart, and the contact is made. Claims: (1) In an electric incandescent lamp having a light-emitting conductor of the kind hereinbefore described, the employment, in combination with contacts fixed to or formed integral with the leading-in wires within the bulb, of an independent movable short-circuiting or contact piece attached to or formed integral with a piece for exerting a wedge-like action upon the leading-in wires, but capable of movement so long as the light-emitting conductor is intact, but which piece when the conductor is ruptured is free to move under the action of a spring or weight; (2) in an electric incandescent lamp of the kind provided with cut-out mechanism the employment of steadying arms; (3) the manufacture of light-emitting conductors for electric incandescent lamps as described; (4) in an incandescent lamp provided with cut-out mechanism of the kind described, a guide stem upon which the movable contact piece slides; (5) the manufacture and use of electric incandescent lamps constructed as illustrated in the specification.—No. 6544. April 16th, 1889. 8*d*.

CHEMISTRY.

OBTAINING ALUMINIUM.—*G. Bamberg, London.*—In the production of aluminium from its chloride, or from the double chloride of aluminium and sodium, by means of zinc, it has been proposed to bring these bodies together, in the solid or liquid form, under heating, whereby zinc chloride is formed and aluminium is set free. Difficulties arise, however, in this process which have prevented its practical adoption. According to the present invention these difficulties are avoided by volatilising the zinc in the first instance, and then bringing the zinc vapour, together with the vapour of aluminium chloride, or of the double chloride of aluminium and sodium, at the temperature of a white heat under the exclusion of air. The chemical affinity of the zinc for the chlorine of the chlorides is thereby increased, and both the zinc and the chloride or chlorides are brought into intimate contact in the finest possible state of subdivision, so that a most effective reaction of the particles is established, resulting in the ready production of chloride of zinc and the setting free of the aluminium, which condenses to metallic form. In practically carrying out the invention, a suitable retort is nearly filled with zinc, previously melted, and of as pure a quality as practicable, and another retort is partially filled with the chloride of aluminium or the double chloride, or materials such as would produce the vapours of the chloride upon being raised above clear red heat (1,040° C.). These retorts are connected with a third retort or suitable mixing chamber by pipes or channels, preferably covered with a suitable non-conducting material, so that no sublimation of the chloride or condensation of the zinc should take place in them. The mixing chamber is maintained, under exclusion of air, as nearly as possible at a white heat at the part where the pipes from the retorts enter, while the further end should be at a lower temperature, so as to allow the particles of aluminium and zinc to run together therein in the form of a liquid to be drawn off to cool. The zinc chloride will escape at the furthest least-heated end as a vapour, and it can then be condensed to a liquid state by means of any of the usual cooling apparatus. The mixed zinc and aluminium is distilled, the zinc going off as vapour, which may be injected directly into the above mixing chamber again, to economise fuel, or it can be cooled down to solid form; the less volatile aluminium remaining behind in fluid metallic form is run off and solidified. One claim is made.—No. 7667. May 8th, 1889. 4*d*.

MAGNESIC CHLORIDE AND OXYCHLORIDES.—*T. M. Lyte, London.*—One of the chief impediments to the manufacture of chlorine from magnesic oxychloride is the necessity of drying the oxychloride as usually made and the consequent loss of chlorine as hydrochloric acid. When the magnesic oxychloride is produced in the anhydrous condition the loss is naturally avoided. The inventor produces anhydrous magnesic oxychloride in this state by one of the following methods. By the second method he also obtains anhydrous magnesic chloride. First method: Mixing pure anhydrous magnesic chloride in a fused state with dry magnesia and subjecting to heat. The magnesia, which is powdered and has been strongly burnt, is wetted and fashioned into balls. These balls when left for a short time set into coherent masses, and when heated become anhydrous, retaining the coherence but being porous and absorbent. Second method: Adding to anhydrous ammonic-magnesic double chloride sufficient magnesia to convert the ammonic chloride contained into magnesic chloride (and if oxychloride is produced, enough magnesia in excess to form the oxychloride desired) and expelling the ammonia by heat. The dry double ammonic-magnesic chloride is powdered and mixed with, say, about three-fifths of its weight of dry magnesia, also in powder, and heated to about the fusing point of anhydrous magnesic chloride when the ammonia is expelled. The heat must be applied gradually or the ammonic chloride will volatilise unchanged. Two claims are made.—No. 6172. April 10th, 1889. 6*d*.

TREATING METALLIC ORES.—*S. Alley, Polmadie, Renfrew.*—In treating metallic ores with chemicals, the apparatus usually employed suffers very much from corrosion due to the chemicals; the object of the inventors is to prevent this action and to make certain structural improvements in the appliance. A vertical section of the improved appliance is illustrated. The vessels are coated inside with vulcanised rubber, the vessels being made of iron or steel. The mixing or agitating vessel A is of cylindrical form. It is made with an opening B at one end for introducing and discharging the materials. The vessel is mounted upon hollow trunnions D, the passage C in one trunnion being for the introduction of steam to blow out the air and form a partial vacuum in the vessel, and the passage E for admitting water or a solution. The vessel is closed internally by a valve F pressed downwards by a spiral spring G. In order that the vessel A may be charged and emptied quickly a hopper H is


Industries.

fixed above and a receiving vessel I below it. The receiving vessel is built up of iron plates lined with india-rubber like the agitating vessel. It has a flexible rubber cover J with a mouthpiece K, which is raised to cover the mouth of the vessel A when discharging, to prevent the escape of gases. The mouthpiece K is raised by a hand-wheel L and its connections M N. The act of raising K opens the valve F. The receiving vessel I serves to filter the charge as it leaves the vessel A. Claims: (1) The improved combination of apparatus for treating metallic ores or compounds with chemicals constructed and arranged substantially as hereinbefore described and as shown in the accompanying drawings; (2) a mixing or agitating vessel for treating metallic ores or compounds with chemicals, made of a cylindrical or other convenient form, with an opening at one end, and with the parts near the opening inclined, the said vessel being arranged to rotate about an axis at right angles or inclined to the axis of the vessel, substantially as hereinbefore described; (3) constructing vessels to be used for treating metallic ores or compounds with chemicals, of iron, or steel, or other suitable matter, coated with rubber, substantially as hereinbefore described.—No. 9592. June 11th, 1889. 8*d*.

MISCELLANEOUS.

FILTRATION OF WATER, &C.—*G. W. Hacksley, Sheffield.*—The first part of the invention refers to the method of precipitating the impurities, and the second part to the manner of cleansing the filters. The chemicals for precipitating the impurities are admitted to the water as it passes through the suction pipe of the pumps which are employed to force the water through the filters. The chemicals are thus thoroughly mixed and diffused through the water, and the precipitate will be caught and kept back by the filters. This improved way of dealing with the water is more expeditious than the use of settling tanks. The filters are arranged in series conveniently placed and connected with inlet and outlet pipes. By the arrangement of the connecting pipes and stop cocks, the water, as it is filtered in one or more filters, may be directed to flow in a contrary direction through other filters, and so remove through a sludge pipe the impurities collected in them. By using filtered water for this purpose the filters are not fouled upon their clean sides. Instead of using filtered water, steam may be employed, or steam and water. If some of the encrusted deposit is exceptionally difficult to remove, steam is applied until the crust is thoroughly heated, and the filtering medium charged with steam. The steam is then blown off. This process, if repeated once or twice, will break up the deposit and cause it to crumble to pieces and pass off through the sludge pipe. Five claims are made.—No. 9512. June 8th, 1889. 8*d*.

Copies of the British specifications may be obtained on application to H. READER LACK, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at* ½*d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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ON THE CRITICAL POINTS OF IRON AND STEEL.*

(*Concluded from page* 484.)

INFLUENCE OF FOREIGN ELEMENTS.—In the first place, I must express my thanks to the metallurgists who have kindly procured samples for me, notably to Professor Roberts-Austen and to Mr. Hadfield in England, and to Messrs. Jordan, Brustlein, and Ledeboer in France. Thanks to their help, I have been able to study, more or less completely, the influence of the following elements:—Boron, nickel, manganese, copper, chromium, tungsten, silicon, arsenic, phosphorus, and sulphur.

Boron.—A single sample was examined, prepared by Professor Roberts-Austen, who obtained it by casting iron and crystallised boron together *in vacuo*. The curves of cooling, each of which is the mean of two concordant tests, are plotted in Fig. 6. The bulges in the curve are not very distinct on account of the extreme smallness of the sample, which did not weigh more than four grammes. Two liberations of heat were noted:—a_{r3}/m, of which the maximum is produced between 815° C and 805° C.; $a_{r2}+(m-1)a_{r3}/m$, of which the maximum is produced between 735° C. and 725° C. The two liberations of heat are fairly equal, notwithstanding that in the iron a_{r3} is three to four times stronger than a_{r2}. It follows that the boron has lowered a_{r3} for a portion from 40° C. to 50° C., and for the rest from 120° C. to 130° C. up to a_{r2}. This action is analogous to that of carbon. Moreover, the sample contained no carbon, or merely a negligible proportion, as the curve has no distinct point a_{r1}. The liberation of heat observable between 980° C. and 940° C. during the progress of cooling down from 1,200° C. represents the solidification of a small quantity of borate of iron, formed by the surface oxidation of the metal.

Nickel.—A single sample was examined, containing—

Carbon	0·337
Silicon	0·047
Sulphur	0·022
Phosphorus	0·223
Manganese	trace
Nickel	5·970

It was obtained by melting together in a graphite crucible lined with magnesia—

Iron (rivets)	80 grammes.
Spiegeleisen (20 per cent. Mn.)	10 ,,
Nickel (in cubes)	4 ,,

The lid of the crucible having melted, the atmosphere of fusion was highly oxidising. All the manganese disappeared, and the metal was very red-short. The test was made with two rods, 5 by 5 by 25 millimetres, cut from the ingot. The cooling (Fig. 6) indicates a single station, $a_{r(3\text{-}2\text{-}1)}$ at 650° C., accompanied by a slackening commencing at 675° C. and ending at about 590° C. In a steel containing the same amount of carbon, the points a_{r3} and a_{r2} would be united into a single slackening $a_{r(3\text{-}2)}$ altogether independent of a_{r1}. Thus, the nickel has considerably lowered the changing-point of the iron, and the change of the carbon has similarly been lowered. The recent researches of Hopkinson in England, and of H. Le Chatelier in France, have shown that in steel containing 25 per cent. of nickel, the critical point is lowered below 0° C. during the cooling, whilst the inverse point during the heating remains near 600° C. These facts are exceedingly curious. Nickel being a polymorphous element like iron, the study of the alloys formed by these two metals will be particularly interesting to pursue.

Manganese.—I have examined the products shown in Table IV., page 506. No. 3 is the same as that already utilised in the carbon series. Each sample of steel was submitted to two successive coolings from 1,100° C. The samples of ferro-manganese were not cooled from a higher temperature than 900° C. They present, it is true, between that temperature and their melting point a certain number of special perturbations which are connected with the liquation of different constituents, and which do not bear upon the facts studied in this paper. The results are given in Table V., page 506. In proportion to the increase in the percentage of manganese, the temperature of recalescence is lowered, and that of the allotropic change of the iron is affected in the same way. Ferro-manganese exhibits nothing more than doubtful traces of arrestation. Thus, the more manganese in the metal, the longer is the iron maintained in the β-condition, and the carbon in the condition of hardening carbon. This effect is very similar to that produced by a more rapid cooling on a non-manganiferous steel containing the same proportion of carbon. In fact, the presence of manganese is equivalent to a more or less complete hardening, and this conclusion is in accord with the known properties of manganese steel. It is known that manganese lessens the malleability, increases the tensile strength, the tendency towards oxidation, the electrical resistance, and the ratio of the residual magnetism to the total magnetism. These properties, however, are due to β-iron, the proportion of which in the cooled steel increases with the percentage of manganese, and not to the manganese itself. Hadfield's highly manganiferous steels, according to the researches of Barrett and Hopkinson, behave like ferro-manganese—that is to say, they do not exhibit recalescence. In these metals all the iron is in the β-condition, which is the normal and stable form of iron above 860° C. But β-iron above 860° C. is not magnetic, and this should be the case with Hadfield's manganese steels and with ferro-manganese. This being actually the case, there is a very striking experimental confirmation of the theory.

Copper.—Professor Roberts-Austen has obtained for me three samples prepared by Dr. Edwin J. Ball and Mr. Arthur Wingham, which have been described in a paper read before this Institute (see Table VI., page 506). The bars were filed from the small cast ingots, and were not regular in section throughout their length. This was, however, of no consequence. The curves are plotted in Fig. 6, each curve representing the mean of two tests. The results are given in Table VII., page 506. In the metal containing 0·847 per cent. of copper, the three points a_{r1}, a_{r2}, a_{r3}, are quite distinct; but a_{r3}, the normal position of which is at 855° C., has already been lowered 40° C. to 50° C. When the percentage of copper increases, a_{r3}, with the exception of a small residue remaining near the normal position, becomes confounded with a_{r2} at about 720° C. Similarly a_{r1} is also lower. It is evident that copper acts

* Paper read by Monsieur F. Osmond, of Paris, before the Iron and Steel Institute on the 8th inst.

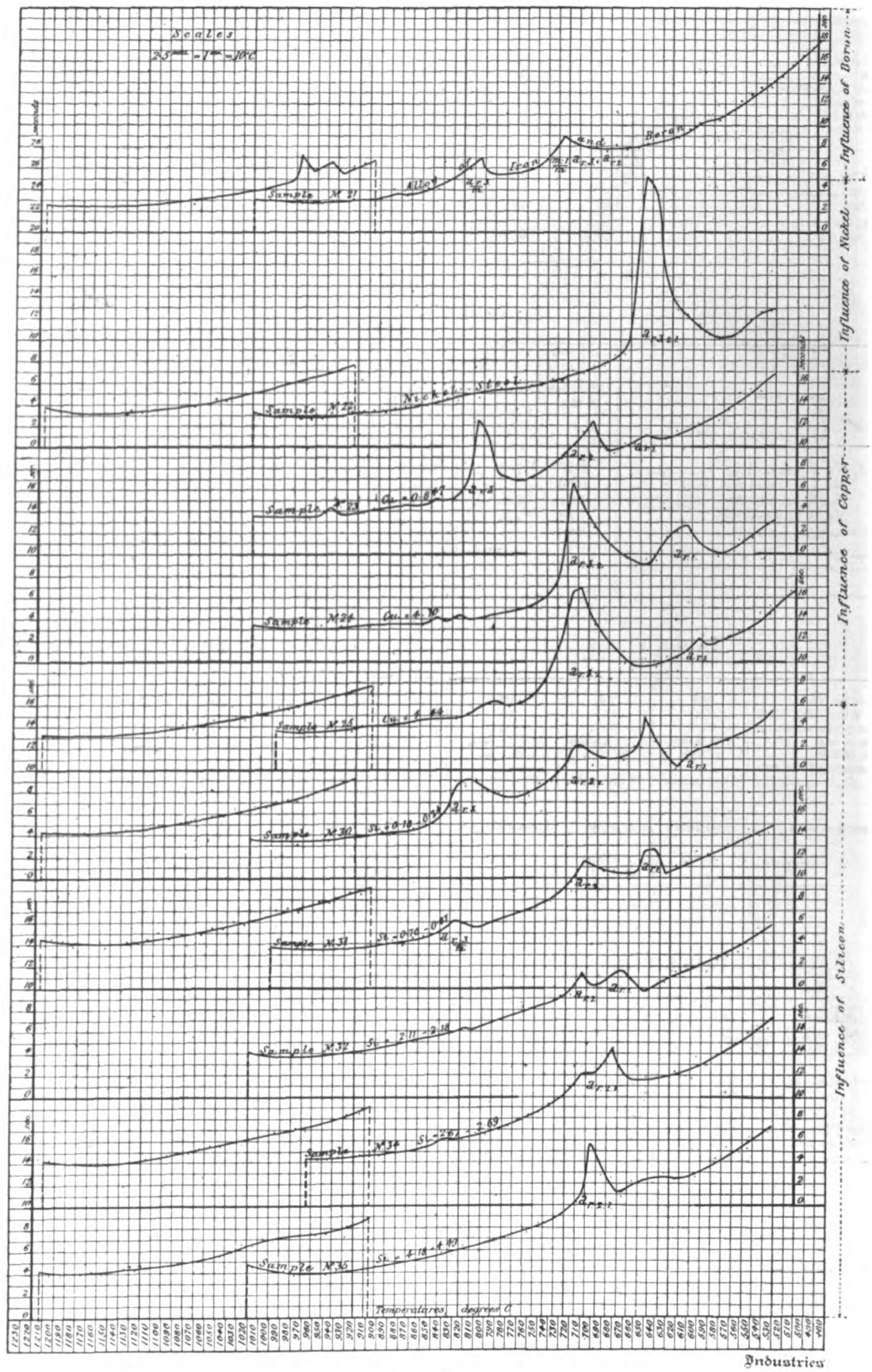


FIG. 6.

in the same manner as the elements previously studied, but in a less energetic manner; 4 per cent. of copper having nearly the same effect on the change of the iron as 0·20 per cent. of carbon.

Chromium.—Three samples were examined. These are numbered 14, 15, and 16, and were obtained from the steelworks of J. Holtzer et Cie., at Unieux. They are in the form of forged square rods, 8 millimetres in side and 60 centimetres in length. Their approximate chemical composition, given by M. Brustlein, is as follows:—

Nos.	Carbon.		Chromium.
14	0·33	...	1·00
15	0·50 to 0·50	...	2 00
16	2·00	...	10·00 to 12 00

In soft chrome steel, the molecular modification of the iron $a_{r(3\text{-}2)}$ begins at about 770° C., exhibits its maximum at about 727° C. (about 720° C. in another test), and is not completely finished at the moment when the change of the carbon commences. The latter gives its maximum at 680° C.

If these results are compared with those given by the sample No. 3 containing no chromium, but with approximately the same percentage of carbon, it is seen that the maximum of $a_{r(3\text{-}2)}$ is slightly higher for chrome steel than for ordinary steel.

Samples 15 and 16, cooled from 1,100° C., present but one perturbation, $a_{r(3\text{-}2\text{-}1)}$, under the form of highly accentuated recalescence.

	No. 15.		No. 16.
The thermometer stops at	676°	...	694°
And continues its rise at	690°	...	716°

By another cooling of No. 16 (the hardest sample) from 800°, the recalescence is changed into a stay at the exceptionally high temperature of 744° C. On the whole, the figures given show that the presence of chromium considerably raises the temperature of a_{r1}. This influence is the opposite to that of manganese; and if manganese is equivalent to hardening, it may be said that the action of chromium on iron has some analogies to that of annealing. If chrome steels reunite in a remarkable degree certain opposite properties, and have the property of being but slightly brittle in proportion to their hardness, we are led to believe that

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THE CRITICAL POINTS OF IRON AND STEEL.

TABLE IV.

Consecutive No.	3.	7.	8.	9.	10.	11.	12.
Nature		Basic Bessemer steel.			Ferro-manganese (St. Louis).		
Mode of preparation		Forged.			Cast.		
Form of rod		Circular.			Square.		
Length of rod		60 centimetres.			40 centimetres.		
Cross section		5 mm. diameter.			7 by 7 mm.		
Carbon	0·20	0·32	0·42	0·46	—	—	—
Silicon	0·06	0·05	0·035	0·07	0·. 0	0·43	0·71
Sulphur	0·06	0·02	0·03	0·035	—	—	—
Phosphorus	0·052	0·051	0·093	0·073	0·098	0·11	0·065
Manganese	0·27	0·50	1·00	1·08	18·00	49·00	81·00

TABLE V.

—	Percentage of Mn.	$a_{r(3-2)}$. Commences about	$a_{r(3-2)}$. Maximum between	$a_{r(3-2)}$. Ends about	a_{r1}. Commences about	a_{r1}. Maximum.	a_{r1}. Ends about
Steel, No. 8, 1st cooling	0·27	780° C.	780° C. = 715° C.	690° C.	680° C.	660° C.	640° C.
,, No. 7, 1st and 2nd cooling	0·50	740° C.	705° C. = 697° C.	660° C.	660° C.	640° C.	620° C.
,, No. 8, 1st and 2nd cooling	1·00	725° C.	655° C. ?	combined		625° C.	600° C.
,, No. 9, 2nd cooling	1·08	725° C. ?	658° C. ?	combined		620° C.	595° C.
Ferro-manganese	18·00	—	no arrestation noticeable.				
,,	49·00	—	,,		,,		
,,	81·00	—	,,		,,		

TABLE VI.

Consecutive No.	23.	24.	25.
Ball & Wingham's mark	(1.)	(5.)	(6.)
Mode of preparation	Cast.	Cast.	Cast.
Section of bar	6 by 6 mm.	5½ by 5½ mm.	7 by 7 mm.
Length of bar	27 mm.	30 mm.	26 mm.
Total weight of the two bars	10 grammes.	13 grammes.	13 grammes.
Carbon, per cent.	0·102	0·183	Less than 0·1
Copper	0·847	4·100	4·44

TABLE VII.

—	23.	24.	25.
Copper, per cent.	0·847	4·10	4·40
a_{r3} begins about	825°	—	—
Maximum	815°–805°	—	—
Ends about	785°	—	—
a_{r2} begins	—	755°	765°
Maximum	710°	725°–715°	720°
Ends	690°	660°	660°
a_{r1} begins	—	650°	—
Maximum	660°–650°	620°–610°	610°–600°
Ends	—	590°	—

TABLE VIII.

Consecutive No.	26.	27.	28.	29.
Harbord's mark	(1.)	(4.)	(7.)	(9.)
Carbon	0·13	0·13	0·115	0·14
Silicon	0·012	0·035	0·012	0·023
Sulphur	0·04	0·064	0·011	0·028
Phosphorus	0·097	0·071	0·09	0·041
Manganese	0·41	0·28	0·38	0·52
Tungsten	0·00	0·26	0·39	1·53

TABLE IX.

No.	Tungsten per cent.	a_{r3}. Commences	a_{r3}. Maximum.	a_{r3}. End.	a_{r2}. Maximum.	a_{r1}. Maximum.
26	0·00	835°	805°–795°	775°	720°–710°	620°–610°
27	0·26	835°	805°–795°	775°	730°–720°	620°–610°
28	0·99	855°	805°	775°	730°–720°	610°–600° ?
29	1·53	800°	775°–765°	755°	710°	540°–530°

TABLE X.

Consecutive No.	30.	31.	32	33.	34.
Hadfield's mark	A.	B.	D.	E.	G.
Carbon	0·14	0·18	0·20	0·20	0·25
Silicon	0·18–0·24	0·70–0·87	2·11–2·18	2·67–2·69	4·18–4·49
Sulphur	0·08	—	0·06	—	—
Phosphorus	0·05	—	0·04	—	—
Manganese	0·14	0·21	0·25	0·25	0·36

TABLE XI.

No.	a_{r3}. Commences	a_{r3}. Maximum.	a_{r3}. Ends	a_{r2}. Commences	a_{r2}. Maximum.	a_{r2}. Ends	a_{r1}. Commences	a_{r1}. Maximum.	a_{r1}. Ends
30	860°	830°–810°	780°	740°	725°–710°	700°	670°	660°–650°	620°
31	850°	835°–825°	810°	?	720°–710°	690°	670°	660°–650°	630°
32		Doubtful.		?	720°–710°	Combined.		680°–670°	650°
33		Doubtful.		?	720°–710°	Combined.		690°–680°	660°
34		Doubtful.		—	—	—	?	710°–700°	670°

they owe their hardness to chromium itself, and their consistency to the comparative freedom from β iron. It must be noted that the influence of the initial temperature of cooling on the position of a_{r1} is greater in chrome steels than in carbon steels.

Tungsten.—Four samples, prepared by Mr. F. W. Harbord, have been procured for me by Professor Roberts-Austen. The test-pieces were cut from forged bars, the dimensions being 5 by 5 by 40 millimetres. The chemical composition is as shown in Table VIII. The curves are plotted in Fig. 7, the results being given in Table IX. The points a_{r3}, a_{r2}, and a_{r1} remain distinct throughout. If tungsten steels are compared with steels not containing that element, it is seen that—(1) a_{r2} preserves its normal position and amplitude (for the fall of a_{r3} in Sample 29 is sufficiently accounted for by the percentage of manganese); (2) the same remarks apply to a_{r2}; (3) When the percentage of tungsten is sufficiently high, a_{r1} is considerably lowered. Thus, tungsten does not, up to a proportion of 1·50 per cent., have any appreciable action on the allotropic change of the iron, although it causes the change of the carbon to take place at as low a temperature as 530° C., as I have had an opportunity of proving in another sample of tungsten steel which contained manganese, and was much harder than those of Mr. Harbord. Hitherto we have invariably seen the two changes of the iron and carbon displaced in the same direction under the influence of a foreign element. Tungsten has a hardening action on iron, and is analogous to that of the hardening process, not *per se*, but by the aid of the carbon which it maintains in the form of hardening carbon. These are remarkable properties, quite peculiar to tungsten. It has others; thus, in the hard steel, of which I spoke previously, the fall in a_{r1} is produced only after heating to a sufficiently high temperature. In cooling from 750° C., a_{r1} appears at 670° C., and is separated from $a_{r(3-2)}$; in other words, the action of tungsten in this case becomes analogous to that of chromium, and exactly opposite to that first observed.

Silicon.—Mr. Hadfield has kindly sent me a fine series of samples selected from amongst those employed in his researches, and described in his important paper on alloys of iron and silicon read before this Institute at the meeting in September, 1889. These samples might have been prepared expressly for my researches, for the silicon in them is the only variable. Even had the variations in iron and manganese been regular and of little importance, I should also have obtained good results. All the bars were forged, and measured 6 to 7 millimetres square and 12 centimetres long. Their chemical composition, according to Mr. Hadfield's analyses, was as in Table X. The curves, each of which is the mean of two concordant tests (except that for No. 30), are plotted in Fig. 6, and the results are given in Table XI.

The action of silicon on each of the critical points is easily seen.

1. On a_{r3}. With increasing silicon, a_{r3} tends to rise and to approach the normal position occupied by it in pure iron (855° C.). At the same time the amplitude of a_{r3} rapidly diminishes. It is very much weakened even in the metal (No. 31) with 0·80 per cent. of silicon, and is reduced practically to zero in the richer samples. Moreover, it is not a case of simple displacement; a_{r3} is not found again on the curves to the right, where a_{r2} and a_{r1} preserve their normal intensity, nor to the left, where I attained with the metal No. 34 the temperature of 1,400° C. Silicon prevents the molecular change of the iron, and maintains the iron in the α-condition in the region where, in the absence of silicon, it invariably assumes the β-condition.

2. On a_{r2}. Silicon appears to slightly lower a_{r2} from 725°–710° C. to 710°–700° C., but this effect is imperfectly marked. I may here repeat that a_{r3} appears to represent the end of a_{r2}—that is to say, the allotropic change of the iron, for the molecules immediately dependent on the carbon.

3. On a_{r1}. Silicon gradually raises a_{r1} in a very appreciable manner from 660°–650° C. to 710°–700° C., so that a_{r1} and a_{r2} are caused to coincide in Sample 34. This action is analagous to that of chromium, and the opposite to that of manganese, of nickel, and of copper. These experiments seem to show that, in the metals examined, the silicon is alloyed with the iron, and does not form with it definite compounds. Indeed, during the cooling of the sample No. 33 from 1,320° C., and of No. 34 from 1,400° C., no abrupt and well-defined liberation of heat is observed which might correspond to the solidification of a melted portion, as is the case in pig iron. (*Annales des Mines*, 8th Series, Vol. XIV., pp. 39–59.)

Arsenic.—Three samples were examined. These were prepared by Mr. F. W. Harbord and Mr. A. E. Tucker, and formed part of the series described in a paper read before this Institute. The test-pieces were cut from forged bars, and have the dimensions of 5 by 5 by 40 millimetres. Their chemical composition is shown in Table XIII. The curves, each of which is the mean of two tests, are plotted in Fig. 7, and the results are given in Table XII. Like silicon, arsenic causes a_{r3} to rise towards its normal position, and diminishes its intensity. It is probable that, with a higher percentage of arsenic, a_{r3} also disappears. The action of 0·50 per cent. of arsenic on a_{r2} and on a_{r1} is not appreciable.

Phosphorus.—Two samples were examined. Their chemical composition was as in Table XIV. The curve for the puddled iron is exactly similar to that of electrolytic iron, except that a_{r3} is gradual and not abrupt. The influence of the phosphorus is not yet felt in an appreciable manner, especially as probably an important portion of the phosphorus is in the inactive form of phosphate of iron in intermixed slag. On the other hand, the basic Bessemer metal previous to the after-blow gives, during the cooling from 1,350° C., but a single critical point, and this is very indistinct, at 680° C. (a_{r1}). a_{r3} and even a_{r1} have disappeared—that is to say, the iron preserves the α-condition at high temperatures. Phosphorus, therefore, acts like silicon.

Sulphur.—A red-short basic Bessemer steel, useless in practice, was examined. Its chemical composition was as follows:—

	Per cent.
Carbon	0·48
Silicon	0·08
Sulphur	0·28
Phosphorus	0·16
Manganese	0·51

The dimorphous change of the iron, $a_{r(3-2)}$, presents its maximum between 740° C. and 730° C., and joins recalescence a_{r1}, producing a

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station at 671°. On comparing these figures given by Sample No. 7, which contains the same proportion of manganese, with 0·32 per cent. of carbon, and only 0·02 per cent., we get:—

	Maximum of $a_{r(2\text{-}3)}$.		a_{r1} (station).
Normal steel	705°–697°	.....	640°
Red-short steel.....	740°–720°	.....	671°

It is thus evident that the presence of sulphur has raised the position of the two critical points some 30°. Thus the influence of sulphur, in so far as it may be determined from a single sample, appears to be similar to that of phosphorus and of silicon.

Professor Roberts-Austen, by studying the effect produced on the mechanical properties of gold by the addition of an equal weight (about 0·20 per cent.) of seventeen foreign elements, has discovered a curious relation between the results obtained and the position occupied by the added metals in the periodic classification ("Philosophical Transactions of the Royal Society," Vol. CLXXIX., 1888, pp. 339–349). Recognising that a similar relation ought to exist in the case of iron, Professor Roberts-Austen, in his British Association lecture at Newcastle, said: "In the case of iron, it is difficult to say what property of the metal will be most affected by the added matter. Possibly the direct connection with the periodic law will be traced by the effect of a given element in retarding or promoting the passage of ordinary iron to an allotropic state, but the future of steel will depend on the care with which we investigate the nature of the influence exerted by various elements on iron, and the thermal treatment to which it may most suitably be subjected." Struck by the originality of these views, and by the importance they might acquire for the iron industry, I revised my early experiments with the object of explaining them, and I also undertook new ones. All the experiments I have described in the last section of this paper, and the general conclusions resulting from them, fully confirm Roberts-Austen's law. The names of the elements, whose action on iron is known, may be arranged in Table XV. in two columns in the order of their atomic volumes. The elements in Column I., whose atomic volumes are less than that of iron (7·2), delay during the cooling, other things being equal, the change of β-iron (hard) into α-iron (soft), and that of hardening carbon into carbide carbon. For these two reasons they tend to increase, with equal rates of cooling, the proportion of β-iron existing in the cooled iron or steel, and, consequently, the hardness of the metal. They are, in fact, equivalent to a more or less energetic hardening. To this list hydrogen might be added, the atomic volume of which is very low, and which renders electrolytic iron hard and brittle, as is well known. Perhaps it would be better to say, with Graham, *hydrogenium*, rather than hydrogen, for hydrogen gas does not appear to have any distinct action. On the other hand, the elements in Column II., the atomic volumes of which are greater than that of iron, tend to raise, during the cooling, the change of the iron towards the normal position that it occupied in pure iron. Moreover, they render the inverse change more or less incomplete during the heating, and hasten during the cooling the combination of the carbon with the iron. Reservations must, however, be made in the case of tungsten. This element exhibits, as we have seen, a certain number of anomalies, and may deviate from the law under certain conditions. Thus they maintain the iron in the α-condition at raised temperatures and *a fortiori* in the cooled metal, and are theoretically a source of softness and malleability, like annealing. If, however, several of them increase the tensile strength and hardness of iron, it is by reason of their personal properties or of that of their compounds, but not by reason of their increasing the proportion of β-iron. In short, they directly play the part of the hardening element which was reserved to β-iron in carbon steels. Thus the foreign elements alloyed with iron act, first, in advancing or retarding, during the cooling, the allotropic change of that metal, in rendering it more or less incomplete, in one direction or the other, according as their atomic volume is greater or less than that of iron. In other words, foreign elements of low atomic volume tend to make iron assume or preserve the particular molecular form in which it has itself its lowest atomic volume, the converse being the case with elements of great atomic volume. These conclusions are in accord with what is known of the influence of foreign elements on the magnetic properties of iron. Indeed, experiments that I have made on this subject (*Génie Civil*, 4th July, 1885), show that, within the limits in which carbon, silicon, sulphur, phosphorus, and manganese may vary in the manufacture of steel rails by the acid and basic Bessemer processes, these elements may be divided into two groups as regards permanent magnetism. In the first group, carbon and manganese increase the permanent magnetism; in the second, silicon, phosphorus, and sulphur have no action on permanent magnetism. Without entering into minuter details, which belong rather to physics than to metallurgy, it is evident that we again find, as regards magnetism, a grouping of the foreign elements into two series. The elements in the first series have a lower atomic volume, and the elements in the second have a higher atomic volume than that of iron.

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THE CRITICAL POINTS OF IRON AND STEEL.

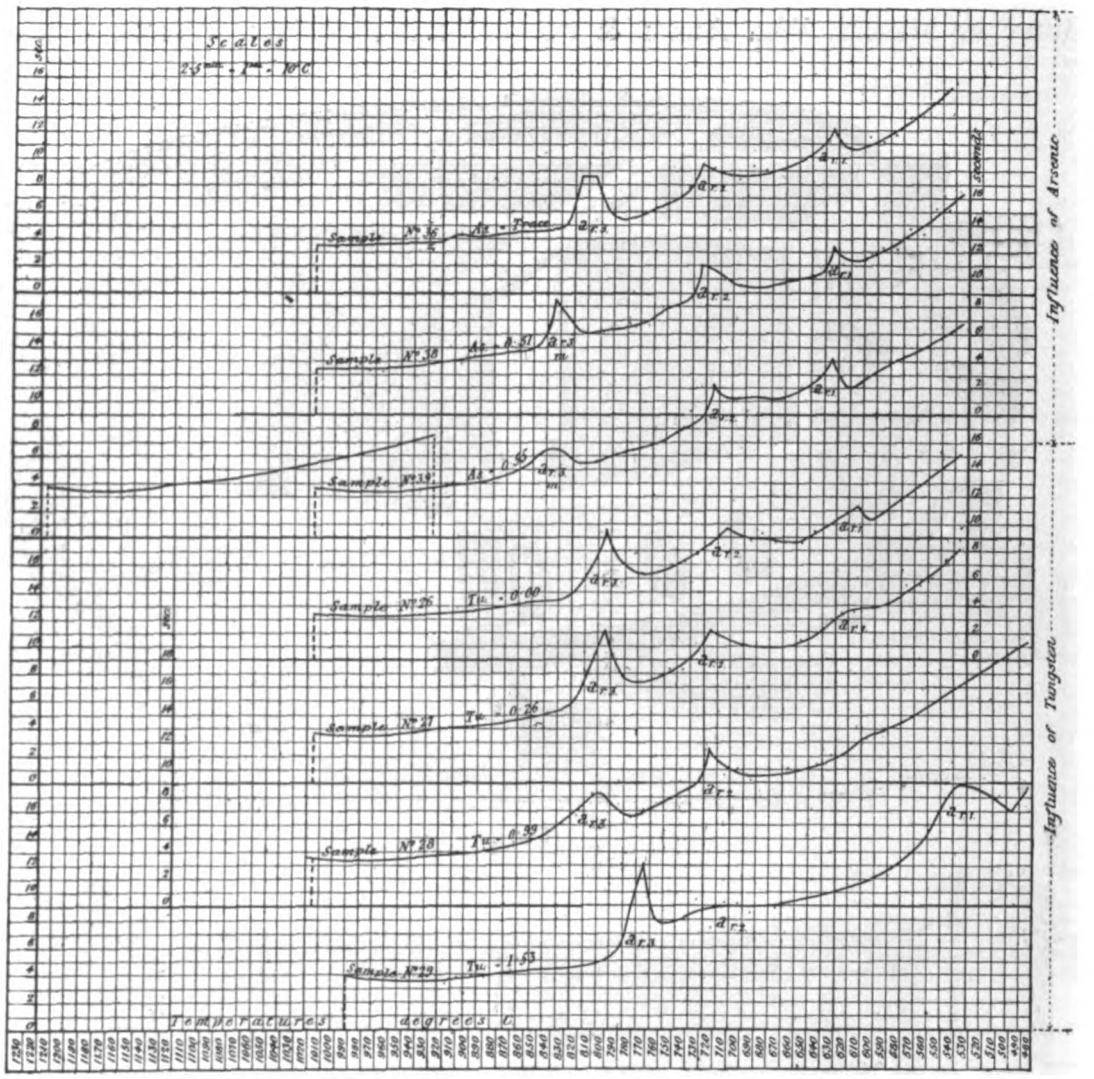


Fig. 7.

TABLE XII.

No.	Arsenic, per cent.	a_{r3}. Begins	a_{r3}. Maximum.	a_{r3}. Ends.	a_{r2}. Maximum	a_{r1}. Maximum.
36	trace	835°	825°–805°	785°	735°–725°	640°–630°
38	0·51	855°	845°–835°	315°	735°–725°	640°–630°
39	0·55	885°	845°–835°	815°	730°–720°	640°–630°

TABLE XIII.

Consecutive No. / Harbord & Tucker's mark	36 (0).	38. (4).	39. (11).
Carbon	0·12	0·12	0·14
Silicon	0·023	0·035	0·023
Sulphur	0·02	0·22	0·04
Phosphorus	0·041	0·035	0·154
Manganese	0·25	0·24	0·24
Arsenic	trace	0·51	0·55

TABLE XIV.

Consecutive No. / Nature	19. Puddled iron.	20. Basic Bessemer metal before after-blow.
Carbon	0·05	0·10
Silicon	0·08	—
Sulphur	0·02	—
Phosphorus	0·38	1·35
Manganese	trace	1·46

TABLE XV.

I. Name.	I. Atomic Volume.	II. Name.	II. Atomic Volume.
Carbon	3·6	Cromium	7·7
Boron	4·1	Tungsten	9·6
Nickel	6·7	Silicon	11·2
Manganese	6·9	Arsenic	13·2
Copper	7·1	Phosphorus	13·5
		Sulphur	15·7

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THE HUDSON TUNNEL SHIELD.

BUILT BY MESSRS. WM. ARROL & CO., DALMARNOCK IRON WORKS, GLASGOW.

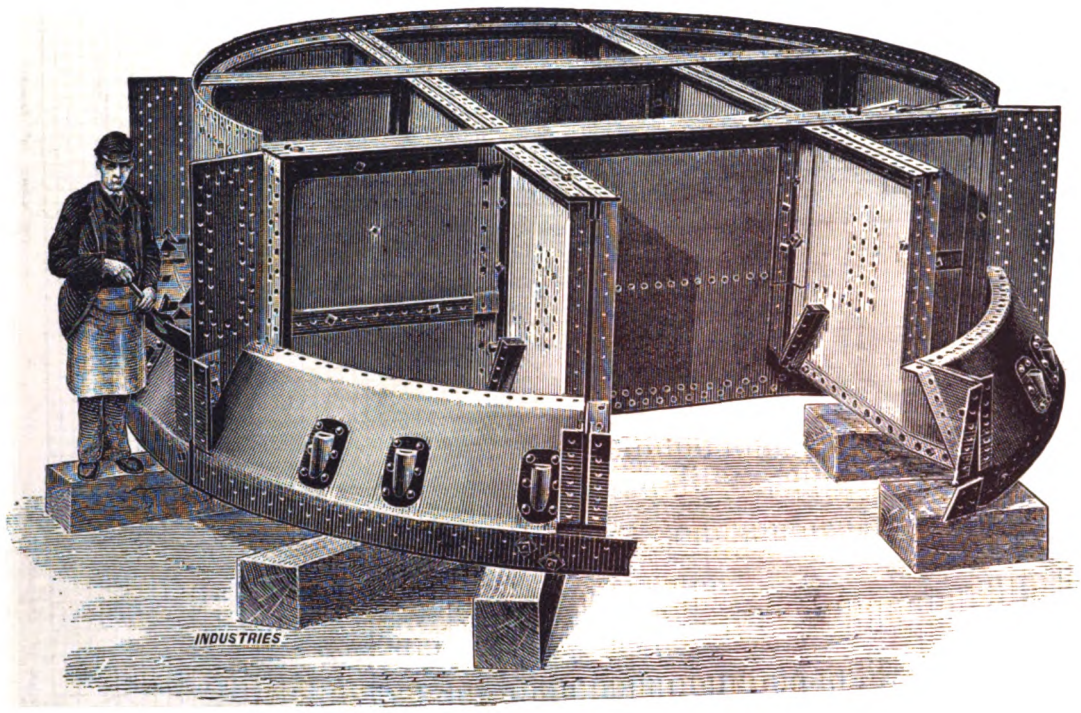


FIG. 1.

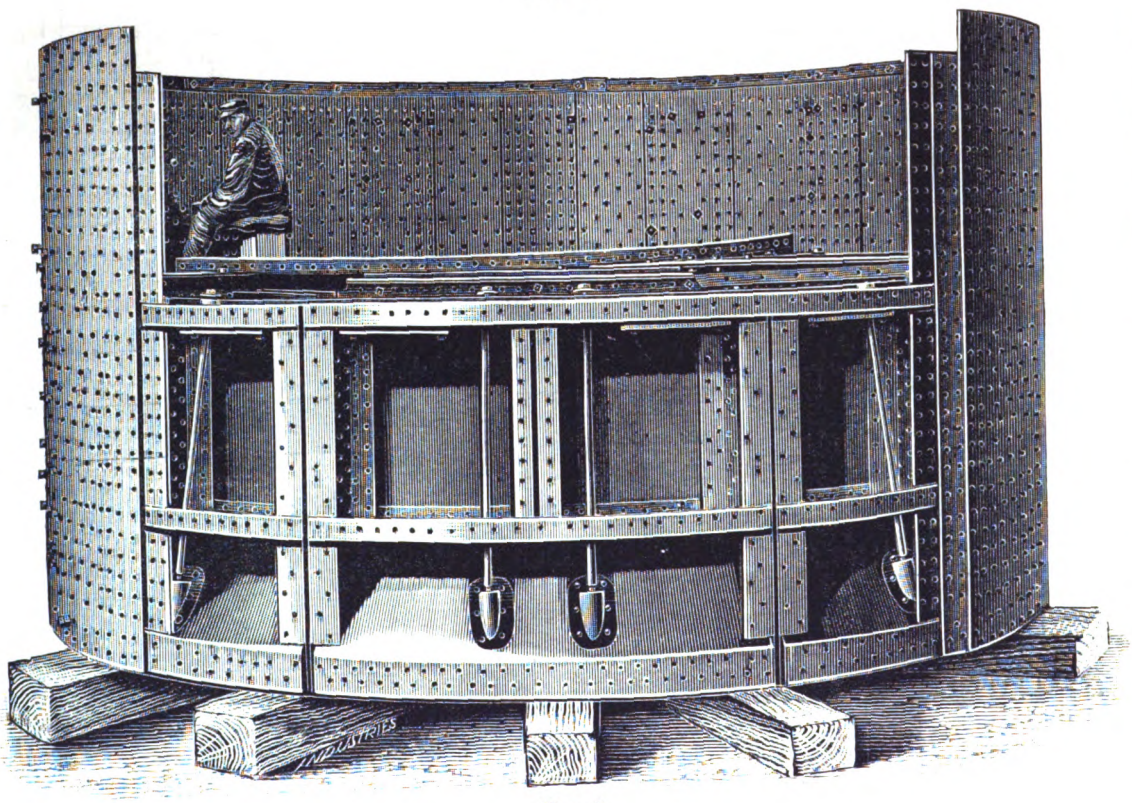


FIG. 2.

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THE HUDSON TUNNEL AT NEW YORK.

DIRECT communication between New York and Jersey City has long been acknowledged as a pressing necessity. New York, with its population of about 1½ millions, is situated on Manhattan Island, and separated from the mainland by the Hudson River. With one exception, that of the New York Central, which crosses the river at Albany, 143 miles distant, the whole of the railways leading to New York have their termini in Jersey City; in other words, a railway mileage estimated at nearly seven times that of the United Kingdom is barred by the Hudson River from direct access to the commercial centre of the United States. The present ferry service, of course, has all the drawbacks inseparable from this means of communication, such as the cost and delays of transhipment; the difficulties and dangers due to fogs, ice, and storms; and the risks of collision in a crowded navigation. The exact figures representing the traffic between New York City and Jersey City are not known; but it has been estimated that the number of passengers carried per annum exceeds 75,000,000, and the freight carried equals 60,000,000 tons.

It is, therefore, no wonder that the project of building a railway between the two cities has occupied the serious attention of engineers and capitalists. Several years ago an attempt was made to drive a double tunnel through the mud and silt of the river. In 1880 the water unhappily burst into the workings when about 100 yards had been driven, and drowned twenty men. On the resumption of operations a pilot tunnel, or iron tube 6ft. 6in. in diameter, was employed, and it was advanced 30ft. or 40ft. in front of the main tunnel. The silt and water was prevented from crushing the plating and flooding the tunnel by compressed air, which was pumped into the tunnel at a pressure of about 20lb. per square inch. After excavation the silt was mixed with water and ejected by compressed air. When, however, about one-eighth of the distance had been successfully driven, operations were suspended owing to financial difficulties, and the project fell into abeyance.

Some years later efforts were made to resuscitate the enterprise, and the abandoned works were visited in 1888 by Sir Benjamin Baker, K.C.M.G., who was furnished with information by the Company's representative as to the nature of the soil, cost and rate of progress of the executed tunnelling, and other details. In the same year a joint report, based upon this information, was presented by Sir John Fowler, Bart., and Sir Benjamin Baker to the directors of the Company, estimating the time for completion at eighteen months, and the cost of finishing the northern and southern tunnels at £180,000 and £250,000 respectively. According to this plan, the two parallel tunnels will be each 5,600ft. in length under the river and, with their approaches, about three miles in length. The tracks will reach Broadway by easy gradients only 16ft. below its level at the New York end, and will also rise by easy gradients to the street level at Fifteenth Street, at the Jersey City end. Early in the following year an issue of £300,000 six per cent. mortgage bonds, forming the first part of a total authorised issue of £550,000, was made in London for the purpose of carrying out the scheme, and the contract was shortly afterwards let to Messrs. S. Pearson & Son, of Westminster, Mr. Hutton, of New York, being the engineer, and Messrs. Fowler, Baker, and Greathead the consulting engineers.

Before passing to a detailed account of the shield now to be employed in the execution of this important enterprise, we may briefly state in general terms that the

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THE HUDSON TUNNEL SHIELD.

CONSTRUCTED BY MESSRS. WILLIAM ARROL & CO., DALMARNOCK IRON WORKS, GLASGOW.

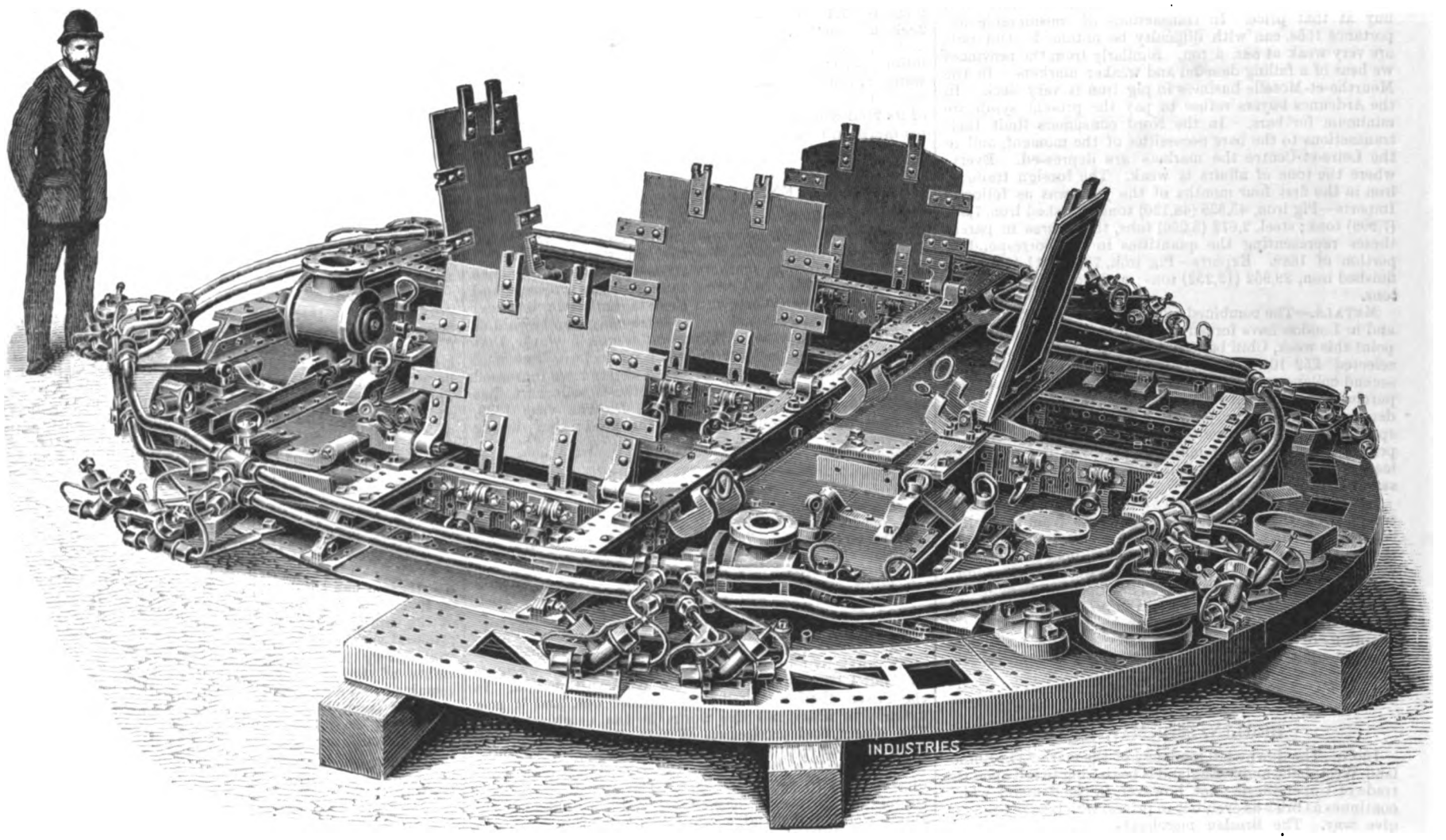


FIG. 3.

shield is supported against external pressure by vertical girders. The face of the shield is formed as a cutting edge, and horizontal shelves extending across the shield are similarly armed to pass through the material met. Behind the cutting edges the shield is closed by a diaphragm of plates completely separating it into two compartments. In this diaphragm doors are placed which can be opened to admit the material being excavated, and the pressure of compressed air in the tunnel prevents the admission of water. When harder and water-tight material is traversed the doors are opened, and the excavators attack the face of the heading. When a sufficient quantity of material has been removed, hydraulic rams attached to the shield advance it by acting against the lining of the tunnel already completed and in position, and a fresh section of lining is at once added. The illustrations which we give in Figs. 1, 2, and 3 herewith, show the shield in several stages of erection in Sir William Arrol's Dalmarnock Works, near Glasgow. We need not add any detailed description of the views, as they are sufficiently self-explanatory.

We will now turn to details of the shields under consideration. The external diameter is 19ft. 11in. by 10ft. 6in. from cutting edge to tail of shield. The outer skin is made up of two thicknesses of $\frac{5}{8}$in. steel plates, with internal covers, and packing pieces between the covers, all of a similar thickness. A division of plates, $\frac{5}{8}$in. in thickness, is placed 5ft. 8in. from the cutting edge, and completely divides the shield into two compartments, being pierced by nine doors, of which hereafter. Two horizontal girders between the doors and the cutting edges divide the shield horizontally, the double $\frac{1}{4}$in. webs of these girders being connected to the door-plates and vertical diaphragms by 6in. by $\frac{3}{4}$in. angles. The two vertical diaphragms, which divide the shield similarly throughout its entire height, are built of 4in. by 4in. by $\frac{1}{2}$in. angles and a $\frac{1}{4}$in. web. The face of the shield is thus divided by these horizontal and vertical girders into nine cells, access to each of which is gained through a door from the after compartment of the shield. The inner skin of the shield is composed of $\frac{1}{2}$in. plating, and extends from the plates forming the division of the shield carrying the doors to within 2ft. 4in. of the cutting edge, and is separated from the outer skin by a distance of 1ft. 5in. Sixteen diaphragms of $\frac{1}{2}$in. plates 3ft. 2in. by 1ft. 5in., with 4in. by 4in. by $\frac{1}{2}$in. angles running completely around on each side, are spaced equidistantly around the shield between the two skins, and arranged to coincide with the attachments of the horizontal and vertical girders already described at their respective junctions with the inner skin. The doors are nine in number, of $\frac{5}{8}$in. plates; seven are square and dished, covering openings ranging from 2ft. 6in. by 2ft. to 2ft. 3in. by 1ft. 9in., the two remaining ones being triangular and about 2ft. square; the clips, hinges, brackets, &c., being stout iron forgings, and calling for no special remark. The doors are faced at the bearing surface with indiarubber $\frac{1}{4}$in. in thickness. The $\frac{5}{8}$in. plates forming the vertical division of the shield are stiffened by six vertical girders 6$\frac{1}{2}$in. in depth, and each made up of four 3in. by 3in. by $\frac{1}{2}$in. angles, with a top flange plate 6$\frac{1}{2}$in. by $\frac{1}{2}$in. and a $\frac{1}{2}$in. web. Sixteen cylinders of cast steel are placed between the two skins equidistantly around the shield. They are 3ft. 4$\frac{1}{4}$in. over all, with external and internal diameters 10$\frac{3}{4}$in. and 8in. respectively. The rams have an internal diameter of 3$\frac{1}{2}$in.

The cylinders and rams were cast by the Steel Company of Scotland at their Newton Works, and prior to despatch were tested to a pressure of 2 tons per square inch, all cocks, tees, valves, &c., being similarly tested to a like pressure. The shields have been made by Messrs. William Arrol & Co., Dalmarnock Iron Works, Baltic Street, Glasgow, to the order of Messrs. S. Pearson & Son, 10, Victoria Street, Westminster. The hydraulic segment erecter, which will follow up the shield in the tunnel, placing the cast-iron lining segments in position as the tunnel advances, has been manufactured by Messrs. Fullerton, Hodgart, & Barclay, Vulcan Foundry and Engine Works, Paisley. A finished view of this apparatus we hope shortly to be enabled to place before our readers. It may be stated in conclusion that Mr. Moir, late of the Forth Bridge, is carrying out the works as Mr. Pearson's agent in New York.

THE NAVIGATION OF THE EUPHRATES.

THE Turkish Government has lately been considering the question of the possibility of navigating the Euphrates in all seasons. The engineers charged with the labour of investigating this point have completed their report, and have expressed the opinion that no very serious obstacle stands in the way of the project. Midhat Pasha, while he was Governor-General of Bagdad, established a service of steamers which were of great advantage to the trade of the province, but which were promptly suppressed as soon as the Governor had changed his residence. The engineers estimate that the only works necessary would be the removal of the remains of old sluices, the dyking of the fords, and the destruction by means of dredges of the moving banks of sand stirred up by the current. The necessary outlay for these improvements would be half a million francs, without counting the cost of the floating material. It is proposed to raise this sum by proportional charges on the revenues of the Imperial property in Aleppo, Mosul, and Bagdad. It is understood to be the intention of the Sultan to establish a regular service by means of a sufficient number of steamers, and to give back to Aleppo part of the trade of Bagdad now drawn away by the Suez Canal. The projected works will be the precursors of the great railway which must ultimately unite the Mediterranean to the Persian Gulf. It will also insure a proper movement to the agricultural products of those provinces, which, at present, in abundant years, are heaped up in warehouses until they spoil for lack of means of transport to other markets. If the project becomes realised, it will be worked from the office of the administration of the Imperial land property in Constantinople.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 27th May, 1890.

IRON.—The firmness in the iron markets, which never had other than artificial causes, is fast giving way. The Paris merchants find themselves unable to maintain the price of bars and joists at 160s. Not even small consumers will buy at that price. In transactions of considerable importance 156s. can with difficulty be obtained. Old rails are very weak at 88s. a ton. Similarly from the provinces we hear of a failing demand and weaker markets. In the Meurthe-et-Moselle business in pig iron is very slack. In the Ardennes buyers refuse to pay the present syndicate minimum for bars. In the Nord consumers limit their transactions to the bare necessities of the moment, and in the Loire-et-Centre the markets are depressed. Everywhere the tone of affairs is weak. The foreign trade in iron in the first four months of the year was as follows: Imports—Pig iron, 43,838 (48,130) tons; finished iron, 7,564 (7,998) tons; steel, 2,672 (3,056) tons, the figures in parentheses representing the quantities in the corresponding portion of 1889. Exports—Pig iron, 70,959 (11,444) tons; finished iron, 29,952 (12,232) tons; and steel, 12,190 (9,312) tons.

METALS.—The combined efforts of speculators in Paris and in London have forced up the prices of copper another point this week, Chili bars being now quoted £55, and best selected £59 10s. But consumers, knowing well that a second collapse must soon come, continue to restrict their purchases to the bare necessities of the moment. The demand for tin on the part of consumers is languid, but speculators have succeeded in giving an upward turn to prices. Lead, after dropping a point, has recovered the loss. Spelter is again higher, but the demand for consumption is light.

THE CAIL ENGINEERING WORKS.—The question of transferring the Cail Engineering Works from the neighbourhood of Paris to Douai has been definitely settled. At the general meeting of the shareholders, held last week, it was unanimously decided to retain the works at Grenelle.

THE LABOUR COUNCIL.—The Special Commission formed to examine and report on the proposed constitution of a Council or Board of Labour has recommended the adoption of the scheme, and expressed its unanimous decision that it should be made a department of the Ministry of Commerce.

BERLIN, 26th May, 1890.

IRON.—The downward tendency of the markets in Rhineland-Westphalia and in England is beginning to tell upon the trade of Upper Silesia; not, however, in the demand, which continues as brisk as ever, but in prices, which have begun to give way. The Breslau merchants have reduced their rates to 197s. 6d. for bars, a price that is below the manufacturers' quotations. Common plates may be bought for 205s. to 220s., and tin sheets from 225s. to 242s. a ton. Clearly the tendency of the market is downward, in spite of the activity at present existing. The contracts of the Donnersmarkhütte with the Upper Silesian Rolled Iron Association for the supply of pig in the next three years are on the bases of from 46 to 50 per cent. of the price of bars. This makes forge pig about 85s. for the price of bars now current, and would leave it at about 54s. 6d. in the case of bars dropping as low as 115s. from the 195s. to 200s. at which they now stand. The tenders for 1,495 tons of steel rails for Breslau gave 160s. a ton at the works as the lowest offer. This tender was made by Krupp, of Essen. The lowest offer from the Upper Silesian works was 166s.

PIG IRON PRODUCTION.—The total production of pig iron in Germany, including Luxemburg, in the month of April amounted to 398,457 tons, against 416,948 tons in March, and 372,742 tons in April of 1889. This makes the total for the first four months of the year 1,551,497 tons, against 1,455,265 tons in 1889, an increase of 6·6 per cent. The consumption of pig in the first quarter of the current year, as represented by the production plus the imports less the exports, amounted to 1,209,767 tons, against 1,061,408 tons in the corresponding quarter of 1889.

METALS.—The metal market continues animated; but the animation is largely due to speculative business. The influences, however, which are being brought to bear are of a nature to force up prices, and accordingly we find the present quotations all round above those of a week ago. Mansfeld refined copper, £62 to £63; English brands from £58 10s. to £62; Banca tin, £103 to £106; Clausthal refined lead, £15 to £15 10s., and W. H. Silesian spelter, £25 to £26 a ton.

THE DISTILLING INDUSTRY.—The official statistics relative to the distilling industry of Germany show a production of pure alcohol in the half year comprised between October 1st and April 30th amounting to 2,479,161 hectolitres. The quantity of spirits, raw and refined, exported in the first quarter of the current year amounted to 204,724 cwt., against 40,266 cwt. in the corresponding portion of 1889.

GLASSMAKERS' ASSOCIATION.—The general meeting of the Association of German Glassmakers will this year be held in Berlin on June 2nd.

NEW QUICKSILVER MINES.—An important discovery of cinnabar deposits has been made at the village of Kurusz, in the district of Dagrestan in Poland. The ore assays 74·7 per cent. of mercury. Preparations are being made to work those deposits at once.

A LARGE PUMPING ENGINE.—A steam engine approaching completion in the Sächsische Maschinenfabrik vormals Rich. Hartmann, Chemnitz, is among the largest that has ever been turned out from these works. The engine, which is constructed on the compound system, is intended for drainage purposes at the Mansfeld copper mines near Eisleben. The high-pressure cylinder measures 1,590 millimetres internal diameter, and the low-pressure cylinder measures 2,480 millimetres; the stroke of the piston is 2,660 millimetres. The diameter of the fly-wheel is 11·4 metres, and its weight 56,000 kilogs. With 11¼ revolutions per minute the engine will raise 16 cubic metres of water 275 metres high, and under ordinary circumstances yields 1,600 indicated horse-power. This engine is the fifth of its kind which has been made by the Sächsische Maschinenfabrik in recent years.

VIENNA, 26th May, 1890.

THE IRON MARKET.—The stagnation noticed in the iron market last week continues, but without shaking the prices. This circumstance shows that the important decreases of prices in the foreign markets are not yet able to influence the home market. This circumstance causes a reserve and a distrust of speculation, and the stagnation in business will become more marked. The same may also be said of the Hungarian market, with the difference, however, that sheets are in good request and ship plates have been sold in large quantities. Prices of tinned sheets have increased by 10fl. per ton. The Alpine Montan-Gesellschaft has issued its report and balance-sheet for the year 1889. The following are the figures of the production during last year:—

	Tons.		Tons.		
Brown coals.....	745,575	...	36,039	increase	over 1888.
Ores	1,051,144	...	184,727	,,	,,
Pig iron	190,742	...	2,253	decrease	,,
Foundry goods..	10,911	...	2,041	increase	,,
Ingots	76,292	...	4,727	,,	,,
Sheets	13,227	...	155	,,	,,
Rails	19,544	...	13	,,	,,
Wires	8,371	...	402	,,	,,
Steel goods	21,828	...	2,974	,,	,,

The company pays a dividend of 5½ per cent.

THE COAL MARKET.—The Bohemian coal market is extraordinarily animated. The traffic on the Elbe amounts to about 1,300 waggons daily from Western Bohemia. In the Pilsen district a strike has broken out, and it now extends to nearly all the works in the neighbourhood. The yearly coal production of this district amounts to 2,000,000 tons from six large esatblishments. A year ago the strike in this district was terminated by an increase of wages by 10 to 15 per cent. The general movement throughout the empire has encouraged the colliers of the Pilsen works to demand a fresh increase of wages and a reduction of the time of working.

DÜSSELDORF, 27th May, 1890.

IRON.—Business in the iron market continues slack. The prospect of lower prices for coal keeps consumers of iron out of the market in expectation of better terms. This expectation is strengthened by the growing importance of the imports of foreign iron. Spiegel pig has receded in price 2s. a ton. For other sorts, the quotations remain unaltered. The latest official list issued is as follows: Ordinary spiegel pig, 100s.; best Rhenish-Westphalian forge, 78s.; Siegen forge, 80s.; foundry No. 1, 82s.; Thomas pig, 68s.; and Bessemer, 82s. a ton. The demand for bar iron continues to shrink both on home and on foreign account. Joists are still freely dealt in, but the demand is scarcely so brisk as it was a week ago. Hoops, on the contrary, are more inquired for. Plates are in fairly good demand for home consumption; but the export trade is languid. This remark applies equally to wire. The Association of German Iron Founders report business brisk, and the near prospect satisfactory, and announce that no reduction in the price of castings will be proposed in the present state of trade.

COAL.—The expected collapse in the coal market has not yet occurred, but there is a distinctly marked downward tendency in prices. That the danger is serious is shown by the fact that a great meeting of mining shareholders in this district is to devise means for preventing any excessive fall in prices. The means adopted will probably be a restriction of the production by dismissing the least efficient hands. It has caused surprise to learn that in the district of Saarbrück, the price of coal at the fiscal mines has for some sorts been raised within the last week 9d. and 1s. a ton. Here the tone of the market is greatly depressed.

LINEN YARNS.—The situation of the market for linen yarns is not altogether satisfactory. The demand has fallen off considerably of late, and prices are maintained with difficulty. Moreover, these prices are not sufficiently remunerative. A slight improvement is noticeable in the trade of the last week. Buyers are operating more largely, but not above the requirements of the moment. The labour agitations have shaken the confidence in the stability of the industrial situation. The general meeting of the Association of German Linen Goods Manufacturers is to be held in Berlin on the 4th of June.

LILLE, 27th May, 1890.

IRON.—The tendency of the iron market is this week unmistakably feeble. For some time past the volume of business has been shrinking, but the manufacturers have firmly maintained their prices. Now, however, their attitude is less resolute, and we hear of important concessions being made to buyers. Coal cannot, it is believed, be long maintained at its present high prices, and with cheaper coal we must have cheaper iron. This is the reasoning of consumers, and a consequence is that not a ton is bought that is not wanted for immediate use. The pig iron market is lifeless.

TEXTILE MANUFACTURES.—Business in linen goods at Armentières continues above the average of the last three years. Buyers operate freely, and the tone of the market is in all respects strong. The demand on export account is moderately brisk. The declared value of the linen and hempen goods exported from France in the first four months of the current year amounted to £147,800, against £114,120 in the corresponding period of 1889. At Roubaix business in woollen goods remains languid. For raw wool the market is dull and somewhat weak. The declared value of the woven woollen goods exported in the first four months of the year amounted to £4,880,200, against £4,772,320 in the corresponding months of 1889.

FLAX AND YARNS.—The market continues active for home-grown flax, and prices have further advanced in a slight degree. Business is moderately brisk in Russian produce, notwithstanding the continued rise in prices due to the higher rates of exchange. Tows are in good demand on home account, but they are not much inquired for for export. The situation remains unchanged for yarns; spinners easily dispose of the whole of their produce. Jute yarns, which are in brisk demand, are again higher. The declared value of the linen yarns exported in the first four months of the current year amounted to £151,320, against £143,080 in 1889.

AMSTERDAM, 26th May, 1890.

TRAMWAYS IN AMSTERDAM.—The Town Council of Amsterdam has rejected, by a large majority, the proposal of several members to acquire the whole tramway system of the capital and to work it on behalf of the town. The proposal was in the form of an amendment to the Bill, introduced by the town authorities, extending the concession rights of the existing tramway company. The Bill still remains to be considered.

WORKMEN'S INSURANCE IN ROTTERDAM.—The Town Council of Rotterdam has just passed an important enactment providing for the compulsory insurance of all workmen whilst employed at public works. It is provided that no contractors' tenders shall be accepted by the town authorities unless the contractors shall have agreed to a proviso giving the town authorities the right to deduct certain sums of money from the contract price for the insurance of the workmen against accidents or death. In the case of an accident causing the death of a workman, the contractor must agree to pay to his nearest relatives a sum of one thousand guilders, unless the contractor can prove that death was due to the man's own negligence; a similar sum is to be deducted from the contract amount also where an accident takes place disabling the workman for life. In all other accidents the town authorities shall have the right to fix a reasonable amount of compensation to the injured artisan. These proposals were not accepted by the Town Council without some sharp opposition; several members objected to them because they could not be generally applied, and others voted against them as tending to demoralise the workman and to make him careless and improvident.

THE ROYAL STEAMBOAT COMPANY.—This undertaking has had a very flourishing time of it during 1889, and the directors will distribute a dividend of 12 per cent. among the shareholders. The company has now a fleet of twenty-three steamers, valued at nearly 2¼ million guilders. Two hundred and forty-four journeys were made in 1889, extending from the Baltic and the North Sea to the Mediterranean and the Levant. Some of these lines were extended last year, and an attempt was made to establish a direct line of steamers with South Africa, but it could not be called successful. In 1889 the company carried 290,860 tons of goods for 2,712,676 guilders. The net profits were 233,086 guilders, after providing for depreciation and reserve. The company had no accidents last year. Several new steamers are building. The rise in the price of coal has affected the company's profits somewhat, and the directors have been compelled to make new contracts in England, where coal is cheaper than in Germany. Latterly experiments have been made to mix the coals with peat, in the proportion of two-thirds coal to one-third peat. The results are stated to have been highly satisfactory.

COPENHAGEN, 24th May, 1890.

INSURANCE OF WORKMEN.—The insurance of labourers against accidents by the employers is becoming a very general thing in Scandinavia. Among others, the Malmö Woollen Manufactory has insured 740 men for an aggregate sum of 1,125,000kr.

THE STATE TELEPHONE IN SWEDEN.—The second large State telephone connection right across Sweden,

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between Stockholm and Malmö, will be completed during the month of August, and will probably be opened for public use in the following month. It was originally the intention to connect this line with intermediate stations, such as Vexiö, Norrköping, Nyköping, &c, but this has now been altered, so that the first line will be direct between Stockholm and Malmö, and afterwards a secondary line, with intermediate station service, will be installed. The State telephone between Norrköping and Linköping has just been completed, and the State telegraphs are altogether pushing ahead with their telephonic installations with much energy.

NEW LIGHTHOUSE AT THE SCAW.—When the new Houstholm Electric Lighthouse was lighted a few months ago mention was then made of the inefficiency of the Scaw Lighthouse, and the Danish Government has now decided to build a new lighthouse and provide a couple of fog-horn installations in this dangerous neighbourhood. The first lighthouse was built at the Scaw in the year 1561, and the present one dates from 1853. Although this has a comparatively powerful light, a large number of shipwrecks take place, and during the last eleven years over ninety vessels have been stranded within a few kilometres of the lighthouse. The position of the new lighthouse is about 14,000ft. to the W.N.W. of the present Scaw lighthouse, and it will be placed as near the shore as practicable. The machinery for the two new sirens will be placed in the lighthouse, from which pipes lead to the sirens. The cost is calculated at about £7,000, of which £750 is for the lenses, £400 for the tower, £500 for the lantern, and £2,000 for boilers and machinery. One siren will be placed in the immediate vicinity to the north-east, and the other about 1 kilometre from it, in the south-western direction.

THE COPENHAGEN WATER WORKS.—Some extensive works are going on at present in connection with the Copenhagen Water Works. One of the reservoirs is being enlarged. The ground is now ready, but on account of the bricklayers' strike the work on the building cannot commence for the present. The deepening of the reservoir situated outside the town is also being proceeded with. During the summer, Copenhagen receives most of its supply of water from artesian wells in the vicinity of the Sändersö Lake, and it is only when the former cannot supply the necessary quantity that the surface water from the lake itself is used. As this class of water is not well adapted for drinking, it is only used in cases of emergency. During the winter, Copenhagen gets its water from another lake—the Damtuss Lake. From the springs and the lakes the water is led to the large reservoirs, close to the water works; from there it passes through the filters, and is then pumped into the high level reservoir at Söndermarken, from whence it passes through the pipes all over the town. The Söndermarken reservoir has hitherto not only been dug out, but also surrounded by large dams. These will now disappear, and by the deepening of the reservoir the top will be level with the ground. The cover will consist of concrete arches, resting upon brickwork pillars, or, if the bricklayers' strike should make this impracticable, pillars of concrete. On the top of the cover there will be shrubberies, &c., but it is not thought advisable to make this area accessible to the public.

THE SWEDISH-NORWEGIAN RAILWAY COMPANY.—With regard to the Norwegian section of this railway, of which no portion has been completed as yet, it is reported that a new syndicate will apply to the Norwegian Government for an extension or a renewal of the concession for the building of a railway from Ofoten to Luossavoura, or even as far as Gellivara.

MADRID, 26TH MAY, 1890

COAL IN SPAIN.—The total amount of coal imported into Barcelona last year was 371,000 tons. Of this quantity 323,000 tons came in British steamers from Great Britain, 3,000 tons in British sailing vessels from Australia, and the remainder in foreign vessels from Great Britain. The quantity continues to increase yearly, although the native coal from San Juan de Abadesas is largely used in the interior of Catalonia for steam purposes, and in spite of the increasing importation of French coal. There is no doubt that Australian coal would be largely used for gas-making purposes if it were not so costly owing to the high freight that has to be paid on it.

A FORTHCOMING EXHIBITION.—An exhibition of appliances for sprinkling vines with chemicals is to be held in Barcelona this year.

THE LEON COBALT AND COPPER COMPANY.—A new company has been formed in England under special circumstances to work mines in Spain. This venture deserves some attention, as it marks the beginning of a new era in mining in Spain. The Spaniards generally, after getting possession of a new mine, hand it over to foreign capitalists, who form companies of which the working capital is all foreign. The Spanish vendors receive shares as payment. The case of the Leon Cobalt and Copper Company is a new departure. The Spanish holders of these mines, which cover some 350 hectares, offered them for sale in England, and a company was organised in London with a capital of £50,000. The bankers, the Union Bank of Spain and England, offered these shares for sale in Spain, with the unprecedented result that the demands for shares at Madrid and Bilbao alone have been double the required capital. It is not yet known what applications there have been at the branches of Barcelona, Valencia, and Seville, nor in the mother establishment at London. The explanation of this is that the Spanish capitalists, especially those of Bilbao, have shown more confidence in the English management of mining business than in their own, and that they are more willing to put their money with them than in a mining business of a purely Spanish character.

STRIKES IN SPAIN.—The strike in the coal district of Asturias has come to an end without any concession on the part of the owners of the mines, and the workmen have resumed work after an average loss of £1 per head. They could not claim shorter hours, because none of them work more than six or seven, and many less. They could not claim higher wages, because they work on contract, and they can make from 1s. 6d. to 3s. per day, according to their ability and the time they stick to their work. At Bilbao the strike has had a different end. There the contractors, as a rule, supply the workmen with victuals at exorbitant prices, and the profit made by the contractors in many instances depends on the prices of these victuals. In fact, the workmen of the mines were the slaves of the contractors. The effect of the strike has been to do away with these practices. The strike at the Belmez collieries is not yet over.

NEW YORK, 17TH MAY, 1890.

IRON AND STEEL.—The iron trade is in about the same condition. Prices are holding their own, and a fair amount of business is being done. In pig iron there has been a good bit of inquiry, but this has not resulted in much business. Buyers are bidding very low, and sellers are not willing to shade prices. The supply continues large, and as long as present prices can be obtained is likely to continue so. In view of the present cost of production sellers cannot stand much lower rates, so that it is likely that the present state of the market will continue until the market improves in the fall. Prices are $18 to $18·50 per ton for No. 1 foundry for small sales, $17 for No. 2, and $16 for grey forge. Southern iron is about $1 less. In manufactured iron the demand is only fair. The business in bar iron is heavy, but as there is considerable competition, it is not easy to get orders ahead, and prices are pretty low. Actual prices are about 1·85c. to 1·90c. per lb. The plate market is irregular, as most makers are anxious for more work, and low figures must be quoted to obtain desirable orders. The outlook for structural iron is not very good, as the amount of business is less than was expected, and prices are being shaded considerably. There is considerable inquiry for steel rails, especially from the west, but as the competition is very sharp the orders will probably be placed at very low figures. In other forms steel is in little demand. Nominal prices for billets are $31 to $33 50 delivered, but these prices would probably be shaded considerably on orders for immediate delivery.

THE METAL MARKETS.—The copper market is strong, and several large sales have been made at 14¼c. to 14⅜c. per pound. The event of the week has been the sale of 8,000,000lb. of Lake Superior ingot to consumers at probably the lower figure. Casting brands are quieter, but the demand is good, prices ranging from 12⅜c. to 12½c. per pound. The tin market has been active, chiefly on speculation, and prices have varied from 20c. to 20·50c. per pound. A large amount of business is being done in lead at advancing prices. Sales to consumers have increased, and there is considerable speculative dealing. Sales have been made at from 4c. to 4·075c. per pound. Spelter is quiet; prices are variable, and the supply is not very heavy. Antimony is in fair demand, and prices are quite irregular.

THE COAL TRADE.—The anthracite trade is in a little better condition. Prices are somewhat improved, and the demand has increased. The companies are still standing by their agreement to limit production, and it is probable that if the tonnage can be kept down until the end of June the companies will have the trade in good shape for the rest of the year. Bituminous coal is in an unsettled condition. While prices are nominally kept up to the schedule rates, quite a number of contracts have been taken at a lower figure.

A NEW DRY DOCK.—The new Simpson dry dock has been opened at the New York Navy Yard. The construction was commenced in December, 1887. The dock is built on piling throughout, the floor piling being driven in rows and spaced 3ft. by 4ft. On these heavy Georgia pine timbers are placed lengthwise of the dock, and on these again transverse timbers are placed 4ft. apart. Upon these timbers the working floor of Georgia pine planking is laid, running lengthwise. The keel blocks are supported by four rows of piles capped with heavy timber. The heads of all foundation piles are enclosed in a continuous bed of Portland cement concrete, which also fills all the spaces between the timbers, and rises to the working floor. Open concrete drains lead to the drainage culvert and well. The steps have a rise of 8in. and 10in. tread, and are backed with clay puddle, and are of creosoted Georgia pine. The iron caisson bears against rubber packing attached to the sill and abutments the whole length of the keel and stem, no grooves being used. The dimensions of the dock are:—Full length over coping, 530ft.; full length from inside caisson, 500ft.; width on top amidships, 130ft.; width of floor at entrance, 53ft.; width on top at entrance, 85ft.; depth of gate sill below coping, 30ft. 6in.; depth of gate sill below high water, 25ft. 6in. The pumping machinery consists of two 42in. centrifugal pumps driven by vertical engines, each with 28in. cylinder diameter by 24in. stroke. There are three steel boilers, 13ft. diameter by 11ft. long. The pumps have a capacity of 80,000 gallons per minute, and are capable of emptying the dock in about forty minutes. There are eight flood-gates 22in. in diameter operated by hand wheels on the pump deck of the caisson.

IRRIGATION IN THE UNITED STATES.—The Senate Irrigation Committee in its Report says that more than two-fifths of the area of the United States, including Alaska, requires irrigation to insure regular crops. With dams and reservoirs at suitable places a large extent of this region could be made productive and the floods of the lower Mississippi alleviated. The process of irrigation could be aided by boring artesian wells. All of the country west of the eastern base of the Rocky Mountains requires irrigation except a part of Washington, Oregon, and Northern California, west of the Cascade Mountains, and small areas in Eastern Oregon, Washington, and Northern Idaho. The committee submit in conclusion an estimate of the areas under cultivation. From this it seems that the area under ditch is 13,560,000 acres, of which 4,000,000 is in California and 3,000,000 in Colorado. The amount cultivated by irrigation is 7,763,000, of which 3,300,000 is in California and 1,600,000 is in Colorado. Projects under way and partly completed will bring the acreage under ditch up to 15,000,000 acres. The total value of reclaimed land is nearly $700,000,000. Allowing for the reclaimability of 100,000,000 acres of arid land, we have a total real estate of the value of $2,500,000,000.

ARTESIAN WELLS.—The Artesian belt of the James River Valley, Dakota, is the largest water body of its character known to the world. The James River takes its rise in the Devil's Lake basin, and runs for over 400 miles almost due southward until it enters the Missouri River at Yankton, where the artesian belt has so far reached its largest development. The area thus embraced is at least fifty miles in average width. It contains about 7,000,000 acres, of which certainly 98 per cent. could be made available for tillage. From Jamestown, N.D., about fifty miles above the northern line of South Dakota to Yankton, in the extreme northern part of the same State, there are now about fifty artesian town wells in operation, striking water at a depth that ranges from 1,577ft. in Jamestown to 610ft. and 600ft. at Yankton and Frankfort. There are in all nearly or quite one hundred flowing wells in South Dakota, though all but those named as town wells are usually of small bore, and were sunk for farm purposes only. The remarkable features of this belt of artesian water are its quantity, force, and continuance. The pressure of the principal wells is from 25lb. to the square inch at Highmore to 170 at Yankton, where five wells supply the town with water for domestic uses, town purposes, and as power for manufacturing. The flow of water per minute ranges from 4,000 gallons at Columbia, 3,500 at Aberdeen, 1,500 at Yankton, down to 14 at Highmore. The cost of sinking such wells ranges from $2,700 to $7,300. If the business were systematised, the cost may probably be not over $1,500 each. The altitude ranges from 1,906ft. at Yankton to 1,000ft. above sea level at Grafton.

THE NORTH AND SOUTH AMERICAN RAILWAY.—The Two Americas railway project has been reported upon by a committee of the Pan-American Conference. The committee recommends the appointment of an international commission of engineers, three appointed by each nation, to study the possible routes, determine their true length, and estimate the cost of each. At the present time the city of Mexico is 3,680 miles from New York, *vid* El Paso and the Mexican Central Railroad, and 3,026 miles *vid* Laredo and the Mexican National Railway. A line is in operation 183 miles south of Mexico, and a concession granted for its extension 585 miles further to the borders of Guatemala. A line is also being surveyed for an extension from the border to the city of Guatemala. Lines are projected through Salvador and Honduras, and Nicaragua has a railway system 90 miles long. About 35 miles of an existing Costa Rican may be used in the 210 miles through that State. In the extreme South, the railways of the Argentine Republic are within 120 miles of the Bolivian border, and concessions have been granted for lines to connect with the railway systems of Bolivia and Peru. With these lines built there would be a line 2,190 miles long, from Buenos Ayres to Cuzco, in Peru. Beyond Cuzco, northward to the railways of Costa Rica, a line 2,200 miles long would be required, on which practically nothing has been done. In fact, between Mexico and the northern terminus of the Argentine railway system, a distance of 4,900 miles, there are only 230 miles of railway in operation.

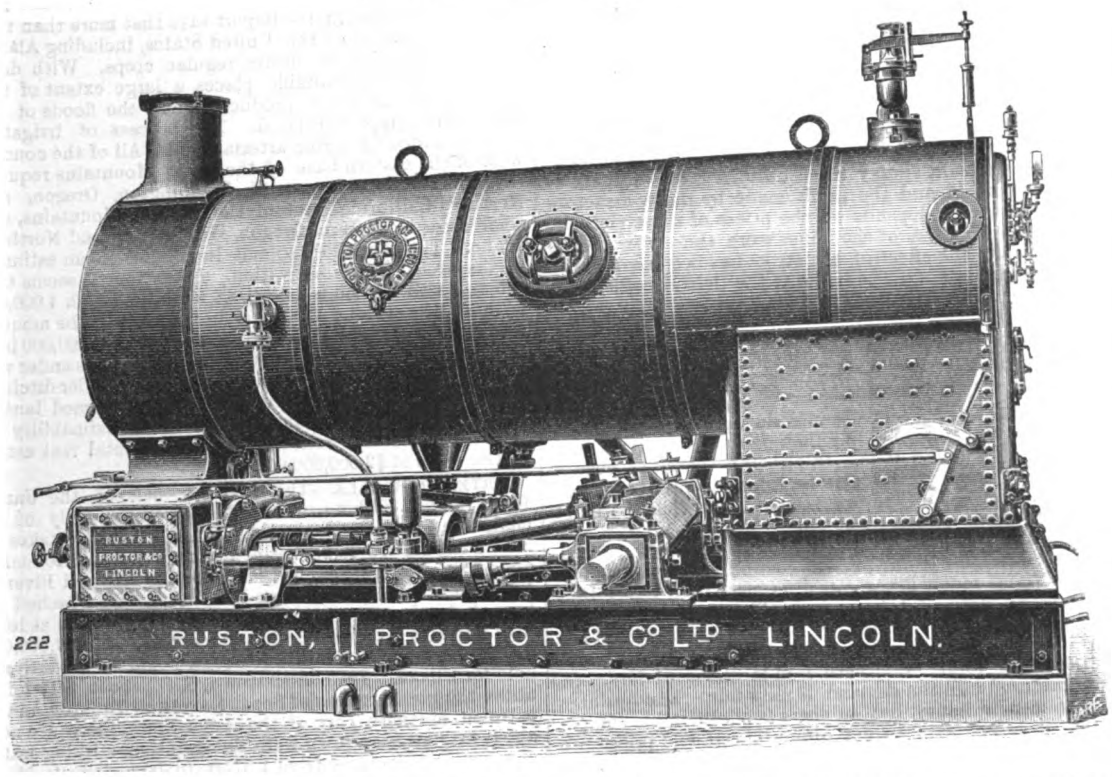
PHILADELPHIA, 16TH MAY, 1890.

FAST RAILWAY RUNNING.—The building of a new bridge over the Schuylkill River has enabled the Philadelphia and Reading and the Baltimore and Ohio Railroads to reorganise their traffic between New York and Washington. The running time of nearly all the trains has been shortened by ten minutes, and a new "flyer" has been added to the service. The northward train leaves Washington at 10 a.m., and Philadelphia (136 miles away) at 12·52, and arrives in New York (226 miles) at 3 p.m. This is the fastest train in the United States.

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THE EDINBURGH EXHIBITION.

Compound Undertype Engine Exhibited by Messrs Ruston, Proctor, & Co., Engineers, Lincoln.



THE EDINBURGH EXHIBITION.

PRIME MOVERS.—II.

Messrs. Ruston, Proctor, & Co., Lincoln, have put down an engine which is used for driving the line of shafting in the machinery hall. This engine is a 25 h.p. compound fixed engine, class N, cylinders 10in. and 16in. diameter and 18in. stroke. It is fitted with automatic gear and a high speed governor, and is altogether excellently finished, substantial, and serviceable. The leading exhibit of this firm is, however, an improved compound undertype engine, 16 h.p. nominal (see illustration given above). This engine is also fitted with automatic expansion gear, and is extremely compact. Like others of its type, the engine is placed beneath the boiler. The cylinders are respectively 8in. and 12¾in. in diameter. The stroke is 16in. The cylinders are jacketed, and covered with wood lagging. A patent ejector is employed to drain the steam jackets. The connecting rods are of best scrap iron, and are fitted at both ends with gun-metal bushes. The admission valve of the high-pressure cylinder is automatically regulated by the governor. The variation may be from 1 per cent. to 50 per cent. of the stroke, according to the power required. The gear used is an arrangement of the slot-link gear, a double-ported expansion valve being connected by a radius rod to a rocking slot link, to which motion is given by a separate eccentric. The governor is of the Porter type, and is directly connected to the expansion gear. The feed pump is worked by a separate eccentric; the plunger, valves, and valve seats are of gun-metal, and the delivery pipe is of copper. The feed pump works continuously, the water not required by the boiler being returned to the feed tank. The water heater consists of a branch from the exhaust, connected by a copper tube to the "return" pipe of the pump; the water in the feed tank is by this means raised to nearly boiling point. The crank-shaft is of steel, and is sufficiently long to carry a fly-wheel or pulley at either end. The crank-shaft has three bearings lined with gun-metal. An outside pedestal and sole-plate are also provided. The fly-wheel is 5ft. 8in. diameter, and is turned to carry a belt. The engine runs 135 revolutions per minute. The boiler is of the ordinary type, the plates both of the boiler shell and fire-box being of Siemens-Martin mild steel. The working pressure is 120lb. per square inch. A rapid-action starting valve—admitting steam directly from the boiler to the low-pressure steam chest—is also supplied when the engine is required for hoisting or other purpose for which sudden stopping and starting are necessary.

CLYDE SHIPBUILDING FOR APRIL.

The increasing number of vacant berths in many of the Clyde shipyards, together with the almost total cessation of inquiries for new work, is a matter for regret, as it betokens an approaching period of slackness in this most important industry. Nothing significant was booked during the month, and no very great increase in the way of new business can be expected until the freight markets improve or a falling off in prices for labour and material takes place. The work in hand, however, is vigorously being pushed forward to completion, and the large number of general traders now on the stocks cannot but have a further depressing influence on the existing rates of freights. The past month is credited with an output of twenty-six vessels having a combined tonnage of 42,875 tons, an amount which has rarely been exceeded in the history of Clyde shipbuilding. Considerable interest is attached to two of the vessels contributing to this large tonnage—the "Adder," a fast paddle steamer, constructed by the Fairfield Shipbuilding and Engineering Company, for Messrs. G. & J. Burns, Glasgow, to conduct a daylight service between Scotland and Ireland; and the paddle steamer "Duchess of Hamilton," built by Messrs. William Denny & Bros., Dumbarton, for the service of the Caledonian Steam Packet Company, between Ardrossan and Arran. The "Adder" has a length of 280ft. between the perpendiculars, with a beam of 33ft., and is provided with a set of diagonal compound engines having cylinders of 51½in. and 93in. respectively, with a stroke of 6ft. The guaranteed speed for this vessel is 19 knots. The "Duchess of Hamilton" is 250ft. by 30ft. by 10ft. 6in. moulded depth. She is provided with powerful compound surface-condensing engines, is fitted up in luxurious manner, and has a promenade deck extending her whole length. She represents quite a new departure in Clyde river steamer construction, and when completed will be the fastest and best-appointed craft running on the river.

The following are the particulars of the vessels launched:—

Single Screw Steamers.

"Asphodel," steel, 2,700 tons, and engined with triple-expansion engines by Messrs. A. Stephen & Son, Linthouse, to the order of Mr. J. B. Murray, Glasgow, and intended for general trade.

"Banda," steel, 3,300 tons, built by Messrs. Charles Connell & Co., Scotstown, and fitted with triple-expansion engines by Messrs. David Rowan & Sons, Glasgow, for the Hamburg-Calcutta line of steamers, Hamburg.

"Brand," steel, 2,000 tons, 3,500 tons carrying capacity, built by Messrs. Robert Duncan & Co., Port Glasgow, and supplied with triple-expansion engines by Messrs. Muir & Houston, Glasgow, for Mr. Gunnar Knudsen, Porsgrund, Norway.

"Brazilian," steel, 3,203 tons, built and fitted with triple-expansion engines by Messrs. D. & W. Henderson & Co., Partick, for the South American trade of Messrs. J. & A. Allan, Glasgow.

"Clyde," steel, 5,650 tons, 7,000 i.h.p., built and engined with triple-expansion engines by Messrs. R. Napier & Sons, Govan, for the West Indian, Brazil, and River Plate service of the Royal Mail Steam Packet Company, London.

"Lord Bangor," steel, 3,000 tons, built by Messrs. Russell & Co., Greenock, and fitted with triple-expansion engines by Messrs. Dunsmuir & Jackson, Govan, to the order of Messrs. Dixon & Sons, Belfast.

"Priam," steel, 2,800 tons, 1,500 i.h.p., built and supplied with triple-expansion engines by Messrs. Scott & Co., Greenock, for the China trade of the Ocean Steamship Company, Liverpool.

"Prince," iron, 400 tons, built by Messrs. J. Fullerton & Co., Paisley, and engined by Messrs. Muir & Houston, Glasgow, for the general coasting trade of Messsrs. J. & J. Hay, Glasgow.

"Ping Suly," steel, 3,150 tons, 2,500 i.h.p., built and fitted with triple-expansion engines by Messrs. Barclay, Curle, &c., to the order of the China Shippers' Mutual Steam Navigation Company, London, and intended for their service between London and China.

"Rotokino," steel, 2,000 tons, built by Messrs. William Denny & Brothers, Dumbarton, and fitted with quadruple-expansion engines by Messrs. Denny & Co., Dumbarton, for the Union Steamship Company of New Zealand.

"Sama," steel, 700 tons, 700 i.h.p., built and fitted with triple-expansion engines by Messrs. Hanna, Donald, & Wilson, Paisley, for Mr. J. Christensen, Bergen, and intended for the West Indian fruit trade.

"Wodonga," steel, 2,400 tons, 3,000 i.h.p., built and fitted with triple-expansion engines by Messrs. A. & J. Inglis, Pointhouse, for the Australasian United Steam Navigation Company, for trade in Australian waters.

Twin Screw Steamers.

"Apa," steel, 600 tons, built by Messrs. Robert Duncan & Co., Port Glasgow, and fitted with Rankin's patent disconnecting twin-screw engines by Messrs. Rankin & Blackmore, Greenock, to the order of Paraguayan Development Company, and is intended for service on the River Plate.

"Bute," No. 2, iron, 400 tons, built by Messrs. Scott & Co., Bowling, and fitted with compound surface-condensing engines by Mr. W. Kemp, Govan, to the order of Messrs. Hill & Co., Glasgow.

"Duckenfield," steel, 1,200 tons, 1,200 i.h.p., built and fitted with quadruple-expansion engines by Messrs. Fleming & Ferguson, Paisley, to the order of Messrs. J. & A. Brown, New South Wales, for their colonial trade.

"Hornby," 180 tons, built by Messrs. M'Knight & Co., Ayr, and supplied with compound surface-condensing engines by Messrs. Ross & Duncan, Govan, to the order of the Alexander Towing Company, Liverpool, for towing purposes.

Paddle Steamers.

"Adder," steel, 1,000 tons, built and fitted with compound surface-condensing engines by the Fairfield Shipbuilding Company, Govan, to the order of Messrs. G. & J. Burns, for their mail and passenger service between Scotland and Ireland.

"Duchess of Hamilton," steel, 580 tons, built by Messrs. William Denny & Bros., Dumbarton, and engined with compound surface-condensing engines by Messrs. Denny & Co., Dumbarton, to the order of the Caledonian Steam Packet Company, for their Clyde passenger traffic.

"Marchioness of Breadalbane," steel, 250 tons, built by Messrs. John Reid & Co., Port Glasgow, and fitted with compound tandem engines by Messrs. Rankin & Blackmore, for the passenger traffic of the Caledonian Steam Packet Company.

Yachts.

"Tessa," 6-ton racing yacht, built by Mr. James Adams Gourock, for Mr. F. B. Jamieson.

"White Heather," steel, 636-ton steam yacht, built by Messrs. John Reid & Co., Port Glasgow, for Mr. R. Cecil, Leigh.

Sailing Ships.

"Andromeda," steel, 1,900 tons, built by Messrs. Robert Duncan & Co., Port Glasgow, for Mr. G. F. Smith, St. John, New Brunswick.

"Chicharra," steel, 460 tons, schooner, built by Messrs. Blackwood & Co., Port Glasgow, for the River Plate coasting trade of Messrs. J. & A. Allan, Glasgow.

"Dumbarton Rock," steel, 1,700 tons, built by Messrs. Russell & Co., Port Glasgow, to the order of Messrs. James Cornfoot & Co., Glasgow.

"Garnet Hill," steel, 2,200 tons, built by Messrs. Russell & Co., Port Glasgow, to the order of Messrs. J. R. Dickson & Co., Glasgow.

"Portugo," sister ship to the "Chicharra," and constructed for the same service, by the same builders, for the same owners.

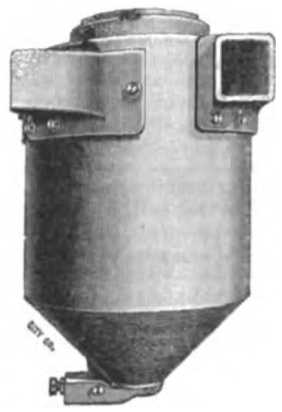
Analysis of Launches.

	Steamers. No.	Tonnage.		Sailing Vessels. No.	Tonnage.		Yachts. No.	Tnge.
Great Britain	13	25,313	...	4	4,820	...	2	642
Norway	2	2,700	...	—	—	...	—	—
Australia	2	3,605	...	—	—	...	—	—
Paraguay	1	600	...	—	—	...	—	—
New Brunswick ...	1	3,300	...	1	1,900	...	—	—
	19	35,513		5	6,720		2	642

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THE "GLOBE" SEPARATOR.

It is highly desirable that the steam which is used for engine purposes should be quite dry and devoid of watery vapour. Many boiler makers provide apparatus, the object of which is to separate the moisture from the steam as it issues from the boiler; but many of them are expensive, and not all of them are certain in their action. Mr. A. G. Brown has recently designed, and Messrs. John Musgrave & Sons, Globe Works, Bolton, are now manufacturing, a new form of separator, which, on account of its simplicity of action and construction, combined with its efficiency, bids fair to have an extensive application. Below will be found illustrations of this apparatus and of its arrangement in the boiler. It consists of a cylindrical vessel, which is placed within the steam space immediately below the steam pipe. It has around its upper portion four orifices, arranged tangentially to its



Exterior View of Separator.



The Separator as Fixed in Boiler.

circumference. The orifices have also a slight downward inclination, so that the several entering currents of steam shall be clear of each other. The steam is thus given a rapid spiral movement, and the whole forms a sort of inverted vortex. Owing to the higher specific gravity of the moisture the latter is thrown against the sides, and from there it trickles downwards. The lower end of the separator is closed by a valve, which oscillates on knife-edged bearings made of hard brass. This valve is very nearly balanced, and a small addition of weight at one end is sufficient to move it. The valve is thus caused to open periodically and the water to fall back into the boiler. The opening of the valve does not allow either steam or water to pass into the separator. The nozzle of the steam pipe is placed just above the water valve, so that the steam has to traverse the whole length of the vessel before finding an exit.

Notices of Meetings.

NEXT WEEK.

Royal Institution.—Friday, June 6th, at 9 p.m. Professor W. Boyd Dawkins, M.A., F.R.S., on "The Search for Coal in the South of England."

Physical Society.—Monday, June 6th. (1) "The Effect of Change of Temperature on the Villari Critical Point of Iron," by Mr. Herbert Tomlinson, F.R.S.; (2) "The Diurnal Variation of the Magnet at Kew," by Messrs. W. G. Robson and S. W. J. Smith.

Society of Chemical Industry (London Section).—Monday, June 2nd, at 8 p.m. Messrs. Cross and Bevan's paper on "Some Considerations on the Chemistry of Hypochlorite Bleaching" will be read and discussed.

Society of Engineers.—Monday, June 2nd, at 7.30 p.m. A paper will be read on "Pick's System of Manufacturing Salt in Vacuo," by Mr. Perry F. Nursey.

Institution of Civil Engineers.—Tuesday, June 3rd, at 8 p.m. Annual general meeting, to receive the report of the council, and to elect the council and officers for the ensuing year.

Chemical Society.—Thursday, June 5th, at 8 p.m. Note on "The Preparation of Pure Crystalline Copper," by Mr. C. C. Duncan.

PRICES CURRENT, 28th May, 1890.

Quotations at per ton, unless otherwise specified.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	5 17 6	.....	6 7 6	f.o.t. wks.
„ Angles	5 12 6	.....	6 2 6	„
„ Plates	5 15 0	.....	6 5 0	„
Staffordshire Bars (cheaper makes)	7 10 0	.....	8 0 0	London.
„ Angles	7 10 0	.....	8 0 0	„
Crown Sheets	7 2 6	.....	7 12 6	„
„ Hoops	6 17 6	.....	7 7 6	„
"Siemens-Martin" Steel Boiler Plates			7 17 6	„
„ Ship and Girder			6 17 6	„

Market quiet.

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	69/-	..... 59/-

F.O.B. Grangemouth or F.C.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

METALS.

Spelter:	Ordinary	£24	0	0			
Copper:	British Cakes and Ingots	59	10	0	to	60	10 0
„	Chili Bars, G.O.B.'s	54	2	6	„	54	10 0
„	Other sorts, G.M.B.'s (equal to Chili Bars)	54	2	6	„	54	10 0
„	Manufactured (strong)	66	0	0	„	.....	
Lead:	Common Pig	13	10	0	„	13	15 0
„	English Sheet	14	5	0	„	14	10 0
Tin:	Straits	94	10	0	„	94	15 0
„	Australian		.....		„	.....	
„	English Ingots	99	0	0	„	.....	

Messrs. Carrick & Brockbank, Manchester, report as follows:—

Copper continues in a strong position, with a tendency to higher rates. The demand for consumption is reported good, and the decrease in stocks this month is expected to be heavier than for some time past. There is still an active speculative inquiry which helps to strengthen values. The London market opened strong on Tuesday, with an active business in Chili bars at £54 2s. 6d. to £54 10s. cash. Manufactured is firm at £66 sheets and £69 bottoms.

Tin quiet, with values unchanged. Although the business done during the week has been small prices have been maintained.

Lead continues inactive, without quotable change in price.

Spelter is a shade easier, but mainly owing to the holidays. The stocks are very low, and it is difficult to get prompt deliveries from smelters.

PIG IRON.

Middlesbro' Warrants, No. 3.	40/6	Cash
Scotch Warrants, m/n	44/6	„
Hematite Warrants, m/n	53/-	„

Stocks in Stores	Scotch 748,805	—Dec. for week	10,956	Tons.
	Middlesbro' 107,730	—Dec. „	11,066	„
	Hematite ... 321,088	—Dec. „	4,373	„

	No. 1.		No. 3.	
Coltness	65/-	.....	58/-	f.o.b. Glasgow.
Gartsherrie	61/-	.....	56/6	„ „
Langloan	64/6	.....	58/-	„ „
Summerlee	62/6	.....	57/6	„ „
Glengarnock	63/-	.....	57/-	„ „
G.M.B. ex Store	45/-	.....	44/9	„ „

CHEMICALS.

		£ s. d.		£ s. d.
Acid: Carbolic Crystals	lb.	0 0 8½	to	0 0 10
„ „ Liquid	gal.	0 1 2	—	.....
„ Citric	lb.	0 1 7	—	.....
„ Oxalic	„	0 0 4	—	.....
„ Sulphuric	ton	1 12 0	—	.....
„ Tartaric	lb.	0 1 4	—	.....
Alum: Lump (powder 10/- ex.)	ton	4 17 6	—	.....
Ammonia: Carbonate	lb.	0 0 3½	—	.....
„ Muriate (Grey)	ton	22 15 0	—	.....
„ „ (White)	„	26 10 0	—	.....
„ Sulphate	„	11 10 0	—	.....
„ Liquor	lb.	0 0 8¾	—	.....
Antimony	ton	.....	—	.....
Bleaching Powder	„	5 0 0	—	5 2 6
Bisulphide of Carbon	„	13 10 0	—	.....
Borax	„	80 0 0	—	.....
Benzole (90 %)	gal.	0 3 10	—	.....
„ (50/90 %)	„	0 2 10	—	.....
Copper Sulphate	ton	26 0 0	—	.....
Copperas	„	2 0 0	—	.....
Kieserit	„	.....	—	.....
Lead: Nitrate	„	22 10 0	—	.....
„ White Sugar	„	24 0 0	—	.....
„ Brown „	„	19 0 0	—	.....
Potash: Bichromate	lb.	0 0 4	—	.....
„ Caustic	ton	22 0 0	—	.....
„ Carbonate	„	19 10 0	—	.....
„ Chlorate	lb.	0 0 5	—	.....
„ Prussiate (Yellow)	„	0 0 9½	—	.....
„ Sulphate (Basis 90 %)	ton	9 10 0	—	.....
Precipitate: Red	lb.	0 3 1	—	.....
„ White	„	0 3 2	—	.....
Salts: Epsom { Bags	ton	3 0 0	—	.....
Salts: Epsom { Casks	„	3 15 0	—	.....
„ Glauber	„	1 10 0	—	.....
Sulphur: Sublimed Flowers	„	9 0 0	—	.....
„ Recovered	„	4 10 0	—	.....
Soda: Ash	deg.	0 0 1½	—	.....
„ Caustic (White 70%)	ton	7 10 0	—	7 12 6
„ „ „ 60%)	„	6 12 6	—	6 15 0
„ „ (Cream 60%)	„	6 7 6	—	6 12 6
„ Crystals	„	3 2 6	—	3 5 0
„ Bicarbonate	„	6 5 0	—	.....
„ Hyposulphite	„	6 5 0	—	.....
Solvent Naphtha	gal.	0 4 0	—	.....
Tartar, Cream of	cwt.	5 12 6	—	.....
Zinc Sulphate	ton	7 10 0	—	.....

OILS.

		£ s. d.
Cocoanut: Cochin	per ton	29 10 0
„ Ceylon	„	25 10 0
Cottonseed	„	22 10 0
Cod	„	20 0 0
Lard	„	36 0 0
Linseed	„	23 15 0
Palm, Lagos	„	25 10 0
Rapeseed: English	„	32 10 0
Seal: Pale	„	27 0 0
„ Brown	„	22 0 0
Sperm	„	45 0 0
Whale	„	24 0 0
Turpentine	per cwt.	1 9 3
Coal	per gal.	
Petroleum (Refined)	„	0 0 5 1/16
„ Spirit	„	0 0 7

SHIPBUILDING NOTES.

On the 19th inst. Messrs. Richardson, Duck, & Co. launched, from their yard at South Stockton a steel screw steamer of the following dimensions:—Length over all, 307ft. 4in.; breadth, extreme, 40ft.; depth of hold, 20ft. 2in. The vessel has been built to the order of the Commercial Steamship Company, Limited, of London. She has a half poop aft, with accommodation for captain, officers, and passengers, a raised quarter-deck, and a long bridge from the after engine-room bulkhead to the stem. The engineers are berthed in a deck-house on the quarter-deck, and the crew on the 'tween decks alongside the fore hatch. She has a double bottom all fore and aft on the cellular principle, capable of containing about 560 tons of water ballast. She is fitted with an Emerson Walker's steam windlass, a large donkey boiler, four horizontal steam winches, and every modern improvement for the loading and discharging of cargo. The engines have been built by Messrs. Blair & Co., Limited, of Stockton, and have cylinders 22½in., 37in., and 61in. diameter, by 42in. stroke. As the vessel was leaving the ways she was christened "Darlington."

On the 20th inst. there was launched from the yard of the Tyne Iron Shipbuilding Company, Limited, of Willington Quay-on-Tyne, a steel screw steamer which has been built to the order of Messrs. Jennison, Taylor, & Co., of Sunderland. She is of the following dimensions:—Length, 300ft.; breadth, 41ft.; depth, 22ft. 2in. The engines, which are to be supplied by the Wallsend Slipway and Engineering Company, Limited, are of the triple expansion type, and the cylinders are 23in., 38in., and 61in. diameter, by 42in. stroke. On leaving the ways the vessel was named the "Mendelssohn."

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HOME INDUSTRIES.

LONDON, 29th May, 1890.

The Money Market.—The supply of money is largely in excess of the demand just now, and exceedingly low rates are the rule. Even for the Stock Exchange settlement this week lenders have been unable to obtain more than two per cent. for accommodation, for which higher rates are charged as a rule than any other. Discount rates are still low, but with a firmer tendency through fears of further gold withdrawals. No change of importance has occurred in the silver position, but the partisans of that metal are for the moment less sanguine about the promised American legislation. The stock markets have hardly got into full swing after the holidays, as the incidence of the settlement so soon after the Exchange had been closed for a couple of days tended to restrict business all the week. American and Canadian railway securities have been fairly steady without much feature. Among foreigners, Egyptian and Turkish stocks continue in favour, and South American securities have some vogue. Copper shares have risen very considerably, but gold mining shares are quiet. Miscellaneous and industrial securities have shown no characteristic of interest.

Companies.—The following companies have been registered since our last report:—San Francisco Breweries, Ld., with a capital of £1,000,000; Indian Consolidated Gold Mining Co., Ld., with a capital of £275,000; The Planing-Saw Co., Ld, with a capital of £50,000, to acquire certain patent rights; John Brodie & Co., Ld., with a capital of £20,000, to carry on the business of shipbuilders and engineers; Eagle Matting Co., Ld., with a capital of £2,000; Bissol Tin Smelting and Arsenic Co., Ld., with a capital of £50,000; Aberystwith Marine Pier Co., Ld., with a capital of £5,000, to acquire this pier; Neuhaus's Combination Machine Co., Ld., with a capital of £5,000; Emma Co., Ld., with a capital of £125,000, to acquire the New Emma Silver Mining Co., Ld.; Mexican Portland Cement Co., Ld., with a capital of £20,000, to acquire certain patents for the manufacture of cement in Mexico; Congo Exploration, Ld., with a capital of £20,000; Shildon Coal Co., Ld., with a capital of £11,000, to purchase the Shildon Colliery, Durham; Buenos Ayres Western Railway, Ld., with a capital of £6,900,000; Rowland & Marwood's Steamship Co., Ld., with a capital of £275,000; The Berlin National Brewery, Ld., with a capital of £30,000.

Railway Receipts.—The gross receipts of the twenty-three principal railways in the United Kingdom for the week ending the 18th inst. amounted, on 16,159¼ miles, to £1,333,497, and for the corresponding period of 1889, on 16,031 miles, to £1,273,712, an increase of 128¼ miles, or 0·8 per cent., and an increase of £59,785, or 4·7 per cent.

Railway Extension in the West of England.—On the 2nd prox. the Plymouth, Devonport, and South-Western Junction Company's new line from Lidford to Tavistock, Devonport, and Plymouth will be opened for traffic by the South-Western Railway Company, whose trains will run over the line in connection with their through services from London and with the north of England *vid* the Midland Railway and Templecombe. Considerable accelerations in the journey between London and Plymouth are announced, the time occupied being as follows:—To Exeter, 3¾ hours; Devonport, 5¼ hours; and Plymouth, 5 hours and 20 minutes. These fast trains will be extended through the north of Devon to Barnstaple, Bideford, and Ilfracombe. The quickest train at present running between Waterloo and Plymouth performs the journey in a few minutes under six hours; it will be seen, therefore, that the acceleration stated is very considerable.

The Explosive "Fortis."—An addition is about to be made in this country to the list of high explosives suitable for use in practical blasting, the new compound being known as "Fortis." It was invented some three years since, and as soon as it was developed into practical form a factory was erected in Belgium, where it has since been manufactured on a commercial scale, and meets with a steady demand from mine and quarry owners. "Fortis" is made of various strengths suitable for the different requirements of mining, and is a black powder containing some six or seven ingredients, the chief of which are nitrate of potash, sulphur, and tan. In a series of experiments carried out by Mr. C. Napier Hake, in the Mount Sorrel granite quarries, "Fortis" was found to do two-and-a-half times the work of blasting powder. The new explosive is being introduced in this country by the Fortis Powder and Explosives Company, of 17, Coleman Street, London.

Mining in Devon and Cornwall.—The last annual report of the Inspector of Mines for Devon and Cornwall has been laid before Parliament. The total number of persons employed was 13,464, or 275 less than the previous year. The quantity of minerals wrought from the various mines of the two counties was 118,201 tons, of which 12,464 tons consisted of tin ore, 7,688 tons of arsenical pyrites, 7,618 tons of dressed copper ore, 4,758 tons of arsenic, 3,200 tons of iron ore, and 1,200 tons of barytes. Of the rest 81,051 tons consisted of clays, stone, and slate, and there were, in addition, small quantities of zinc ore, ochre, and copper. The number of deaths by accident in 1889 was 23, being one less than 1888, and the number per 1,000 was 1·70. The average for the past seventeen years was 1·63. The inspector thinks that many of the accidents underground are due to the negligence of the miners themselves. There were four prosecutions, followed by the conviction, of mine managers during the year. Tin mining has progressed steadily during the year, in spite of market fluctuations. Amongst the several lodes which have shown a marked improvement, the most important is that being worked at the Carn Brae mine, which has caused the shares to rise 500 per cent. value. Dolcoath mine adit, although sunk to a depth of over 400 fathoms, still continues to make large returns, and the lode at this great depth shows no sign of decreasing in value.

The Mining Exhibition.—The date for the opening of this Exhibition at the Crystal Palace has been changed to the 16th July. It promises to be international in more than name, as it is announced that products of France, Belgium, Germany, Spain, and many other European countries will be represented, in addition to the United States, Canada, Mexico, various South American Republics, Australia, South Africa, Borneo, &c. The Governments of New South Wales, South Australia, and Western Australia have taken space officially.

Her Majesty's Inspectors of Factories.—The Civil Service Commissioners have just issued a new scheme for the examination for inspectorships of factories. Hitherto candidates who could produce a certificate of having been actually employed in a factory or workshop for seven years as employer, manager, foreman, or workman were exempt from a part of the prescribed examination, but the new scheme applies to all candidates, the advantage given to practical men who have been engaged in factories already being that the maximum limit of age is extended from thirty to thirty-eight years. The subjects of examination are—(1) Handwriting; (2) spelling; (3) arithmetic, including vulgar and decimal fractions; (4) English composition; (5) theoretical and practical acquaintance with factories and workshops, including a knowledge of their sanitary requirements; (6) applied mechanics, including elementary mechanical drawing; (7) (*a*) the Factory and Workshop Acts of 1878, 1883, 1888 (Scotland), 1889, and the Truck Acts (1 and 2 Will. IV., c. 37, and 50 and 51 Vict., c. 46), also certain other Acts practically administered by the Inspectors of Factories, such as the Education and Protection of Children Acts; (*b*) an acquaintance with the history of factory legislation in the United Kingdom. Candidates must pass to the satisfaction of the Civil Service Commissioners in all these subjects. When two or more candidates are nominated for one vacancy the competition will be in subjects 5, 6, and 7. The limits of age are twenty-one to thirty, with an extension up to thirty-eight in favour of candidates who have been occupied as master, manager, foreman, or workman in a factory or workshop for at least seven years, and have acquired practical acquaintance with the working of factories and workshops. An official nomination by the Home Secretary is required before examination.

The Automatic Photograph (Foreign and Colonial) Company.—So large an application was made for the shares of the Automatic Photograph Company that the promoters are now putting upon the market another company to carry on automatic photography in foreign countries and in the colonies. It is not necessary to enter here into the question as to the possibility of executing a photograph for a penny in a minute; the only reason we refer to the subject is to point out that in the prospectus of the company the promoters only quote the opinions of the non-technical press.

MANCHESTER, 29th May, 1890.

The Iron Trade.—The market for iron does not improve, and buyers are very scarce. There are a few parcels sold, but prices have to be reduced to effect the sale. Finished iron especially is weak, and orders are very bad to obtain. Many of the old contracts are almost completed, and makers have some difficulty in replacing them. Users cannot be induced to buy ahead.

Greater Manchester.—The Local Government Board has granted a provisional order for the extension of the boundaries of the city of Manchester. An inquiry was held in February last by Commissioners of the Board, who heard the evidence presented and reported to the Board. The effect of the order is to largely increase the area of Manchester, and to include within it certain industrial districts, which are sure to become populous and wealthy in a few years. The present acreage of Manchester is 5,927, its population 378,000, and its rateable value £2,416,330. The additions to be made will raise these figures to 12,788, 480,700, and £2,766,392 respectively. The city corporation is carrying out large water and drainage works in which the surrounding townships will participate, and the burden of which will be jointly carried. Provisional orders have also recently been granted for an important street improvement, and for the clearance of certain congested districts preparatory to the erection of better dwellings.

Sewage Experiments.—The Salford Corporation are at present investigating the subject of sewage purification at their works at Mode Wheel. The lime system has been in operation, but its results have not been altogether satisfactory. Accordingly they are trying the International Sewage Purification Company's system, which is in operation at Acton and other places, and in which salts of iron are used. The system of Mr. William Webster, which is the property of the Electrical Purification Association, is also to be tried later on. The "Amines" system, in which fish brine is the chief agent, is also to be experimented with. The Salford Corporation appear to be making a determined effort to solve a very difficult problem.

The Engineering Trades.—The holiday season has not led to as much cessation of work as usual. Engine builders and millwrights are busy with repairs, in addition to the large volume of new work which they have in hand. The remarkable feature of the trade is the great activity observable in the tool trade. Although there is a general report of fewer orders in other departments, the volume of orders for tools shows no sign of diminution. Railway tools of all sorts are in request, and heavy machinery for treating large forgings are also well ordered. In fact, the activity is remarkable, and there is hardly an exception to this state of things. Textile machinists are also well engaged, and new orders are coming in freely. There are a number of new mills projected, and replacements are also being made in large quantities. Various kinds of humidifiers are being introduced at present, some of them having features of novelty in their mechanism. Mr. Chas. Lancaster, of Manchester, has just perfected an instrument for graphically recording the humidity in a shed.

The Linen and Jute Trades.—The season thus far has on the whole been satisfactory, although in some departments complaints have been freely made as to the unfavourable results of the year's business. Roughs and other goods of a similar make have moved off very slowly, and stocks both here and at Belfast have accumulated, while prices have weakened. Many looms employed in the production of roughs have either been idle or turned on to other fabrics. Of late, quotations have been slightly firmer, and hopes are entertained that matters will improve. There is the more reason for anticipating that such will be the case owing to the fact that cotton roughs have now lost the hold they at one time possessed in the market. This week business has been extremely quiet owing to the holidays, the leading distributors having been closed on Monday, while during the remainder of the week they close at noon. Apart from this circumstance, the general feeling in the linen department is dull, as buyers keep down deliveries as much as possible until after the June stock-taking. The American demand is not as active as was anticipated, and the future course of business with that quarter is not regarded in a hopeful light in consequence of the cablegrams with reference to the discussion on the McKinley Bill in the House of Representatives. The Yorkshire trade is of an average character, and sales of Barnsley linens in the warehouses of this city are fairly maintained. Leeds crashes which are of a superior quality continue to meet with favour.

Projected New Railway.—An agitation has been commenced for the construction of a new line of railway to Windermere. It is proposed that the existing branch of the Midland Railway which connects with the Furness Railway should be extended to Bowness. The object is to obtain easier access to the lake district from Bradford and Leeds, the inhabitants of which can only reach it by a circuitous and slow route. The attention of the directors of the two lines named has been called to the subject.

GLASGOW, 29th May, 1890.

Pig Iron.—As the dealers and brokers were anxious to be relieved from attendance upon a rather listless and wearisome market, the Glasgow pig iron market was closed from the evening of the 21st to the morning of the 27th inst. On the resumption of business on the last-named day a cheerful feeling was manifested. So far as Scotland is concerned there is very little wrong with the trade, but the low price at which Middlesbrough iron is now obtainable threatens to interfere materially in the near future with the present good demand for G.M.B.'s, while special brands are only in moderate request, and are offering daily at drooping prices. A very important change will be brought about in the pig iron trade if a proposal be carried out which the Board of Management of the British Iron Trade Association are said to have in contemplation. This is the controlling of speculation in pig iron warrants by legislation. While, no doubt, serious disturbances are often introduced into the trade by outside "bulling" and "bearing," the difficulties in the way of preventing speculative transactions in pig iron or in anything else would be very considerable. If, however, it were by any means effectively managed, it is probable that in the main it might contribute to the steadying of prices, although there is something in the contention that speculation as often steadies prices as it disturbs them.

Coal Trade.—The fears of a serious drop in prices are so far being falsified, only, however, because the output is being sedulously limited. The result is that prices, both for local consumption and shipping, are steady.

Engineering.—Orders in the engineering world are at the moment rather scarce. The only one of any note is for steel for bridge building, booked by the Steel Company of Scotland. Tube makers have met a falling market by increasing the discount by 5 per cent. There is a general feeling of indifference among buyers, and orders are difficult to secure even at concessions in price. This applies to all the branches of the iron trades.

General Trade.—Though manufacturing industry goes on as usual the exchanges are at a standstill, owing to the English holidays. Shipping business, too, is very dull, owing to there being no London market. Freights are, however, generally steady. The disengaged tonnage is reported as about 24,000 tons register. Two furnaces are about to be blown out—one at Gartsherrie, and one at

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Eglinton. This will leave 84 furnaces in blast, as compared with 82 twelve months ago.

CONGRESS OF FLOUR MILLERS.—Dr. John Forbes White, of Dundee, has been elected President of the forthcoming Congress of British Flour Millers. The meeting is to be held in Edinburgh about the middle of July.

(From our own Correspondents.)

LIVERPOOL, 28TH MAY, 1890.

ENGINEERING AND SHIPBUILDING.—Although most of the shops and yards on both sides of the river are now exceedingly busy, most of them have had to stop for a few days during Whitsuntide, this being now a recognised holiday time in the district—much more so than formerly. Advantage has been taken of the stoppage to overhaul the machinery and plant, and to effect any necessary repairs, painting, &c. Owing to the beautiful weather the town has been crowded with excursionists from all parts of the country; the traffic across the river by the different ferries, especially to New Brighton, has been enormous, and great credit is due to the Landing Stage officials for the admirable manner in which the traffic was managed, not a single serious accident having been reported. The Welsh and Manx steamers were all crowded, and extra boats to the latter place were put on, all of them being well filled. Considerable interest is centred upon the Welsh competition, but the new boat, "St. Tudno," has proved herself to be a fast boat, and accomplishes the journey to Llandudno in nearly three-quarters of an hour less time than the old boats.

FOREIGN MEAT IMPORTS.—Sixteen steamers arrived in the Mersey during the past week with 6,040 cattle, 1,042 sheep, and 33,401 quarters of beef. Notwithstanding these enormous arrivals, the totals show a decrease of 4,167 quarters of beef, but an increase of 1,015 cattle when compared with the returns for the previous week.

SHEFFIELD, 28TH MAY, 1890.

IRON AND STEEL TRADES.—Most of the works are closed this week. The exceptionally fine weather and the recent good times have given the workmen the means of enjoying a longer holiday than usual. In all the heavy branches of iron and steel work will not be resumed for a week or ten days, as it will be impossible to complete the necessary repairs to the presses, rolls, hammers, and furnaces. The recent fall in prices has caused an influx of railway work to Sheffield, sufficient to find employment to the mills throughout this year. The English Colonies, India, and South America are the chief customers.

THE COAL TRADE.—On Saturday the Duke of Portland turned the first sod of a new colliery shaft at Whitwell, the property of the Shireoaks Colliery Company. This company already raise 350,000 tons of coal per annum from the same coal field.

NORTH STAFFORDSHIRE, 28TH MAY, 1890.

THE IRON TRADE.—Owing to the Whitsuntide holidays the ironworks of the district are at a standstill, and in many cases will not resume operations till next week, advantage being taken of the stoppage to carry out any necessary repairs. There is, on the whole, a somewhat firmer feeling in the trade, and an advance in prices is looked for. Consumers are showing more readiness in giving out their orders and specifications. In the case of pig iron prices have reached a point below the present cost of production, and blast furnaces are being blown out in consequence. The restriction in the output will naturally have a tendency to harden prices.

LEICESTER, 28TH MAY, 1890.

WOOL, SPINNING, AND YARN TRADES.—Owing to the action of the holidays, and to a considerable uncertainty as to fixity of prices, trade has been markedly limited in volume in the wool market since our last report. During the last few days there has been a tendency towards more confidence, but users content themselves with merely supplying their present wants. Trade of a speculative nature is quite absent. Skin wools are not so much in demand, and in these wools there is some stock accumulating. Spinners have their machinery fairly well employed on old contracts, but new business is difficult to obtain, as buyers are very cautious and spinners are trying for rather better rates. As a rule the new business is for immediate wants.

HOSIERY TRADE.—There is a decided improvement in this industry, and orders are being placed freely for heavy woollens, both on home and shipping account. The fancy department is also more active, and the workpeople generally are having fuller employment.

BOOT AND SHOE TRADE.—Up to the end of last week the various factories were engaged to their utmost capacity in filling orders before the holidays. This week but little will be done, but there is every prospect of a resumption of the brisk business on recommencing work. Leather merchants are making a good turnover in supplying consumers' present wants, but buyers will not do any speculative business.

ELECTRIC LIGHTING.—The Corporation have received a draft of the Provisional Order of the Board of Trade in response to their application. It insists on the Corporation providing the light for the whole of the borough. It also compels the Corporation, within two years from the date of the Act confirming it, "laying down suitable mains for distributing the supply" in the area asked for, and also that they do so in any street in the borough within six months of the receipt of a requisition from six or more owners or occupiers. The minimum supply is 20 "units" per quarter. The price is fixed at 8d. per unit, the object being to bring the light within the range of all classes.

SWANSEA, 28TH MAY, 1890.

REOPENING OF IRON MINES.—The Mwyndy Iron Ore Company have just reopened the Llanharry Iron Ore Works, which have been closed during the last fifteen years.

TINPLATES.—The heavy shipments of tinplates, which have reduced stocks by nearly 40,000 boxes, have imparted firmness to this market. Prices show no advance on recent quotations, and common iron cokes can be bought at from 13s. to 13s. 3d., with an advance of from 6d. to 9d. per box for Siemens quality. Nevertheless, the position of makers has materially improved, the competition of the West Coast houses with local manufacturers having brought down the price of steel bars to below £5—a decided reversal of the condition of affairs that obtained only a few weeks ago, when the steelmakers were having it all their own way. It is hence a matter for regret that the attempt to introduce a revised list should now form a new source of trouble. The following are the employers' prices, which the men seem determined to resist:—Rolling, 3s. 5d. per dozen; doubling, 2s. 9d. per dozen; furnacing, 2s. 7d. per dozen; behinding, 1s. 3d. per dozen; shearing, 1s. 1d. per dozen (all 116 sheets to the box); tinning, 3d. per box; washing, 3d. per box; washing by apprentices, list sizes, 2d. per box for the first 5,000 boxes, and 2½d. for the second 5,000 boxes (all 114 sheets to the box); dipping in patent pots, 1½d. per box; greasing, 1d. per box; sorting 6s. 3d. per day, for three sets when working. Boxing payment according to circumstances. XX plates, and all above, to be paid for at the rate of 140lb. per box in mills and tin houses. The disturbance of the standard by establishing 116 sheets to be paid for in mills, as against 114 sheets per box in tin houses, is objected to by the men, who are also against the re-introduction of the apprentice system. The Old Lodge Tinplate Works, Llanelly, are now in active operation. The works possess six mills, and are fitted up with the electric light, having also the very latest improvements in other respects.

BARROW-IN-FURNESS, 28TH MAY, 1890.

HEMATITE PIG IRON.—There is less activity this week in the iron trade, owing to the observance of the holidays as well as to the want of spirit on the part of buyers. The reduction of stocks is a feature which sooner or later will help to stiffen the market, but before that can be done buyers and merchants must be satisfied that the bottom of the decline in prices has been reached. During the week business has been done in hematite warrants at 53s. 3d. cash, but makers, who are still unable to produce pig iron at this figure, are quoting 57s. per ton for mixed numbers of Bessemer net f.o.b. Further restrictions in the make of iron are to be carried into effect shortly.

STEEL.—A better feeling is reported this week in rails and shipbuilding material. Prices for rails are firmer at £5 per ton for heavy sections. The reduction in the selling price of ship plates and angles is evidently resulting in the strengthening of the inquiry for terms of delivery; plates are now at £6 17s. 6d., and angles at £6 7s. 6d. per ton. Tinplate bars, billets, slabs, and blooms are a quiet trade, but there is activity in hoops and wire.

IRON ORE.—There is less doing in hematite iron ore, and the tonnage raised shows a falling off. Prices are steady at 10s. to 12s. at mines.

SHIPBUILDING AND ENGINEERING.—The local yards have suspended operations for the week, but when work is resumed there will be great activity in both departments. The work in the engineering department renders it necessary to work night and day.

MIDDLESBROUGH, 28TH MAY, 1890.

PIG IRON.—It is thought that the bottom price of pig iron has been reached, and that henceforth things will improve. The market opened yesterday with buyers offering 41s. for No. 3 G.M.B., but 41s. 6d. had to be paid, and where brands were specified even more. Warrants were quoted at 40s. 3d., but in the light of an improved prospect holders decline to part with them at that. In hematite East Coast brands have been bought at 55s., which is a good deal lower than the quoted price, and is less than West Coast can be delivered for here.

SHIPMENTS OF PIG IRON.—The shipments have improved of late, and have tended much to strengthen the market. Last week they amounted to 24,845 tons, against 19,975 tons during the similar week last year. As makers have not been holding off so much as they did, the stocks in the public stores have not been drawn upon so much for shipment.

MANUFACTURED IRON AND STEEL.—The finished products are unchanged. The holidays have been fully taken advantage of, as orders are not being pressed for, and manufacturers are in no hurry to complete. Even the low prices seem not to affect the demand. In all probability buyers are waiting to see the price of the raw material settled ere they commit themselves to the finished article, to be sure that they have bought for the best. Iron ship-plates are from £5 10s.; angles, £5 7s. 6d.; bars, £5 17s. 6d. per ton; steel ship-plates from £6 15s.; angles, £6 10s.; heavy rails, £4 17s. 6d. per ton, all 22 per cent. f.o.t. at works.

ADVANCE IN WAGES.—In the face of a falling market, manufacturers, in accordance with the sliding scale arrangement of the Board of Conciliation and Arbitration, have to give an advance of 3d. per ton on puddling and 2½ per cent. on all other forge and mill wages, to take effect from the 2nd of June. The average net selling price per ton of manufactured iron for the two months ending April 30th was £6 16s. 5·73d., as against £6 12s. 2·39d. for the two months preceding.

NEWCASTLE, 28TH MAY, 1890.

THE IRON TRADE.—In spite of the dulness in the finished iron trade, and the substantial reduction in values which has taken place during the past few weeks, the fact is now announced that wages have to be advanced 2½ per cent. This is owing to an arrangement by which wages, instead of being governed by the present state of the market, are regulated by the ascertained average selling price of finished iron during the preceding two months. The ascertainment for May and June will be made in July, when a very different result may be looked for.

THE COAL TRADE.—The shipments of coal and coke from Tyne Dock during the week ending May 24th amounted to 113,228 tons, being an increase, as compared with the shipments for the corresponding week last year, of 4,093 tons.

THE WHITSUNTIDE HOLIDAYS.—All the industrial establishments in the district are idle during the first half of the present week in accordance with the usual custom at Whitsuntide. It is needless to say that these frequently recurring and unduly prolonged holidays are a cause of serious loss, and it would be to the interest of the community if something were done to abate the evil. Some few weeks ago an understanding was arrived at between representatives of the workmen in the engineering trade and the employers, by which it was stipulated that the holiday periods should in future be kept within certain prescribed limits, and it remains to be seen whether the workmen will on the present occasion keep in mind their part of the compact. Should they adhere honourably to the conditions agreed to by their representatives on the occasion referred to their example may possibly have a good effect on the workmen connected with other branches of industry, and even more beneficent results may follow than were originally looked for.

SHIPBUILDING.—The announcement has been made that the Palmer's Shipbuilding and Iron Company, Limited, have received from the Admiralty an order for two more cruisers of the second class, making five in all of this type of war vessel which the company have been commissioned to build for the home Government. Besides these, the Palmer's Company have two line-of-battle ships to build, and are, on the whole, better secured against the recurrence of slackness than almost any shipbuilding firm in the kingdom.

BELFAST, 28TH MAY, 1890.

SHIPBUILDING AND ENGINEERING.—The dulness in these trades has not yet found its way here. All the shipyards continue busy, and the high wages which have been obtained during the past winter have not in any case been reduced. Two large vessels were launched during the past week; one of them, the "Plassy," will be the eighth ship Messrs. Harland & Wolff have delivered to Liverpool owners this year. Although no new orders are reported in the engineering trade, work still continues fairly good. Boiler makers are also well employed.

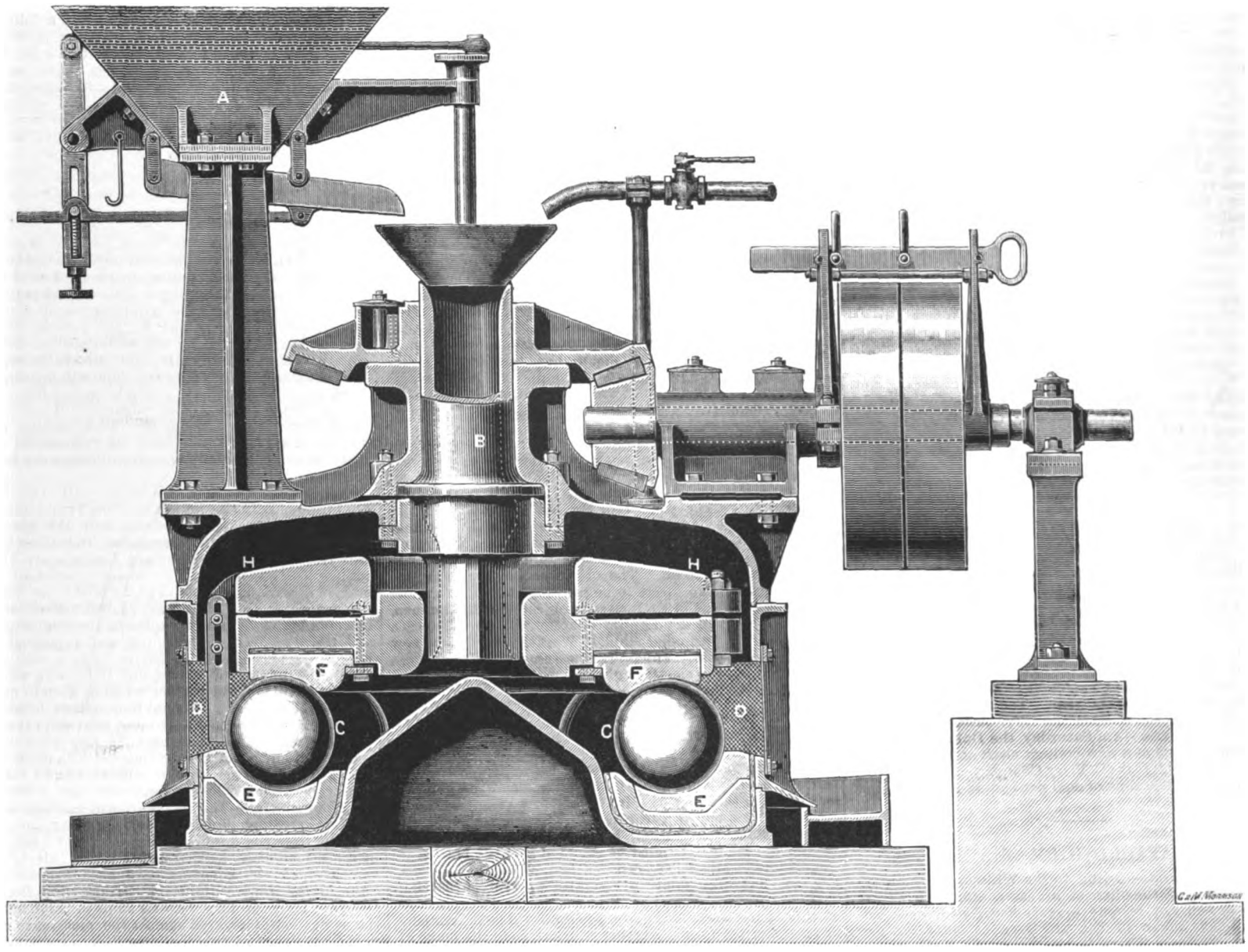
THE BELFAST ROPE TRADE.—Although this industry is a comparatively new one in Belfast, it is making very rapid progress. The Belfast Rope Works Company are especially busy, and are at present working overtime three nights in the week, in order to fill the orders they have in hand. It is only a few years since they rebuilt part and enlarged their premises, and now they are obliged to again add to their works. The new buildings will be situated on the opposite side of the Conswater river, and will be connected to the present works by means of three iron bridges.

THE LINEN TRADE.—The proposed American Tariff Bill has caused a good deal of uneasiness in this trade, as there can be no doubt that its effects would be considerably felt here. Sales of yarn have not been large during the past week, and the prices for raw materials have gone up. Flaxes from abroad have advanced in some cases as much as £3 per ton; but as a rule the spinners have large enough stocks to make it unnecessary for them to buy largely at the higher price. A very healthy sign with regard to the North of Ireland linen trade is that many of the large firms are enlarging and improving their works, and in the neighbourhood of Belfast there have been several new main engines and boilers put down lately in connection with this trade. Messrs. William Barbour & Sons are the first in Ireland to adopt the triple-expansion engine for mill driving.

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THE LAMBERTON ORE CRUSHING MILL.

CONSTRUCTED BY MESSRS. LAMBERTON & CO., ENGINEERS, COATBRIDGE, NEAR GLASGOW.

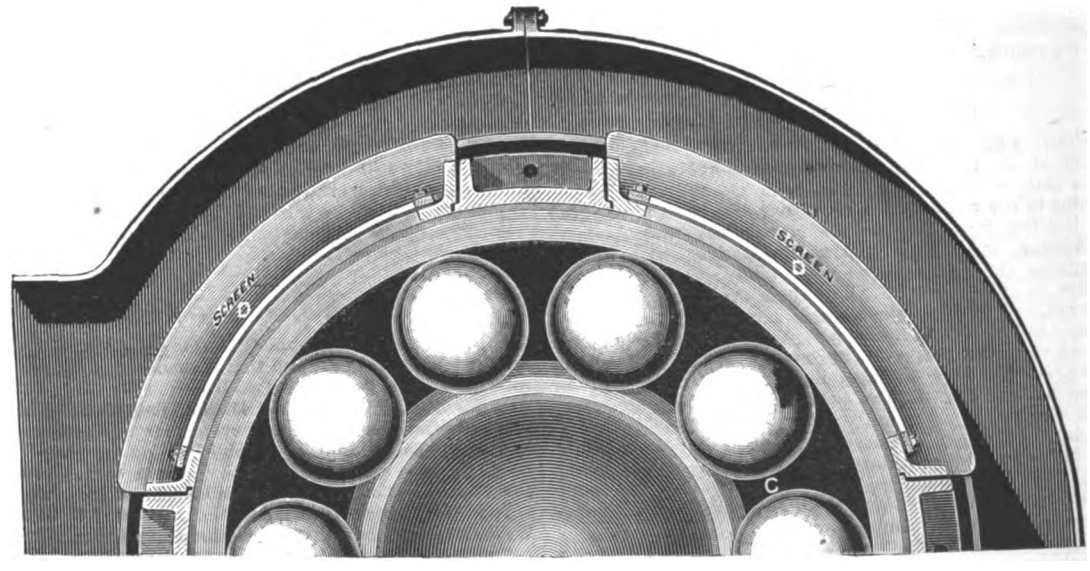


VERTICAL SECTION.

THE LAMBERTON ORE CRUSHING MILL.

THE Lamberton ore crushing mill, which we illustrate herewith, is an interesting example of a roller mill applied to the crushing of ores and to the manufacture of cement, phosphates, &c. The adoption of the roller principle marks an important difference between this machine and all attrition mills. In working the mill the material is placed in the hopper A, from which it is automatically fed at any desired rate down the hollow vertical shaft B, and, diverging at the bottom, falls underneath the group of rolling balls C, and so is quickly pulverised. The balls are of hardened steel, ten in number, and are driven round in the cup-shaped renewable track E by means of a heavy rotating disc H, which is also provided with a renewable face F bearing on the top of the balls. The lower end of the hollow vertical shaft has a square end which fits loosely into a square hole in the centre of the rotating disc, and in this way imparts rotary motion to the disc, allowing at the same time perfect freedom for any oscillation which may arise from unequal feeding. In crushing ores by the wet process the water is allowed to enter along with the feed, and the crushed ore is washed out through four screens D in the manner usual in stamp batteries. It is then caught in the circular trough surrounding the mill, and led over the amalgamating plates.

In dry crushing the fan-blades or scrapers attached to the revolving disc H create an induced current of air down the hollow vertical shaft B, which assists in blowing the fine material through the screens D, at the same time serving to draw away all dust from the shaft bearings and keeping the inside of the mill cool. Another arrangement is to allow the mill to deliver freely at one point from which the material is taken to a revolving screen, where the fine stuff is removed and the coarse returned to hopper A for further reduction, the whole being performed automatically. The output in wet crushing is 15 tons per day of twenty-four hours, and in dry crushing 12 tons. Only 6 nominal horse-power is required for driving. The renewable wearing parts—viz., the balls C, track E, and face of disc F—are castings, with no machine work on them whatever, and can therefore be cheaply renewed when worn out. The patentees and makers are Messrs. Lamberton & Co., Coatbridge, Scotland.



SEMI-SECTIONAL PLAN.

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

Contents.

	PAGE
On the Critical Points of Iron and Steel (*Illus.*)	505
The Hudson Tunnel at New York (*Illus.*)	508
The Navigation of the Euphrates	509
Foreign Industries (Corres.)	510-511
The Edinburgh Exhibition (*Illus.*)	512
Clyde Shipbuilding for April	512
The "Globe" Separator (*Illus.*)	513
Notices of Meetings	513
Prices Current	513
Shipbuilding Notes	513
Home Industries (Corres.)	514-515
The Lamberton Ore Crushing Mill (*Illus.*)	516
Mining in 1889	517
Lord Rosebery on Co-operation	518
The British Association	518
Affairs in Japan	518
Letters to the Editor:—	
Pig Iron Warrants	519
Piece Work	519
Compressed Air Tramcars	519
Jarman's Electric Car	519
Books Received	520
Reviews	520
The Institution of Electrical Engineers	521
The Conley-Lancaster Process for Extracting Iron from Ore	522
The Carbonised Refuse System of Sewage Treatment (*Illus.*)	523
The Physical Society	524
Notes	524
"Industries" Patent Record:—	
Applications and Acceptances	525-526
Illustrated Abridgments	526-528

To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

We cannot undertake to return manuscripts or drawings, and must request correspondents to keep copies.

BOUND VOLUMES OF **Industries**,

In half calf, gilt lettered, may be obtained at our London, Manchester, and Glasgow Offices, Price 20s. each.

Industries:

FRIDAY, 30TH MAY, 1890.

MINING IN 1889.

THE summaries of the statistical portion of the Reports of Her Majesty's Inspectors of Mines constitute one of the most instructive publications of the Board of Trade. The volume recently issued, dealing with the mining industries in the year 1889, is specially interesting, because it contains much of the evidence concerning the state of trade, and the immediate prospects of industry in this country which all are anxiously looking for. Moreover, these bare tabular statements convey information on other matters of an important character which men of science and philanthropists will best appreciate. Turning first to that portion of the evidence which relates to the state of industry and trade, we find much that is encouraging, with little or nothing of importance to set off against it. In nearly all directions there has been progress; and if in some there seems at first sight to have been retrogression, a fuller consideration of the subject will reveal relations and tendencies that must be accepted as signs of advance. The number of persons employed in and about the mines classed under the Coal Mines Regulation Act increased from 534,945 in 1888 to 563,735 in 1889, nearly 5½ per cent. This is a mark of prosperity in which the working classes have chiefly shared, for not only has the circumstance given employment to an additional 28,790, but the activity which this fact indicates has enabled all to obtain higher remuneration for their labour. The number of women employed about the mines increased from 3,935 to 4,027. But if we consider them relatively to the total number of persons occupied above ground, we shall find a slight decrease, the proportion being 1 to 23·9 in 1889, against 1 to 23·4 in the previous year. The "efficiency"—that is, the average quantity of mineral wrought per unit of the hands employed—declined a little, as it always does in times of prosperity, when the toiler finds himself able to take some relaxation, the output per head being 336·4 tons, against 341·5 tons. It is instructive to compare this efficiency with that of our Continental neighbours, who, working under less favourable natural conditions, are unable, in spite of a longer working day, to exceed two-thirds of what is accomplished in this country.

The total quantity of minerals wrought in 1889, exclusive of those extracted from the metalliferous mines, which are classed under another Act, increased from 182,660,163 tons in 1888 to 189,633,656 tons last year, or some 4⅓ per cent. This increase was chiefly in coal, the production of ironstone having diminished considerably. The figures which represent the production of coal in this country are of a magnitude to excite astonishment. The output, which amounted to 169,935,219 tons in 1888, rose to 176,916 724 tons last year, an increase of a little more than 4 per cent. The vast importance of our coal mining industry here stands out in striking prominence, showing at a glance whence our industrial greatness is derived. The enormous increase in the cost of coal on the Continent which has taken place within the last twelve months gives additional interest to these latest statistics of production. The increase is the best possible evidence of industrial activity in the manufacturing centres, for the customs returns show that the larger part of the increment has been consumed at home. We learn, too, from the same sources, how great the home consumption of coal is. The exports scarcely amount to twenty-five million tons, and the quantity shipped as bunker coal for ocean steamers is less than ten million tons. More than four-fifths, therefore, of this colossal output is burned in these islands and on board vessels engaged in the coasting trade. Nothing could indicate more clearly the importance of British industry. We cannot, however, contemplate a production of this magnitude, with its constant tendency to increase, without misgivings concerning the duration of our coal supply, and the distant future of the industries which are dependent on it.

From this satisfactory view of trade, we turn to another portion of the summaries which deals with facts relating to the safety of human life in and about the mines. Here, unhappily, the prospect is less pleasing. The tables of accidents are a practical commentary on the working of the Mines Regulation Act, and as such they deserve to be studied with the utmost care and diligence. The results of the year's work, as told by these statistics, are not encouraging. Fatal accidents were numerous in spite of the many precautionary measures rendered obligatory by Act of Parliament, and enforced in their observance by a strict system of Government inspection. There was, it appears, one death by accident for every 530 persons employed in 1889, against one in 602 in the previous year, or 1·887, against 1·660, per 1,000. Expressed in another way, one human life was sacrificed for every 178,227 tons of coal raised in 1889, against one in 205,698 tons in 1888. This absence of progress, where it is so much to be desired, is not to be explained away by means of special circumstances, for none have occurred. The loss of life from fire-damp explosions is, it is true, a fluctuating quantity, and we find in 1889 the number of deaths from this cause 138, against 49 in the previous year. But this very fluctuation is evidence of the persistence of the danger against which one portion of the Mines Regulation Act was directed. There is, moreover a steady persistence in the figures, year after year, in those columns of the tables filled with the records of accidents from other causes, so that we cannot comfort ourselves with the assurance that time will bring appreciable improvement. We can but hope that new means will be discovered and fresh measures devised of greater efficacy and wider scope. The summary which deals with these matters indicates the directions in which future efforts should be turned. There is a belief commonly prevalent among what may be described as the outside public that the principal source of danger to the coal miner is "fire-damp," and that, consequently, the most pressing need is a safer system of lighting the underground workings. Now the total number of deaths from accidents last year was 1,064, of which only 138 are attributed to explosions. Falls of rock are much more destructive of life, the number of deaths last year from that cause being 465. In truth, it may be roughly stated that 50 per cent. of the deaths due to accidents in mines are caused by falls of rock, while the proportion attributable to explosions is below 15 per cent. An explosion, with its numerous victims and its horrible associations, appeals strongly to the imagination, and is heard of all over the country. Individuals are quietly crushed to death beneath a "fall," and no one outside the immediate locality in which it happens ever hears of the occurrence.

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The number of persons employed in and about the mines classed under the Metalliferous Mines Regulation Act underwent a slight diminution—43,420 in 1889, against 43,472 in 1888. Of these, 1,436 were women, a number greater by 14 than that of the previous year. The number of lives lost by accident in these mines was 64, against 72 in the previous year, or 1 in 678, against 1 in 603; or, differently expressed, 1·474, against 1·656 per 1,000, the average for the ten years from 1874 to 1883 inclusive being 1·645 per 1,000. This is an improvement; but other years, notably 1884 and 1887, have shown better results.

LORD ROSEBERY ON CO-OPERATION.

The annual function of the co-operators at Glasgow was rendered notable by an address from Lord Rosebery as clever and interesting as Lord Rosebery's addresses usually are. The co-operative movement is in the full blaze of its prosperity. It wields a capital of over ten millions of money, turns it over three and a half times a year, and makes a gross profit upon it of something like 30 per cent. This is a business too big to despise, and yet, after all, the co-operative movement, big as it is, hardly seems to affect general business in an appreciable degree. It has, for the most part, wisely kept itself to small things; the Ouseburn experiment was too great a failure for repetition. It needs no uncommon prescience to see that the growth of the co-operative movement on "shop-keeping" lines must go on. Delusive as are the advantages of dividend-making, the idea has obtained too firm a hold upon the working classes to make them readily forego it. No matter though pretensions to social progress by means of a discount on purchases may be exposed ever so plainly, the growth of the co-operative movement through this very principle is one of the most remarkable instances of the facility with which people are victimised by illusory advantages. Yet the fact that co-operation on the customary terms has been so successful is proof that its policy commends itself to some dominant human tendency, and no very subtle analysis is needed to discover that after all the tendency to which co-operation appeals is our old friend self-interest, though it does masquerade under the disguise of benevolence. The co-operators would certainly not admit so much; but, even if they did, there would remain some solid benefit in the movement. It brings people into line, and trains them in industrial and commercial discipline; it teaches them how to act together, and shows them, though slowly and gradually, how important are the qualities of organisation and management, which in their own experience of industrial life they are apt to look upon from the under side and with too much antagonism. Lord Rosebery evidently thought it necessary to apply the spur. He did not refer to the vexed question of profit sharing, but he urged them to look round and see where they could apply their capital productively to the best advantage. This, indeed, is the crux of the co-operative movement at the moment. They have so much cash they do not know what to do with it. With the capital that they possess an enormously greater business could be safely carried on; and they know this, but, with praiseworthy caution, are chary about adventuring too far afield. Lord Rosebery pointed to previous experiments in co-operative farming, and urged co-operators to experiment anew. With the unfortunate collapse of Mr. Bolton King's experiment, carried on, as it was, with immense enthusiasm and much skill, the signs do not seem favourable for the adoption of Lord Rosebery's suggestion. The difficulty of co-operative farming is the difficulty of co-operative production in general—that is, the difficulty of choosing men. A farmer working on his own account gets rid at once of an incompetent labourer, but on a co-operative farm the incompetent is apt to remain. It is only fair to mention, however, that in some of the experiments it is said that an actual improvement in the character of the labourers has been observed.

Lord Rosebery mentioned an element which is of increasing importance for the future of the co-operative movement—that is, its reluctance to pay high salaries to officials, even where they are worth them. In some cases, doubtless, it is possible to get men to work for enthusiastic rather than pecuniary motives; but it is a question whether it is fair to underpay the man who is an enthusiast, and who therefore does his work well. The principle, pay and enthusiasm inversely proportioned, is suicidal, and to some extent, no doubt, this is the co-operative principle. In the early stages of the movement there were times when enthusiasts did the work, and did it for nothing; but now that the whole movement is established on a firm financial basis it will become impossible to get men to deal efficiently with large masses of capital without paying them fair salaries. The one abiding satisfaction in the co-operative movement is that it is all spontaneous and voluntary. It ha been founded by no Act of Parliament, it is constituted by no Royal Charter, it has grown from a small beginning to a great institution; sometimes on the eve of failure, but always triumphant in its self-helpfulness and independence. It has, to be sure, many of the weak points to which all mature institutions are subject, but when these are deducted there remains a monument of the energy and patience of the early co-operators, in the enormous industrial and commercial concern which has been the result of their labours.

THE BRITISH ASSOCIATION.

We have before us a copy of the Report of the British Association meeting last year at Newcastle-on-Tyne. The "success" of the meetings of this Association is gauged, it would seem, by the number of persons who attend—a criterion suggestive of a demonstration in Hyde Park. It is to be presumed that the 3,838 persons who were present at the Manchester meeting were influenced more by probabilities of fine weather, the Exhibition, and the facilities afforded by the locality, than by any expectations raised by the presidency of Sir H. Roscoe, or by the anticipated interest of any of the communications. But their very presence made a successful meeting, while Bath only attracted 1,984—a comparatively tame affair—and Newcastle came close to the average of the last nine years with 2,437.

The British Association meetings offer a twofold interest. On the one hand, the transient enjoyment of an assortment of lectures, papers, discussions, excursions, and picnics (the former being remarkable for a variety of subject, the latter no less "mixed" from a social point of view); and on the other hand, the real scientific work done. No doubt the attendance roll sufficiently indicates the "success" of a meeting in a certain sense; but the papers read, and the reports presented, are the only real elements of value, apart from the holiday aspect of the Association.

The British Association, as we have before pointed out, has its weak points. It may be compared not unaptly with the Royal Academy, who, in the first place, offer their best accommodation to 280 pictures—*i.e.*, seven from each academician—without any reference whatever to the merits of the picture or of the academician. After these, the productions of the associates, and selections from those of the public, are accepted. We need not mention the names of those who are always to be found "on the line" at the meetings of the British Association, but we cannot push the Academy analogy far, for in the one case a tangible picture is presented, while in the other there is often not even an old envelope with a few notes on the back, and if we wish to study the extempore "communication" in any other way than by listening to the speaker we must wait until perhaps long after the meeting has been dispersed, with the hope, frequently not to be fulfilled, of finding some of it in print. The Royal Society and the British Association are perhaps at the two extremes on the scale of real usefulness in publication of sound scientific work. Any one is welcome to send a paper to the former, and the "communication" is a paper, and not a mere discourse. It is referred to some high authority, who most carefully deliberates, frequently, we believe, calling in the advice of brother Fellows as to the true value and originality of the work which it embodies. The British Association, on the other hand, appoints secretaries for its different sections, and the chief business of not a few of these is to persuade members to "send a paper." After sufficient persuasion the member probably gives his promise and the title of his "paper." As the time draws near he is asked to send an abstract; should he do so it will probably appear in the report—a bulky volume published some seven or eight months after the meeting. Should he decide otherwise, he has only then to consider whether he is inclined to keep his promise, in which case he goes to the meeting and has "his say." A sufficiently interesting title and a chat with the secretary will secure the "acceptation of the paper by the committee," if the author is not a well-known faddist or advertising manufacturer. No shorthand reporter is in attendance, unless on behalf of some journal; no official cognisance is taken of any discussion that may arise, although, in most scientific societies, the discussions are often of a value at least equal to that of the paper. In our hypothetical case, which is not exceptional, the interesting title and the author's name appear in the report, and that is the end of the matter. Happily there are cases where the author attaches some value to his own communication, and he will send in his abstract, and perhaps a copy of his paper. He will in many cases prepare, and send to the meeting, specimens, or apparatus for experiments, or diagrams; he may secure the attendance of a reporter for some journal, in order that the discussion may be recorded; but after all he may find that the very men to whom he wishes to communicate his work are away at a committee meeting, or are at a meeting of a kindred section.

In the Report for 1889 we find, in Section A (Mathematical and Physical), no less than fourteen titles of reports and papers with no abstract, and no information is given as to whether they have been published elsewhere. The abstracts of seven other papers average less than four lines to each. The other sections are treated in a similar manner, with the exception of Section G (Mechanical), where papers containing new matter are seldom to be found, but where an opportunity is afforded for discussion. Here we find foot-notes referring to technical journals where abstracts, or the papers *in extenso*, are to be found. It may be pleaded that the expenses of printing will not allow any further space to be devoted to publication of the papers and reports, but a glance at the volume before us is sufficient to show that it is impossible to find any one reader who can be interested in all the immense range of science with which it deals. The volume contains 1,171 pages, exclusive of the publisher's advertisements. Of these, 124 are devoted to the rules, historical list of officers, balance sheet, lists of committees, the President's report, and another 171 contain the list of members and the index, making 295 pages, which are supposed to interest all members. The remainder, divided by the number of sections, gives about 110 pages to each. If these were issued separately, allowing, say, two sections to each member who applies (though he should not be restricted to this number), about two-thirds of the printing would be saved by this change alone. If double the present space were allowed for the reports and proceedings of each section there would still be a saving of more than one-third, still allowing an average of two sections to each member applying.

The limits of our space will not allow a discussion of the work of the committees. Much good work has been done by them, assisted by grants of money, but at the conclusion of their labours there is no one to whom to refer. An instance of this occurred last year, when the London Chamber of Commerce wished to push the B.A. standard screw thread, which was the outcome of a considerable amount of labour. But the committee had been dissolved, and there was no committee or individual who could render any assistance whatever. For more than eleven months of the year the British Association has no other abode than rooms shared by, or in connection with, the Royal Asiatic Society, the Society for the Promotion of Hellenic Studies, the Aristotelian Society, and the Numismatic Society, and other miscellaneous institutions. The officers are, with one exception, we believe, all honorary. Under these conditions we fear that it must continue to be rather an Association for the organisation of an annual scientific holiday, than for the Advancement of Science.

At about this time of year the committees begin to meet to arrange for the forthcoming autumn, and we trust that, though there may be some difficulty among eight sectional committees and sixty-five working committees, a general committee, and a council, in arriving at any useful conclusion, an endeavour will nevertheless be made to promote some solidarity and joint responsibility of the body as a scientific society, and that measures will be taken for properly recording the work done.

AFFAIRS IN JAPAN.

From information recently received from Japan, we learn that the new Foreign Minister of that country, who was formerly Ambassador in Berlin, does not intend to allow the matter of treaty revision to lapse. We have on several occasions indicated the difficulties in the way of a solution of the problem of treaty revision in Japan, and shown that these have arisen, in great part, from the dilatory obstructive conduct of the foreign Powers. There would have been no difficulty in settling the matter years ago if only a little reasonable common sense had been allowed to prevail, for then the Japanese Government would have agreed to terms which they will have great difficulty in accepting now, as they have to reckon with a public opinion which has been created in the country during the past few years. Every one knows that the Japanese have made great advances in industry, education, and legislation since the question of treaty revision was first raised, and, what is more, they have a very good—perhaps in some cases an exaggerated—opinion of that progress and of their present position. However that may be, there cannot be the slightest doubt that the new Minister of Foreign Affairs has

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before him a very difficult task. On the one hand the foreign Powers will insist on foreign judges being appointed at least for some years, while, on the other, the Japanese people will not hear of the indignity of having foreigners sitting as judges in their Courts. In the meantime the Japanese Government is teaching the foreign Powers a few lessons as to the limits of their present extra-territorial rights. Two cases have recently arisen in which Portugal and Britain were concerned, in which the Japanese refused to allow subjects of those countries who had committed crimes before they came to Japan to be extradited under the ordinary extra-territorial powers. They pointed out that these only applied to offences committed in Japan. The British Minister had the good sense to see the reasonableness of the Japanese position, and applied for extradition through the usual diplomatic forms, instead of through consular jurisdiction, and his action has been approved by the British Foreign Office.

We mention this merely to show that the Japanese are not likely to stand dictation on these matters in the future, and it would be well for our politicians to study all the bearings of the problem. The *Times* put the matter very fairly quite recently when it said that the Japanese "have formed a clear conception of what law means, and of the sacredness of the rights which it conveys, and they are properly resentful at any attempted infringement of them. It is no more than natural that they should look with dislike on the treaty fetters with which they were once willing to be bound, and the need of which they now believe themselves to have outgrown. The maintenance of foreign consular jurisdiction in Japan is felt as a standing insult to the local administration of justice. Nor can the Japanese willingly endure to have the regulation of their customs tariff taken entirely out of their hands, and settled for them by foreign dictation. The country that wishes to stand well with them might do wisely to allow play to their somewhat recent national aspirations. England has a larger stake in Japan than any other country, so that it is the more needful for her to recognise the enormous changes which the last few years have brought about, and the practical consequences which they involve. It is quite true that the Japanese people are not yet quite so far advanced as they fancy themselves, and that their impatience of control has gone beyond its proper limits. But that they ask more than their due is no reason why England should persist in giving them less than their due. Treaties such as the late Japanese Ministry was willing to sign with America, and with the other Powers, might safely be accepted by Great Britain, when the time comes, as come it must before long, for Japan to be again in the mood to offer them."

Letters to the Editor.

PIG IRON WARRANTS.

To the Editor of "Industries."

Sir,—There is no doubt that the speculation in pig iron warrants has had a most prejudicial effect upon the iron trade, and while a few have made large profits, owing to special acuteness, severe losses have been incurred by a greater number. The action which you report is being taken by the British Iron Trade Association in the matter may, and it is to be hoped will, be of benefit. It is premature to form an opinion until their suggestions have been formulated, but I have grave doubts whether legislative measures can be devised which will effectually curb the speculator. Similar complaints to those which are now being made regarding warrants have often been heard about Stock Exchange transactions, but no remedy has been devised. In any case, even though the subject is a burning one at the present moment, undue haste must be avoided. To try and rush an ill-considered Bill through Parliament would probably only tend to make affairs worse instead of better.

Yours, &c.,
A User of Iron.

Glasgow, 27th May, 1890.

PIECE WORK.

To the Editor of "Industries."

Sir,—I would like to add a few words to those of your correspondent, "J. D. W.," in your last week's issue, on this subject. No complete statement has ever, to my knowledge, been made by the trades unions of their reasons for objecting to piece work. Half a dozen arguments have been put forward from time to time, each suitable to the particular occasion, but not always consistent with the others.

One elementary principle which is taught by a certain school of socialists is that the fair day's work of one man is as good as that of another. This is the school which delights in visions of a community where one half of the traits of human character and physique have been annihilated, and whose social machinery would be completely upset by an individual with only a moderate amount of laziness, of greed, of conceit, of stupidity, of improvidence, or even of ambition. It is difficult to foresee, if indeed it is worth while to consider, the result, in such a community, of some of the opposite characteristics—energy, cleverness, prudence. They might exist: their presence would not be so fatal to the scheme as the others, but there would be no inducement whatever to cultivate them, except for ethical considerations. Dragging down all to their level, and extinguishing every incentive to the progress of individuals, of which our national prosperity is the sum, these socialists desire for the whole community an insipid uniformity, which the trades unions would have in every workshop. No one who has served his time in shops where piece work is done, and has mixed at all among the men with whom he has worked, can have been blind to the envy with which a unionist often sees a non-unionist engaged on a bit of piece work.

As I have pointed out in another place, a young man just out of his apprenticeship is easily persuaded to join the union, and he feels that this is one mark, at least, of having reached manhood. Having no particular desire to do more than he need, and having the increase of wages to which he is then entitled, he takes but little interest in the piece work question. But after a few years, if he is worth anything, he will have acquired such skill that he can get through a day's work with less expenditure of energy. He may have a wife and family to support, he recognises the fact that he could with ease do half as much work again in a day (piece work statistics can show cases of double this, and more), and he finds himself fettered by the rules of his union. He could withdraw his membership, but not the subscriptions which he has been paying, week after week, for years. These represent to him simply so many payments of an insurance premium to a fund from which he will be entitled to draw when he is out of work or ill. If he were to throw over the union, and get good piece work employment, he could put by a quarter of his wages and live more comfortably, but he dare not take the risk of possible want of work or health.

Lord Bramwell said at the Bath meeting of the British Association that political economy "has made the workman a free man. He may employ himself in any work which he can get trusted to him. He may demand any wages he thinks right, refuse to work for less, and get all he can. He is no longer, by the mischievous laws of settlement, almost confined to the parish where he was born. He may go to any part of the kingdom in search of work. He is no longer subject to punishment for joining with his fellows to better his condition. He may combine with them and agree that they will, as a body, refuse to work unless their wages are raised or other demands complied with. His doing so is no crime, provided he does not violate the freedom and rights of others." Obviously, he has a right to impose on himself, and on others who voluntarily combine with him, abstinence from piece work, but considering the men who are put forward—I should say, who put themselves forward—as the representatives of the trades unions, it is as useless to hope to influence them on the subject, as to expect any good to come from a Royal Commission on piece work.

The unions are invaluable as insurance societies, and it is excusable if they are used as organisations to support common interests; but it is not easy to see any other hope for a solution of the difficulty than by the gradual education of the individuals to realise what are their true interests.

Yours, &c.,
Alex. P. Trotter.

Westminster, 23rd May, 1890.

COMPRESSED AIR TRAMCARS.

To the Editor of "Industries."

Sir,—We really cannot understand your correspondent, "Car." First, he says that our system requires a new roadway because we have to lay pipes. On its being pointed out that the pipes would be under the footway, he says he can see no difference between footway and roadway, and now he expresses astonishment that anyone could imagine that the taking up and relaying of tram rails on a different system, such as required for an underground cable, or for alteration of gauge, could possibly involve a new roadway. It is evident that "Car" has had no experience in these things. Let him just try it on, and the local authority will soon enlighten him. In answer to his question, we beg to inform "Car" that the gauge, on the Bristol Road line in Birmingham was altered before putting on the new electric storage cars. It was said that this was done merely to assimilate the gauge to other lines in Birmingham, and we are asked to believe that it was the merest coincidence that this was done just at the very time when the company were about to employ cars, the gauge of which was made, however, in order to make room for the accumulators.

As regards electric traction in America, it is apparent that "Car" is dazzled, like many others, with the flaming accounts published in the papers, which, he says, "fairly bristle with paragraphs." The stockholders who have so large a stake in the success of electric traction, and are naturally unwilling to give in until everything that can be thought of is tried, have evidently great faith in the efficiency of "paragraphs," and that they are justified in that faith is shown by the letter of "Car." Has "Car" taken the trouble to ascertain how many of the American cars are worked on the accumulator or storage system, and how many on the overhead wire system, which would never be admitted into the public streets in this country?

"Car" cannot understand "our theories of financial operations," which, he politely informs us, are "utterly absurd." To "Car" it seems absurd to suppose that a patentee, on seeing his invention nearly played out in his own country, should endeavour to get up a boom in other countries in order to sell his foreign patents before the bursting of the bubble. Oh, no! he would not dream of doing such a thing. At least, he would not if he did not know that the world is full of people possessing the simple faith of "Car."

"Car" refers to Mr. Baines' letter as proof absolute, but we can find nothing in it but assertions without proofs. Mr. Tittlebat Titmouse said that he could "prove" that he was the only son of his parents "by saying so truly," but this sort of proof is not generally considered good enough in the practical affairs of life. Mr. Baines says "the cost of renewals in accumulators is *estimated* by various authorities at from 1d. to 1½d. per car mile," but "estimated" is not good enough. In Brussels the maintenance of the accumulators alone was "estimated" at 3·51 centimes per car kilometre, but actually *cost* 9 centimes, or 14½ centimes per car mile. So much for the difference between estimates and actual results.

We will conclude by the following quotation from an article in the *Liverpool Daily Post* of the 27th May, referring to the report of Sir John Fowler to the Agent-General of New South Wales, on the subject of electric traction:—"One very significant remark is made by Sir John Fowler as to the cost of maintenance. He says, 'There is not sufficient reliable data to fix a lifetime for accumulators.' This is really the root of the matter as regards economy of working. We have frequently seen estimates of cost of repairs, but they all stop short before the period when substantial renewals would have to be made. When that point is reached, new apparatus is provided, not for the purpose of replacing the used-up apparatus, but 'to take advantage of the most recent improvements,' only it generally happens providentially that these improvements come just in time to avoid the renewal of the old apparatus, which is thus charged to capital instead of revenue account. Then with the new apparatus a fresh start is made in the repairs account."

We are really too busy to waste any more time in answering anonymous correspondents like "Car."

Yours, &c.,
Hughes & Lancaster.

City Road, Chester, 28th May, 1890.

JARMAN'S ELECTRIC CAR.

The electrically worked tramways in Great Britain are very few in number, but an addition will presently be made on the London Tramways Company's system, on which the Electric Tramcar Syndicate, Limited, 31, Lombard Street, E.C., have arranged to run several accumulator cars. The inventor of the system is Mr. A. J. Jarman, who has got one car now in readiness, with which private trips have already been made with successful results. Some considerable time back the same inventor made many experimental runs with a car, and the experience derived from these trials has resulted in the practical development of the present system. The stretch of line on which the cars are to be worked is from Clapham Common to Tooting, on which some 1 in 25 gradients are met with, but the cars do not seem to find any difficulty in overcoming them.

The car is of the same type as the ordinary horse cars on the line, with the exception that it stands a few inches higher. The accumulators are placed under the seats of the car, but instead of being put into position from the sides, as is the case at Barking, they are run in on trays from the ends. It is proposed to eventually use hydraulic plant for this purpose. As inconvenience would arise in inserting and withdrawing the cells simply through the hinged doors, corresponding doors are provided in the splash boards.

There are, in all, 52 double ebonite cells of the "E" type, 26 on each side, connected in series, the total weight being two tons. In order to provide ventilation for carrying off any fumes from the cells, hinged doors are placed at each end fitted with horizontal louvre boards. Access to the cells can be obtained from the interior of the car by lifting up the seats.

The motor is of a special and peculiar type. Two separate armatures are placed on a single shaft, so that one may revolve in one direction and do work, while the other revolves idly and dissipates heat acquired while running, by radiation in an induced current of cold air within the inert field magnet. Mr. Jarman's theory is that an electric motor, when applied to purposes of locomotion, cannot work efficiently when a single armature is employed, for the reason that greater power has to be developed in order to overcome the increased resistance when starting the vehicle from a position of rest than is required to maintain the motion at the required rate of speed. The motor has, as already stated, two armatures, and two bi-polar field magnets. It is carried in a steel frame, bolted to the body of the car, and also supported by the axles through the axle boxes. With a view to obtain exceptional power when making a start, the magnets have been wound in a special manner, termed the "gamut" winding. This consists in the cores being wound with layers of wire of varying resistances, and which can be either cut out of, or included in, the circuit by means of a suitable switch, the ends of each layer being led to the switch, so that each or all of them may be withdrawn or included as already stated.

The gearing is also special. A wrought-iron pinion, running at 650 revolutions per minute, is placed between the two armatures on the motor shaft. On the countershaft there is a mortice wheel, but the cogs, instead of being of wood, are of vulcanised fibre. Two flanges are placed an each side of the mortice wheel, and the cogs are sunk into slots. Holes are bored through the flanges on the pitch line, through each of which a pin is inserted keeping the cog in place. The size of the mortice wheel is such as to reduce the revolutions to 216. Another wrought-iron pinion on this countershaft gears into a second mortice wheel on the axle of the car, further reducing the revolutions to 90 per minute. These speeds obtain when the motor is running at its normal rate. The vulcanised fibre cogs have the effect of causing the car to run with a minimum of noise.

At either end of the car is a cylindrical case, containing the switch. The handle of the switch at the top of

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the case may be revolved in either a backward or forward direction—corresponding to a forward or backward movement of the motor. This operates the switch, which consists of a wooden cylinder placed upon a metal spindle. On the surface of the cylinder are fixed circumferentially strips of gun-metal, of different lengths and widths. These are wide enough to form contact with any pair of contact tongues which represent the ends of the various layers forming the "gamut" winding. Between these strips are placed plugs electrically coupling the spindle with the tongues connected with the termination of the last layer that has been placed in circuit, a connection from the end of the spindle serving to couple the spindle to the brush or other part of the circuit so as to complete it.

At normal speed one of the armatures is doing work while the other revolves without performing work. At half speed the motor is in series, and in full speed in parallel. The cars will be worked for the Tramway Company by the Electric Tramcar Syndicate at a rate not exceeding 4½d. per car mile.

Books Received.

The South's Redemption from Poverty to Prosperity. By R. H. Edmonds. Baltimore: The "Manufacturers' Record" Company.

Notes on Permanent Way Material, Platelaying, and Points and Crossings. By W. H. Cole. London: E. & F. N. Spon.

Gas and Petroleum Engines: A Practical Treatise on the Internal Combustion Engine. By William Robinson, M.E. London: E. & F. N. Spon.

Everybody's Pocket Cyclopædia. 300th Thousand. London: Saxon & Co.

Transactions of the American Society of Civil Engineers, December, 1889.

Proceedings of the Society of Architects. Vol. II., No. 9.

Transactions of the North East Coast Institution of Engineers and Shipbuilders. Vol. VI., No. 5.

Force as an Entity with Stream, Pool, and Wave Forms. By W. Sedgwick, Lieut.-Col. R.E. London: Sampson Low, Marston, Searle, & Rivington.

The Art of Paper Making. By Alex. Watt. London: Crosby Lockwood & Son.

Limited versus Unlimited Liability in Business: Notes on the Conversion of Private Firms into Joint Stock Companies. By Jenkinson & Co., 37, Walbrook, E.C.

Elements of Machine Design. Part I. By W. Cawthorne Unwin, F.R.S. London: Longmans Green & Co.

Annual Statistical Report of the Secretary to the Members of the British Iron Trade Association on the Home and Foreign Iron and Steel Industries in 1889. London: E. & F. N. Spon.

Transactions of the American Society of Civil Engineers, January and February, 1890.

Report and Syllabus of the Gordon Technical College, Geelong, Australia.

Reviews.

A Dictionary of Applied Chemistry. Vol. I. By T. E. Thorpe, Ph.D., F.R.S. Longmans, Green, & Co. 1890.

When the first volume of the new edition of Watts' Dictionary of Chemistry, under the editorship of Dr. Morley and Mr. Muir, was issued, the publishers promised a separate dictionary devoted to applied chemistry, to be completed in three volumes, and they have now commenced the fulfilment of this promise by the issue of the first part, which includes the subject matter to the end of "dyeing." This companion dictionary is essentially a separate work on chemistry in its applications to the arts and manufactures, and deals but sparingly with the purely scientific aspects of the science which are discussed in the other dictionary. Although produced under different editorship, the general method and plan of the two works is the same, and, what is perhaps more important, the nomenclature and notation adopted is practically identical; it is, therefore, easy to consult both dictionaries for the same subject when one wishes details of the theoretical and applied history of any chemical product. The two new dictionaries are thus meant to be complementary to one another, but it has been found impossible to avoid a certain amount of overlapping. This is more especially the case in the applied chemistry work, which, in order to place its articles in a complete form to its readers, has encroached on the domain of pure science and availed itself of many of the facts recorded in the sister volume. That this is done intentionally may be gathered from a comparison of the two articles on "atmosphere" in the two volumes. These are both written by Professor Thorpe, and we notice that in his dictionary he has given a kind of abstract of his article in the other work, and certain parts are reprinted (*e.g.*, the account of Dr. Percy Frankland's researches), while additional information is given on the technical parts of the subject. This completeness of the Dictionary of Applied Chemistry considerably increases its value, as its scope is sufficiently wide to make it suffice as the only chemical dictionary for the engineer and technologist, for which purpose it is admirably adapted. The publishers have, we believe, done well in thus dividing the science into two parts, for while it will be necessary for every class of chemists to possess both dictionaries, the three volumes on applied chemistry will find their way to the bookshelves of many engaged in the manufactures and industries which are only slightly connected with chemistry. Professor Thorpe has been exceedingly fortunate in securing the co-operation of many of the leading chemical specialists as contributors on subjects with which they are well posted. The rapid progress in many departments of applied chemistry in recent years makes it no easy task for an editor of a dictionary devoted to this subject to insure that his subject matter is well up to date, but from our examination of the volume under review, we have to congratulate Professor Thorpe in succeeding to keep his information free from such criticism.

The editor in the preface states that special attention has been given to the compilation of trustworthy patent lists, and of these the one relating to azo-colouring matters includes a summary of the more important British and foreign patents taken out from 1878 to October, 1888, which will be found of great value to those engaged in the colour industry. Numerous references are given to the *Journal of the Society of Chemical Industry*, but we should have been glad if lists of the papers and abstracts in this important journal had been given at the end of several of the articles. The wide popularity of this journal is, no doubt, due to it forming an admirable work of reference, and as it is now recognised as the leading journal for applied chemistry in the English language, a dictionary might with advantage refer to it for further details on most of the subjects, and thus be able to devote more space to foreign literature which has not yet found its way into English print. This is rendered still more necessary from the vastness of the subject and the small amount of space which the publishers are devoting to its treatment.

A Treatise on Chemistry. Vol. III. Part II. New Edition. By Sir H. E. Roscoe, F.R.S., and C. Schorlemmer, F.R.S. London: Macmillan & Co. 1890.

This is a new edition of the volume of the author's well-known treatise on chemistry, which treats of the more complex members of the "fatty" series of organic compounds. Since 1884, when this part of the work was first published, several important researches have been carried out, with the result that our knowledge of this branch of organic chemistry has been considerably increased. The present volume includes such recent work as the researches of Curtius on the fatty diazo-compounds, of Kiliani on the constitution of the members of the sugar group, and of Emil Fischer on the syntheses of members of this series. Our knowledge of so-called brewing chemistry, as shown by the work of Brown, Heron, and Morris, finds a place in the present volume, where the starches and dextrine are discussed, and the poly-methylene ring compounds of Dr. Perkin, jun., are also added to the list of bodies described.

The authors, by thus keeping their text-book up to date in the different branches, are determined that it shall continue to maintain its place as the chief of chemical text-books. And although, by gradually increasing in size, it is growing to the dimensions of a dictionary, their interesting historical notices of compounds and abstracts from classical papers render it far more pleasant reading than some of the newer dictionaries of chemical science.

Magnetism and Electricity. By A. W. Poyser, M.A. Longmans, Green, & Co. 1889.

This excellent little volume of some 250 pages was written primarily, as the author informs us in his preface, to meet the requirements of students preparing for the elementary stage of the Examination in Magnetism and Electricity of the Science and Art Department, but though the lines of the syllabus drawn up for that examination are pretty faithfully followed, the author has not hesitated to introduce additional matter where it seemed desirable; and, indeed, several chapters are devoted to the treatment of subjects which are not included in the syllabus of the examination. This has been done with the object of providing a suitable course for a year's work at school, and the author has, on the whole, been exceedingly successful in carrying out his plan.

The specially valuable feature of the work is that it is cast entirely in the experimental form, the volume consisting of a series of descriptions of experiments to be actually performed by the student, followed by the inductions to be made from the observed results.

Any teacher of physics worthy of the name would see almost at a glance, independently of the author's statement in the preface, that the book is the outcome of practical work in teaching, and we most emphatically endorse the author's opinion that the only way for a student to gain a real knowledge of magnetism and electricity, or any other branch of physics, is to perform the experiments himself, to regard his text-book or the lectures of his instructor as supplementary to and explanatory of his experimental work, instead of, as is unfortunately most generally the case, the practical experimental work being regarded as a mere supplement to the didactic teaching, and, though advantageous, not absolutely essential.

The book appears to contain very few faults, but there are one or two points in which improvement may be made.

Weber's theory of magnetisation is supported by such a mass of experimental evidence that it may be regarded as raised to the rank of an established fact. Most of the conclusions, moreover, on which it is based are so easily investigated experimentally, and it is so great an assistance to a beginner in fixing his ideas, that it certainly ought to find a place.

In the opening chapter the unfortunate statement is made that when two opposite magnetic poles are placed near together they neutralise each other. A statement of this kind, if given by a student in the South Kensington examination, would result in his answer receiving comparatively low marks, and it has the far more serious defect of confusing his ideas. It ought to be clearly explained that the result is that they neutralise each other's actions on a neighbouring magnetic body by producing opposite inductive effects, a very different explanation from what a student would infer from the author's statement.

The terms "frictional electricity" and "voltaic electricity," though retained in the South Kensington syllabus, are not happy ones, as they tend to perpetuate the erroneous idea that there is a difference in kind between the electricity generated by friction and by chemical action respectively. The author appears to have felt this to some extent, as he employs the term "frictional electricity" to denote a static charge, and "voltaic electricity" as equivalent to an electric current, but this is only introducing further confusion. Experiments should also be given showing that the charge or current is of essentially the same kind, whether obtained from friction or chemical action. A clear understanding of this is of fundamental importance to the learner, and, moreover, it is very properly expected by the South Kensington examiners. These blemishes, however, though by no means unimportant, are hardly sufficient to detract seriously from the value of a book formed upon so excellent a plan, and which, moreover, is on the whole so well carried out.

The book is well got up and illustrated with a large number of well-executed diagrams and representations of apparatus.

Newbigging's Handbook for Gas Engineers and Managers. Fifth Edition. London: Walter King. 1889.

This well-known handbook has quickly run through the earlier editions, and the author in the present edition has made considerable additions to the text, which will make it still more popular with that class of readers for which it is intended. We congratulate Mr. Newbigging on the success of his endeavour to keep his handbook well up to date, and on the production of such a practical and useful work of reference. The capital employed in the manufacture of gas at the end of 1888 amounted in this country to the large sum of £62,778,000, which figure will represent the extent of the manufacture of gas in the United Kingdom, and shows what rapid strides the industry has made since Pall Mall was first lighted with gas in 1807, and since the incorporation of the Gas Light and Coke Company by Act of Parliament in 1812.

In the present edition of his handbook, Mr. Newbigging has devoted considerable space to a *résumé* of the different methods proposed or in use for the removal of the impurities in coal gas, and, while giving details of the older processes in which lime and hydrated peroxide of iron are used, also gives the merits and demerits of the lime, spent lime, and oxide of iron purification process of Dr. Odling, and the newer plans based on the use of pure oxygen, of caustic soda and sulphide of sodium, of caustic ammonia and carbonate of ammonia, and that which is now being tried at Belfast and known as Claus' process of purification by ammonia gas. These methods are discussed fairly by the author, in a manner which gives the gas manager sufficient knowledge of the various processes to enable him to decide on the suitability of any one of them for his own particular works. The testing of gas, as prescribed by the Gas Referees for the London district, is also fully discussed, and the proposals for altering the

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present unsatisfactory standard of light. The chief value of the book will, however, be found to lie in the technical details of the construction and dimensions of the plant necessary in a well-constructed gasworks, and the author's long experience in his profession gives him a store of statistics, which will be found of especial value to the younger members of the profession. The gas engineer or manager who has served his apprenticeship in one of the older gasworks, and is suddenly transplanted to a fresh locality in which newer or larger gasworks have to be erected under his direction, will find in this handbook data which he could only otherwise acquire by consultation with men of greater experience or by laborious search through the chemical and trade journals, and Mr. Newbigging has therefore earned the thanks of all the younger men in giving them a handbook which will supplement their knowledge and give them an amount of confidence which otherwise it would be almost impossible to acquire. Not the least interesting part of the book are the numerous trade recipes which are dispersed throughout, and which are certain to be found of great use in large works.

CIVIL AND MECHANICAL ENGINEERING POPULARLY AND SOCIALLY CONSIDERED. By J. W. C. Haldane. Second Edition. London: E. & F. N. SPON. 1890.

We noticed Mr. Haldane's book at considerable length when it first appeared, and the favourable opinion which we then expres ed about it has been fully justified by the appreciative manner in which it has been received by the press and the public. We pointed out that although it was written in a free and unconventional style, it was likely to convey more useful information to its readers than many more formal treatises, and especially on those subjects relating to everyday practice. It is just the sort of book to put into the hands of a young man who has not decided on the trade or profession he is going to adopt, as it gives a very clear idea of the everyday work of engineers in different departments.

The present edition has been revised throughout, and much fresh information is given concerning the latest phases of engineering. Even the stories are revised and brought up to date. For instance, the one about the Japanese engineer who somehow or other forgot, at a critical moment, his "formula for stopping the engines," is counteracted by a statement of the work done by Japanese students in this country. We are inclined to think that the above-mentioned story is a myth, and only an exaggerated way of stating the tendency of Japanese to attach undue importance to book knowledge. At least during a considerable residence in Japan the writer was never able to get any good foundation for the incident referred to. Throughout the book reference is made to the latest developments in engineering. The two last chapters especially should be studied for those relating to marine engines. We think, however, the explanation of the causes of the higher economy of multiple expansion engines might have been a little more scientific. What is given can only be looked upon as a first approximation. In conjunction, however, with the practical information which is found in the book, and the illustrations, it may lead those who read it to a more thorough study of the very complex phenomena connected with the use of steam in such engines. We have no doubt that this edition of Mr. Haldane's work will be as popular as the last. We would commend it to the attention of teachers as a very suitable book to be put into the hands of boys leaving school. In saying this we do not of course mean that it is essentially a boy's book, for we think that experienced engineers will find much useful information in it.

THE ROMANCE OF MODERN INDUSTRY. By James Burnley. W. H. ALLAN & Co London. 1889.

The proper use of the imagination is a factor which is very much neglected in modern education. The modern practical man insists on his son being taught facts—nothing but facts; and the consequence is, that the young men of the present generation are very often wanting in that energy and "go" which do more to make a man successful than any amount of facts or technical instruction of the ordinary dry-as-dust kind. Enthusiasm, kindled by a proper use of the imagination, has been a very powerful agent in advancing progress in science and the industrial arts, and a great deal of romance is to be found in the history of that progress, and it is of this romance which Mr. Burnley attempts to give a sketch in the book before us. He reminds us that the trade annals of the nineteeth century are full of romantic episodes, and that the imagination is always impressed by stories of men who have carved their way from obscurity to wealth; while the stories of failure and disaster, by which the commercial record is darkened, are no less enthralling. The object of his book is to afford finger-posts to guide those who wish to explore the industrial field to those paths which lead to success, and to warn them against those which lead to failure, and that not by abstract teaching, but by concrete examples of success and failure both in individuals and corporations. The introductory chapters of the book are such as will captivate young men and raise their imaginations, giving, as they do, an account of the romance of steam and machinery, and of industrial Utopias which have been proposed at various times, and some of which are now being revived. The chapter on "Wealth in Rubbish" will bring their imaginations to bear on small matters, and enforce on their minds the truth that dirt is only matter in the wrong place, and that it very often turns out very important matter—in fact, that what was formerly considered rubbish very often now furnishes the chief profit of the industry with which it is connected. The romance of patents will further impress on the reader the necessity for attention to economy in small things. We cannot follow Mr. Burnley through the whole of his twenty interesting chapters, but may mention the titles of a few of them. He treats of gigantic businesses, working men who have risen, commercial crises and failures, some great strikes, wars and their effects on trade, industrial accidents, international trade dealings and British industrial centres—all of which are of great interest, and convey a mass of most useful information, which is well worthy of careful study. Such books as that of Mr. Burnley are well calculated to supplement the more formal instruction which is now given under the name of technical education.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

AT the meeting of this Institution on the 22nd inst. the discussion was continued on Major Cardew's paper, "The Treatment, Regulation, and Control of Electric Supply by the Legislature and the Board of Trade."

Mr. A. A. Curtis Hayward remarked that Major Cardew's paper touched lightly on the appointment of electric inspectors. He considered the vesting of such appointments for the metropolitan district in the London County Council a regretable incident, and was glad to note that in future orders the right of appointment would be vested in the Board of Trade. The appointments were, he said, at present very important, for the public had been somewhat alarmed by the sensational accounts of accidents in America. The knowledge that properly qualified inspectors were to be appointed would tend to restore confidence and give great satisfaction to the community. His opinion as to the future importance of electric inspectors did not coincide with that of Major Cardew, for he believed they would form a case of degeneration rather than one of development. He could not agree with Mr. Crompton about over-legislation, and thought the latter gentleman overstated the case when he said that the gas works clauses might have been easily modified to cover electric supply. A real need for a special Act existed, for there were many subjects in electric supply, such as overhead wires, &c., which were quite foreign to gas distribution.

Mr. Emile Garcke said he was not prepared to discuss the details of the regulations in the face of Major Cardew's statement, that criticism from even a high electrical authority might be erroneous. He would rather confine himself to the historical facts. The parliamentary history of electric lighting was unique, and the rapid changes that had taken place in the industry were phenomenal. The first Select Committee, he said, was appointed in 1879, when the commercial possibility of incandescent lighting was unknown. Its fair report encouraged contracting firms to promote Bills in Parliament. In the spring of 1882 another Select Committee was appointed, and in the same year the memorable Act of 1882 passed. Although its results were lamentable in one respect, he thought it not an unmitigated evil. After detailing the various attempts to remedy the defects of that legislation resulting in the Act of 1888, he pointed out that no time had been lost, and that progress had been comparatively rapid. He laid great stress on the exceptional character of the legislation even of the amended Act, and said that no other industry had been placed under such adverse conditions, excepting perhaps that under the Tramways Act, but even this was much more favourable to the contractors than the Electric Lighting Act of 1888. The exceptional character arose from the fact that Parliament refused to put electric lighting corporations on anything like the same footing as gas companies, and thus the former had to compete on very unfavourable terms. It was in the power of the gas companies, by foregoing their dividends for a year or two, to completely crush electric companies, for, in addition to their power to pay accumulative dividends, they had the advantage of practically perpetual tenure, whilst the electric companies were limited to forty-two years. As regards local authorities, he complained that, according to present regulations, it was in their power to stifle electric lighting, and, as many of them were largely interested in gas, he argued that it was not right that the electric companies should be placed in such a difficult position. To show how vexatious local authorities may be, he quoted a case of a central station established in the early days of electric lighting. The work was carried out satisfactorily by overhead wires until such time as regulations were issued by Board of Trade stating that all wires must be put underground. In the face of the twenty-one years' purchase clause it was financially impossible to comply with the regulations. When the amended Act was passed in 1888, the company applied for a Provisional Order, but were opposed by the local authority, which was at that time negotiating for the purchase of gas works. He was not aware that any other kind of vested interest had been similarly treated.

Mr. K. L. Murray said that in Victoria they had no Acts of Parliament or regulations to control electric supply, and until recently they had no rules. Last year, however, the Victoria Institute of Engineers had drawn up a set of rules based largely on those issued by this Institution and by the insurance companies. An Act of Parliament, he said, was now expected, and the present discussion would aid in framing the Bill. A knowledge of what to avoid, as well as what to do, may, he hoped, lead to a model Act, from which, perhaps, the mother country might copy with advantage.

Captain Rowan said that in Australasia, where he had been engaged in introducing electric lighting, difficulties arose from want of legislation. No public body had power to give authority to lay mains or to erect overhead wires, &c., and in consequence matters had come to a deadlock.

Mr. H. Human disagreed with what Mr. Crompton said about the injustice of compulsory supply at either of two pressures, and pointed out that a grocer who made up his tea or sugar in pound or half-pound packages had not a monopoly granted to him for forty-two years. In his opinion, there was no particular hardship to the undertakers in the regulation, whilst it was a distinct boon to customers. He thought Mr. Crompton, in his remarks about the gas and water companies, had overlooked the fact that they had been sources of complaints for years. His comparison of electricity with gas and water was not legitimate, for in the former case, where such a subtle agent as electricity was dealt with, consumers were much more at the mercy of undertakers. In America, he said, where the industry had not been hampered by legislation, there had been so many accidents and fires that the public were now appealing for control, and the wish had been expressed that a body analogous to our Board of Trade was in existence there. In conclusion, he said that the Acts of Parliament, if harsh, were necessary, and he hoped that those who advised the Board of Trade would hold the scales equally between consumer and undertaker.

Mr. A. Siemens said it should be borne in mind that the objects of the legislation were twofold—1st, to empower electric supply companies, &c., to lay mains in the public streets and conduct the business of supply in a manner recognised by law; 2nd, to recover charges for supply made to consumers. Both these aims were intended to confer powers on companies which otherwise they could not possess. Originally, he said, the Board of Trade had power to grant Provisional Orders without the consent of the local authority, but in the later development neither licences nor orders could be granted without such consent being first obtained.

Mr. J. S. Fairfax hoped that no hard and fast line would be laid down as regards the kind of instrument to be used at testing stations.

Mr. E. L. de Segundo did not agree with Mr. Crompton about the Board of Trade having gone too far; in fact, he thought it had not gone far enough as regards protection of the public by making regulations for insulation tests. He knew a case where a 1,000 volt circuit was tested at 100 volts, and he pointed out that to test a steam boiler intended to work at 100lb., with water pressure at 10lb. would be considered ridiculous. The testing of house wires was also very important, for in one case he was assured that there was no defect in the insulation for in the contractors' tests no indication of a leak was obtained. On applying Evershed's ohmmeter with about 100 volts a dead earth was indicated.

Mr. Mordey, in referring to the question of safety devices, said it was time the subject was settled. The method of earthing the secondary was, in his opinion, perfectly safe. Great opposition had been made, particularly by the insurance companies, to its adoption, but the reasons for such objections were not forthcoming. As far as he could see there was no danger whatever with the secondary volts at 100, for by earthing the middle of the secondary the greatest difference of potential possible was 50 volts. Besides, the method had also the advantage of weeding out all rotten installations.

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THE TREATMENT OF SEWAGE

By the Carbonised Refuse System, as Designed by the Rivers Purification Company, Limited, Leeds.

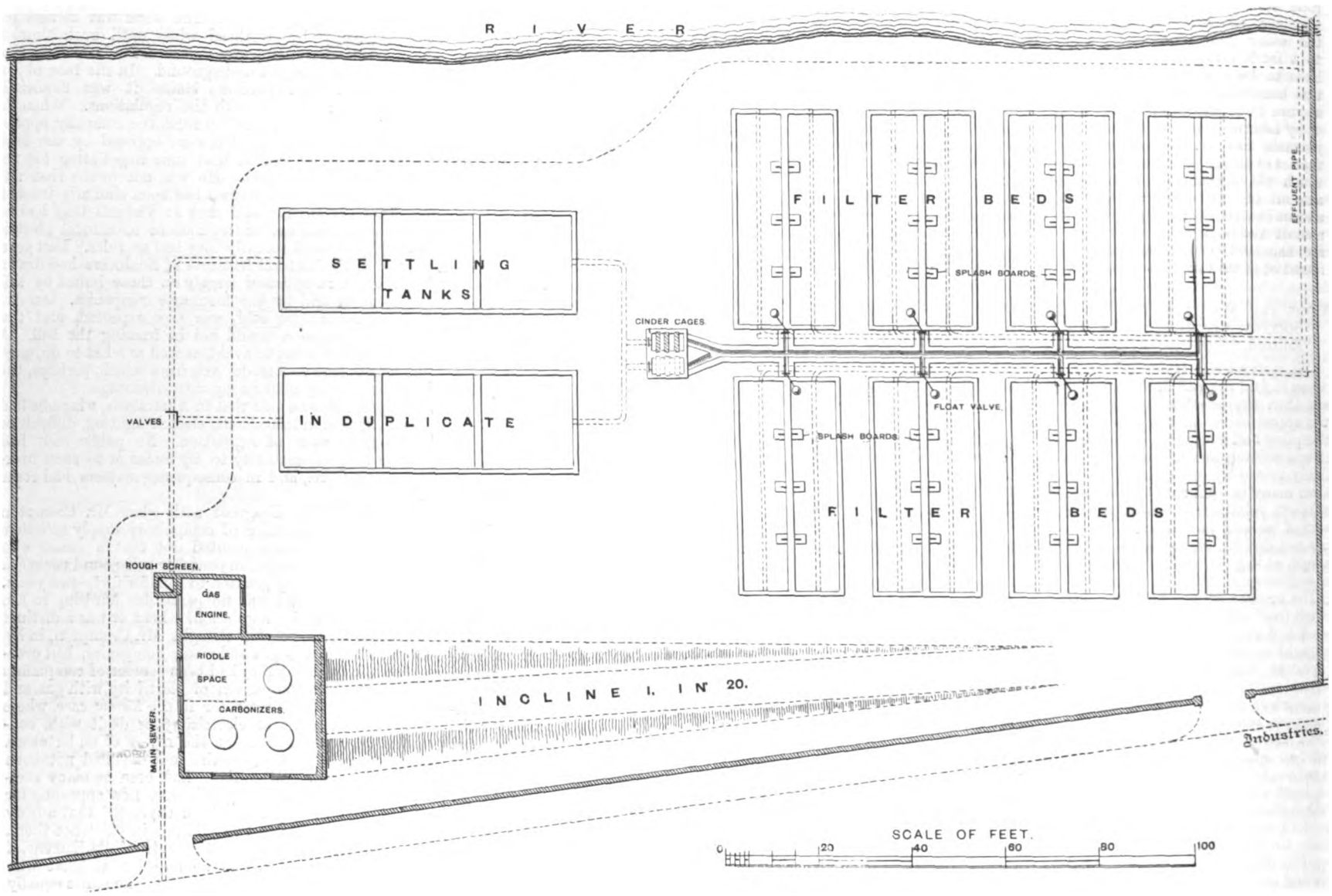


Fig. 1.—General Plan of Sewage Plant.

They had used the method on the Continent, and found it quite successful. The fuses, however, often went, owing to persons inserting penknives, &c., into the switches, for the object of obtaining agreeable medical shocks. As regards the Cardew device, he pointed out that its cost was not an unimportant item; moreover, it was automatic, and might not go off, and generally the fewer automatic arrangements there are about an installation the safer it is.

Mr. A. P. Trotter inquired what excess of current was required to let the fuses off, to which Mr. Mordey replied that about 20 per cent. above the normal was the ordinary average. In his opinion such currents could not give rise to fires.

Dr. Fleming asked what occurred in the case of an earthed secondary when the primary was also earthed. In Italy, where they had had considerable experience in alternate current distribution, the tendency was in the opposite direction, for the greatest care was taken to perfectly insulate both primary and secondary circuits. He himself had used an earthed secondary at the Inventions Exhibition, and had found no difficulty, but he wished to ask Mr. Mordey what his experience was. In reply, Mr. Mordey said that no difficulties had been met with.

Major Cardew, in reply, pointed out that the Board of Trade could not adjust or redress any wrongs, for such changes in the law must be made by Parliament. With respect to the declaration of pressure at consumers' terminals, he said this was rendered necessary by the introduction of transformers, for it was more difficult in such cases to know the fall of pressure in the distributing mains than in continuous current distribution. He then read the following draft, which is to be inserted in the new model orders:—"Before commencing to give a supply of energy to any consumer, the undertakers shall declare to such consumer the constant pressure at which they propose to supply energy at his terminals. The pressure so declared at any pair of consumers' terminals shall not, except by agreement, be greater than 115 volts, or less than 45 volts, if continuous, or the equivalents thereof respectively, if alternating, and shall not at any time be altered or departed from, except in consequence of any authorised alteration of the corresponding standard pressure. In distribution on the three-wire system the central terminal shall for the purposes of this regulation be considered to form a pair with either of the outer terminals, and similarly for multiple wire systems, and, in the case of a transformation of energy on the consumer's premises, the undertakers shall give the consumer the choice of a supply at either of two pressures, one of which shall be approximately half the other, and in such case the pressure so chosen by the consumer shall be the declared constant pressure." In drafting this clause, he said, advantage had been taken of the flexibility of the transformer system, in the interest of consumers. Mr. Shoolbred's questions with regard to meters were answered in the paper itself, for he would there see that they were to be certified by a local inspector, and be of a pattern approved by the Board of Trade. Mr. Murray's remarks about contacts between telephone and electric light wires needed careful consideration, for this was one of the chief sources of trouble and danger where high pressures were used. To Mr. Human he pointed out that the issue of a Provisional Order conferred no monopoly whatever. In reply to Mr. Siemens, he could not say why the change respecting the consent of local authorities had been made by Parliament. Such, however, was the case, and the Board of Trade could not dispense with that consent except in very special cases. As regards testing stations, he thought the arrangement he had suggested would be more satisfactory to the general public than the use of pilot wires and instruments fitted in central stations. To Mr. Fairfax he explained that the reference to dial instruments in pillar boxes was intended for indicating and not for recording instruments. Speaking of safety devices, Major Cardew said the plan of earthing the secondary got rid of some defects when the earth connection was substantial, but he thought the fire risks were increased by such a procedure. He had heard of fires being caused through a small leakage current having gradually charred wood, and ultimately set it alight. The apparatus bearing his name was, he said, admittedly automatic, but its action depended only on gravity and electrostatic attraction, and neither of these were likely to alter.

THE CONLEY-LANCASTER PROCESS FOR EXTRACTING IRON FROM ORE.

As the direct extraction of iron from the ore in a malleable state is the most ancient method known of obtaining this metal, the Hindoos having carried on the process from time immemorial, it would seem somewhat anomalous that the announcement of any invention to supersede the blast furnace is regarded, if not with suspicion, certainly with much indifference. How else can we account for the fact that new enormous blast furnaces are being erected, and old ones enlarged, when it has become a matter of history that an ironworks in Pennsylvania has been making steel by the direct process (and thereby doing away with the blast furnace) for a year past? Some of the finest bridge plates in the United States are being turned out from the Carbon Works where, according to the *Journal of the Society of Chemical Industry* (March, 1890, page 296), coke is broken

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into small pieces and soaked in thin milk of lime, when it is found to answer all purposes. All the impurities of the ore are fused, the oxygen combined with the iron joins the carbon of the coke, passing off as carbonic acid gas, and leaves the impurities in a shape that they can be eliminated, the iron remaining in a malleable form.

Nevertheless, as a matter of fact, it is not without good reason that the designation of "direct process" has also been conferred on the manufacture of ingot iron and steel by the introduction of the molten metal from the blast furnace, either into the Bessemer converter or into the Siemens furnace. It is difficult to conceive of a more economical method for obtaining the metal from the ore in a malleable state, especially where, besides, Gjers' soaking pits are employed. Certainly no process involving two separate operations would seem at first sight able economically to dispense with the blast furnace as the initial step. Where the ore is found in the form of small particles, as in the case of the magnetic sea-sand so abundantly met with in Canada, which is so difficult to deal with in the blast furnace, it is possible that the employment of horizontal closed retorts, "so constructed that the ore can be stirred by a mechanical device, whilst hydrocarbon gas, charcoal, or coke is mingled with it for its purification," may prove to be the most practical way of dealing with it. The process is certainly valuable if, as Messrs. Conley & Lancaster claim, "it deoxidises, desulphurises, dephosphurises, and otherwise purifies the iron ore." In this respect these retorts would seem to perform the function of the Siemens rotator, the malleable iron obtained from which apparatus yields, upon analysis, carbon, 0·15 per cent.; sulphur, a trace; silicon, 0·4 per cent.; phosphorus, 0·05 per cent.; manganese, 0·201 per cent.; and iron, 99·198 per cent.

Really these retorts may more properly be said to replace the rotator of Sir William Siemens than the blast furnace, for the two appliances have one and the same end in view, namely, to furnish a metallic product for immediate use to be melted down in the open-hearth furnace. True, in the case of the Siemens rotator, the flame comes into contact with the charge, whereas, by working in closed retorts, such as the Conley-Lancaster, the formation of iron-containing slag is in a great measure guarded against, and thus a serious source of loss is obviated. It is mainly in this direction that the advantages of the new process would appear to exceed those of the rotator. Some ingenuity is exercised so as to prevent the oxidising action of the atmosphere during the operation of transferring the product of the retorts into the Siemens furnace. "When the treatment has reached perfection the retort mouthpiece door is opened by simply raising it, and is held in position by a catch while the retort is being cleansed. The cap covering the mouth of the chute is then removed, and the product of the retort is as rapidly as possible hauled into the chute, which is instantly closed when the removal is finished. This operation must be so conducted that it will expose the purified and deoxidised ore as little as possible to the oxidising action of the atmosphere. The purified ore within the chute is then run off into a closed vessel through a spout. The vessel is then hoisted and held above a depression on the top of the open-hearth furnace. A cap is then removed, and the valve of the vessel is opened, allowing the ore to pour into the molten bath within the furnace."

From some figures before us, which Mr. Lancaster indorses, the cost of producing steel in 4in. billets, by the Conley-Lancaster direct process, in either the United States or Canada, is 21·05 dols. if sea-sand ore is employed, or 24·05 if the steel is made from mined rock magnetic ore. As the selling cash price per ton in New York at the time of 4in. billets was from 38 to 40 dols. per ton, there would appear to be a good margin for profit in the process.

THE CARBONISED REFUSE SYSTEM OF SEWAGE TREATMENT.

We illustrate above and on page 522 the plant which the Rivers Purification Company, Limited, 9, East Parade, Leeds, propose to use for the sewage treatment of towns with a population of 10,000. This process has the advantage of dealing with the dry refuse and dust, as well as the sewage of the town, and by not employing any chemical treatment other than the carbon filters, which are charged with the carbonised dry refuse, appears to possess economically advantages over the older processes. The method of working is as follows:—Dry town refuse is taken up an inclined road, and deposited as required in a carboniser of the form shown in Fig. 4. The animal and vegetable matter contained in the refuse is reduced to charcoal by a process of slow combustion. The carbonisers are fully charged with the refuse, where it remains until the whole mass is thoroughly charred.

THE TREATMENT OF SEWAGE

By the Carbonised Refuse System.

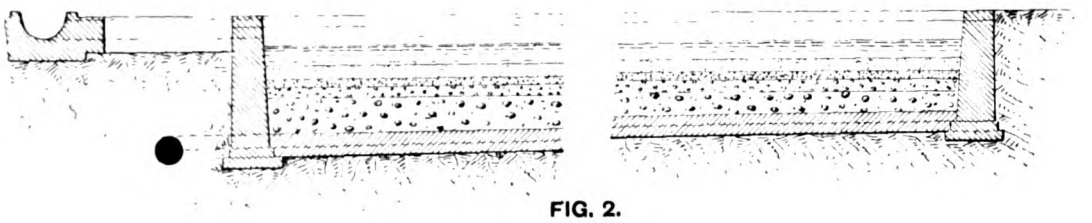


FIG. 2.

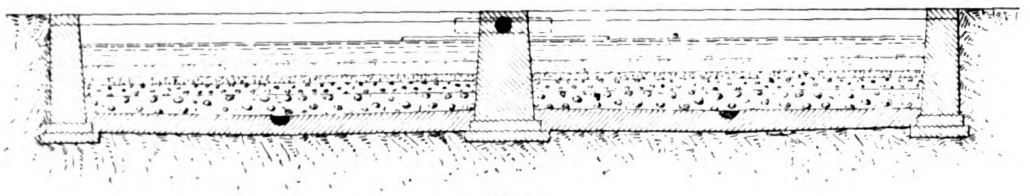


FIG. 3.

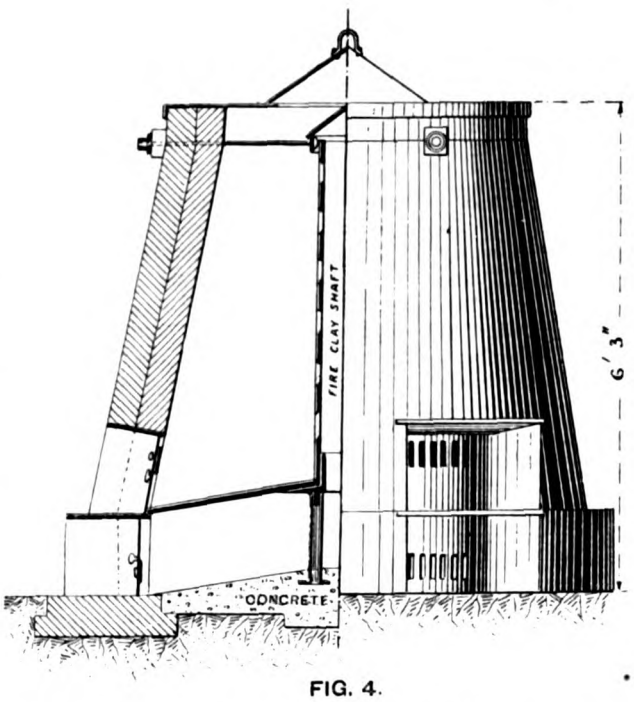


FIG. 4.

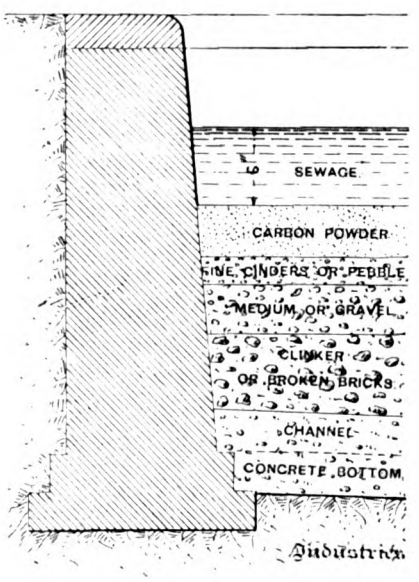


FIG. 5.

The carbonised material is then withdrawn and riddled by means of a circular riddle. Cinders and clinker are laid on one side for use in forming the bottom layers of the filters to be hereafter described. After the filters have been constructed the clinker and cinders will not be required for the filters, but may be utilised for making mortar, road repairing, or may be tipped in any suitable place without any fear of creating a nuisance. The lower layers of the filters may, where convenient, be formed of broken stones or bricks, gravel, and fine pebbles. The finer carbonaceous material, composed principally of charcoal with a small percentage of ash, is used as a filtering material by being placed as an upper layer, 4in. thick, upon shallow filter beds. The method of forming the filters will be readily understood upon reference to Fig. 5. Fig. 1 shows the plant required for a town of 10,000 population, and Figs. 2 and 3 show longitudinal and cross sections of a filter bed. The method of treating the sewage is briefly thus:—It is first passed through a screen which holds back the larger floating substances, after which it is passed through three settling tanks, and thence through three wirework cages filled with cinders of various sizes. The settling tanks and the cinder cages remove the bulk of the solid matter from the sewage. The clarified liquid then passes on to and through the filters previously described, and the effluent, as shown by analysis, is a remarkably good one.

Each filter bed is controlled by a valve connected with a clough, which prevents more than 6in. of sewage being upon the filter at one time. The sewage is distributed on to the filters by means of branch pipes connected to a central pipe built into the middle wall dividing the filter. Under each branch is placed a floating splash board, which prevents the sewage damaging the surface of the filters. After a filter has worked 24 hours the flow upon that particular filter is diverted to another one at rest. To facilitate the cleansing of the filter put out of work, any sewage remaining upon it is run off by a valve provided for the purpose on to the spare filter above named. As soon as the filter put out of work is sufficiently drained a thin film which forms on the surface is removed by means of a mechanical contrivance called a scum plough, a little fresh carbon is added, and the filter is again ready for work. A filter of 100 square yards can be cleansed and prepared for work in about ten minutes. The solids deposited in the settling tanks are mixed with the skimmings of the filters, the result being a portable manure, upon which the company have not fixed any great value. It will be noticed that this manure is not mixed with lime or other chemicals, and, therefore, is very different from the sludge obtained in similar processes. If it is of a stable nature, and not prone to undergo any fermentative or putrifying change, it should be a useful nitrogen food for cereals and grass. We should imagine that the filter beds would require to be renewed from time to time with fresh carbonised refuse in order that the effluent may be of a constant standard of purity. The land required for this process is one acre for each 20,000 population, which is only $\frac{1}{200}$th part of that required for broad irrigation, and $\frac{1}{10}$th part of that necessary for the combined process of chemical precipitation and land filtration. The company guarantee in their contract an effluent the purity of which shall come within the standard laid down in the Fifth Report of the Rivers Pollution Commissioners.

It is not absolutely necessary that in all cases the refuse be taken to the sewage works. Where the outfall is inconveniently situated with regard to the town, the refuse could be carbonised at any suitable point, and the carbon only delivered to the company at the purification works. The refuse, for instance, might in some cases be carbonised at the gas works. In towns where destructors are already in existence they, at no great cost, might be converted into carbonisers.

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THE PHYSICAL SOCIETY.

At a meeting of this Society, held on the 16th inst., Lord Rayleigh exhibited and described an arrangement of "Huyghen's Gearing in Illustration of Electric Induction." This gearing consists of two loose pulleys mounted on the same axle, with an endless cord laid over them, the loops or bights of which carry weighted pulleys, whose planes are parallel to the axis on which the upper pulleys turn. If one of the latter pulleys be started to rotate the other turns in the opposite direction until such time as the speed of rotation of the first one becomes constant. Whilst this constant speed is maintained the second pulley remains stationary, one weight being raised and the other lowered; but on retarding the motion of the first pulley the second commences to turn in the same direction as the first. It will be noticed that the phenomena are analogous to those which occur in electric induction, where starting or increasing a current in one circuit induces an opposite current in a neighbouring circuit, whilst decreasing or stopping a current induces one in its own direction. Lord Rayleigh pointed out that in this apparatus there is nothing strictly analogous to electric resistance, for the friction does not follow the same law. The analogy, he said, was complete as regards there being no change of potential energy, and the mathematical equations for the kinetic energy of the system are precisely the same as those given by Maxwell for electric induction.

Dr. S. P. Thompson then made a communication on Dr. Kœnig's "Researches on the Physical Basis of Music," in the course of which Dr. Kœnig performed numerous novel and interesting experiments, clearly illustrating the subject of beats and timbre to a crowded audience. He defined "harmonics" by tones whose frequencies are true integral multiples of their fundamental. This is distinctly different from the theory of the "upper partial tones" of Helmholtz or the "overtones" of Tyndall. As to the main question whether beats, when sufficiently rapid, blend into tones just as primary shocks do, Dr. Thompson briefly recalled the various arguments for and against such an effect, and then Dr. Kœnig proceeded to experimentally prove the affirmative. Taking two forks tuned to 2,048 and 2,304 vibrations respectively (ratio 8:9), and sounding them simultaneously, the middle C of the piano (256) was distinctly heard. The same beat-tone resulted from forks having frequencies in the ratio of 8:15, whose negative remainder was 256. Various other tones were sounded simultaneously in pairs, and in all cases the corresponding beat-tone was clearly recognised by the audience. Dr. Kœnig had constructed steel bars of approximately rectangular section, whose periods of vibrations were different in two directions at right angles. Striking one face of the bar a certain note resulted, whilst a blow on an adjacent face produced a different one. When the bar was struck on the edge joining the two faces *both the notes* could be heard as well as the beat-tone resulting therefrom. The experimenter had gone still further and made such bars so short that neither of the fundamental notes are within the limits of audition, but the resulting beat-tone can be heard quite distinctly. In all cases the frequency of the beats agree with that calculated from Dr. Kœnig's formula, and secondary beats follow the same law.

The phenomenon of beats was further illustrated by an experiment remarkable for its simplicity. A tuning fork held in the hand was moved towards a wall or other reflecting surface at various velocities. According to Doppler's principle, as the fork recedes from the observer and approaches the wall, the frequency of the direct waves is less, and that of the reflected waves greater, than that of the fork, and these two series of waves produced beats. Coming to the second half of Dr. Kœnig's researches, Dr. Thompson said that Helmholtz contended that the "timbre" of musical sounds was not affected by differences of phase amongst the component tones; on this point, however, Kœnig had come to the opposite conclusion. The subject was treated experimentally by means of a wave siren, consisting of a brass disc whose edge had been cut like a coarse-pitch circular saw, each tooth being shaped to a calculated wave-curve. Against this a stream of air issuing from a slit could be directed. By inclining the slit to one side of the radius or the other, the phases of the component waves could be altered, and this had a marked effect on the character of the sound produced.

After a large number of experiments of great scientific interest, Dr. Kœnig acknowledged the very cordial reception accorded to him by the meeting. At the close of a short discussion, in which Lord Rayleigh, Mr. Bosanquet, and Mr. Blakesley took part, the President said that, in view of the production of audible sounds by the beats from notes beyond the range of audition, it might be possible to demonstrate that insects produce sounds inaudible to the human ear by putting several together in a box and listening for beat tones.

Notes.

ENGINEERING PHOTOGRAPHY.

A process has been brought out by Messrs. J. Halden & Co., 8, Albert Square, Manchester, whereby, instead of engineering tracings being copied by the usual blue print process, it is possible to reproduce them in black lines on white paper. This is a decided advantage, and some specimens we have seen are clear and distinct. A dark room is not necessary.

THE ADVANTAGES OF EXHIBITIONS.

Some firms are found to be constantly represented at Exhibitions, while others are indisposed to take the trouble and expense which accompany them. If a show is made at all, it is advisable to do the thing well, or else the money is thrown away. Although at the late Barcelona Exhibition English exhibitors were not numerous, those who put in an appearance seem to have reaped a benefit, for the British Consul at Barcelona states that one of the results of the Exhibition has been to increase the importation of English machinery. Several instances have occurred of Catalan manufacturers who, having been struck with the excellence of the spinning and weaving machinery, have since proceeded to England in order to arrange for the purchase and erection in their own factories of similar machinery. All manufacturers are alive to the necessity of having modern machinery, and large sums have been spent on new looms of French, Belgium, and English make.

PAPER MILLS IN CHINA.

Not only are the Chinese developing their mines and railways, and such important industries as those connected with cotton in all its departments, but they are also pushing on many of what may be called the subsidiary industries. The Japanese have established a very large number of paper mills in their country, and now the Chinese are following their example. A company has been formed in Canton, composed entirely of Chinese, under the title of the Canton Paper Manufacturing Company, and they have erected an establishment costing about £30,000, and it is estimated that this will turn out about forty tons of paper per week. At first it is intended to produce only the varieties of brown paper in common use in China, but the plant can, without much difficulty, also be adapted to the manufacture of white paper, if necessary. All the employés will be natives, except the manager and engineer, who are British. Several of the Chinese who are engaged in the works have had experience in American paper mills for some years.

MINING IN CHILI.

Some time ago Consul Grierson, of Coquimbo, stated that attempts were being made at Andacolla to obtain alluvial gold, but these did not succeed. He attributes this fact, not to the scarcity of gold, but to the want of proper machinery. Several rich mines exist near Ovalle. Owing to the uncertainty of the copper industry, more attention has been paid to silver mining, and some good finds have been made in the Condoriaco, Quitana, and Arqueros districts, though on the whole expectations have been disappointed. The demand for manganese ore fell off last year, and, in consequence, shipments were small, but this year's prospects are better. The Chilian Manganese Company, Limited, are laying a narrow gauge line of railway between their mines and the port of Carrizal, a distance of about twenty miles. It is expected that mining interests will be advanced by the Government taking over several lines of railway in the Coquimbo district.

THE VAN RYSSELBERGHE SYSTEM.

We have recently received a book containing diagrams and statistics of the Van Rysselberghe system of working telegraphs and telephones simultaneously on the same line, but we cannot discover any new improvements which are likely to extend the use of this method. The total length of lines on which this system is stated to be in use is given as 15,747 kilometres; but in November, 1887, 15,123 kilometres were at work, so that since then there has only been an increase of about four per cent. The system in its simplest form consists of the introduction of impedance coils into a telegraph circuit, for the purpose of wire-drawing the currents, and rounding them off so that they give a continuous motion to the diaphragm of a telephone, instead of a sharp click at the commencement and make and break of the telegraph key. But to make the method of any practical use, condensers of considerable capacity and resistances have to be employed, a system which renders it impossible to work the telegraph instruments at any high speed, and offers difficulties also to the telephone service. These difficulties, such as the impossibility of "ringing up" in the ordinary way, necessitate the invention of special call apparatus, and in this way a "system," so dear to the Frenchman and to the American, is built up. For mere Morse lines, the retardation is not very serious, but Hughes' instruments, so largely used on the Continent, can hardly be worked on this method, while anything like a Wheatstone instrument would be rendered useless. The Van Rysselberghe system was given a two years' trial on the Government lines in Holland, and had to be abandoned, and a similar fate met it in several other countries. We are not aware that it has ever been tried in this country, where, bad as many of the telephone exchange systems are, they at all events have separate wires. The telegraphic methods in use on the 15,717 kilometres to which we have referred are evidently of a very elementary kind.

THE GOLD FIELDS OF WESTERN AUSTRALIA.

Glowing accounts come to hand respecting the prospects of the gold fields in this Colony. A report from the Pilbarra country states that two men who were starting for the Nullagine had gone but a few hundred yards when their horse kicked up a small nugget. They looked about and found more gold, and in nine days obtained 26oz. It is also stated that a man found in the conglomerate in the main camp at Pilbarra a stratum of gold-bearing ore about 4in. thick at a depth of 15ft. to 20ft. It gets thinner but richer as it is worked, and it takes an average of eight days to obtain a load. It is estimated that he has got nearly 1,000oz. in two months. Another big nugget, weighing 30oz., has been found near Mosquito Creek, and also one weighing 20oz.

AGRICULTURE IN QUEENSLAND.

A return has recently been issued by the Lands Department at Brisbane, showing the applications made for agricultural and grazing farms, under the Crown Lands Act of 1884, for the year 1889. The returns are comprehensive, and are interesting as showing the advantage which has been taken of the 1884 Act as compared with its predecessors, and the revenue which it has created. Throughout the whole Colony, the number of agricultural farms applied for was 1,644, with an area of 322,731 acres. The rent paid on them was £5,818 8s. 5d., of which £127 17s. 4d. was received in the form of land orders. The survey fees amounted to £7,428 10s. 3d. The grazing areas applied for numbered 210, with an area of 1,363,293 acres, producing a rental of £8,194 8s. 1d., while the survey fees on these amounted to £5,436 6s. Taking the two lots together, there were, therefore, 1,854 farms applied for during the year, the total area being 1,686,024 acres, and the total rent received in cash and land orders £14,012 16s. 6d. For 1888 the returns were—1,766 farms; area, 1,683,207 acres; rent, £12,735. The increase for the year just past is therefore little more than perceptible.

AGRICULTURAL MACHINERY IN RUSSIA.

In 1888, owing to the good harvest, there was a large sale of agricultural machinery in the Taganrog and Rostov district. Last year the numbers sold were only about half as much, but that business was considered satisfactory. About 6,000 ploughs were sold, most of them being German. Consul Talbot states that neither English nor American ploughs can compete with them in price. A good many Russian engineers have now taken up this branch of manufacture, and are underselling even the Germans, but their products are not as good. About 1,000 reapers, 500 mowers, 500 hay rakes, 200 horse-gear thrashers, and 55 steam thrashers were sold. The steam thrashers were all English, but the reapers, mowers, and rakes were American. Efforts are being made by many of the leading agriculturists in South Russia to obtain a diminution of the duties on agricultural machinery. Local machine shops did a good trade last year. From Berdiansk Vice-Consul Lowe reports that heavy sales were made of the home-made reaping machine, which cuts very low. The foreign reaper was found almost useless last year, not being able to cut low enough for the excessively short growth of straw. A very large business is done every year in the Russian reapers, makers being unable to meet the demand.

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Patent Record.

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

12th May, 1890.

7334. Phillips & Archer ..... Valve and piston rods.
7337. Cocker, B. F. ..... Starting and stopping tramcars.
7338. Leach & Wilkinson..... Forging shafts.
7340. Keep, F. ..... Strainers for wire fencing (*Morrin*).
7348. Bennett & Hides ..... Metallic rods, tubes, &c.
7349. Alley, S ..... Nut locks.
7350. Martin, P. A..... Nail-making machinery.
7358. Greening, W. A. ..... Packing rings of pistons.
7359. Westwood, F. ..... Lubricators.
7361. Martin, E. ..... Filtering machinery.
7363. Gebelein, L. ..... Machine for polishing slate.
7366. Webb, S. H..... Driving wheels
7368. Flower, Flower, & Cousins ..... Scrubbing machines.
7369. Kiddier, H..... Straight bar knitting machines.
7371. Wood, C..... Railway chair.
7372. Brokas & Irving ..... Lubricating bearings.
7374. Nobbs, J. J..... Shields for tunnelling.
7375. Saint, T. ..... Governors.
7377. Imray, O..... Rolls for rolling hay forks (*Spiegel*).
7381. Wells, C..... Steam engines.
7385. Livens, F. H. ..... Thrashing machines.
7386. Boult, A. J. ..... Spring motors (*Richard*).
7388. Thompson, W. P. ..... Injectors (*Schutte*).
7389-90. Longmore & Watson Decorticating machines.
7391. Thompson, W. P. ..... Injectors (*Schutte*).

13th May, 1890.

7395. Ligowsky, G..... Lathe tools.
7397. Pain, A. C..... Lubricating steam engines.
7403. Johnson, J. Y. ..... Type-setting machines (*Chadwick*).
7406. West, W..... Apparatus for pressing bricks.
7407. Huntington, F. A. ..... Crushing mills.
7412. Outram, E..... Steam gauges.
7419. Walkington, W. ..... Town refuse destructor.
7424. Ligowsky, G..... Screw cutting dies.
7426. Lake, H. H..... Vacuum pumps (*John Patten Manufacturing Company*).
7427. Knickerbocker, R. ..... Brick-making machines.
7429. Ligowsky, G..... Grinding machines.
7431. Rothwell, R. P. ..... Sinking shafts.
7432. Garfield, L. M. ..... Railway switches. (17th October, 1889.)
7437. Campion, W. ..... Sewing machinery.
7440. Boult, A. J. ..... Railway ties (*Wallace*).
7442. Greenbough, J..... Rotary engines.
7447. Lake, H. H..... Printing presses (*Cottrell*).
7449. Watkins, T. ..... Railway trucks.
7451. Braby, J..... Windlasses.
7454. Bunnell, M. G..... Road-making machines.
7455. Goodson, G. A. ..... Justifying machines.
7457. Stewart, R. ..... Portable buildings.
7458. Landis, J. H. ..... Band saw machine.
7459. Schoff, F. ..... Casing for flexible shafts.
7460. Stevens, R. ..... Fencing.
7461. Lake, H. H..... Annealing metals (*Russel and Erwin Manufacturing Company*).

14th May, 1890.

7470. Baird, R. ..... Stuffing boxes.
7472. Sugden & Hardaker ... Jacquard machines.
7475. Edwards, W. J..... Grading and ditching machines.
7477. Mathus, H..... Ironing machines.
7483. Smith, Sen., Smith, Jun., & Smith ..... Machines for straightening steel plates.
7500. Hesse, L. ..... Destructors for town refuse.
7502. Munzenmaier, C. G..... Tube cleaners.
7504. Boult, A. J. ..... Embroidery machines (*Legrand*).
7508. Thompson, W. P. ..... Rotary pumps (*Bornet*).
7514. Ambler, W..... Moulding metal.
7517. Coxon, J. N. ..... Gearing for rotary motion.
7519. Renaud, R. M. L. G..... Liquid meters (*Lacoste*).
7524. Druckenbrodt, W. ..... Apparatus for measuring strains or forces.
7528-9. Lock, C. ..... Locomotives.
7530. Brodin, G. A ..... Lathes.
7538. Piatkowski, J. J. ..... Hoisting apparatus.
7539. Hornsby, Innocent, & Smith ..... Reaping machines.
7541. Bayly, J. P. ..... Locomotive head lights (*Crowley*).
7544. Bayly, J. P. ..... Drawing, compressing, and polishing metal bars (*Moltrop*)
7545. Bayly, J. P. ..... Thread doubling machine (*Perkins*).

15th May, 1890.

7550. Fairburn, J. ..... Looms.
7554. Duvinage, G..... Slide valves.
7574. McDougald, A..... Car couplings.
7587. Hunt, T. ..... Planing and milling machines.
7588. Goss & Goss..... Reaping machines.
7590. Sanderson, F. ..... Typewriting machines.
7591. Haddan, R..... Automatic balances for grain (*Riedinger*).
7592. Franke, C. ..... Rock drills.
7594. Ford, B. F. ..... Looms. (26th October, 1889.)
7595. Walters, W. M. ..... Ballast tanks for steamers.
7598. Richardson, C. J..... Paper-making machines.
7600. Boult, A. J. ..... Hydraulic engines (*Kölz*).
7603. Capel & Ladd ..... Baling presses.
7606. Hemans, W. B. ..... Mounting naval guns (*De Latouche*).
7607. Martin, A..... Explosive projectiles.

16th May, 1890.

7612. Barraclough & Rhodes Tool holders for lathes.
7615. Coultard & Hargrave Securing rails in chairs.
7620. Fletcher & Clare ..... Gas ovens.
7623. Chapman, G. ..... Propulsion of vessels.
7625. Grimshaw, W. D. ..... Consumption of smoke.
7626. Johnson, J. Y. ..... Engines (*Loutsky*).
7627. Crossley, S. ..... Scutchers.
7628. Groombridge & South Brakes for tramcars.
7630. Morison, W. C. ..... Propellers.
7631. Towler, J. A. ..... Compound engines.
7632. Wolseley & Craven ... Shafts.
7635. Willoughby & Horsfield ..... Pulleys, &c.
7639. Young, Young, & Wright Hydraulic pumping machinery.
7640. Baynes, Topping, & Whittaker ..... Looms.
7642. Surridge, A. ..... Blowing engines.
7643. Bury & Booth ..... Looms.
7649. Brown, T. A..... Railway chair.
7652. Swalwell, J. ..... Machinery for the manufacture of horseshoe nails.
7659. Rutter, G. E..... Weighing machines.
7667. Kingsford, C. ..... Pressure pumps.
7671. Little, H. W. ..... Steam engines (*Little*).
7680. Heidelmann, W. ..... Printing apparatus.

17th May, 1890.

7682. Rutter, G. E..... Weighing machines.
7683. Grindrod, J. K. ..... Windmills.
7688. Martin & Goodey..... Propelling ships.
7689. Anderson, A ..... Sewing machines (*Singer Manufacturing Company*).
7700. Gorse & Gorse ..... Nail-making machinery.
7701. Lilljequist, J. R ..... Tunnelling apparatus.
7704. Tattersall, W..... Humidifying and ventilating apparatus.
7708. Kay & Young ..... Machinery for shearing fabrics.
7715. Middleton, H. ..... Flying machines.
7728. Mitchell, J. ..... Drying machinery.
7730. Horn, W. W. ..... Nut lock (*Harris*).
7731. Pierce, M. H..... Railway chair. (19th December, 1889.)
7733. Lake, H. H..... Annealing steel (*Cummins*).
7736. Clark & Clark ..... Steam engines.
7738. Cleathero & Nichols ... Feeding printing machines.

ELECTRICITY.

12th May, 1890.

7373. Hooker, G. S. ..... Electric switches.
7378. Brüll, A..... Electrical switches.
7383. Levsen, J. N. ..... Battery element.

13th May, 1890.

7399. Kennedy, R. ..... Heating by magnetism and electricity.
7422. Bryan, F. ..... Regulating electrical circuits.
7425. Conly, M. S. ..... Alternating currents.
7433. Vogel & Calkins ..... Telephones.
7436. Dukes, B..... Electric switches (*Bosse*).
7438. Garrett & Lucas..... Protection from lightning.
7444. Million & Bony ..... Galvanic batteries.
7456. DeBrouchere & Anspach Applying electricity to produce water-pressure for fire extinction.
7465. Kingsbury, J. E. ..... Telephone exchanges (*Western Electric Company*).

14th May, 1890.

7473. Sayers, W. B..... Incandescent lamps.
7505. Taylor, A. L. ..... Safety devices.
7511. Immisch, M. ..... Brush for dynamos and motors.
7513. Wise, W. L. ..... Secondary batteries (*Schoop*).
7518. Walker & Rawlins..... Primary batteries.
7520. Johnson & Phillips..... Signalling on electric lighting circuits.
7540. Wise, W. L..... Arc lamps (*La Société Japy Frères*).

15th May, 1890.

7553. Furtado, E. F. ..... Telephonic apparatus.
7560. Smythe & Payne ..... Ammeters and voltmeters.
7572. Suter, F..... Electric sign.
7581. Thoms, W. A..... Electro deposition.
7599. Belfield, R. ..... Arc lamps (*Lange*).

16th May, 1890.

7624. Kingdon, J. A. ..... Electrical transformers.
7654. Todd, H. L..... Telephonic apparatus.
7663. Fischinger, E. ..... Distributing current.
7670. Abel, C. D..... Electric meter (*La Société Anonyme Continentale*).
7674. Jobling, J. A. ..... Electric lamps.

17th May, 1890.

7725. Challis & Graham ..... Electric switches.

CHEMISTRY.

13th May, 1890.

7421. Holliday, R. ..... Hydroxyquinone.
7464. Smuts, W. J. ..... Amalgamator (*Croñoun, Hicks, & Laitz*).

14th May, 1890.

7527. Vivian & Bell ..... Ammonia soda process.

15th May, 1890.

7575. Green & Lawson ..... Amido bases.
7596. Turpin, E. ..... Explosive substances.

16th May, 1890.

7673. Mayer, E. L. ..... Treatment of sewage.

17th May, 1890.

7706. Clough, J. A..... Soap.
7714. Newton, C. B. ..... Gas purifiers.
7739. Von Langer & Cooper Water gas.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form of such opposition.

Year 1889.

7830. Grove.
7884. Greenwood.
7909. Perry.
7915. Higgins.
7924. Smith.
8013. Weatherhogg.
8010. Myall (*Lancaster*).
8071. Moore.
8124. Ingham.
8177. Hermite, Paterson, & Cooper.
8225. Smith.
8227. Furnival.
8231. Mackenzie.
8340. Thornycroft.
8428. May.
8592. Stansfield.
8772. Le Mesurier.
8786. Dickson.
8872. Wise (*Solray & Co.*).
8904. Hogan.
8993. Wilkinson.
8996. Thomas-Jésupret.
9201. Snowdon.
9311. Burgess.
9416. Vigers.
9419. Simon.
9515. Vero & Besley.
9618. Davey.
9763. Brownen & Gamgee.
9776. Nicholson & Palmer.
9777. Nicholson & Palmer.
9812. Nicol.
9936. Cleminson.
9987. The Alkaline Reduction Syndicate, Ld., & Cunningham.
10008. Zipernowski.
10069. Bird.
10082. Binswanger.
10098. The Union Boot and Shoe Machine Company, Ld., & Cox.
10154. Bull.
10186. Robinson.
10242. Farran & Crawford.
10274. Cave.
10454. Christie (*Simonds*).
10481. Pearson & Bennion.
10529. Whittaker.
10611. Smith.
10627. Smith (*Addis*).
10635. Hulme & Walton.
10929. Snell & Thompson.
10976. Willshaw & Haynes.
11046. Thompson (*Westinghouse Electric Company*).
11074. Jackson.
11076. Longle.
11104. Carr.
11116. Cristall.
11159. Birt.
11164. Schmidt.
11170. Kimberley.
11181. Martin.
11213. Gedge (*Croulbois*).
11218. Rawson.
11249. Anderson.
11270. Lundberg.
11296. Ryder & Dopson.
11298. Blakely.
11312. Walton.
11344. Josz.
11350. Garton, Garton, & Lawrence.
11351. Garton, Garton, & Lawrence.
11366. Brownhill.
11378. Preston & Haines.
11380. Greenwood & Ashworth.
11384. Kerslake.
11400. Hardingham (*Goyder & Murray*).
11401. Holden, Hesson, & O'Neill.
11402. Bazin.
11404. Anderson.
11424. Maskelyne & Maskelyne, Jun.
11426. Newton (*Main*).
11441. Thompson & Powell.
11440. Broadbent.
11454. Burn.
11442. Menzies.
11468. Edwards (*Stelzner*).
11467. Edwards (*Stelzner*).
11487. Burton.
11489. Richards.
11504. Strawson.
11511. Oberwarth.
11589. Crompton.
11595. Allen & Bowers.
11654. Drabble.
11754. Thurman.
11913. Van de Waal.
11965. Stone.
11980. Strawson.
12083. Haas.
12249. Butterfield & Batchelor.
12430. Lake (*Seaver*).
12434. Hooper & Moore.
12488. Hoskins.
12619. Horn (*Tribe*).
13825. Nicole.
14749. Von Reibnitz.
15783. Lake (*Brown*).
16460. Swindells, Peel, & Freeman.
16692. Whitehead.
16929. Rebmann.
17005. Johnson.
18029. Perl.
18237. Garsed.
18355. Gibbs & Fesquet.
19357. Eggis. (18th May, 1889.)
19448. Lake (*Guraschi*).
20381. Summerskill.

1890.

122. Edwards (*Terp*).
127. Younger. (5th June, 1889.)
137. Lyon.
673. Von Babo.
902. Kenealy.
1097. Lake (*Gesner*).
1425. Sommerfeld.
1787. Harries & Davis.
2372. Boult (*McNeill & Clarke*).
2376. Boult (*Noxon*).
2644. Lake (*The Automatic Fire Alarm and Extinguisher Company Ld.*).
2683. Thompson (*Sutcliffe*).
2814. Schievenbusch.
2991. Farrell.
2951. Warren.
2957. Aubert.
3025. West.
3035. Perrna & Theoharescu.
3241. English.
3451. Naylor.
3590. Hughes, Rigby, & Pirrie.
3850. Tyler & De Vesian.
3914. Boluda.
4059. Normanton & Normanton.
4181. Spitzer.
4234. Sorel.
4251. Simpson.
4306. White.
4408. Adels.
4528. Schoone. (22nd August, 1889.)
4686. Schneider.
4688. Potts.

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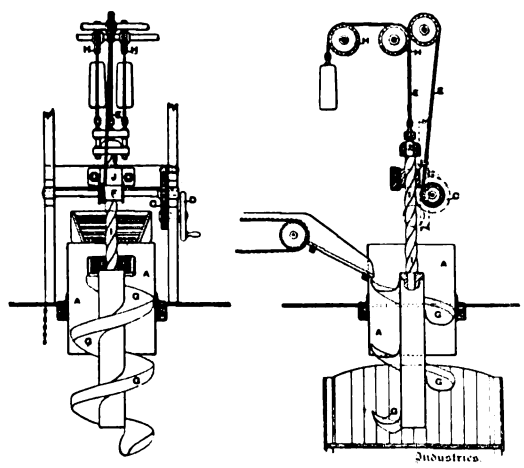
4825. English.
4945. Mumford.
5127. Banks.
5200. Vickers & Vickers.
5270. Jennings.
5337. Carpenter.
5352. Cottrell.
5372. Mitchell & Lawson.
5476. Higley.
5512. Bettenhauser.
5573. Cito & Funck.
5645. Odell.
5650. Taylor.
5669. Palmer.
5698. Newton (*The National Machine Company*).
5724. Lake (*Knapp*).
5735. Heberling, Sprague, & Austin.
4907. Colthurst, Symons & Co., Ld., & Pierce.
5165. Knight & Higgins.
5229. Ekroth.
5322. Allison (*Fennessy*).
5341. Brittain.
5367. Lake (*McKenzie & Braker*).
5487. Duff.
5534. Burbridge.
5608. Letcher.
5647. Griffin.
5660. Barnes (*Winslow*).
5677. Radam.
5703. Boult (*Coxon, Shelton, &c., Pender*).
5726. Lake (*Fleischmann*).
5884. Smith.
5835. Lilwall.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

Delivering Coal to Waggons, &c.—*M. Nichols, Leeds.*—The inventor's object is to provide means for delivering coal from screens on a pit bank into railway waggons in such a manner as to minimise the breakage of the coal. The invention comprises a helical shoot which intercepts the coal in its fall from the screen to the waggon. The figures are respectively a front and side elevation of the appliance. The following is the mode of operating the appliance: When the empty coal waggon has been brought under the casing A the pawl B is moved out of gear with the wheel C, which is then rotated by means of the hand-wheel D. This motion uncoils the rope E from the barrel F, and allows the spiral shoot G and its attachments to descend until the lower edge of the spiral shoot is slightly above the

FIG. 2. FIG. 3.

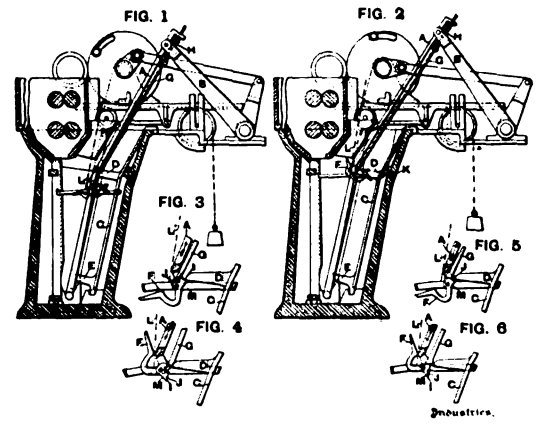


bottom of the coal waggon. The pawl B is then thrown into gear, and holds the spiral shoot in this new position. The coals are now allowed to slide down the inclined side spout on to the upper end of the spiral shoot G, down which they slide to the bottom of the waggon. The coal is moved sideways from the bottom of the shoot by the attendant or "dresser" in the waggon. When this end of the waggon has been filled round, up to the level of the bottom edge of the spiral shoot, the shoot G is raised a suitable height by means of the hand-wheel D and the mechanism described. The supporting rod I has the same pitch as the spiral shoot G, and passes through a fixed nut J; therefore the raising of the spiral shoot G and the rod I imparts a corresponding rotation to the shoot G. In consequence of this rotation the outer end of the spiral shoot retains throughout this motion the same relative position to the edge of the side spout, so that a vertical section of the spiral shoot in proximity and through the centre line of the side spout remains the same, whatever may be the position to which the spiral shoot has been raised or lowered. Four claims are made.—No. 7917. May 18th, 1889. 8*d.*

Tanks for Storing Petroleum.—*J. Stewart, T. Charlton, & J. Casey, London.*—For storing and transporting volatile and inflammable liquids tanks and other vessels have been constructed so that the increase or reduction of bulk of the liquids is compensated for by means of non-inflammable gases or water contained in suitable chambers. When water is so used some of the volatile liquid becomes absorbed or mixed with it, and the water being afterwards discharged the absorbed liquid is lost. To recover this liquid from the water the inventors construct an additional receiver or accumulator connected to the tanks containing the oil or liquid stored under pressure of water. The accumulator receives the surcharged or waste water as it is drawn off from the tank. The water is caused to pass outwards through a series of filtering mediums or apparatus, of any form, to separate the oil from the water as it is allowed to run away to waste. Claims: (1) In combination with safety vessels or reservoirs for storing petroleum and other inflammable liquids, the application and use of filtering apparatus for the purpose described; (2) the improvements connected with tanks used for the storage of petroleum and other inflammable liquids, as described.—No. 9986. June 18th, 1889. 6*d.*

Coating Metal Sheets with Tin, &c.—*H. F. Taylor, Tynant, Neath.*—These improvements refer to the cradle and nipping apparatus for taking down the plate to be coated, canting it and raising it into the nip of the rolls on the exit side of the pot. The appliance is illustrated applied to a self-acting gear such as described in a previous specification No. 4350 of 1888. Fig. 1 is a vertical cross-section through a tinning pot with the self-acting gear. In connection with the rod A and lever B is a tappet bar C (shown in detail, Figs. 3 and 4). The upper end of C is fixed to the pot. Its tappets or steps D E act upon the two faces set at an angle on the upper hook F. The plate is nipped between the hook F and cradle rod A. To retain the nipper hook in the open or closed position, the upper end of a rod G is held in a yielding manner by a spring H in a projection from the cradle rod A. When the cradle rod A is nearly in its uppermost position and whilst still rising (see Figs. 1 and 2), the upper face

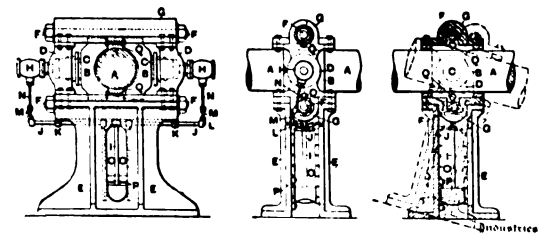
FIG. 1 FIG. 2



I of tumbler having recess J comes against the upper tappet D, the latter thus depressing that end of the hook F, and raising the opposite or nipping part so as to nip the inserted plate L ready subsequently to take it down as required into the coating material. The cradle is then lowered. When the cradle with the plate is nearly in its lowest position, the nipper hook F or tumbler comes with its face M against the lowest tappet E, and the nippers are opened again so that the plate is released, and can be canted, and in the rising stroke entered into the nip of the rolls on the exit side of the pot. Claims: (1) In apparatus for coating plates with tin, lead, or other metals or alloys, a plate-nipping hook F provided with faces which is carried up and down by machinery or by hand, said faces being adapted to come against tappets for the purpose of opening and closing the hook, which is retained in the closed or open position by a yielding part in connection with a spring or weight above the coating metal, substantially as set forth; (2) the application of a rod which is operated by a spring or weight above the coating metal and which serves to hold the nipper hook in the required closed or open position, substantially as set forth; (3) the nipper hook F which is carried up and down by rod A from a reciprocating lever B and has faces which are adapted to come against the stationary tappets D and E, said hook being retained in the required closed or open position by the elastically mounted rod G, substantially as described with reference to the accompanying illustration.—No. 6594. April 17th, 1889. 11*d.*

Preventing the "Racing" of Propellers.—*F. G. Harvey, Vere, Jamaica.*—The invention consists essentially in arranging a brake, operated by hydraulic or other fluid pressure, in conjunction with the propeller shaft, and in utilising the motion of the vessel for controlling the valves by means of which the supply of fluid for operating the brakes is regulated. In the accompanying illustrations, Fig. 1 is a side elevation of apparatus constructed according to the invention, Fig. 2 is an end view of the same, and Fig. 3 is a vertical section on the line X X of Fig. 1. A is the propeller shaft, and B B are two brake-blocks which are adapted to grip it; the said blocks being provided with plungers C C entering cylinders D D supported on the frame E. F F are tie-rods, which pass through lugs G G on the cylinders D D, for preventing the said cylinders from moving relatively to each other. H H are valves for controlliug the supply of the fluid to the cylinders D D. I is a weighted arm or lever which is suspended from the shaft J carried in bearings K K on the frame E. At each end of the shaft J is a lever-arm L connected by a link M to the stem N of one of the valves H H, in such a manner, that when the shaft J is rotated by the weight the valves are operated. The weighted arm I is suspended between

FIG. 1. FIG. 2. FIG. 3.



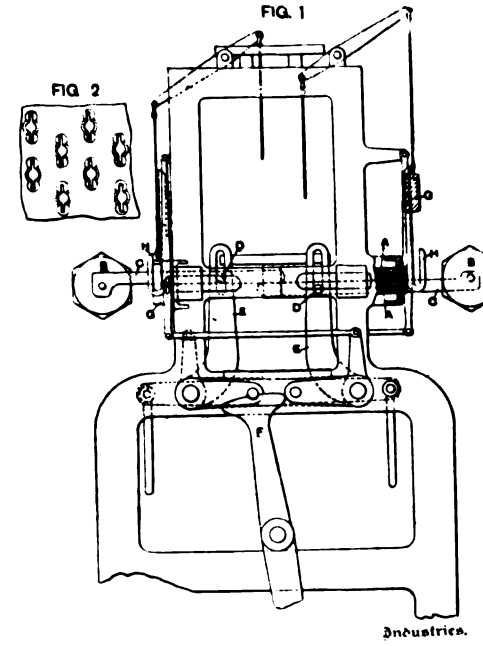
guide-plates O O, so that it is not affected by any rolling motion of the vessel, and so that it will only operate the valves when the stern of the vessel rises out of the water. When the bow of the vessel is higher than the stern the weight on the said arm is supported against one side of the frame E, a cushion P being arranged to prevent the weight from forcibly striking the said frame during the lurching of the vessel. Claims: (1) Braking the shaft of the propeller of a steamship to compensate for the non-resistance of the water, and utilising the motion of the vessel for controlling the application of the brake-power, substantially as and for the purpose described; (2) in apparatus for utilising the motion of a vessel for applying a brake to the propeller shaft, the combination of brake-blocks adapted to be forced into contact with the said shaft by fluid pressure, valves for controlling the supply of fluid for actuating such brakes, and a shaft carrying a weighted arm, the said shaft being connected with the stems of the valves, all substantially as described; (3) the improved apparatus hereinbefore described and illustrated in the accompanying drawing for preventing the "racing" of the propellers of steamships.—No. 10097. June 20th, 1889. 6*d.*

Coupling Railway Carriages.—*G. W. Moon, London.*—For the purpose of facilitating the coupling and uncoupling of railway and other carriages without the necessity of men having to go between them, the inventor attaches to the existing hook at the end of the draw-bar, another hook which has a hinged joint and moves in an oblique direction slightly out of the horizontal. This hook engages in a similar hook upon the opposite carriage. When the carriages meet the hooks displace one another and move upon their hinged joints, but on passing their hooked ends they return to their normal positions by force of gravity consequent upon the sloop of the hinge, and become interlocked. Chains are secured to the hinged hooks to enable them to be pulled back and disengaged from the side of the car. Claims: (1) In apparatus for automatically coupling railway or other vehicles, hinging or pivoting the arm carrying the coupling hook at an angle of 60° to the horizontal or vertical or approximately; (2) the construction of automatic coupling apparatus for railway or other vehicles as described.—No. 6983. April 26th, 1889. 6*d.*

Looms.—*H. Fawcett, Kidderminster.*—According to this invention the loom has two or more jacquards each, with its own cards. Each jacquard is tied up with the figured warps of the fabric, and when at work raises them in selected order under control of the cards. Only one jacquard is at work at a time, mechanism being provided for putting them in and out of work. In weaving bordered carpets with a loom constructed according to this invention, the change from border to pattern, and *vice versâ*, is made by stopping one jacquard and starting another. In Fig. 1 of the accompanying illustrations an elevation of the jacquard mechanism is shown. A are the jacquard needles, B the jacquard cylinders, each carrying its own cards. The cylinders are supported in sliding bars C, which have inserted in them pins D. These pins work in the slots of the bell-cranked levers E, so that as the levers E are oscillated by the cam lever F the sliding bars C, and with them the jacquard cylinders, are moved to or away from the needles, one cylinder approaching as the other recedes. The cylinder which is to be kept out of action is removed the farthest from the needles. In addition to providing two jacquard cylinders, two levelling boards G are

FIG. 1

FIG. 2



also provided. Either of these is brought into action by lowering it into the hooked ends of a swinging arm H. The levelling boards may be connected to the shafts of the lever E as shown, so that their movement operates both cylinders and boards. The several holes in the lifting board H, up through which the lifting cords are led, are shaped in the manner shown at Fig. 2, with a slot extending from opposite sides of the hole. When the cords pass centrally through the hole and the board is lifted in the ordinary manner, the knots on the cords will pass freely through the holes, and the cords will not be raised; if, however, the needle to which any cord is threaded is pushed from its central position either towards one end or the other, the cord will be deflected and moved into either one or the other of the narrow slots which extend from opposite sides of the hole, and then when the board is lifted the cord is carried up with it, the knot not being able to pass through the slot. Claims: (1) The manufacture of bordered carpets in looms provided with two jacquard cylinders, one carrying cards suitable for controlling the making of the border, the other carrying cards suitable for controlling the making of the body, and with either jacquard cylinder capable of being brought into action whenever desired; (2) a loom having two jacquard cylinders, either of which can at pleasure be brought into action when the other is held at rest, each cylinder carrying its own set of cards, and when in action controlling the raising and lowering of the warp; (3) the construction of jacquard mechanism for looms substantially as described and illustrated.—No. 8261. May 17th, 1889. 8*d.*

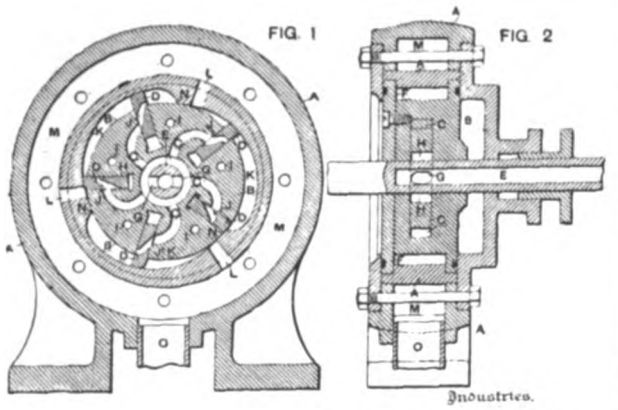
Fog Signalling Apparatus.—*W. Smith & G. Stephenson, New Wortley, Yorkshire.*—Along the side of the railway tract are fixed at right angles to it a number of rollers. The rollers are connected to a switch so that their positions may be altered by the signalman. On the locomotive there is pivoted a lever, whose upper end is arranged to strike the hammer of a bell when the lower end is raised. The lower end of the lever is raised by the rollers when they are placed in a certain position by the signalman, and as the locomotive travels pass them. The number of rollers correspond to the number of blows to be struck on the bell. When no signal is to be made the rollers are shifted in

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their position by the switch and the lever passes by without being raised. Claim: The arrangement, construction, and combination of parts forming the fog signalling apparatus.—No. 8781. May 27th, 1889. 6*d*.

COMBING MACHINES.—*J. C. Walker & J. E. Stephenson, Leeds.*—The improvements refer to Noble's and other kindred combing machines. Firstly, in order to cause the large and small comb circles to rotate with greater steadiness, runners are provided underneath the rack circles, having their peripheries running in a diagonal line to the plane of the movement of the rack circles. These runners may be fixed to the rack circle plate and rotate with it, or they may be placed on any suitable part of the steam chest or framework of the machine, working against a suitable annular ring, such ring being formed on the rack circle; or the angular runners may be mounted upon the rack circle and travel round with it. Secondly, the circular steam chest for imparting heat to the circular combs is made of a trough-like form, and a thin plate used to cover the top, the cover being riveted, soldered, or otherwise secured to the top. By this arrangement a steam chest is provided of larger steam capacity, the heat is given off readier at the part required, and the construction is simplified. Claims: (1) The arrangement of pulleys or runners and angular rings or parts upon which the runners or pulleys revolve, such pulleys or runners and angular rings or parts having their peripheries or steadying surfaces in a diagonal line to the plane of movement of the rack circle, whereby greater steadiness is imparted to such rack circle when in motion, as described; (2) the construction of steam chest, having a thin plate or cover fixed on the top, as described.—No. 13755. August 31st, 1889. 6*d*.

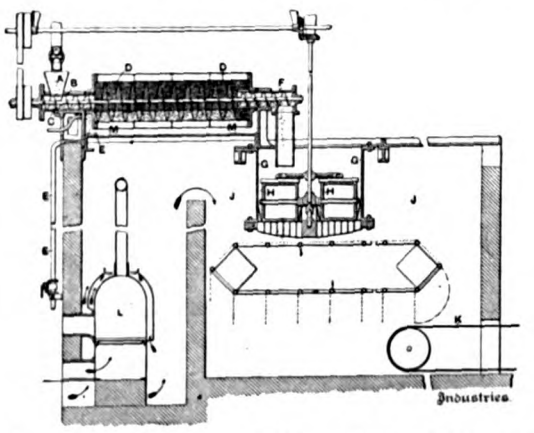
ROTARY ENGINES.—*H. Bleasdale, Astley Bridge, Bolton.*—This rotary engine consists of a cylindrical chamber A, which is stationary, and of a disc B, which is made to revolve about its axis in bearings in the former. The disc B is mounted on the steam pipe or hollow shaft E, with the openings G to convey steam into the chamber or cavity H in the disc B. The latter is also provided with the passages C leading from the chamber or cavity H to the slide valves D. The disc B is fitted with the loose plate or disc F, secured by set screws to facilitate the mounting of the disc in the casing or framing A. The slide valves are constructed with the ports J. The inside of the casing or framing A is constructed with the eccentric or cam-like working surfaces K to operate the slide valves D in their respective slots as the disc B rotates in a direction from right to left. The



casing or framing A is provided with the exhaust ports L leading into the exhaust chamber M between the inner and outer shell of the casing A. This engine operates in the following manner:—Steam is conveyed from the boiler into the hollow shaft E, from whence it passes through the openings G into the chamber or cavity H and passages C to the slide valves D. As the disc B rotates, the outer ends of the valves are pressed tightly against the eccentric or cam-like working surfaces K by the action of steam. When the valves pass the points N, they are at once blown outwardly by the pressure of steam. As the disc B rotates, the valves are moved inwardly by their movement or traverse on the eccentric or cam-like working surfaces K. When the steam side of the slide valves pass the exhaust ports L, the steam in the spaces between the points N and the exhaust ports L passes into the chamber M and away through the pipe O into the atmosphere, or to any suitable condensing apparatus. Claims: (1) In a rotary steam engine the use of the casing or framing A, with the eccentric or cam-like working surfaces K for the purpose of operating the valves so as to work steam expansively, substantially as described and as shown on the drawings; (2) in a rotary steam engine the use of the slide valves provided with the steam port J, substantially as described and shown for the purpose specified; (3) in a rotary steam engine the combination of the disc B, hollow shaft E with the openings G, chamber or cavity H, passages I, slide valves with the ports J sliding to and fro in the slots C, the casing or framing A with the eccentric or cam-like working surfaces K and the exhaust ports L, the casing N, and the side discs, applied and operating substantially as described and as shown on the drawings; (4) the general construction, combination, and arrangement of parts forming the improved expansive rotary steam engine, substantially as described and as shown on the drawings.—No. 9615. June 11th, 1889. 8*d*.

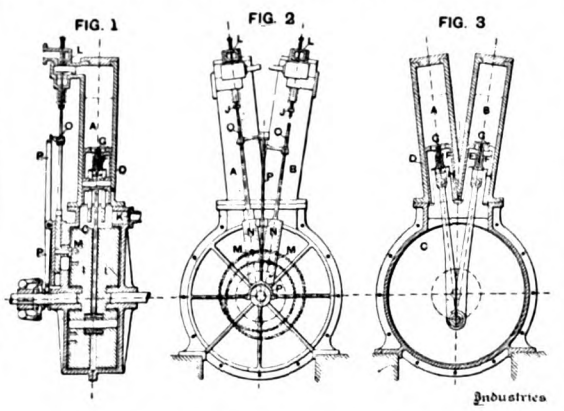
REVERSING MECHANISM FOR ENGINES.—*F. Daugy, Paris.*—The mechanism consists essentially in an arrangement by which the eccentrics may be turned through an angle of 180° on the crank-shaft. The eccentrics are formed in one with a loose sleeve upon the engine-shaft, this sleeve being carried round with the shaft by a projection upon the latter. The projection abuts against one or the other of two shoulders in a circular groove in the sleeve, and the shoulders are so arranged that the shaft can turn half round relatively to the sleeve in moving its projection from one shoulder to the other. If during the running of the engine in one direction the eccentric sleeve be turned half round upon the crank-shaft, it will be evident that the slide valves will be worked in the contrary direction to that in which they previously worked, and that consequently the motion of the engine will be reversed. The reversal of the position of the eccentric sleeve is effected at will by the engine itself by means of an auxiliary shaft parallel to the crank-shaft, and capable of being put in gear with it at one end at the required moment. The other end of the auxiliary shaft carries a pulley which gears frictionally with a circular surface upon the eccentric sleeve. When the auxiliary shaft is put into gear with the crank-shaft, the former is driven in the reverse direction to the latter, so that the friction pulley reverses the eccentric sleeve, and thus the engine. Three claims are made.—No. 10,100. June 20th, 1889. 8*d*.

PREPARATION OF CEREALS FOR BREWING.—*A. Perry, London.*—The object is to render rice and other grain more suitable for brewing, distilling, vinegar making, and for purposes of food. For this purpose the grain is first submitted to the action of hot water to cook the grain and saccharify the starchy constituents.



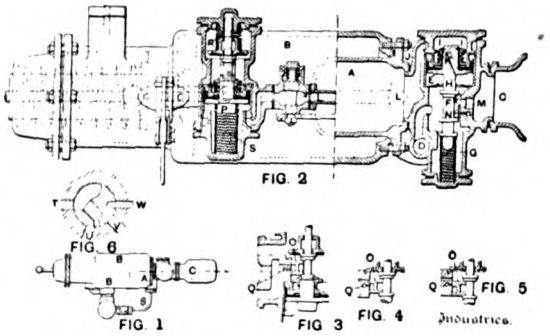
It is then shredded in a suitable machine, and the shreds removed and dried. The apparatus used in the above processes is shown in the illustration. The rice or other grain is fed to the hopper and falls into the cylinder B, where it is propelled by the helical blade C to the gauze cylinder D. The gauze cylinder has secured in it a helical gauze blade, and revolves about its axis partly immersed in boiling water. The water is heated by steam supplied through pipe E. As the cylinder D revolves, the rice is conveyed by its helical blade along the cylinder until it is finally discharged into the cylinder F, from which it passes to the shredding machine. During its travel through the gauze cylinder the rice is partly cooked by the boiling water. The shredding machine is composed of a cylindrical vessel G with a perforated bottom. In the vessel are heavy rollers H, which are revolved and roll over the surface of the perforated bottom. The rice, therefore, as it falls into the vessel is forced through the perforations, and issues in a thread-like shape. These shreds, as they fall from the shredding machine, are received upon the travelling belt I, which conducts them through a heated chamber J to dry them. The dried shreds are finally removed from the chamber by a second belt K. The chamber is heated by a furnace L, which can also be made to heat the boiler supplying steam to the trough M. Twelve claims are made.—No. 221. January 5th, 1889. 8*d*.

GAS ENGINES.—*G. Daimler, Canstatt, Germany.*—This invention relates to a modified construction of engines of a type described in a previous specification, No. 4315 of 1885. Two working cylinders are connected to and communicate with one and the same closed space containing the crank-shaft. The rods of both pistons are so connected to the crank-shaft that they perform their strokes together, both acting as pumps for compressing a charge of air or of gaseous mixture in the said closed space, but the admission of the combustible charges into the cylinders being so regulated that while the one piston is performing its working



forward stroke the other is performing its suction or charging forward stroke. The illustrations show one form of this improved engine. C is a closed chamber communicating with the two cylinders A B, and constituting with the pistons of the latter a pump to supply the outer ends of the cylinders with air or gaseous mixture. The charge of air or gaseous mixture is drawn in at the opening K during the up-stroke of the pistons, and is compressed, and at the end of the down-stroke passed to the cylinders through valves G fitted in the pistons. The valves G are pressed downwards by springs F, whose force is removed at the end of the down-stroke by the supporting sheave coming into contact with the fixed forks H. L is the entrance for the main explosive charge, and J the exhaust valve. The valve J is operated by a system of tappets worked by sliding blocks M. The blocks M impart an up and down motion to the rods N, and cause the bell-cranked levers O to strike against the valve rods and lift the valves, unless the levers O are thrown out of the vertical by the action of the governor lever P. The charge of each cylinder is conducted in three stages. The piston at the end of its working down-stroke opens the exhaust and propels the exploded charge by admitting a preliminary charge of air or gaseous mixture from the chamber C through the valve G, the air or gaseous mixture having been previously compressed by the down-stroke of the pistons. The pistons next make their up-stroke, and draw in a fresh supply of air at K, whilst the valve J closes. A second and the main charge is now taken in through the valve L as the piston descends, and at the end of its stroke a third charge is taken in from the chamber C, bringing the whole charge up to the pressure in C. The whole charge is finally compressed at the next up-stroke, and then exploded. The force of the working charge keeps the valve G closed after the pressure of its spring is removed and until the exhaust valve is opened. The cylinders are arranged so that one takes in its main charge as the working stroke is made in the other. Two claims are made.—No. 10007. June 18th, 1889. 8*d*.

PNEUMATIC BRAKES.—*A. Wenger, Paris.*—These improvements are to accelerate the action of pneumatic railway brakes and improve the construction of the engineer's brake valve. To accelerate the action of the brake, an apparatus as illustrated in Figs. 1 and 2 is provided. Fig. 1 is a plan and Fig 2 an enlarged elevation. A, B, and C are reservoirs. The reservoir B is always in communication with the brake cylinder, and therefore the brake piston is subjected to the variations of pressure in it. The train pipe D communicates with the chamber E of a slide valve F. The valve F covers the ports of the reservoir C, and has imparted to it an up-and-down motion by the spring G working in conjunction with the piston H. The air from the brake pipe D normally passes the cap leather of the piston H, and escapes through vents I and port J to the reservoir A, and from A by the pipe L to the reservoir B for the brake cylinder. This part of the invention acts as follows:—When the pressure in the train pipe D is reduced the force of the air above the piston H overcomes the spring G and shifts down the valve F. The port M is then opened, and the air in the train pipe and from the reservoir A escapes to the reservoir C until the pressure upon the top and bottom of the piston H is equalised. The spring G then recovers itself, and lifts the valve F up until it covers the port M, and puts it in communication with a second port N, open to the atmosphere. The reservoir C is thus emptied, ready to repeat the operation described. To make the pressure acting in the brake cylinder correspond with the reduction of pressure in the train pipe a valve of the following construction is interposed between the reservoirs A and B. This valve O (Figs. 3 and 5) is raised and lowered in a somewhat similar manner to that already described. It is actuated by a piston P, whose under side communicates with the pipe L leading from A to B. In the figures the piston and valve are shown



in their raised positions, the pressure of air at the top and bottom of the piston being in equilibrium, whilst the brake cylinder is in communication with the atmosphere through the port Q. On reducing the pressure in the train pipe D, and consequently the pipe M, as already explained, air from B forces the piston and valve O down, so that air now passes from B to the brake cylinder X, bringing the brakes into play. As the piston P descends, however, it is released of the pressure due to the spring R (see Fig. 5), and the piston reascends until it receives the load of the spring R (see Fig. 4), and the force of that and the pressure in B equilibrates the force of S and the reduced pressure in L. The force upon the brakes is thus maintained until the full pressure is again brought to bear and the valve O forced up. The driver's brake-cock is shown in Fig. 6. The casing has four passages—T opening under the plug and supplying compressed air, U opening to the air, V leading to the discharge reservoir, W leading to the train pipe. Four claims are made.—No. 9480. June 7th, 1889. 8*d*.

SAWING MACHINERY.—*S. Bastow, Leeds.*—This specification describes an improved self-acting feed, which may be used either for ordinary ripping, deep cutting, cutting at any angle, and to feed a number of boards through at one time. The feed rollers, four in number, are mounted in pairs in two frames. These frames carry the feed rollers at right angles to a bed, along which they are slidden by a right and left hand screwed shaft. The bed reaches across the saw frame at right angles to the saw, and is pivoted at its centre upon a longitudinal and horizontal shaft, whose bearings are fitted in quadrant guides. For ordinary deep cutting the bed is horizontal and the frames and feed rollers vertical. To cut at an angle the bed, and consequently the feed rollers, are tilted, the rollers being afterwards brought to the centre opposite the saw by moving the shaft upon which the bed is pivoted up the quadrant. To rotate the feed rollers, the shaft supporting the bed is revolved, and a worm wheel upon its centre, between the quadrant guides, made to gear with a similar wheel upon a sleeve on the left and right hand screwed shaft. On the sleeve are secured mitre wheels, which gear with mitre wheels upon the shaft of the feed rollers, each pair o feed rollers being geared together at their opposite endsf Claims: (1) An improved feed, which can be used for the various purposes such as described; (2) the canting of the feed rollers, so as to cut at any angle, from vertical to horizontal, such as described; (3) the arrangement whereby the feed rollers can have any lead required given them towards the fence when they are in the horizontal position; (4) the guide rollers constructed so as to act either as a table or fence.—No. 9851. June 15th, 1889.

CASTING METAL.—*G. Höper, Westphalia, Prussia.*—This is a method for the manufacture of dense metal castings to be afterwards rolled into sheets or formed into wire. The castings are

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made of annular form, and the moulds are rotated about their axes during the casting and until the metal has solidified. The inner opening of the annular casting can be formed either by the introduction of a core into the mould, or, without such a core, simply by the centrifugal force imparted to the metal by the rotation of the mould. With horizontal moulds the casting is effected either from the centre or from the circumference, but in vertical moulds it is best effected from the centre. The casting made in these moulds shows great density, with the fibre of the metal lying in a circular direction. To make wire the moulds are made spiral. Claims: (1) The process for the production of dense castings for sheet metal and wire manufacture wherein annular discs are formed by running metal into revolving moulds as described; (2) an improved manufacture of annular rings or discs produced in the manner set forth in the preceding claim, such rings being, when required, formed into bars by cutting through and straightening them out; (3) the use for the process referred to in claim (1) of rotating casting moulds, the speed of rotation being such that the central hole of the cast disc or ring is either produced by centrifugal force or by a central core; (4) in the manufacture of annular discs such as are referred to in the claim (2), the method of cutting spiral grooves on the surfaces thereof for facilitating the cutting of the disc into a spiral strip.—No. 1754. February 1st, 1890. 8*d.*

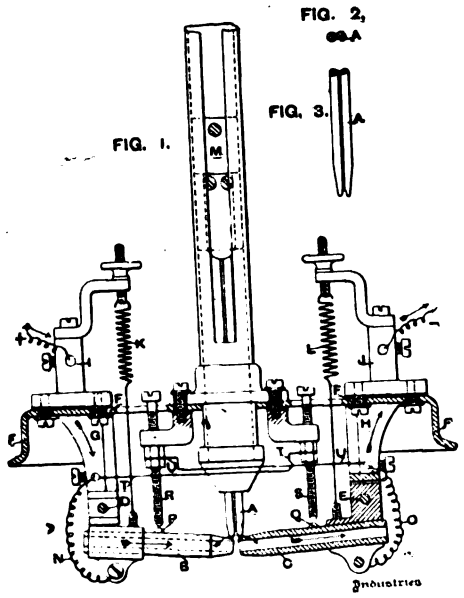
ELECTRICITY.

ELECTRIC LAMPS.—*H. Pieper, Liége, Belgium.*—In lamps of this description the light is produced by means of a carbon rod and two or more electrodes in contact with one end of the rod, so that when the electrodes are excited the current passes transversely through the carbon. The improvements will be understood from the following explanation of the lamp, referring to the illustrations. Fig. 1 is a sectional elevation of the lamp, and Figs. 2 and 3 a section and elevation of the carbon rod. In Fig. 1, A is the carbon and B C are the two electrodes. These are pivoted at D and E to the respective posts G and H, which are fixed to the plate F, but insulated from it. The post G is provided with the binding screw I, and the post H with the binding screw J. The electrodes are drawn by springs K and L against the end of the carbon rod, which in turn presses by gravity and by a weight M against the latter. A current introduced at I will, consequently, pass through the post G and the electrode B to the carbon A, and, after having traversed the carbon, it flows through the electrode C and the post H to the binding screw J, the carbon being, in consequence, caused to become incandescent at its end. In order

FIG. 2.

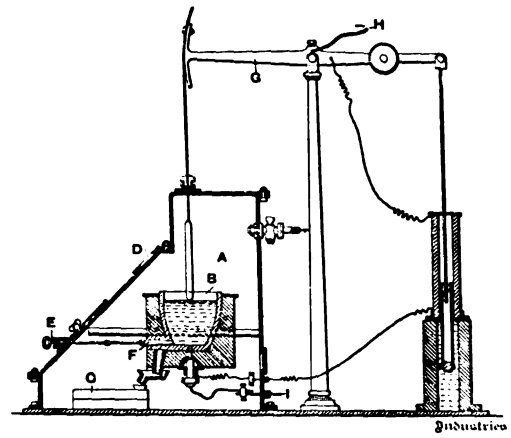
FIG. 3.

FIG. 1.



to avoid the transmission of the current through the pivots D and E, it is advantageous to connect the posts G and H with the respective electrodes B C by means of wires N O. If the carbon is consumed unequally at its points of contact with the electrode, the latter will still remain in contact with the carbon by reason of the spring adjustment. To keep the electrodes cool, they are made tubular to permit a current of air to pass through the interior. The lamp is switched out of circuit automatically when the carbon rod is nearly consumed by the contacts P Q striking the contacts R S and connecting the electrodes up through the wires T U. It may be seen that by this construction, if contact is made upon either side by part of the carbon rod fracturing, the lamp will be likewise switched out of circuit. Claims: (1) In an electric lamp, the combination of a carbon rod, an electric circuit, two or more electrodes in contact with one end surface of said rod, one or more of the said electrodes being movable with its, or their, contact point or points lengthwise to the rod, and means for pressing the movable electrode or electrodes against the end surface of the same, substantially as described; (2) in an electric lamp, the combination of a carbon rod, an electric circuit, and two or more electrodes in contact with one end of the said rod, one or more of the said electrodes being tubular and inclined upward from their points of contact with the carbon, substantially as specified; (3) in an electric lamp, the combination of a carbon rod, an electric circuit, two or more electrodes in contact with one end of the said rod, one or more of the said electrodes being movable, means for pressing the movable electrode or electrodes against the carbon rod, contact surfaces on the movable electrode or electrodes, other contact surfaces arranged opposite thereto, and each of which is conductively connected to the pole of the lamp being of different denomination from that to which the corresponding movable electrode is connected.—No. 10801. July 4th, 1889. 8*d.*

ELECTRIC FURNACES.—*E. Taussig, Badrenfeld, Germany.*—The object of this invention is to provide for the casting of objects with a smooth non-oxidised surface, and to avoid the disadvantages arising from the admission of air during the melting and conveyance of the molten material to the casting apparatus and moulds. The metal is melted in a crucible B by electricity. The crucible and the moulds C are enclosed in a chamber A, from which air is exhausted by any suitable means. To watch the



process the chamber A is provided with windows D. The metal is poured by withdrawing the plug F attached to the handle E. The heating device consists of a negative carbon-rod G, which is suspended with a Siemens electric furnace upon a balance lever G. H and I are the negative and positive wires, leading to some source of electricity. Claim: The method of melting and casting metal in a rarefied atmosphere consisting in arranging an electric melting-furnace of suitable construction, with the casting apparatus and moulding boxes in a chamber within which the air may be suitably rarefied during the melting and casting, with means for controlling said parts from outside the chamber without disturbing the atmospheric pressure in said chamber.—No. 20223. December 16th, 1889. 6*d.*

ELECTRIC MOTORS.—*L. B. Atkinson, London.*—It is known that, in that class of motor in which the alternating current passes both through the magnetising circuit and the armature or working circuit, the output for a given weight or size of motor is usually small, owing to the lag of the current behind the e.m.f., due to the self-induction of the circuit, and that the only way of reducing this lag is to reduce the magnetic resistance of the motor. This resistance is largely composed of the air space between the armature core and magnet faces. The object of this invention is to reduce this space to a minimum by leaving only the necessary mechanical clearance, which is effected by using the iron of the core as the conductor. To do this the motor is constructed on the principle of a "non-polar" or "uni-polar" dynamo. Several forms may be constructed, the chief object being to combine the following principles:—Calling the direction of the magnetic induction A, the direction of motion of the conductor B, and the direction of the current C, the iron of the revolving part must be divided electrically in planes parallel to C and A. Taking these principles the motor is so constructed that the current is led into the armature by sets of brushes on one end of the armature circuit, and passes once through the magnetic field along the divided plates of iron of which the armature is composed, and thence to another set of brushes. The magnetisation is produced by leading the same current round the magnetic circuit. The brushes are carried in rings all round the armature, and as the magnetic induction must pass through at least one such ring, special construction must be adopted to prevent a closed electric circuit being formed. Five claims are made.—No. 6884. April 25th, 1889. 8*d.*

CHEMISTRY.

COLOURING MATTERS.—*S. Pitt, Sutton, Surrey.* (*L. Casella & Co., Frankfort-on-the-Main.*)—In Patent No. 9214 of 1885, the inventors described a series of tetrazo compounds, whose combination with the naphthols or their sulpho-acids produced some valuable colouring matters. They have since discovered that the same tetrazo compounds can be combined with the substituted meta-diamines and meta-amidophenols with the formation of black colouring matters, which are fast and have an affinity for unmordanted cotton. The production and manufacture of these dyestuffs form the subject of the present specification. As an example of the processes we quote as follows:—34·7 kilogs. of alpha-naphthylamine disulphonate of sodium are mixed with an aqueous solution of 18 kilogs. of alpha-naphthylamine chlorhydrate and the resulting amido-azo compound into a tetrazo compound by the addition of 7 kilogs. of nitrite of soda. This tetrazo compound is poured into an alcoholic solution of 16 kilogs. of tetramethyl-toluylenediamine which contains also an equivalent quantity of acetate of sodium. The colouring matter thus produced is almost entirely dissolved, and it crystallises after the evaporation of the alcohol. Three claims are made for the colouring matters as described.—No. 7977. May 13th, 1889. 6*d.*

COATING PLATES WITH TIN.—*J. Bang & A. Ruffin, Paris.*—It is usual to cover the bath of molten tin used to coat the plates by a layer of oil or tallow, for the purpose of preventing the oxidation of the tin both in the bath and on the plates when they are removed and are hot. The use of this oil has many serious disadvantages; it is a constant danger of fire, and has to be removed from the plate whilst it is still hot by an expensive scouring operation. If the grease is removed from the plate too early in the process the coating of tin assumes a blue and yellow tint, losing its brilliancy. A complete removal of the grease has to be effected generally by a final cleansing with turpentine. By the application of the invention to the process of tinning the oil is dispensed with. The tinning is conducted in a chamber deprived of free oxygen, but filled with a carbonaceous gas or air deprived of free oxygen by bringing it in contact with incandescent fuel. The chamber in which the process is conducted has a glass top to observe the operations, and has inclosed in it the tanks containing the hydrochloric acid and molten tin. The dipping is conducted by manual labour, leather sleeves being provided in the top of the chamber through which the men thrust their hands and manipulate the plates. An endless chain conducts the plates, after they are dipped, to a series of cooling chambers before they are exposed to the atmosphere. Claims: (1) The process of tinning metal plates and other objects wherein the operations are conducted in an atmosphere free from uncombined oxygen and other bodies, such as sulphur and chlorine, that will attack the tin; (2) the use, for carrying out the process referred to in the preceding claim, of apparatus consisting of an inclosed glazed chamber containing the baths of molten tin and acid necessary for the tinning operation, and having (firstly) orifices with gauntlets for enabling the workmen to manipulate from the outside the objects, (secondly) a closed aperture for introducing the objects to be tinned, and (thirdly) a refrigerated exit passage through which the objects are conveyed on a travelling apron.—No. 128. January 3rd, 1890. 8*d.*

MISCELLANEOUS.

PROTECTING SHIPS' BOTTOMS.—*T. Fisher, Holywood, Ireland.*—This invention is to prevent the attachment of barnacles and other shell fish to the bottom of ships during their voyage, without interrupting the ship's motion, and to diminish the resistance of the water. A mixture of oil and nitrate of copper is stored in a tank or other reservoir, and distributed by gravitation or mechanical agency through perforated tubes or pipes, placed at intervals along the side of the ship, and reaching nearly down to the keel. Shoulders or grooves are formed down the side of the ship along the lines of the perforations, to counteract the pressure of water against them, and to allow the escape of the mixture, which is diffused over the ship's bottom by the force of the water. Three claims are made.—No. 9085. June 1st, 1889. 8*d.*

MINERS' SAFETY LAMPS.—*T. Thomas, Pontypridd.*—Means are here introduced into the above lamps to prevent explosions by currents of air laden with explosive gases passing through the lamp, and also to provide an automatic lock for the outer shield. In the accompanying illustrations, Figs. 1 and 2 are elevations of the lamp, Figs. 3 and 4 details, and Fig. 5 a sectional elevation of the automatic lock. The lower portion of the outer shield A terminates in a base ring C (shown enlarged in Fig. 3). Air apertures D are formed in the base C and within the base is a tube E. The lower part of the tube E is screwed to a plate F, which rests upon the lamp glass G. The holes or apertures D H admit the necessary air to feed the lamp, and when the lamp is exposed to a current of high velocity the arrangement causes a

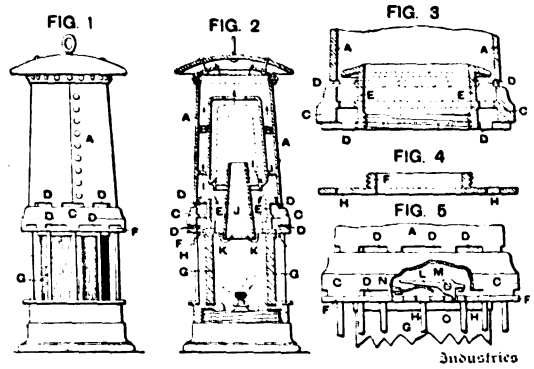
FIG. 1

FIG. 2

FIG. 3

FIG. 4

FIG. 5



whirl in the air at its entrance, so deflecting a part and admitting only the amount required to maintain a perfect combustion. Within the outer shield is a second shield B, which extends from the top of the gauze F to within a short distance of the bottom, where it rests upon the gauze by a flange I. Inside the gauze is a tube J which is supported by the flange K upon the top of the glass. The currents formed by the air and products of combustion are indicated by the arrows. The second part of the invention consists of a bar L pivoted at M about a third of its length from one end, the other end pressing on a spring N. On the under side and being a part of the bar L is a tongue O which is forced by the action of the spring into any of the holes H formed in the supporting ring F above the glass which may coincide with the position of the tongue O. The action of this automatic lock is such as to admit screwing on, the tongue being capable of gliding over the interstices, but instantly intercepts any attempt to unscrew until a special form of key is used to remove the tongue. Three claims are made.—No. 8136. May 16th, 1889. 8*d.*

Copies of the British specifications may be obtained on application to H. READER LACK, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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THE AMERICAN SOCIETY OF ENGINEERS.

(From our New York Correspondent.)

The Cincinnati meeting of the American Society of Mechanical Engineers was held from the 13th to the 16th of May. The majority of the Eastern members attending the session availed themselves of a special train of Pullman cars running from New York to Cincinnati, arriving there on the afternoon of Tuesday, the 13th. The first meeting began at 8 p.m., in the Scottish Rite Cathedral, by an address of welcome by Mr. M. E. Ingalls.

The first paper was on "The Measurement of Durability of Lubricants," by Professor J. E. Denton, of Stevens Institute. Practical differences of durability of lubricants depend, he said, not on any difference of inherent ability to resist being "worn out" by rubbing, but upon the rate at which they flow through and away from the bearing surfaces. The conditions which control this flow are so delicate in their influence that all attempts thus far made to measure the durability of lubricants have failed. The primary idea in determining durability is to supply a measured quantity of lubricant to certain rubbing surfaces, and to determine how great an amount of rubbing the lubricant will withstand before its power of maintaining the friction at some agreed upon minimum is exhausted. As a means of measuring the friction between two rubbing surfaces there is no device superior to what is known as the Thurston form of oil tester, which consists in forcing a pair of brasses in opposite directions against a journal by a spring, which latter is contained in a pendulum free to swing about the journal under the influence of the friction, the amount of friction being measured by the inclination to the vertical of a line joining the centre of the journal to the centre of gravity of the pendulum. Suppose one of these machines to have a journal about 1¼in. square, then an amount of oil forming a single drop let fall from the sharp point of a steel rod ⅛in. in diameter will cover the rubbing surfaces, so that with these surfaces in the very best condition a very low coefficient of friction can be obtained with a pressure of 75lb. per square inch on the journal at a rubbing speed of about 200ft. per minute, and at the same time there will be no surplus oil. If under these circumstances we run the journal continuously until the friction, after remaining practically constant for a considerable time—half an hour at least—gradually increases until it is double the original amount, it might easily be supposed that the number of revolutions necessary to accomplish this would measure the durability of the lubricant used as compared with another tested in the same manner. This was the opinion of the author, and in making tests in this way it was found that after about 10,000 revolutions with a standard lard oil the friction might have increased to double the minimum, but the appearance of the oil would show no signs of deterioration. It was found that the cause of the extra friction was the uneven distribution of the oil over the rubbing surfaces. There being no continuous supply, the oil distributed itself more or less by chance, and part of the rubbing surfaces could be seen to be devoid of oil. Accordingly the oil was redistributed and the pressure reapplied, and the friction at once assumed its minimum value, showing that the oil was in no sense worn out. The machine would therefore be run until the friction again doubled itself, when the same trouble might again be found. Finally, after several redistributions of the oil, the latter had lost its translucent appearance and oily nature, having become a dark-coloured paste. The total number of revolutions to produce this result might be 12,000 with lard oil on a first trial, and the same number might be obtained on a second trial. In fact, so far did duplicate trials of the same oil give the same revolutions within a small per cent. that the relative durability was thought to have been determined by this method with reference to lard oil. But upon a more extensive trial with the standard oil, 30,000 revolutions were required to reduce it to the gummy state, and again 60,000 revolutions, and upon one occasion 400,000, and in between these figures would occur records of 10,000, 7,000, and as low as 5,000 turns of the machine, which, with no variation of pressure, temperature, speed, atmosphere, amount of quality of oil, were the apparent measure of the durability of this standard oil. Upon analysing this black paste, Dr. C. B. Dudley, chemist of the Pennsylvania Railroad at Altoona, found that it was composed mainly of the materials of the bearings themselves, showing that the limit of the friction-producing qualities of a lubricant tested in this manner was the rate at which it adulterated itself with the metal worn off the bearings. This rate of metallic wear being infinitely variable, it is evident that the durability of the oil cannot be measured by restricting our measurement to the behaviour of a fixed quantity whose amount shall be so small as to allow of no surplus oil about the bearings. An attempt was then made to determine the durability by allowing a slight surplus of oil applied by a plan which would enable the surplus to be employed to secure regularity in the distribution of the oil over the rubbing surfaces. In spite of every precaution the successive records of lard oil were 82,000, 67,800, 53,000, and 29,000 revolutions, while trials with a pure mineral oil of about the same fluidity as lard gave 36,000, 33,000, and 27,000 revolutions. These last results were calculated to lead the experimenter to the belief that this method gave duplicate results, but on continuing the test one record was 10,600, while a second was 64,000 revolutions, with practically the same conditions. It was evident, therefore, that irregularity of conditions existed of a nature beyond the reach of any available means of control, and probably there is no method of employing so little oil on a journal as to prevent its escape from the latter, and determining anything representative of the quality of durability. The economy of one oil over another, so far as the quantity used is concerned—that is, so far as durability is concerned—is simply proportional to the rate at which it can insinuate itself into and flow out of minute orifices or cracks. Oils will differ in their ability to do this—first, in proportion to their viscosity; and, second, in proportion to the capillary properties which they may possess by virtue of the particular ingredients used in their composition. Where the thickness of film between rubbing surfaces must be so great that large amounts of oil pass through bearings in a given time, and the surroundings are such as to permit oil to be fed at high temperatures, or applied by a method not requiring a perfect fluidity, it is probable that the least amount of oil will be used when the viscosity is as great as in the petroleum cylinder stocks. When the oil must flow freely at ordinary temperatures, and the feed of oil is restricted, as in the case of crank-pin bearings, it is not possible to feed such heavy oils in a satisfactory manner. Oil of less viscosity, or of a fluid approximating to lard oil, must then be used, and the differences among such oils, with respect to the quality of entering and leaving the spaces between the bearing surfaces, probably depend in a considerable degree upon the differences of capillary property arising from choice of ingredients forming the mixture. It seems hardly possible that the quality of durability in lubricants can be measured, except by copying in a very perfect manner the exact conditions of arrangement, proportion, and method of feeding, which are to be used where the lubricant is to be applied, and even when this precaution is taken, the fact that in some kinds of service the limit to the consumption of oil depends upon the extent to which dust or other refuse becomes mixed with it, as in railroad car lubrication and in the case of agricultural machinery, makes it almost hopeless to expect that laboratory tests can contribute very much of practical value in the determination of relative durability of lubricants.

In the discussion following this paper Mr. Thomas R. Almond, who manufactures a coupling for connecting shafts at an angle, cited an example in which one of his couplings was charged in the oil case with a half-pint of "electric" machine oil, and after running for a number of months the oil was removed and was found to be from appearance in the same condition as when first put in, but when the same quantity of the oil from the same can was put in the case the coupling ran warm for some time, apparently showing that the oil improved by use.

Mr. George S. Strong, of the Strong Locomotive Company, called attention to the fact that on many new locomotives beeswax and plumbago were first fed to each cylinder in large quantities until the cylinder was highly polished, and after that no lubricant was used, in some cases the service extended over ten years with no oil.

The next paper was on "Some Experience with Crane Chains," by Mr. C. S. Dutton, of Youngstown, Ohio. A power crane, of 25 tons capacity, built about fifteen years ago, was equipped with a chain of 1¼in. iron, running over 16in. shears. The winding drum was 20in. diameter, and the grooves were so deep that the chain did not touch the bottom. As this chain was badly worn a new one was ordered, and within two weeks it broke under 18 tons, and a second break occurred under a 12 tons load. An examination showed that the iron was "cold short," and a chemical test gave ·00125 of phosphorus, and a new chain was made. To secure good chains the materials should be inspected before manufacture and the workmanship after. Giving a piece of chain a mild pull in a testing machine enables the manufacturers to certify that it has been "tested," and may occasionally open a particularly bad weld, but can serve no other useful purpose. The ability to stand bending cold is the most important quality of chain material, because that is the principal, if not the only, cause of chain failure. In fact, for this purpose the cold-bend test will usually show all the engineer wants to know of the material.

In the discussion, Mr. G. C. Henning stated that 95 per cent. of the strength of the bar was now guaranteed by the electric welding process, and there should therefore be no difficulty in obtaining chains that were practically safe against giving way at the weld.

The next paper was by Mr. George H. Barrus, of Boston, on "Memoranda Regarding the Indicating of the Engine of the Steamer 'City of Richmond.'" As many of the members had gone to Europe on this steamer the paper was of special interest. The paper gave sample cards, together with the data found therefrom and the estimated coal per i.h.p. per hour.

The second meeting of the Convention began at 10 a.m. on Tuesday, the 14th. The report of the Committee to memorialise Congress to provide a suitable method of perpetuating the memory of John Ericcson was presented, and afterwards the report of the Committee on "A Standard Method of Conducting Duty Trials of Pumping Engines" was handed in, and was referred back to the Committee, that the members might have an opportunity to study the report before final action was taken. The report is practically the codifying of the methods now in common use, and the establishing of a common basis on which to compare the economy of different engines. It is proposed to establish a new unit. At present the duty is estimated on the basis of 100lb. of coal, and it is recommended that this basis be abolished and that 1,000,000 heat units be hereafter used. Provision is made for separating the performance of the engine from that of the boiler, and contract clauses are framed for each case—that is, when the whole plant is furnished by one party, and also when part is furnished by one contractor and part by another. On the heat unit basis it is proposed to make the computation from the quantity of heat supplied to the complete plant, and the scope of the test should be so broad that the steam passing through the cylinders of the engine, as well as that used by each accessory, such as feed pumps, jackets, &c., should be separately determined. To determine the work done the use of the so-called Venturi tube inserted in the delivery main is advocated, and also the employment of nozzles or other similar means of indirect determination is recommended. It is further recommended that the work of overcoming the friction of the water in passing through the passages and valves should not be included in the desired total, but that that of the delivery and suction mains should be included in computing the duty: the data to be determined being the indication of pressure and vacuum gauges attached to the delivery and suction mains and the vertical distance between them. Equations are given for the computation of the results and a form for the data and results. Minute instructions are given as to the apparatus and method of attaching, and the report is a decided advance in the direction of making exact duty trials.

The next report was that of the "Committee on Standard Tests and Methods of Testing Materials." This Committee sent duplicate samples to the principal parties interested in testing several years ago, and reports were received from many of these parties. The reports varied so much in methods and data that the Committee found it impossible to formulate or tabulate these results. A second set of specimens, 236 in number, were sent to 24 different parties, together with a form to be filled out requesting tests and results; ¾in. round steel and iron, and flat or square steel and iron specimens were sent to each party. Complete results were received from sixteen parties. At the same time inquiries were made as to the work done abroad, and results of the Munich Conference of 1884 and the Dresden Conference of 1886 are given in an appendix. Generally, the Committee did not find it advisable to recommend the use or adoption of any particular form of testing machine, as there are a number now in daily use which, when kept in good repair, give good results. The use of the form of wedge holders in almost universal use is strongly deprecated, as the results are invariably lower than those given by good forms of holders. Although very desirable, no recommendations are made as to abrasion tests of straight or curved rails, as the Committee had not the necessary data. The Committee gives general recommendations as to the necessary conditions of testing machines, holding appliances, standard apparatus for routine testing, and standard drop test apparatus. The tests to be carried out with rails, axles, tires, wrought iron, low steel and high steel for structural purposes, wrought iron and low steel for boilers, materials used in shipbuilding, wire and wire rope are given, with recommendations as to the method of carrying out each of the required tests. The shape of test pieces for all kinds of testing is given. For round pieces in tension each piece should be turned in the centre ·8in. diameter, 8·8in. long, then coned towards each end to 1in. diameter in 2in. length, then carried along cylindrical for ·8in. and filleted to ½in. radius, the ends being cylinders 1in. long by 1·6in. diameter. This is recommended for all material except copper and its alloys. Flat specimens are about as now used, 8·8in. between centres, 1·2in. wide, the ends to be 2½in. wide, the corners between the ends and centre

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to be ¼in. radius. This is to be the standard size of all material less than 1in. thick. Over 1in. the specimen is to be ·4in. wide, and as thick as the material. Compressive specimens are to be 2in. long by 1in. diameter if ultimate resistance alone is required. For elastic resistance the specimens should be 10in. to 20in. long, the strain to be measured in 8in. For transverse specimens bars 1in. square by 40in. long are to be used, the bearing blocks to be 36in. apart. Wood is to be tested in 3in. square pieces Scientific tests of castings are to be made of cast pieces 2in. square or 2½in. diameter, machined down to standard sizes.

The President was directed to appoint a committee to determine a standard method of conducting tests of locomotive engines and boilers.

The next paper was by Mr. W. F. Dixon, of Paterson, N.J., on "The Efficiency of Locomotives." The object, he said, of by far the greater number of improvements which have been made in steam engines has been to improve the distribution of steam in the cylinders and to mitigate the losses arising from liquefaction during the early stages of the stroke. Objections against the shifting-link valve gear have been raised so often that many appear to take it for granted that it is a wasteful and inefficient device. While it has faults, its many advantages would seem to be a sufficient guarantee of future use as extended as its past. The principal charges against it are the slow opening of the ports for admission, and the early closing of the exhaust. A horizontal admission line and a sharply defined point of cut-off on an indicator diagram are desirable, but a considerable deviation from them is possible before a really appreciable reduction of the mean effective cut-off takes place. The excellent balanced slide valves now in use, and the supplementary port of the Allen or Trick valve, is a valuable aid in overcoming "wire drawing." It is no exaggeration to say that, with a well designed link motion, the objection of wire drawing is of no practical weight. Compression does at times become excessive. In engines like the locomotive it is undesirable to reduce the clearance spaces to less than 7 or 8 per cent. of the piston displacement, for at short points of cut-off the compression line would run off so abruptly as to reach the initial pressure before the piston has reached the end of its stroke. The reduction of indicator diagram area caused by early exhaust closure, and the large clearance spaces found in locomotive cylinders, are often over-estimated. The author has been led to the conclusion that, although the clearance spaces in locomotive cylinders are usually larger than desirable, there is a limit, pretty sharply defined, below which it is prejudicial to go in reducing them, provided the link motion is retained. That steam jacketing of the cylinders of locomotives, taken by itself and not in connection with compounding, would result in some little saving, may be taken as certain, provided sufficient means of drainage were used, but it is also probable that the expense of constructing and maintaining the jackets would more than neutralise the benefit derived. Superheating has been tried several times and as often abandoned, the difficulties being the expense of construction and maintenance, those of lubrication and of preventing the leakage of the steam around the rods. The Chicago, Burlington, and Quincy Railway Company went fully into the subject in 1870 and 1874, and found that the resulting economy was off-set by the expense of repairs. The advantages of compounding are economy in the use of steam and consequently fuel, and a more uniform pressure on the cranks. The latter is considered by many engineers as the more important, but if compounds had only this latter advantage the continuance of the ordinary single expansion engine would be assured. Locomotive engine drivers are notoriously disinclined to run with a full open throttle and to regulate with the link, but in a compound engine we have an engine that must be worked expansively and good results must follow. It may be safely asserted that no locomotive built during the past twenty years has been deficient in adhesive weight after the train is once in motion. A feature of any substantial change in locomotive design will then probably be a method of increasing the adhesion at starting, as we must now rely on deadweight, a large proportion of which is useless at other times, to get trains away from the stations.

In the discussion on this paper the necessity of improving the combustion was shown. Mr. Strong said that a locomotive boiler, when worked within its capacity, was fairly economical, as 5·5lb. to 6lb. of water could be had per pound of coal when burning 150lb. per square foot of grate, but when exceeding its capacity it is very wasteful. The necessity of some satisfactory method of determining the moisture in the steam in all locomotive trials was brought out as something in which there is at present much doubt.

The next paper was by Mr. Willis E. Hall, of Altoona, on "Working of Railroads by Electricity." The author stated that the day is not far distant when we will see railroads run by electricity from a central station. One very important gain would be the concentration of the power at one point, for a given length of line, into a few cylinders, instead of working with a number of isolated engines where the chances of condensation and radiation would be great. A number of central stations—located, say, thirty or forty miles apart—could be worked by large powerful engines, and the expansion of the steam arranged at an economical point by better and more mechanical means of cut-off than can be obtained in the present type of locomotive construction. In furtherance of a reduction of coal consumption, the use of condensing—and possibly compounding—at a central station, would raise this part of the working of the line to the highest grade of efficiency. In recent experiments it was found that an electric motor could climb a grade far greater than those climbed now by locomotives; so that in this direction we could look for a marked improvement. From a central station a greater amount of power can be supplied than it is necessary to develop at the station, and in locomotive work a reduction of perhaps 25 per cent. could be counted on. The number of moving parts, and consequently the cost of repairs, would be much less, and the internal friction of the driving mechanism reduced. The loss in electric transmission would amount, in a line 30 miles long, to some 50 per cent., which includes loss in dynamo, motor and line. This, together with the cost of necessary plant as capital, comprise the two main objections against the introduction of electricity for transportation purposes.

This paper called forth considerable discussion, and there was a decided difference of opinion as to the probability of such a change ever being made. Mr. F. A. Scheffler said that for such a plant, assuming that electric locomotives were to be used, the running expense would be simply prohibitory.

Mr. William Forsyth stated that if his line ever tried to use electrical propulsion they would build their own dynamos and motors at a cost of probably ¼ to ⅕ present prices, which would reduce Mr. Scheffler's estimate materially.

Mr. Dashiell, speaking of the increased traction of an electrical over a steam locomotive, said that, from experiments he had been making, the simple passage of a current from the wheel to the track did not increase the adhesion of the locomotive.

The next paper was by Mr. A. F. Nagle, on "Determination of the Sensitiveness of Automatic Sprinklers." All automatic sprinklers, he said, use the same low-fusing solder (155° Fahr.) for holding their outlets closed; yet the time and temperature at which the solder fuses varies considerably with different makes. This difference is due to the quantity of solder to be melted, the amount of metal with which the solder is in actual contact, the proximity of the solder joint to large masses of metal, and the strain on the solder. The purpose of the paper was to correct the erroneous opinion now held as to the actual temperatures at which automatic sprinklers open. The method generally employed is to place the sprinkler in an oven heated by a common gas stove, and note the temperature at which it opens. Such tests give rise to very different published statements of relative sensitiveness. The author was convinced that the mercurial thermometer is a very sluggish means for correctly indicating such rapid changes of temperature. Air carries such a small quantity of heat that it must be heated greatly above that indicated by the thermometer in order to make the thermometer ascend at a rate corresponding to the conditions of a fire. A hot water test would not be delicate enough, for no appreciable difference in the sensitiveness of sprinklers would be discernible by a water test. The practical difficulty is, however, with the mercurial thermometer, as it changes its readings comparatively slowly. To determine the corrections the thermometer is heated over the gas stove to, say, 300° F., and then removed and the fall of temperature noted for every ten seconds. The room was, say, at 73° F. It required some practice to keep the air around the thermometer at the same temperature as that of the room. The fall for ten seconds was then divided into the mean temperature above that of the room shown on the thermometer during that time, and the result was practically constant. In the particular case here taken it was 7·8. If, then, the rise for ten seconds is noted and multiplied by 7·8, and added to the temperature of the room, the result is the correct reading of the thermometer. But after correcting the reading of the thermometer, we have still not a satisfactory expression for the sensitiveness of automatic sprinklers; it is the quantity of heat and the time together which supply the necessary elements of comparison. The author recommends the area on a diagram enclosed between the temperature as indicated by a mercurial thermometer and the calculated actual temperature as the measure of the sensibility.

The third meeting of the Convention was held on Wednesday, the 15th May, at 2.30 p.m. The first paper presented was by Mr. R. C. Carpenter, of Lansing, Michigan, on "Tests of Several Types of Engines, under Conditions Found in Actual Practice." This paper was simply the results of a series of tests on a number of engines under the conditions in which they were working, and are of little value either as to methods or results. The same author read a paper on the "Comparative Test of a Hot Water and a Steam Heating Plant."

TECHNICAL EDUCATION AT FINSBURY COLLEGE.

The City and Guilds of London Institute for the Advancement of Technical Education, with its colleges at South Kensington and at Finsbury, is a well-known educational body, and we do not now propose to recapitulate the history of its establishment and progress. The two branches at the West End and in the City are in some respects intended to satisfy different classes of educational wants, but it is with the latter, the Technical College at Finsbury, that we are at present concerned. The college, as many of our readers are no doubt aware, is situated in Leonard Street, a thoroughfare at right angles to the City Road, and within a very short distance of Finsbury Square. The building itself is a plain rectangular brick structure, with no pretensions to architectural beauty, and, as far as its external appearance is concerned, might be anything from a warehouse to a hospital; with its internal arrangements we shall deal subsequently. On pages 532 and 533 we give a series of plans of the various floors of the building.

The instruction given at the Finsbury Technical College provides for two distinct kinds of students, those who attend the day classes and those who attend the evening classes. In the words of the official programme: "The object of the day classes is to provide for the education of—(1) Pupils who are desirous, before taking their place in factory, workshop, or studio, of receiving a scientific training of a kind that will bear directly upon industrial production. (2) Persons of either sex who wish to receive such a practical preparatory training in science or art as shall fit them hereafter to fill intermediate posts in industrial works. (3) Pupils who contemplate, after the completion of at least a two years' course at the college, entering upon the advanced scientific and technical courses of instruction, such as those at the Central Institution, Exhibition Road."

"The object of the evening classes is to provide scientific and artistic education of a thoroughly practical kind for apprentices, journeymen, and foremen and others, who are engaged during the day time, and who desire to receive supplementary instruction in the application to industries and manufactures of the principles of technical science and art."

It is expressly stated that the courses of instruction in the institute are laid out, not to prepare the student to pass examinations, but solely with the object of training him in what will best fit him to become a competent worker and thinker in the career that he has chosen. We only wish that all educational establishments were guided by these principles, and that the Finsbury College will continue to act up to them and avoid being dragged into the examination vortex.

The college is divided into five departments—(1) Mechanical engineering and applied mathematics; (2) electrical engineering and applied physics; (3) industrial and technical chemistry; (4) applied art: (5) the building trades. The students of the first three departments have, during their first year, many classes in common, and even the chemical students have to do a certain amount of practical work in the pattern shops; we shall, however, confine our attention in the present article to the Mechanical Department.

The Mechanical Department is under the care of Professor John Perry, M.E., D.Sc., F.R.S., and to his courtesy we are indebted for much of the information given and for a very interesting and instructive visit to the institution. Day students have to pass an entrance examination in elementary mathematics, and give evidence of a fair knowledge of English. The examination in mathematics includes arithmetic, algebra, comprising problems involving simple equations and geometry, the latter covering the subjects of the first two books of Euclid. After entering the college all students are required to study mathematics, and for this purpose are grouped in classes according to their attainments. The more advanced students attain to the differential and integral calculus and differential equations, with applications to thermodynamics, mechanics, and electrical engineering. Professor Perry, we understand, finds it quite practicable to teach the calculus at an earlier stage of general mathematical knowledge than is usual in most centres of tuition.

The most important course of lectures for mechanical students is that on "Practical Mechanics," which, in the second year, really develops into mechanical engineer-

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ing, and includes steam and gas engines and machine design. Hand in hand with these lectures go the exercises of the students in the mechanical laboratories, and this forms one of the most interesting features in the instruction given at the Finsbury College. The illustrative apparatus and models of mechanisms, &c., in the mechanical laboratories are kept in constant use by the students, who are expected to spend a certain number of hours every week in systematic experiments. As an example, after hearing in the lecture room an explanation of the parallelogram of forces, the student is required to verify the truth of the laws stated by actual trial with an apparatus suited for the purpose, and consisting of cords with weights suspended at the ends passing over pulleys, arranged in the well-known way. Of course, on making the experiment, it is found that the correspondence between theory and practice, as represented by the apparatus, is not exact, and on investigating the cause of this the student makes practical acquaintance with the phenomena of friction, the amount of which he has to determine for each of the pulleys. There are also models showing the essential construction and mode of operation of all the principal valve gears, the leading dimensions of which can be varied. The students work in the laboratories in groups of three, and they make accurate notes of their observations and plot the results as curves. By this system of instruction, the reality of the laws, demonstrated in the lecture room or expounded in the text-book, is brought home to the student in an impressive manner by the experimental exercises, and he learns truly to appreciate the fact that those laws are not mere fictions existing only on paper, but represent very tangible phenomena.

We cannot too highly commend this method of education, and, if our space permitted, should like to dwell more in detail upon the subject. The apparatus employed is purposely made as straightforward and simple in design as possible, in order that the leading features and fundamental principles may not be obscured by a mass of subordinate detail. For instance, in the transverse testing machine for first year students, the load is applied by actual weights hung upon the beam to be tested, so that it approximates, as nearly as possible, to what is represented by the diagrams in the text-books. Another point worthy of notice, in connection with the laboratory apparatus, is that, in experiments on torsion, the strains are produced by a force-couple, and thus side pressure and bending stresses are avoided. It is hardly necessary to say that the testing of materials forms an important part of the experimental training, more especially of the second year students. The tests are of the character required in practice, and, generally speaking, extreme refinements in method and apparatus are not indulged in, as the time available is too short.

The following is a list of the apparatus employed in the mechanical laboratories at Finsbury:—

APPARATUS FOR

Illustrating triangle of forces.
" polygon "
" link polygon.
" forces in braced frames.
" inclined plane.
" friction of lapping band.
" energy of a rotating body.
" stress and strain in a wire.
" law of work.
" moments of forces.
" " parallel forces.
" efficiency of block and tackle, plain and differential.
" screw jack.
" hydraulic jack.
" laws of friction of solids.
" " " fluids.
" " torsion in wires.
" " " in strips.
" stress and strain in wires (up to 3,000lb. pull with Ayrton and Perry spring to show elongation).
" stress and strain in wires (Bailey's wire tester recording a pull of 5,000lb.).
" centrifugal force.
" bending of beams (simple for wooden and small iron or steel beams).

Bailey's bar tester (for cast iron bars, 3ft. × 1in. × 1in.), Bailey's cement tester, Thurston's oil tester, Sir F. Abel's petroleum tester for determining flashing point of oils, calorimeter for testing heating power of coal; working model of horizontal steam engine with variable travel, lap, and advance of valve; working models of link motion, Stephenson's link motion, Hackworth or Marshall radial valve gear, Joy's valve gear, Meyer's independent cut-off gear, apparatus for illustrating unwinding moment of flat spiral spring, mass controlled by vibrations of flat spiral spring, vibrations of mass controlled by cylindric spiral spring; one 2 h.p. vertical steam engine for driving oil tester and other machines, fitted with belt dynamometer for finding useful horse-power, &c.; one 2 h.p. Ayrton and Perry electromotor for the same purpose.

The workshops consist of a turning and fitting shop and a pattern shop. The turning shop is provided with several lathes, arranged for screw-cutting, two shaping machines, drills, and fitters' benches. The tools are driven from a horizontal engine, to which we shall presently refer. To familiarise the students with the different methods of transmitting power, various systems have been adopted in the shop for driving the shafting, such as ropes, belts, spur and bevel gear. Owing to the large number of mechanical students, the workshops are much too small, and on this account the students have to be divided into batches and attend the shops at different hours. This entails very heavy labour on the part of the instructor, who, it should be said, is a practical workman. Mechanical students, both in their first and second year, have to spend a certain time every week in manual work, but it is distinctly understood that this is not intended as a substitute for regular training in manufacturing engineering works, but merely as a preliminary instruction in the handling of tools. On the other hand, it is not considered necessary for those who have successfully passed through Finsbury College to spend more than two years subsequently in the shops as apprentices, since the knowledge they have acquired in the former enables them more rapidly to assimilate what they learn in the latter. Those who aspire to the higher branches of engineering are recommended by Professor Perry, after going through the shops, to devote a year to further study at the Central Institute at South Kensington. As we have previously stated, not only the mechanical but also the electrical students are expected to give a portion of their time to manual labour, and even those of the chemical department have to learn something of carpentery.

The engine and boiler room, from which power is transmitted to the line shafting in the turning shop, may be said to form a part of the laboratories, since it is here that the engine and boiler trials are carried out. The engine is a simple horizontal one, with ordinary distribution and cut-off valves, the latter being controlled by a "Hartnell" governor acting through a link. The diameter of the cylinder is 12in., the stroke 24in.; the nominal horse power is 20, but as much as 66 h.p. can be developed. In connection with the engine is a surface condenser, which, owing to want of space, is placed on the roof of the building. This condenser is of the so-called vaporising type, in which, in place of the ordinary method of circulating the condensing water by a pump, a thin stream of cold water is allowed to dribble over the exterior of the tubes, on the surface of which it evaporates. On the line shaft near the engine is one of Professor Perry's well-known dynamometer couplings, by which the power transmitted can be measured. The boiler looks on the outside like a short Cornish boiler, but it has a combustion chamber and tubes instead of the Cornish flue.

At certain times, what Professor Perry terms a "field day" is held in the engine room. On this occasion engine and boiler trials are carried out on a systematic plan; indicator diagrams are taken, effective power determined from the dynamometer coupling, feed water and coal are measured, temperatures and pressures recorded, and, in short, all observations taken incidental to a complete series of experiments on the engine and boiler. Besides this, the electrical horse-power given out by the dynamo, when it alone is driven, is determined. From the recorded results the students have afterwards to work out diagrams of various kinds. In making the engine and boiler trials three students are told off to observe each class of phenomena, and, according to a preconcerted plan, matters are so arranged that every student takes his turn at every kind of observation. Each whole group of three is not transferred bodily from one post to another, but a single student at a time is transferred from one group to another, so that the novice always works in conjunction with two colleagues who have already gained a little experience in the work.

Near the engine and boiler room is the dynamo room, which, however, appertains more to the electrical department; here, however, there is a 12 h.p. Crossley gas engine, on which the students of the mechanical department make experiments analogous to those carried out with the steam engine.

We will now turn our attention to the drawing office, not the least important branch of the establishment. It is in the charge of Mr. George Halliday, Wh.Sch. In this first year mechanical students are required to work for seven hours every week on practical geometry and machine drawing; in the second year the hours of attendance are extended to ten. Under practical geometry are included plane geometry, which embraces the construction of the parabola, ellipse, hyperbola, and cycloid, descriptive geometry, exercises in graphical statics, and valve diagrams. Machine drawing proper commences with tracing a series of working drawings of machine details, and with this the first term is generally occupied. During the second and third terms students are required to make sketches of models of machine details, and from such sketches to prepare working drawings. In the second year the students proceed to sketch and make working drawings of machines in the workshop and engine room, and are then instructed in the design of machine details. The exercises in practical geometry are continued during the second year, and extended, among other subjects, to elastic curves, diagrams of the sensitiveness of a governor, and heat and temperature diagrams of a gas engine. Situated in the heart of London, the work in the drawing office has often to be carried on with the help of artificial light, and, in this respect, the students are to be congratulated on the fact that this department, in common with the rest of the building, is illuminated by electric glow lamps; nothing is more trying and injurious to the eyes than drawing by the light of an unsteady gas flame which at the same time vitiates the air by the production of carbonic acid. On the whole, we think that the plan of instruction followed in the drawing office is a sound one, especially in view of the limited time at the disposal of the students. The practice of preparing drawings from sketches made from models or actual parts of machinery is very useful, and Professor Perry makes a point of impressing upon students the necessity of completing their sketches at once, so as to avoid the necessity, after the working drawing has been commenced, of having to return to take some dimension which has been omitted. Professor Perry is quite frank in expressing the opinion that it it only under his system that it is possible for students in a two years' course to produce "drawing office drawings." He says that in all other drawing classes with which he is acquainted, students produce drawings which would be laughed at in the shops. He says, however, that he cannot produce draughtsmen, for a draughtsman is able to design and no man can design until he has been in the shops.

The students of the mechanical department, together with all the first year students of other departments, attend a course of lectures on practical physics, parallel with which runs a series of experimental exercises in the physical laboratory; among these are included quantitative experiments in proof of the fundamental laws of gases, determination of the latent heat of steam, and calorimetry generally. Hand in hand with the lectures on mathematics, mechanics, and physics go so-called tutorial classes, in which numerical calculations are made on the subjects dealt with in the lectures. These exercises are conducted in mathematics and mechanics by Mr. Blaine and (since Mr. Crombie's elevation from the position of junior demonstrator at Finsbury to the more congenial one of principal of the Technical College at Parã, Brazil). Mr. Graham—who also superintend the mechanical laboratory—and in physics by Mr. Robinson and Mr. O'Keefe. The drawing office is under the care of Mr. Halliday and Mr. Waynforth, while the workshops are managed by Mr. Shepherd.

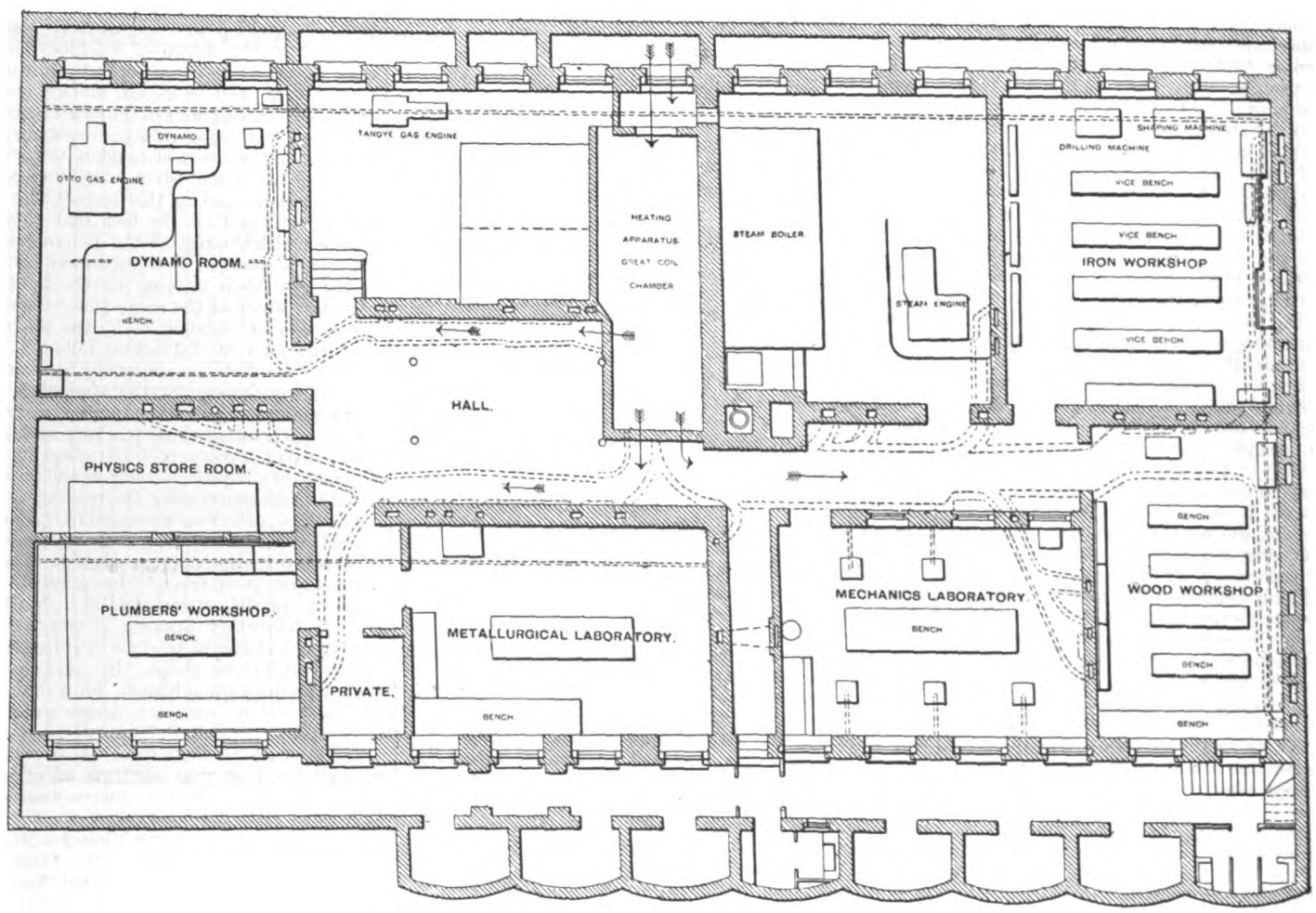
In addition to the experimental exercises already described, it is arranged that every mechanical student shall, at least once during his course of instruction, in conjunction with a fellow-student, take entire charge of the engines and boilers for a whole day. On this occasion he is required to make accurate observations of the performances of the machinery under his charge and furnish a full report to Professor Perry.

On the completion of their studies at Finsbury College, students are advised by Professor Perry to spend two years in an engineering workshop, and after that, if they wish to further pursue their theoretical studies, to spend a year under the instruction of Professor Unwin at South Kensington. Professor Perry very strongly recommends every student, on leaving the college, to get a job as an ordinary apprentice, obtaining, if possible, wages from the first. He insists on the advantages of a personally-conducted search for employment, and is very strongly opposed to the premium pupil system, which he considers calculated to produce loafers, and to prevent beginners from obtaining a thorough acquaintance with their work, while it does not tend to promote sympathy between them and the workmen, from whom alone they can learn their trade. We think that all who have gone through both the theoretical and practical "mill" will agree with Professor Perry as to the necessity of workshop training for the mechanical engineer, although this view does not appear to be shared by all engineering professors. It ought to be very clearly recognised that the manual training, in Finsbury and similar colleges, is not intended to, and never can, supersede experience in an engineering establishment conducted on commercial principles; on the other hand, the college offers facilities for acquiring an experimental knowledge of the testing of motors and materials, which can rarely be obtained elsewhere, in addition to the more exclusively theoretical instruction.

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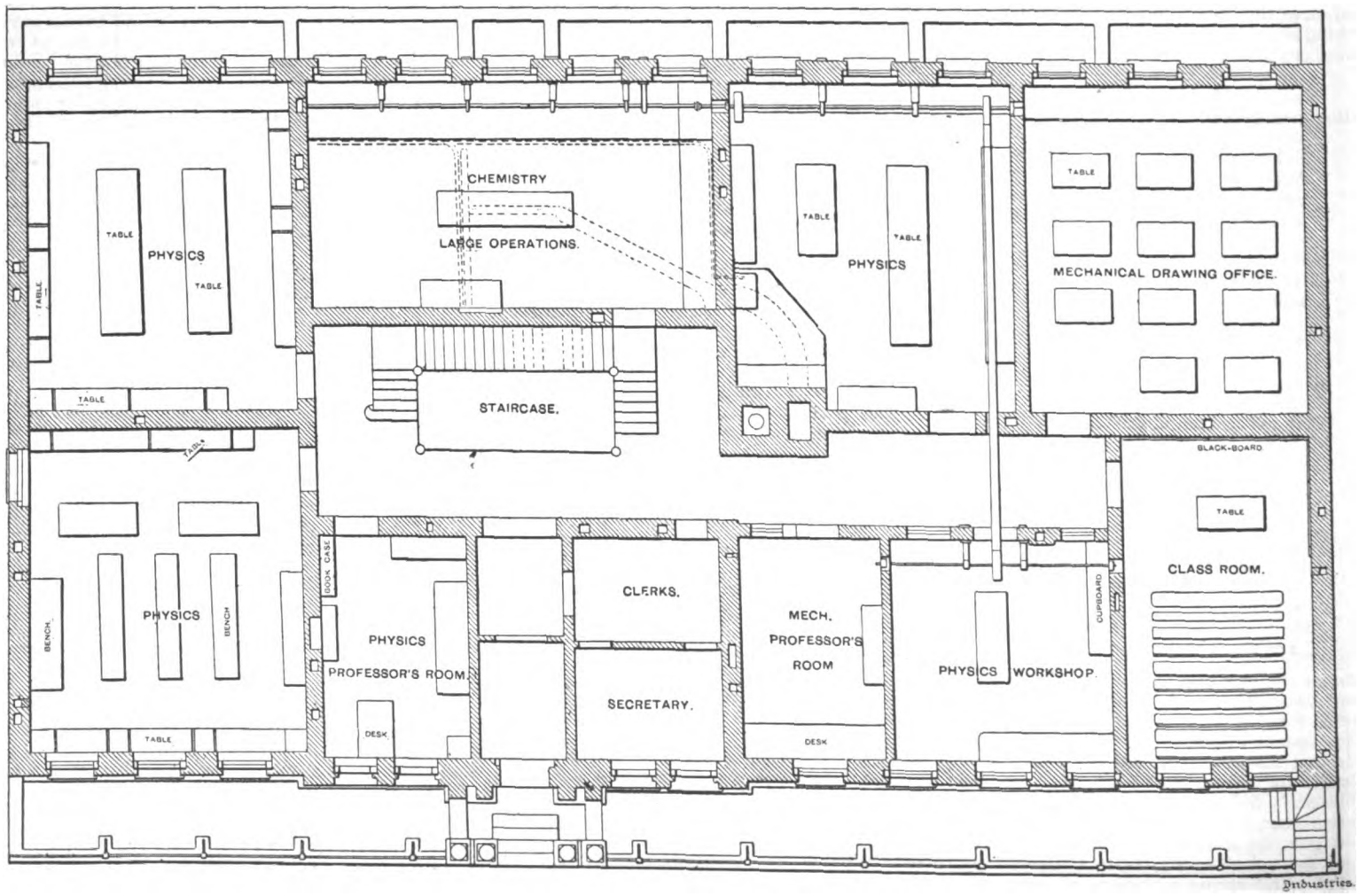
THE FINSBURY TECHNICAL COLLEGE.

(*For description see page* 530.)



Industries

Basement.

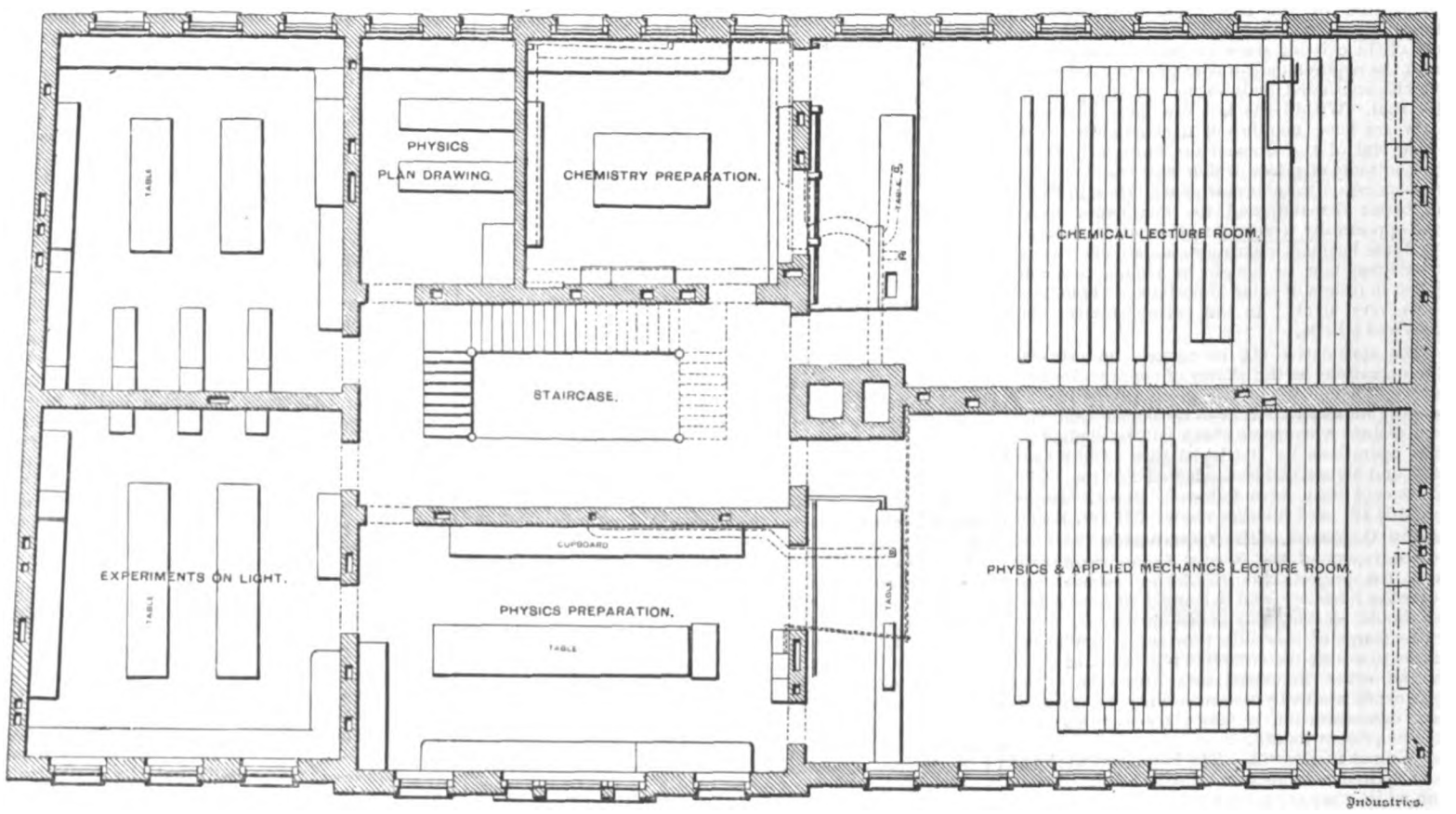


Ground Floor.

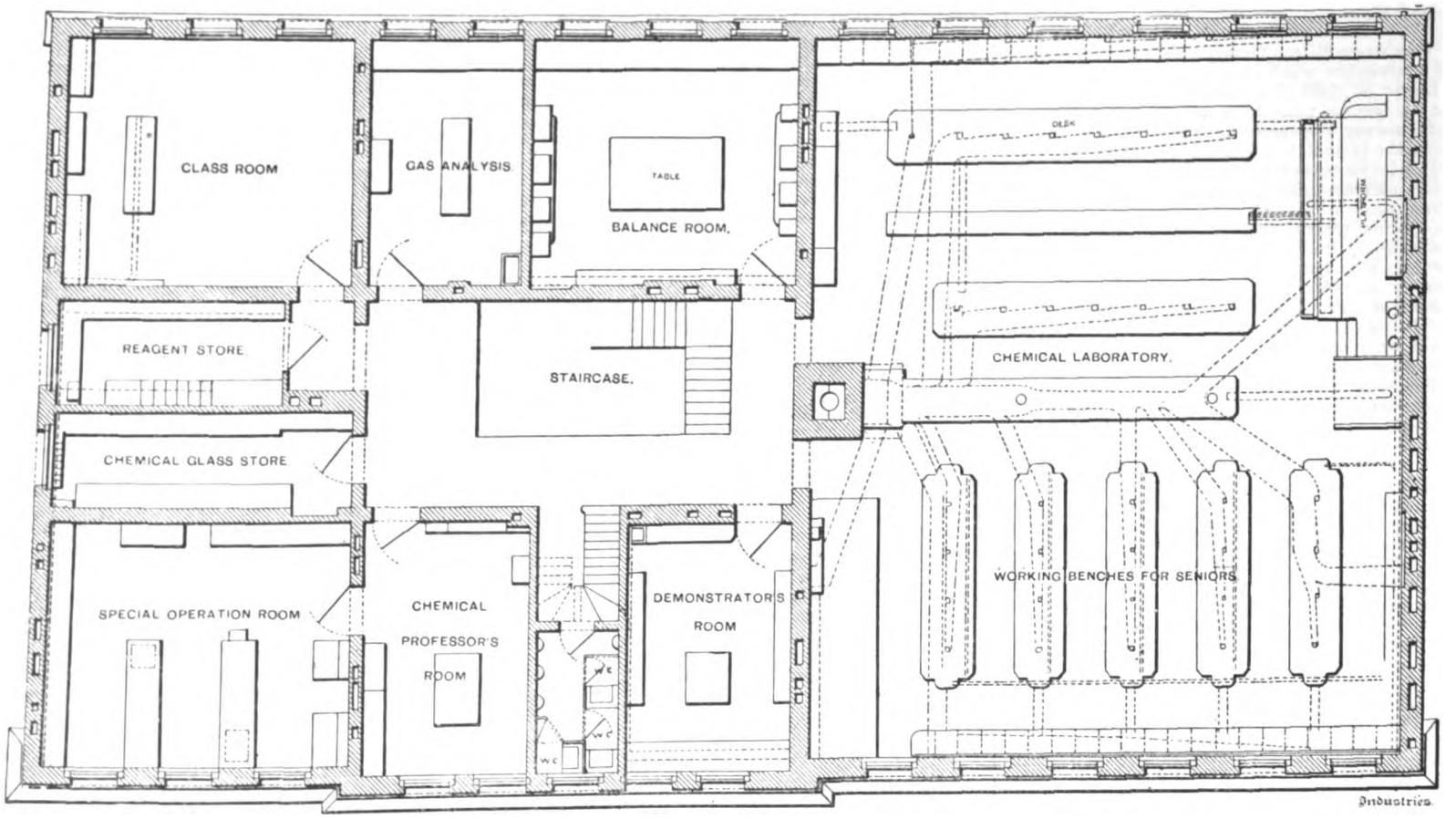
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THE FINSBURY TECHNICAL COLLEGE.

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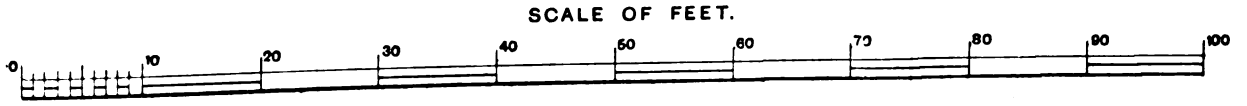


First Floor.



Second Floor.

SCALE OF FEET.



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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 3rd June, 1890.

Iron.—Here, as in the provinces, the dominant note or characteristic feature of the iron trade is hesitation. Buyers hesitate to place fresh orders, having no confidence in the stability of the existing state of things, and sellers hesitate to meet the requirements of consumers by reducing prices, fearing the continued maintenance of the present high rates for coal. Within the last few days, however, the colliery owners have manifested a conciliatory disposition, and several of the ironmasters have, it is said, renewed their contracts at prices which will enable them to make some concession to their customers. Here in Paris joists are in better demand, and the merchants have profited by the opportunity to return to the price of 160s. In the Haute-Marne business continues to fall off. As a consequence bars may now be bought at 152s. a ton, and considerably less in orders of some importance. Founders report business very slack. In the Loire-et-Centre the demand has revived a little.

Metals.—The speculative rig in copper, undertaken with a view to operations in the shares of copper mines, is running a successful course, to the great injury of the copper-consuming industries. It is to be hoped that the time is not far distant when some check will be applied to these financial operations by the legislature. Chili bars are quoted £58 and higher, and best selected, £58 10s. The other metals, except lead, have followed copper. Banca tin is quoted £102 10s., and Silesian spelter £24 12s. a ton.

The Labour Question.—The Government, without waiting for the report of the Special Commission now occupied with the projects for regulating labour, has decided to take the initiative, and to bring in at once a Bill fixing the maximum working day at ten hours. M. Jules Roche, who has charge of this Bill, proposes to introduce into it measures to ensure the complete regulation of work in factories and other industrial establishments. The working men's syndicate at Lyons are seeking to organise another labour demonstration to take place somewhere in the course of the present month.

New Iron Works in France.—The large iron works of Creusot have acquired a large plot of land by the side of the Adour, on which they are going to establish new works. It is evident that their intention is to use the excellent Spanish ores found in the neighbourhood of Irun, but they may also have in prospect the employment of Spanish coals from Asturias. A large Bilbao capitalist, who is connected with the Creusot Works, has sent an engineer to examine the coalfields of Ubies.

A Novel Wrought Iron Chimney.—The following are particulars of a wrought-iron factory chimney, of a somewhat novel description, which has been built at Creusot. The total height is 279ft., the diameter 23ft. at the base and 7ft. 6in. at the top; the total weight being 80 tons, exclusive of masonry foundations. The latter are carried 3ft. 3in. above the ground, and weigh about 300 tons. The shaft was built in successive rings, each 4ft. 1in. high, the thickness varying from $\frac{9}{16}$in. at the base to $\frac{1}{4}$in. at the top. The nine lower rings were formed of eight plates each, the upper ones of four plates each. The base was encircled by a massive angle iron bolted to the foundation. The eight lower rings were lined with fire-brick. The erection of the chimney occupied 70 days, including taking down the flying scaffold. The latter was of a somewhat novel character. It consisted of a central wrought-iron tube 7in. in diameter, and provided at the bottom with four wooden crossbars or arms, so clamped that their length could be adjusted to suit the varying diameter of the chimney, and carrying the internal platform. These arms rested on angle brackets refitted to the interior of the plates. The upper part of the central tube carried four cross-arms, or jibs, each consisting of a pair of timbers stiffened by raking struts from the central tube. From their outer ends was slung the exterior circular platform. The latter consisted of a pair of angle iron rings, to the outer part of which was riveted a plate iron fence, while the inner was provided with T-iron stanchions. Radial bearing timbers, resting on these rings, and adjustable endwise to suit the varying diameter of the chimney, carried the platform, an annular space being left just sufficient for hoisting the plates. The latter operation was effected by a rope passing over an adjustable pulley fixed to each jib in turn, and carried down a central tube to a snatch block fixed at the bottom of the chimney. As each successive ring was riveted up, two pairs of bars were laid across, by which the scaffold was slung by four jack-screws furnished with ratchet collars, and thus raised high enough to take a bearing on the next set of angle brackets. The complete scaffold weighed about 4 tons, and the heaviest plate about 8 cwt. The total cost of the chimney, without foundations, was about $8,000.

BERLIN, 2nd June, 1890.

Iron.—The iron markets of Upper Silesia continue active, and afford in this respect a contrast to those of Western Germany and abroad. The production of pig is kept up to the full capacity of the blast furnaces, and the deliveries absorb the whole of the output. The demand is brisk for all classes, for foundry as well as forge and steel pig. The market is animated, too, in all branches of the finished iron and steel trades, bars, joists, and plates being equally inquired for. It is worthy of note that wire and wire nails, neglected in the markets of Western Germany, are there in very brisk demand. Here in Berlin business is slacker, the market being influenced by the weakness of the Western markets.

Metals.—There is but a moderate current of genuine business in metals, yet the tendency of the market is constantly upwards. Obviously the movement is due to speculation. Copper has further advanced. Mansfeld refined being quoted as high as £64, and English brands up to £62 10s. Banca tin is firmer at £106. Lead is in brisk demand, and very firm in price. Spelter is quoted at last week's prices, but the tendency of the market is distinctly upward. Antimony regulus has moved slightly in favour of buyers; English, £74 to £77 5s. a ton.

The Lamp-Glass Trade.—The syndicate of lamp-glass manufacturers is not to be broken up. At a numerously attended meeting of members and others interested in the trade held last week at Görlitz, some important changes were made in the constitution of the association, and a proposal to continue it in its altered form was unanimously agreed to. This is a matter of considerable importance to the export trade.

Soap Makers' Convention.—A largely attended meeting of the Soap Manufacturers' Convention of Eastern Germany was held last week at Breslau, to deliberate on a proposal to raise the prices of soap. It was stated that the cost of all the raw materials of manufacture, including fuel, as well as the rate of wages, have considerably advanced of late, so that the present prices of soap leave no margin for profit. Resolutions were passed adopting the proposal, and prolonging the Convention, with some slight changes in its constitution.

The Import Trade in Italian Wines.—The import trade in Italian wines is rapidly growing. Excluding from the returns the port of Hamburg, the quantity received amounted to 49,583 hectolitres in 1887, 71,392 hectolitres in 1888, and 120,664 hectolitres in 1889. The latter quantity, which is equal to some 16 million bottles, is about one-fourth of all the foreign wines imported into Germany.

Beer Production in Germany.—The beer production in the beer excise district, comprising the following States, Prussia, Saxony, Hesse, Mecklenburg, Thuringia, Oldenburg, Brunswick, Anhalt, Lubeck, Hamburg, and Bremen, amounted in the fiscal year 1888-9 to 28,655,675 hectolitres, as compared with 27,475,846 hectolitres in the previous year. The industrial breweries numbered 8,540, and the non-industrial breweries 1,016. The brewing materials consumed were: Bruised barley malt, 11,185,250 ctrs. (1 centner = 50 kilos.); wheat malt, 281,058 ctrs.; other grain, 688 ctrs.; rice, 25,484 ctrs.; sugar, 75,774 ctrs.; syrup, 3,710 ctrs.; other malt substitutes, 14,088 ctrs.; total, 11,566,052 ctrs., compared with 11,094,430 ctrs. in the preceding year. The brewing tax yielded 26,645,511 marks, against 25,128,393 marks in the previous year. One centner of bruised malt yielded, on an average, 2·47 hectolitres of beer, and the excise per hectolitre amounted, on an average, to 82 pfgs. The average production of industrial breweries was 2,998 hectolitres. The excise-free breweries for home consumption numbered 40,967.

Sugar.—The consumption of beet for sugar-making purposes in the German customs district during the period from the 1st of August, 1889, to the 30th of April, 1890, amounted to 98,250,394 dble. ctrs., against 78,961,330 dble. ctrs. in the corresponding period last year. The export in April was:—Raw sugar and refined sugar under 98 per cent. polarisation, 613,507 dble. ctrs.; other sorts of sugar, 343,194 dble. ctrs. The respective quantities exported in the first-named period were 4,033,674 dble. ctrs., against 3,586,700 dble. ctrs., and 1,586,840 dble. ctrs., against 1,472,755 dble. ctrs.

Electric Transmission of Power.—The Würtemberg Portland Cement Works, at Lauffen-on-the-Neckar, has decided to utilise the large amount of water power at its disposal, in so far as it is not required for the cement factory, in the production of electric currents, which are to be transmitted to the town of Heilbronn, distant about 11 kilometres, to be used for lighting purposes and for working electric motors. In order to supply the electrical current for industrial purposes, it is proposed to reduce the cost of the installation as much as possible by the erection of thin overhead wires. The company has already applied to the State and municipal authorities for power to carry out the undertaking, in order if possible to have it ready for the winter. Mr. Oscar von Miller, of Munich, has been commissioned to design the details and superintend the execution of the enterprise.

VIENNA, 2nd June, 1890.

The Iron Market.—The situation of the iron market has altered in a satisfactory manner. Once more the syndicates have obtained a victory over speculation, and have pushed it out of the field. This result was obtained by the steadily increasing demand, which was quite irrespective of prices, and by the diminishing stocks. Notwithstanding the events in the Glasgow market, the Austrian and the Bohemian iron markets are again firm, and if the present tone prevails it would not be at all unlikely for the prices to increase. The chief ironworks and machine manufactories are now taking stock, and most of them show good results. The Bohemian Montan Company held its general meeting last week; there it was reported that the production of ores amounted to 207,925 tons. The profit was 80,000fl., and a dividend of 7 per cent. was declared. The administration of the Brünn machine manufactory will propose to the shareholders' meeting a dividend of 10 per cent. The sale of the products of the Simmering machine and waggon building manufactory amounted to 2·713 million florins, and the profit to 162,929fl. A dividend of 6 per cent. will be paid. The orders received for the new business year already represent 2·5 million florins. The machine manufactory of the Hungarian State railways had an income of more than 3,000,000fl., and a profit of 637,718fl.; this is 200,000fl. more than in the previous year. The iron and steel manufactory of Diösgyör had an income of 3,878,988fl., and a clear gain of 907,862fl., nearly 750,000fl. more than in the last year. In comparison with 1888 the profit of the machine manufactory increased by 136,200fl.; that of the iron and steel manufactory decreased by 106,600fl.

The Coal Market.—It does not appear likely that there will be any further change in the coal market this year. The demand continues very brisk, and as the strike in the Pilsen district is nearly terminated, all the business goes on much as usual. In concert with the directors of the State Railways the Prague Chamber of Commerce called a public meeting last week to consider the ways and means of preventing the congestion of traffic due to the scarcity of coal waggons, which is felt most seriously in the autumn. Deputations from the Bohemian railways, the coal works, and some sugar manufactories were present at the meeting. The meeting resolved to recommend that the year's traffic should be distributed more equally, and that encouragement should be given to consumers to procure their supplies for the winter during the summer months.

DÜSSELDORF, 3rd June, 1890.

Iron.—The Whitsuntide holidays brought a slack market almost to a standstill, a state of things that has hardly yet passed away. The languor which now oppresses the iron trade of this district shows itself in the continued downward tendency of prices. The present quotations are, it is true, little more than nominal, since there is practically no business being transacted; but the weakness makes itself apparent in the general tone of affairs, which is more and more depressed. The reductions that were made a short time ago have failed utterly to stimulate the market. On the contrary, the effect on buyers seems to have been to keep them away in the hope of obtaining still better terms later on. Spiegel pig has dropped to 98s. a ton, and Siegen forge to 78s. English Bessemer is offered at 75s. delivered free at Ruhrort. For bars there is but little inquiry, and business is very slack in hoops and wire. Joists are in fairly good demand, and there is a steady, but weaker, current of business in plates and thin sheets.

Coal.—The Berlin financial papers are publishing statements concerning the coal trade of Rhineland-Westphalia, with a view to influence the share market. These "bearing" reports have, however, no foundation in fact. So far from the coal market going to pieces, as these speculators' journals would make people believe, it is manifestly stronger than it was a week ago, and there is no prospect whatever of a collapse. Consumers are restricting their purchases till they see whither the market is tending, but the current of business is still sufficient to absorb the greater part of the output. There will be, no doubt, some accumulation of stocks at the pits as usual during the summer months, but it is certain that next winter's trade will commence with much less than the average amount of stocks in hand. Any estimate of the industrial prospects based on much cheaper fuel must therefore be fallacious.

Krupp versus Bange.—Valparaiso newspapers publish a report of shooting experiments with Krupp and Bange cannon which took place simultaneously a short time ago. Twenty-five shots were first fired from field guns to a distance of 1,000 metres. Sixteen shots from the Bange guns hit the mark, but were spread over the entire surface; whilst the Krupp cannon made nineteen hits with considerably less divergence. In testing the hill guns, 20 grenades and 20 shrapnels were fired at three marks, 20 metres wide, and 2·70 metres high, behind one another at distances of 20 metres, the guns being 1,500 metres from the butts. The Krupp cannon required 17½ minutes to fire the 20 grenades, and the Bange cannon 24 minutes. The result was as follows:—First butt, Krupp 180 points, Bange 101; second butt, Krupp 132, Bange 34; third butt, Krupp 45, Bange 11; total, Krupp 357, Bange 146. To fire the shrapnels Krupp required 24 minutes and Bange 62. The effect was as follows:—First butt, Krupp 327 points, Bange 134; second butt, Krupp 215, Bange 82; third butt, Krupp 120, Bange 35; total, Krupp 662 points, Bange 251. It should also be observed that several shrapnels burst in the Bange cannon. Other experiments were afterwards made, but the results all tended in favour of Krupp.

The Explosives Trade.—The Rhenish-Westphalian Blasting Explosives Company have declared a dividend of 15 per cent. The export trade in blasting explosives is steadily increasing.

The Bremen Exhibition.—The Trade and Industries Exhibition at Bremen was opened on May 31st. The exhibits are very numerous and well chosen, and give a good idea of the trade of that locality.

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LILLE, 3rd June, 1890.

Iron.—For iron, in so far at least as this district is concerned, the situation certainly does not improve. Export orders have ceased to come in, our manufacturers being, in the present state of the markets, unable to continue the competition with Belgian and English producers. The tone of the market is therefore weaker. Manufacturers no longer maintain the firm attitude which they preserved down to the Whitsuntide holidays. On orders of considerable importance it is now easy to obtain large concessions. Bars may be bought for 148s. and less, and joists, for 150s. a ton. Thus the tendency of the market is distinctly downward.

Textile Manufactures.—Business, interrupted by the Whitsuntide holidays, has hardly yet resumed its normal course. In linen goods there is not much doing. We are now getting well into the slack season, and there will be nothing extraordinary in having to chronicle a quiet market for some weeks to come. The Roubaix woollen goods trade continues very slack, but manufacturers express themselves satisfied with the situation. It is an average season, and there are indications of a good season to come. The terminal market for raw wool is steady, with a tendency to greater firmness.

Flax and Yarns.—The demand for home-grown flax continues active, and the supply is falling short. In such circumstances prices are, of course, easily maintained. A good deal is being sold on export account. A further rise in the price of Russian flax, due to exchange movements, has checked the demand in a marked degree. For tows there is a fairly active home market, but there is not much doing on export account. Business is somewhat less active in yarns, but prices are firm, especially for the finer numbers. Jute yarns are in brisk demand and dearer.

AMSTERDAM, 2nd June, 1890.

The Royal Machine Factory.—The shareholders of the Royal Machine Factory at Amsterdam, which a short time since had to apply for a legal postponement of paying its debts, owing to heavy losses on contracts last year, have held a meeting, at which a somewhat gloomy state of affairs was disclosed. The creditors have, indeed, not been pressing their claims, and the customers have been very accommodating. In consequence, the company has been able to continue its operations and maintain its staff. On the other hand, the negotiations with the Government have not led to any results. It had been hoped that this being the Royal Factory, with 1,400 hands, and the largest establishment of its kind in the Netherlands, and nearly the only one able to turn out the largest orders for Navy and other purposes, the State would have considered it its duty to assist the undertaking over its difficulties, and to give it a good start on a new and, it was hoped, more prosperous career. But the Dutch Government has not been found willing to go beyond the maintenance of the Admiralty orders at present in hand. This has caused much disappointment among the shareholders.

The Coming International Exhibition at Amsterdam.—The Exhibition of appliances tending to minimise the dangers to the life and limb of workmen in factories and workshops promises to be a great success. The committee has received many more applications for space than it had originally calculated upon. Before the close of the Exhibition in September, an International Congress concerning the same subject is to be held in Amsterdam. Apart from that subject, accidents in mines and shipwrecks, with the means to prevent them, will be discussed at the Congress.

Dutch Sugar Refineries.—The leading Dutch sugar refineries have suffered somewhat in 1889, in consequence of the speculation in raw sugar, which drove up its price tremendously. The directors of the Western Sugar Refinery Company at Amsterdam state that they were compelled to stop operations for awhile, until the prices of the raw article had assumed a more normal level. In consequence of better methods of working upon an extended scale, a larger quantity of sugar was turned out than in 1888—viz., 32¼ million kilogs., as against 31 millions the year before. The net profits were 465,552 guilders, enabling the directors to recommend a distribution of a dividend of over 15 per cent. among the shareholders. The latter have resolved to increase the capital to 1½ million guilders, by the issue of 1,500 new shares of 1,000 guilders. It was stated at their meeting that the company has done well in 1890 hitherto, 22 million kilogs. being turned out this year against an output of 12 million in the same period of 1889. The directors of the Dutch Sugar Refinery Company have reported similar operations in 1889, resulting in a net profit of 89,189 guilders, equal to 10 per cent. on the share capital.

COPENHAGEN, 31st May, 1890.

A New Petroleum Steamer.—The "Kockum" has just been completed at the Kockum Engineering Works, Malmö, Sweden. The principal dimensions are: Length, 155ft.; breadth, 27ft. 9in; and depth, 9ft. 6in. The engines indicate 350 h.p., and the calculated speed is 10 knots. The steamer is divided into six compartments by oil-tight bulkheads. The pumping machinery is capable of discharging the cargo in three hours and a half. The ventilating arrangements are very complete, and the whole of the vessel is protected by a cover against the heat of the sun, for the sake of the cargo. She is intended for the Astrakan-Baku naphtha trade.

Railways in Norway.—The question of new railways is very much to the fore in Norway at present. Not only is the Government going in for several lines, but private enterprise is also busy. A syndicate is being arranged to build a railway from Christiania to Gjövik, the total cost of which has been calculated at 10,500,000kr. The time required for the building of the line has been put down at six years.

Swedish Wooden Villas for Export.—The firm of Ekman's Mekaniska Snickersfabrik continues to extend its business, and their handsome and practical villas of wood are now being sent to distant parts of the world. The Argentine Republic has proved a good market. A large order was received not long ago from Portugal, and in Italy, too, they have been largely sold.

Spirit Refining in Sweden.—The refining of spirits has become a regular and, to all appearances, a profitable industry in Sweden. The Reymersholm New Spirit Refining Company sold last year 7,574,372 litres, of which about half was sold to the Stockholm Spirit Company. The quantity sold last year was some 400,000 litres less than during the previous year. The gross receipts amounted to 397,779kr., and the expenses to 294,124kr., leaving a net profit of 103,655kr. In the expenditure is, however, included a dividend to the shareholders of 12 per cent., so the net profits, according to ordinary bookkeeping, amount to 235,655kr. The reserve fund has now reached 760,017kr., so it has been decided to turn 550,000kr. of this into shares and place them to the credit of the shareholders.

Strikes.—The bricklayers' strike in Copenhagen continues, neither of the parties showing any signs of weakness. The strike at the large engineering works of I. & G. C. Bolinder, Stockholm, has not been settled. The strike at the match manufactory at Jönköping has ended.

MADRID, 2nd June, 1890.

Pig Iron.—So far Spain has not been able to make hematite pig at a sufficiently low price to allow of it competing in foreign markets, and as regards the lower and cheaper sorts of pig this country was quite out of the running. It is now known that the Union Hullera and Metalurgica de Asturias, a company formed by French and Spanish capitalists, and managed by the able engineer Señor Adaro, has purchased some large iron ore mines situated between Gijon and Luanco, and that they intend to make pig iron. The ores are 50 per cent. metallic iron, with a large proportion of silicon and phosphorus. As they are also large owners of coal mines cheaply worked, they will be able to make a profit at any price above 34s. to 36s. per ton. At the present time Spain makes more pig than is required for the consumption of the country.

The Cuban Railways.—The concession of the Cuban system of railways is still undecided, or rather the decision is not yet known. It has become known that Messrs. Gibbs, of London, are at the head of the English company that has tendered for the concession, and many are therefore in favour of giving them the preference over Mr. Ivo Bosch, who is supposed to have too much work on his hands already. The Ministers are expected to decide to give the concession to the English company.

NEW YORK, 24th May, 1890.

The Coal Trade.—The anthracite coal trade is still improving gradually. The demand in April as in March exceeded the supply, and the inquiries for manufacturing and furnace sizes are excellent. The important fact in the trade is that the large companies continue in harmony as regards the tonnage shipments. The last six months of this year are now almost certain to be profitable. It is expected that prices will advance again, and the feeling in the trade is one of entire confidence as to the future.

A Big Commercial Scheme.—Chicago is to have one of the largest department store buildings in this country. The block bounded by State, Adams, and Dearborn Streets, and an alley, and having a frontage on State Street of 190ft. and on Adams Street of 350ft., has been leased to "The Fair" Corporation. This corporation is organised with a capital of $5,000,000, and at present runs a department store in a series of low buildings on the property. The corporation will at once begin the erection of a twelve-storey building to cover the entire piece of ground. It will cost $2,000,000, and will be constructed of steel, iron, and brick. The land is leased at an annual rental of $154,000, which is 5 per cent. on the valuation of $3,000,000.

North Dakota Industries.—Two industries are being rapidly developed in Dakota. Some of the German farmers have been experimenting with the sugar beet, and they have been so successful that many hundreds of others are intending to plant them this year. The temperature and the moisture of the atmosphere seem to be admirably adapted to maturing the beet to the point where it contains the greatest quantity of saccharine matter. In many places in the State there are veins of soft coal, from 3ft. to 10ft. in thickness, and in many places cropping out on the surface. If the beet crop is what it promises to be, arrangements to transform it into sugar will be made on a large scale, the coal supply being an important factor. It has but recently been determined that barley of a superior quality can be raised in the State, and the industry is rapidly reaching such a point that large quantities will be raised, made into malt, and shipped in that form to the great markets.

Double Tracks on Railways.—Before 1893 the Pittsburgh, Fort Wayse, and Chicago Railroad will be double tracked from Pittsburgh to Chicago. As soon as it became apparent that Chicago was likely to get the World's Fair, the officers of the Pennsylvania Company began holding meetings, at which the amount of traffic and business which would, no doubt, come to them from the Fair in Chicago was discussed. Many of the officials were opposed to the double track because of the expense, and it was only a few days ago that the double tracking was decided upon. The work will require an outlay of several millions. One of the highest officials in the company stated that their business had been increasing rapidly for the past ten years. Plans have been discussed for years as to the best method of meeting this increase without going to so great an expense. The company will have a large trade from the Fair, and they might as well build the track now and get the benefit of the business.

Bridges at Niagara.—The new Niagara River Bridge Bill has been signed by Governor Hill. The Bill provides for the construction of a bridge across the Niagara river about 1,000ft. north of the present railway suspension bridge. The capital is $500,000, with the power of being increased to $2,000,000, and the company is to be managed by a board of nine directors. The construction of the bridge must be begun before July, 1895, and it must be completed within five years. The company is stated to have been organised in the interest of the Canadian Pacific Railway Company, and the bridge is being built to furnish it an entrance into Buffalo.

The Jamaica Railways.—The Jamaica railways, to the extent of 65 miles, have been bought of the Government by an American syndicate for $4,000,000, of which sum $500,000 was paid down to the Government of Jamaica, and the rest is to remain in bonds and mortgage. The lines extend from Kingston to Porne, and from Spanishtown to Ewarton. These lines are to be extended to 185 miles. Two parties of engineers have been in the field for several months, and though no grading contracts have been let, bids have been received for steel rails from England and the United States. The lowest bid for rails came from Birmingham, Alabama. By the terms of the contract 12½ miles of the road must be finished each year; included in this construction will be a number of bridges and tunnels. The Government of Jamaica gives the syndicate 65,000 acres of land, and guarantees bonds to the amount of $40,000 per mile.

United States Railways.—The net earnings of United States railways for the month of March and for the first three months of 1890 show a favourable increase over the corresponding periods of 1889. The gross and net earnings of 124 railways for March, and of 149 railways for three months, compare as follows, with last year's earnings:—

	March. 1890.	1889.
Gross	$50,022,598	$44,985,561
Net	15,510,037	14,238,219
	Three Months.	
Gross	$166,628,417	$151,706,160
Net	49,117,906	43,528,074

This gives a gain of 8·93 per cent. over last year for March and a gain of 12·84 per cent. for three months. The South-Western roads show the greatest increase for both March and the three months—54 per cent. and 41 per cent. respectively. The North-Western, Eastern and Middle, and Trunk lines follow with 21 and 27 per cent., 7 and 23 per cent., and 8 and 16 per cent. respectively. The Southern roads show an increase of 9 per cent. for three months and a decrease of 7 per cent. for March. The Pacific roads show a decrease of 11 per cent. for three months and an increase of 1 per cent. for March. The decrease in both cases is due to adverse weather. Taken as a whole, however, the condition of the railway transportation business is very favourable.

PHILADELPHIA, 23rd May, 1890.

A Gas Company.—The annual meeting of the United Gas Improvement Company, of Philadelphia, was held a few days ago, and preliminary steps were taken towards the complete organisation of the American Gas Investment Company. The new enterprise will be capitalised at $50,000,000, of which one-half is to be subscribed in this country and the remainder is to be offered abroad. The capital will be distributed in 500,000 shares of $100 each, and 2,000 of these will be offered at par as founders' shares to subscribers in consideration of guaranteeing $200,000 to pay for the organisation. As soon as the organisation of the new company is effected 30 per cent. will be paid in, and the $15,000,000 thus raised will be used by paying $10,000,000 for the absorption of the present United Gas Improvement Company, and $5,000,000 to go into the concern as immediate working capital. The money to buy out the present United Gas Improvement plant covers the $5,000,000 of capital of the present company, and a surplus of $5,000,000 which the company has accumulated in addition. A meeting for the organisation of the larger company will be held next month.

A Steamship for Puget Sound.—The steamship "City of Seattle," built at the shipyard of Neafie & Levy, in Philadelphia, for the Puget Sound and Alaska Company, was successfully launched the other day. She is of steel, with two upper decks, and accommodation for 250 passengers. She is 275ft. long, 40ft. beam, 17ft. deep, and of 1,560 tons register. The engines are compound, and will drive her through the water at 20 miles an hour.

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ELECTRIC LIGHTING AT THE EDINBURGH EXHIBITION.

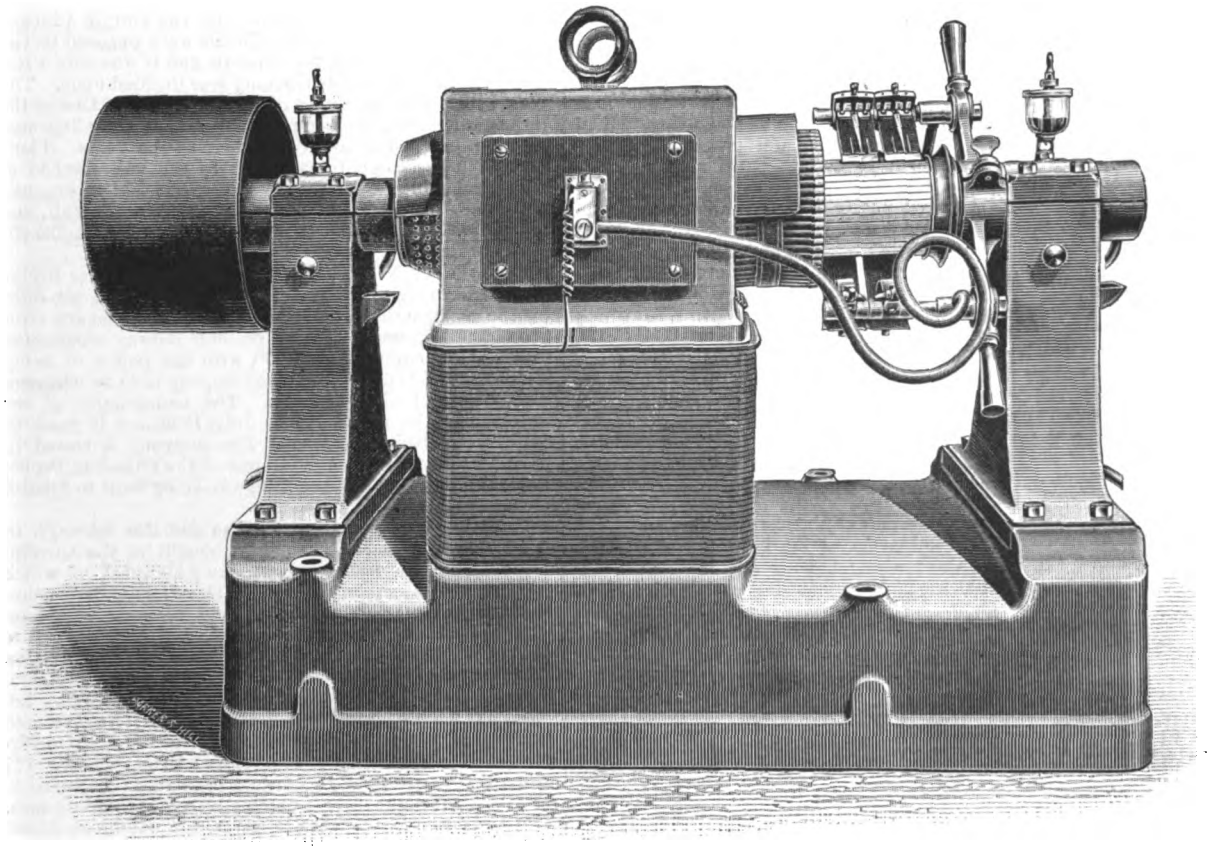


Fig. 1.—The Elwell-Parker Continuous Current Generator.



Fig. 3.

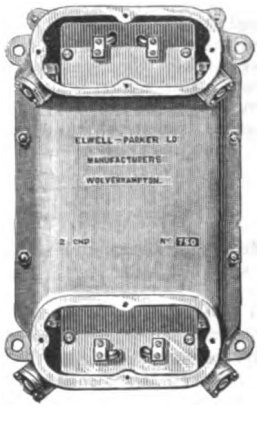


Fig. 4.

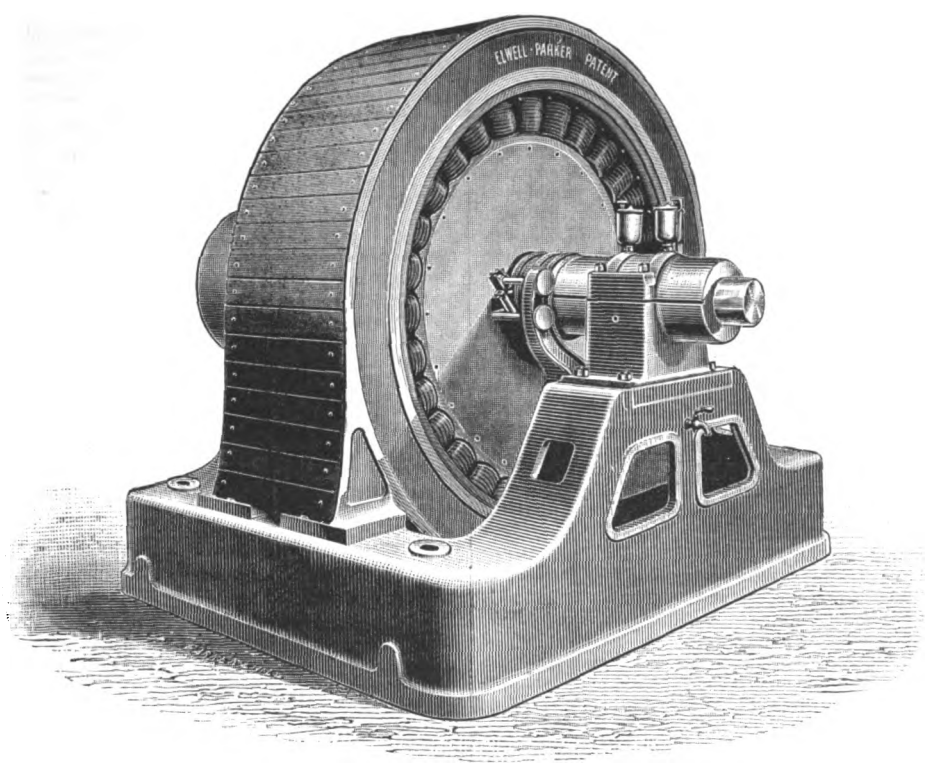


Fig. 2.—The Elwell-Parker Alternator.

ELECTRIC LIGHTING AT THE EDINBURGH EXHIBITION.

I.

In dealing with the electrical exhibits it is necessary to avoid any definite classification, and simply to take the exhibits somewhat at haphazard. Speaking generally, it may be admitted at once that there is no startling novelty. This may indeed be said of most exhibitions, since the first bloom of novelty has, for the most part, had time to wear off ere inventions find their way into an exhibition stand, to be gazed at by the instructed and uninstructed public. One thing is, however, specially noticeable in the general aspect of the electrical exhibits—that is, an increasing attention to finish in workmanship. When one remembers the badly-designed machines, and crude and ill-made fittings, that a few years ago represented the high-water mark of the electrical engineering of the time, one cannot help being struck by the improvements that, in spite of survivals here and there, have been effected both in design and in workmanship. There is still vast room for improvement, both in the unseen but most important items in an installation and in the necessarily more or less obtrusive fittings. We have to get rid, somehow, of the convention of the oil-lamp and the gaselier, and strike out a new convention adapted, and adapted alone, to the exigencies of the new order of things. Where all are by force of circumstances involved in the limitations prescribed by fashion, it would be invidious to make comparisons, but it may be suggested broadly that, notwithstanding the efforts of a few well-known firms—and to some extent because of these efforts—there lies for the expert and original designer a vast untrodden field in designs for electric fittings. In a previous notice of the electrical exhibits, we dealt with those of the Brush Company, which employs its machinery in illuminating the grounds and the interior of the buildings with arc lights; with those of Messrs. King, Brown, & Co., Edinburgh, whose machinery lights the interior with incandescent lamps and actuates some electromotors; Messrs. Ernest Scott & Co., whose alternators and transformers are employed in some of the more distant incandescent lighting in the outbuildings; and the India Rubber, Gutta Percha, and Telegraph Works Company, of Silvertown. Bearing in mind that the order in which we deal with the firms is entirely promiscuous, the next exhibit to be noticed is that of the Edison and Swan United Electric Light Company, Limited. The Edison-Swan exhibits comprise solely lamps and fittings. There is no machinery in motion. Round the stand there is a great show of lamps, numbering upwards of 2,000, and varying in power from the tiny microscope or medical lamp of a single candle-power to incandescent lamps of over 1,000 candle-power. The central case contains instruments and fittings, some of which have not been exhibited before. The instruments comprise Cardew's patent voltmeter, which the Edison-Swan Company manufacture under licence. This instrument is made in four sizes, measuring from 10 to 30 volts, 20 to 80 volts, 30 to 120 volts, and 40 to 150 volts respectively. The instrument with medium range is now made with a dial 12in. in diameter, with large figures, for use in the engine-room.

In addition to Cardew's voltmeter, the company show that of Messrs. Fleming & Gimingham. It is claimed that this instrument combines the advantages of portability and accuracy. It is adapted for measuring either direct or alternating electromotive force. The principle of its construction is that of the dynamometer. If parallel coils, one fixed and the other movable, be traversed by the same current, the movable coil will be attracted towards the fixed coil, and the force required to bring it back to its original position varies as the square of the strength of the current traversing the coils. A steel chronometer spring is used in this instrument to bring back the movable coil to its normal position. The relative position of the coils is shown by an index projecting through the dial. Resistance boxes are supplied with these voltmeters. The voltmeter being put in as a shunt, the resistance gives the current in amperes. The Fleming & Gimingham voltmeters are supplied to read from nil to 220 volts.

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Among the miscellaneous exhibits of the Edison-Swan Company are their electric focus lamp for optical lanterns, a simple arrangement by which an incandescent lamp can be fixed in a lantern at any desired height, the carbon being in the shape of a square grating in which the whole luminous length of the carbon is coiled. This point of light can, by means of the adjustment mentioned, be accurately focussed. There is also a simple but efficient cut-out, which is supplied at less than a shilling; a stoke-hold fitting, with cap, to be used when the light is not required; a new ceiling plate with cut-out; a slate base with cover to be had in various metals, fastened to the base by a couple of screws; a new enamelled iron shade for high-power incandescent lamps, and a holder for lamps of large size. The company also show their well-known "Tumler" switches, and their slide rule for calculations connected with incandescent lamps.

The Electric Construction Corporation, Limited, have a varied and interesting stand. They show (not in motion) an electric tramcar for propulsion by storage batteries, and fitted with an electric bogie. This car is of the most recent type. It is suitable for running on any line of suitable gauge without any special adaptation of the permanent way. They also exhibit a 50-light EPS storage battery, consisting of fifty-five L 15 cells, 1888 type, in glass boxes. These are shown with complete fittings, as they would be in an ordinary installation. There is besides a variety of secondary cells adapted for different purposes. Among these are an L 31 glass cell giving 60 amperes in 10 hours, one L 15 cell for half this current, one for 45 amperes, and another for 22, both for ship lighting, several for train lighting, traction, boats, medical works, &c. The company also show two distributing switch-boards, one for 80 amperes and another for 60 amperes. Among the accessory instruments for use with secondary batteries are Mr. King's automatic distributing apparatus, consisting of a balance with a running counter-weight, which automatically switches in a new battery when the current of the old becomes exhausted. This is specially intended for use in central station public lighting by means of secondary batteries. It has been employed since April, 1889, by the Chelsea Electricity Supply Company.

The stand of the company is surmounted by a sign-board, the lettering upon which is picked out by 800 16 candle-power incandescent lamps. There are also exhibited a large Elwell-Parker machine and transformers. This plant consists of 100-kilowatt combined alternating dynamo and engine capable of developing 100 amperes at 1,000 volts, a supply sufficient for 3,330 lamps of 30 watts - sixteen plants of this type being supplied for the Metropolitan Electric Supply Company, Limited. The high-tension current is transformed by means of twelve Parker transformers, which reduce the e.m.f. from 1,000 volts to 100 volts. There are also exhibited two continuous current dynamos erected on tension frames in working order. Each machine is capable of simultaneously exciting the field magnets of the alternator, charging the storage battery, lighting 120 16-candle-power lamps, and running two motors. In this case these are on the stand of the Singer Manufactory Company.

In connection with electric traction there is shown the Sprague car equipment. The gear, by this method, is carried at one end by the axle, the other end being supported by springs from the car body, the intention being to secure steady suspension and freedom from vibration due to the jolting of the wheel.

Among the accessories are two types of switchboards for use with accumulators. One is suited for a current of 80 amperes of 100 volts, and is fitted with patent ring-contact switches. The second is suited for a 60-ampere circuit of 100 volts or less, and is fitted with "tongue" switches. The boards are fitted with regulating switches in order to secure that, whatever number of cells the dynamo may be charging, the lamps may be worked at their normal voltage.

Besides these major exhibits, the company show an automatic current alarm, a low constant voltmeter, an automatic make-and-break switch, and a variety of switches and fittings, besides ammeters and voltmeters. Fig. 1 on the opposite page shows the continuous current machine, Fig. 2 the alternator, and Figs. 3 and 4 the Parker transformers, one view showing the interior with the ends of the coils exposed.

SHIPBUILDING NOTES.

On the 29th ult. the "Ruskin," a steel screw-steamer, built by Messrs. Raylton Dixon & Co., Middlesbrough, to the order of Messrs. Arthur Holland & Co., London, proceeded from the Tees on her trial trip. This vessel is built on the raised quarter-deck principle, having a poop aft, and a continuous bridge deck, forming a partial awning deck. The principal dimensions are:—Length, 307ft.; breadth, 40ft.; depth, moulded, 21ft. 4in.; and dead-weight capacity about 3,650 tons. Her engines have been fitted by Messrs. Thos. Richardson & Sons, Hartlepool; the cylinders are 22in., 35in., and 59in. by 39in. stroke.

On the 31st ult. the steamer "Adder," built by the Fairfield Shipbuilding and Engineering Company for Messrs. G. & J. Burns' service from Greenock to Belfast, went on her official trial. The conditions of the trial, as stipulated by the contract, were that the vessel was to make six consecutive runs between the Clock Lighthouse and the Cumbrae Lighthouse at an average speed of 19 knots per hour. The vessel, however, exceeded the contract limit of speed, having made an average of 19¼ knots per hour. The average on the measured mile was 20¼ knots. The "Adder" will be placed upon the Belfast route on the 14th inst.

On the 31st ult. there was launched by the Campbelton Shipbuilding Company a screw steamer, named the "Dieppois." The dimensions of the vessel are:—Length between perpendiculars, 260ft.; breadth, 36ft. 9in.; depth, moulded, 19ft. 6in.,; and dead-weight capacity, 2,650 tons. Messrs. Muir & Houston, Glasgow, are to supply the engines, which will be of the triple-expansion type, with cylinders 19in., 31in., and 51in. diameter, by 39in. stroke. The "Dieppois" will be fitted with all the latest improvements for navigating and for loading and discharging cargo. She has been built to the order of Mr. Robert Delarne, Dieppe.

On the 3rd inst. the s.s. "Valin" was launched from the yard of Messrs. Wm. Doxford & Sons, Pallion. She has been built to the order of Messrs. A. d'Orbigny & Faustin Fils, of La Rochelle, France. The principal dimensions are:—Length, between pp., 250ft.; breadth, extreme, 35ft.; depth, moulded, 18ft. 6in. The engines are on the triple-expansion principle, and have been made by Messrs. Doxford; the cylinders are 21in., 33in., and 54in. in diameter, by 36in. stroke. This vessel is a duplicate of the "Reaumur," recently launched by Messrs. Doxford for the same owners.

Notices of Meetings.

NEXT WEEK.

Society of Arts.—Thursday, June 12th, at 5 p.m. "The Rationale of Indian Railways," by Sir Theodore C. Hope, K.C.S.I., C.I.E. The Marquis of Ripon, K.G., will preside.

Royal Institution.—Friday, June 13th, at 9 o'clock. Professor Silvanus P. Thompson, D.Sc., on "The Physical Foundation of Music."

PRICES CURRENT, 4th June, 1890.

Quotations at per ton, unless otherwise specified.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.	Best. £ s. d.	
Middlesbro' Bars	5 15 0	6 5 0	f.o.t. wks.
„ Angles	5 10 0	6 0 0	„
„ Plates	5 12 6	6 2 6	„
Staffordshire Bars (cheaper makes)	7 10 0	8 0 0	London.
„ Angles	7 10 0	8 0 0	„
Crown Sheets	7 2 6	7 12 6	„
„ Hoops	7 0 0	7 10 0	„
"Siemens-Martin" Steel Boiler Plates		7 17 6	„
„ Ship and Girder		6 17 6	„

Market very dull.

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton	67/-	57/-

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

METALS.

		£ s. d.		£ s. d.
Spelter:	Ordinary	£24 0 0		
Copper:	British Cakes and Ingots	59 10 0	to	60 10 0
„	Chili Bars, G.O.B.'s	54 10 0	„	54 15 0
„	Other sorts, G.M.B.'s (equal to Chili Bars)	54 10 0	„	54 15 0
„	Manufactured (strong)	68 0 0	„	.....
Lead:	Common Pig	13 10 0	„	13 15 0
„	English Sheet	14 5 0	„	14 10 0
Tin:	Straits	93 17 6	„	94 2 6
„	Australian	94 10 0	„	95 10 0
„	English Ingots	98 5 0	„	.....

Messrs. Carrick & Brockbank, Manchester, report as follows:—

Copper: A steadier feeling is observable in copper. During the week a fair amount of business in raw has taken place at fluctuating rates, chiefly on three months' account, but values generally have been maintained. As expected, the decrease in stock last month has been very large. The visible supply on June 1st was returned as about 82,000 tons (the lowest since September, 1888), showing a diminution during May of about 8,000 tons. Chili bars to-day are quoted £54 10s. to £54 15s. cash, with firm business. Manufactured quiet at £68 sheets, £71 bottoms.

Tin: No business of importance has taken place during the week, and prices have given way. The market, however, is reported stronger to-day.

Lead firm, with small business doing.

Spelter firm, supplies being small and stocks low everywhere.

PIG IRON.

Middlesbro' Warrants, No. 3.	39/10½	Cash
Scotch Warrants, m/n	43/7½	„
Hematite Warrants, m/n	50/10½	„

Stocks in Stores	Scotch	739,251—Dec.	for week	9,554 Tons.
	Middlesbro'	102,480—Dec.	„	5,250 „
	Hematite	306,946—Dec.	„	14,142 „

	No. 1.	No. 3.	
Coltness	68/6	57/6	f.o.b. Glasgow.
Gartsherrie	60/-	56/-	„ „
Langloan	63/-	58/-	„ „
Summerlee	61/6	56/6	„ „
Glengarnock	61/-	54/6	„ „
G.M.B. ex Store	44/-	48/9	„ „

CHEMICALS.

		£ s. d.		£ s. d.
Acid: Carbolic Crystals	lb.	0 0 8½	to	0 0 10
„ „ Liquid	gal.	0 1 2	—	.....
„ Citric	lb.	0 1 4	—	.....
„ Oxalic	„	0 0 4	—	.....
„ Sulphuric	ton	1 12 0	—	.....
„ Tartaric	lb.	0 1 4	—	.....
Alum: Lump (powder 10/- ex.)	ton	4 17 6	—	.....
Ammonia: Carbonate	lb.	0 0 3½	—	.....
„ Muriate (Grey)	ton	22 15 0	—	.....
„ „ (White)	„	26 10 0	—	.....
„ Sulphate	„	11 10 0	—	.....
„ Liquor	lb.	0 0 3¾	—	.....
Antimony	ton	.....	—	.....
Bleaching Powder	„	4 17 6	—	5 0 0
Bisulphide of Carbon	„	13 10 0	—	.....
Borax	„	30 0 0	—	.....
Benzole (90 %)	gal.	0 3 10	—	.....
„ (50/90 %)	„	0 2 10	—	.....
Copper Sulphate	ton	25 0 0	—	.....
Copperas	„	2 0 0	—	.....
Kieserit	„	.....	—	.....
Lead: Nitrate	„	22 10 0	—	.....
„ White Sugar	„	24 0 0	—	.....
„ Brown „	„	19 0 0	—	.....
Potash: Bichromate	lb.	0 0 4	—	.....
„ Caustic	ton	22 0 0	—	.....
„ Carbonate	„	19 10 0	—	.....
„ Chlorate	lb.	0 0 4½	—	0 0 4½
„ Prussiate (Yellow)	„	0 0 9½	—	.....
„ Sulphate (Basis 90 %)	ton	9 10 0	—	.....
Precipitate: Red	lb.	0 3 1	—	.....
„ White	„	0 3 2	—	.....
Salts: Epsom (Bags)	ton	3 0 0	—	.....
Salts: Epsom (Casks)	„	3 15 0	—	.....
„ Glauber	„	1 10 0	—	.....
Sulphur: Sublimed Flowers	„	9 0 0	—	.....
„ Recovered	„	4 10 0	—	.....
Soda: Ash	deg.	0 0 1½	—	.....
„ Caustic (White 70%)	ton	8 0 0	—	.....
„ „ „ 60%	„	7 0 0	—	.....
„ „ (Cream 60%)	„	6 15 0	—	.....
„ Crystals	„	3 2 6	—	3 5 0
„ Bicarbonate	„	6 5 0	—	.....
„ Hyposulphite	„	6 5 0	—	.....
Solvent Naphtha	gal.	0 4 0	—	.....
Tartar, Cream of	cwt.	5 12 6	—	.....
Zinc Sulphate	ton	7 10 0	—	.....

Messrs. S. W. Royse & Co., Manchester, report as follows:—

Chemicals: A large business continues to be done in sulphate of copper, and the high prices are well maintained. There is also a good inquiry for delivery late this year and into next, but on account of the upward movement in copper makers are by no means anxious to sell. Caustic soda, after a slight spurt, has given way again, and is dull at present. Bleaching powder is also weak. Soda ash is in moderate demand, prices remaining steady. Carbolic acids are firm, makers of crude asking rather higher figures.

OILS.

			£ s. d.
Cocoanut: Cochin	per tun		29 10 0
„ Ceylon	„		25 10 0
Cottonseed	„		22 10 0
Cod	„		20 0 0
Lard	„		35 10 0
Linseed	„		24 12 6
Palm, Lagos	„		25 10 0
Rapeseed: English	„		32 5 0
Seal: Pale	„		27 0 0
„ Brown	„		22 0 0
Sperm	„		45 0 0
Whale	„		24 0 0
Turpentine	per cwt.		1 9 3
Coal	per gal.		
Petroleum (Refined)	„		0 0 5½
„ Spirit	„		0 0 7

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HOME INDUSTRIES.

LONDON, 5th June, 1890.

The Money Market.—Money is rather dearer this week, although no great difference is noticeable in rates. The impression is gaining ground, however, that money must soon become distinctly dearer if the drain of gold to the Continent now going on is not checked. Of a stoppage of the efflux there is no present indication, and discount rates are hardening gradually and steadily in consequence. Dealings on the Stock Exchange are also being affected by the fears of dearer money, and the markets are rather lifeless. In spite of good holiday traffic returns home railway stocks do not show much vitality. American railroad shares depend so much on the silver question just now that in face of a declining market for the metal, and in the absence of active progress with the Silver Bill, this department is also rather quiet. Foreign stocks are fairly well supported, Egyptian and Turkish bonds being in high favour because of the conversion schemes now on the *tapis* in connection with them. Argentine securities fluctuate with the spasmodic jumps up and down of the premium on gold at Buenos Ayres, but they are inclined to improve. Copper shares have been active and firm in sympathy with the tone of the copper market. Gold mining shares have received little attention. Industrial and miscellaneous securities have been rather idle.

Companies.—The following companies have been registered since our last report:—African Exploration Gold Mining and Estate Co., Ld., with a capital of £300,000; H. D. Cooper & Co., Ld., with a capital of £20,000, to carry on the business of glass-lined piping manufacturers; Wolverhampton and Dudley Breweries, Ld., with a capital of £150,000; Anglo-American E.C. Powder Co., Ld., with a capital of £50,000; Lever Brothers, Ld., with a capital of £300,000, to acquire the business of seed crushers, soapmakers, &c.; Smith, Hollinrake, & Co., Ld., with a capital of £6,000; Siston Hill Colliery Co., Ld., with a capital of £100,000; Earl Mill Co., Ld., with a capital of £80,000, to carry on the business as spinners, &c.; The Pine Mill Co., Ld., with a capital of £100,000, to carry on the business of spinners, &c.; Electric and General Investment Co., Ld., with a capital of £200,000; Sjalati Gold Mines, Ld., with a capital of £150,000, to acquire mines, &c., in the Transvaal; China-Clay Union, Ld, with a capital of £800,000; Manchester Glass Bottle Co., Ld., with a capital of £10,000; Caerphilly Brewery Co., Ld., with a capital of £50,000; The Bohmer (Central Andes) Mining and Explorations Co., Ld., with a capital of £200,000.

Railway Companies.—The gross receipts of the twenty-three principal railways in the United Kingdom for the week ending the 25th ult. amounted, on 16,159¼ miles, to £1,470,416, and for the corresponding period of 1889, on 16,031 miles, to £1,274,240, an increase of 128¼ miles, or 0·8 per cent., and an increase of £196,176, or 15·3 per cent., the receipts this year including the first portion of the Whitsuntide traffic.

The Lane Fox Patents.—The Lane Fox Electrical Company have issued a circular, which we have been asked to publish and which we insert on another page. The company set forth some of their claims to work patents, which have been dormant for so many years. They state that Messrs. Crompton & Co. and the Swan United Company have obtained exemption from proceedings for infringement prior to December, 1882. The company repudiates the idea that their only mission is to collect royalties, and declare that they desire to carry on a general electrical and lamp-making business. They give no indication as to the amount of the royalty, but say that it will be small "if the company is fairly met." Attention is called to the fact which we had in mind when we noticed this matter three weeks ago—viz., that from 1878 till 1883 Mr. Lane Fox worked out and applied the system of parallel distribution, in the face of ridicule which had hardly ceased in 1881. The circular refers to many abortive attempts to regain possession of the patents, and to the agreement which was made at the close of the litigation between the Brush Company and the Edison Swan Company, each of these parties obtaining licence to use the patents. Mr. Lane Fox is said to have declined "many times" to join a "ring' proposed by "competent financiers" to control his inventions, and is declared to wish "to liberate, and not to strangle, the electric lighting industry."

Steam Boiler Fluid.—We have received from Messrs. Sydney Minns & Co., Trafalgar Road, Dalston, London, N.E., a small pamphlet referring to their special boiler fluid, and containing analyses of typical waters and ordinary forms of boiler scale. Messrs. Minns claim to treat the question of boiler incrustation on a scientific basis. In the pamphlet before us, they state: "We commence by obtaining a sample of water, analyse it, and prescribe accordingly."

Society of Engineers.—At a meeting of the Society of Engineers, held at the Town Hall, Westminster, on the 2nd inst., a paper was read by Mr. Perry F. Nursey on "Pick's System of Manufacturing Salt *in vacuo*." Dr. Pick's vacuum process is based on the Rillieux, or triple effect, system. The apparatus is made in three duplicate sections, each consisting of four main parts, namely, the boiling chamber, the heating chamber, the collecting chamber, and the filtering chamber. The steam used enters the heating chamber of the first section, and there heats the brine, and the steam given off from that brine enters the steam chamber of the second section, and heats the brine there. The same process is repeated in the third section. The steam generated in the latter section from the brine is drawn off by means of a vacuum pump condenser. The advantages were stated to be a saving in fuel, in labour, and in area occupied, and the avoidance of the production of deleterious gases.

Agricultural Show.—The meeting of the Bath and West and Southern Counties Society for the Encouragement of Agriculture, Arts, Manufactures, and Commerce commenced to-day at Rochester, and will close on Tuesday. The feet run of machinery in motion is 840, as compared with 616 at Exeter last year; and of agricultural implements 3,510ft., as compared with 3,465ft The special features include a working dairy and butter making competitions.

MANCHESTER, 5th June, 1890.

Discovery of Salt Beds.—Two important discoveries of salt deposits have been made. The borings which have been going on at Barrow-in-Furness on Walney Island have resulted in the discovery of an extensive bed of salt. Sinking operations, which have been carried on near Winsford, in Cheshire, have also resulted in the discovery of brine at a depth of 74 yards. The brine is equal to that generally found in the Cheshire district.

The Iron Trade.—Owing to the prolonged holidays, there has been practically no business done during the past week. The market continues to be a very slow one, and buying is on a small scale. Pig iron is only bought for immediate wants, and there is little testing of prices. The continued downward tendency in the large markets is causing buyers to be very cautious in their purchases.

The Cotton Trade.—The quarterly balance sheets of some large spinning companies have just been issued, and are very favourable. Among them are the following:—

	Capital. Share.	Loan.	Profit.	Dividend per Cent.
Crawford ...	£55,960 ...	£90,980 ...	£3,300 ..	
Arkwright ...	37,418 ...	56,726 ...	2,155 ...	10
Gladstone ...	48,542 ...	28,564 ...	856 ...	10
Duchess	35,000 ...	48,153 ...	1,248 ...	10
Star	49,000 ...	65,359 ..	2,025 ...	

All spinners of medium counts are at present doing very well, despite the increased price of cotton. Particulars of the proposed rules under the Indian Merchandise Marks Act are to hand. Those relating to cotton goods provide for the examination and testing by the Customs authorities. In testing yarns nine hanks of varying weight are to be tested, and the average taken. A test of bundles up to 1 per cent. of the whole consignment must be made, if the importer desires it, free of cost to him, but he may, if he chooses, have 10 per cent. tested by paying the cost of such examination. The latter is the extreme limit, and if the tests are not satisfactory the consignment may be refused. Piece goods are to be examined only if the Customs authorities are informed that they are inaccurately stamped. The informant is to deposit a sum as security, which can be forfeited if the information is wilfully false. The only important feature in the section relating to false descriptions of yarns is in the fourth paragraph. It is provided that if the average length of a bundle is less than 815 yards, the description shall be held to be false. This is likely to be modified in accordance with the recommendations of the Manchester and Glasgow Chambers of Commerce, who desire to fix the allowance at 2½ per cent.

The Linen and Jute Trades.—The business done last week surprised most people. As a rule, in the North, Whitsuntide from a commercial point of view is a total blank, and it is customary for the warehouses to close. During a large portion of the week this practice has been observed on the present occasion, but notwithstanding this there has been a larger trade than has been known since the time of the American war, when linen, owing to the scarcity of cotton, which could not be obtained on account of the blockade of the Southern ports, occupied, temporarily, the premier rank amongst the textile fibres spun and woven in the United Kingdom.

General Meeting of Surveyors at Burnley.—On Saturday last the members of the Association of Municipal and Sanitary Engineers and Surveyors (Lancashire and Cheshire District) held their annual meeting in Burnley. Arrangements had been made for the visitors to inspect various works in connection with the borough. Mr. F. S. Button read a paper describing the works to be visited by the members.

GLASGOW, 5th June, 1890.

Pig Iron.—There is nothing new to report in connection with the Scotch pig iron trade. The market is now in the dull season which always follows the spring shipments, and from this time till the end of July there is usually very little doing in makers' iron. This year there is, perhaps, even less doing than usual, and this arises partly from the fact that America is taking very little, and partly from the fact that makers have very little to sell. Shipments to the Continent and to the world at large are going on at a fair rate, and iron is still being taken out of store daily in quantities that were never dreamed of a year ago. Nevertheless prices droop day by day, quite regardless of the question of cost or reduction of stock.

Coal.—The dulness in the engineering trade is manifesting itself in the falling off of demand for coal for use in public works. The price is, however, in the meantime being fairly well maintained in consequence of restriction of output. Still, in dross there has been a decided break, prices having fallen from 1s. to 1s. 6d. per ton.

Local Engineering Operations.—The excavations in connection with the Clyde subway have been begun at Finnieston.—The operation of moving the new bridge carrying the Glasgow and South-Western Railway over the Caledonian line at Eglinton Street is likely to take place next Sunday. The bridge has been erected on a scaffolding immediately to the south of the existing bridge, and the girders will be moved laterally into position between Saturday night and Monday morning. The work is being carried out by Sir William Arrol & Co.

Caledonian Railway.—A new Arran express has been organised by the Caledonian Railway. A new train has been built to run in connection with the new paddle steamer the "Duchess of Hamilton.' The carriages are painted white and chocolate to distinguish them from the ordinary local trains. The train made its first journey on Friday last. It leaves the Central Station at 10.10 a.m. and 4.45 p.m., and is timed to reach Ardrossan in 55 minutes. No stoppage is made on the way.

The Forth Bridge Route.—The new route from Edinburgh, Glasgow, and the South to the North of Scotland, by the Tay and Forth Bridges, to effect which the North British and associated railways have embarked a capital of some four or five millions, was opened on Monday, the 2nd inst. On that day the regular through service of trains to and from the North, *vid* the bridges, was inaugurated. The morning express from Aberdeen at 6.20 is timed to reach Edinburgh at 9.42 a.m. and King's Cross at 6.30 o'clock in the evening—a total time of twelve hours ten minutes; while the ten o'clock express northwards from London performs the journey in twelve hours and twenty minutes. The most rapid train over the new route is that leaving Edinburgh at 5.30 a.m. and arriving in Dundee without stoppage at 6.55. On Monday the traffic was so great that the whole system was thrown into confusion by the consequent delay. The South trains were detained for the connecting trains for the North, each of which was upwards of an hour behind time in reaching Edinburgh. A considerable gale was blowing in both Firths on Monday, but no damage of any kind was done.

(From our own Correspondents.)

LIVERPOOL, 4th June, 1890.

The Leeds and Liverpool Canal.—Owing to the extension of the Liverpool dock system at the north end, the terminus of the Leeds and Liverpool Canal is now some distance from the leading docks and timber yards, and although the various railway companies have followed the trade by constructing new branch lines and depôts, the canal company has hitherto taken no steps to enable them to compete for the traffic. The directors have now, therefore, decided to extend the canal and warehousing accommodation, so as to put the undertaking on equal terms with the railway companies. The proposed extensions are on a large scale, and will involve a large expenditure both for the purchase of land and for construction.

The Belfast and Liverpool Trade.—The trade between these two ports has for many years been steadily increasing, and the business done by the Belfast Steamship Company has attained such large proportions that it has been found necessary to increase the number of steamers for carrying cattle and goods. Messrs. MacIlwaine & M'Coll, of Belfast, have, therefore, been instructed to construct two new screw steamers of 750 tons burthen each, to be fitted with all the modern improvements, at a cost of about £15,000 each.

LEEDS, 4th June, 1890.

The Iron and Steel Trades.—The position of affairs in the iron and steel trades is no more satisfactory than it was a fortnight ago. It was thought that after the Whitsuntide holidays consumers would place orders in the hands of manufacturers, but the anticipation has not been realised to the full. Nearly on all hands complaints are heard of the inactivity of the finished iron and steel trades. Prices are weaker. Engineers and locomotive builders continue fairly busy. The inquiry for agricultural machinery is much less than in the corresponding period of last year. Orders are coming in slowly, and inquiries are few The steel and iron cut nail trade remains quiet. A strike of a large character is threatened in the engineering trade. The demand put forward for a general advance of 2s. a week has met with little consideration on the part of the masters, and consequently between 3,000 and 5,000 men have handed in their notices, the majority of which terminate this week. One or two smaller firms have shown a readiness to come to terms with their men, but none of the larger houses have, it is said, in any way responded to the circulars issued by the local executive of the Amalgamated Society of Engineers. The wages of engineers at Doncaster have recently been increased, and this circumstance seems to encourage the Leeds Committee that they will succeed in what they are attempting to obtain. Whatever may be the result of the movement, it must be recognised that the Leeds engineering industry has of late declined somewhat, and that the

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present prices for materials and cost of working do not admit of large remunerative returns. Yet, on the other hand, it is urged that the rate of wages paid in Leeds is less than on Tyneside and in Manchester. It is to be hoped that the dispute may be settled without resorting to a general strike.

THE COAL TRADE.—Trade in all qualities of fuel for domestic use is weaker, with falling prices. Gas coal is also in less demand, but steam and shipping sorts remain active. Engine coal and slack dull, and prices lower. Coke continues in a very depressed state. Pits are running on an average four days per week.

SHEFFIELD, 4TH JUNE, 1890.

IRON AND STEEL TRADES.—The unusually fine weather had the effect of prolonging the holidays a full week. On Thursday Messrs. Hadfields, Ld., were compelled to extinguish their fires on account of so few workmen having turned up. A good order for tires has just been placed here, and orders for the axles will shortly be placed here also. The Parkgate Iron and Steel Company have issued a notice to advance the wages of their workmen 2½ per cent. commencing the 1st June; the firm will also pay 3d per ton extra for puddling. Engineers continue well off for work. Messrs. Davy Brothers, Ld., have just shipped a powerful hydraulic forging press to the North of France, and they have also others in hand for local firms. Messrs. Wm. Jessop & Sons are progressing well with their new forge; the hammer for it is to be supplied by Messrs. Thwaites Brothers, of Bradford. The engineers of Doncaster have been granted an increase of wages.

MEANS OF TRANSPORT.—The Sheffield Canal scheme is being pushed forward vigorously, the bright prospect of the Manchester Ship Canal acting as a stimulant. The Manchester, Sheffield, and Lincolnshire Railway Company have failed to come to terms with the Sheffield Canal promoters, and will have to submit to arbitration. It is quite evident that something must be done to reduce the cost of transport if Sheffield intends to compete in the world's market. Every month brings an additional amount of work to the heavy trades, which, as yet, are not subject to much outside competition. All the raw materials for this trade have to be imported a considerable distance.

NORTH STAFFORDSHIRE, 4TH JUNE, 1890.

THE IRON TRADE.—Operations at the iron works in this district have now been resumed after the holidays, though manufacturers find some difficulty in obtaining sufficient orders and specifications to keep the mills and forges fully employed. The collapse in the trade is a complete one, and with the high cost of production prices are unremunerative. In accordance with the award under the sliding scale, an advance of 2½ per cent. in ironworkers' wages came into operation as from the 1st inst., and continues for two months.

THE COAL TRADE.—There is a downward tendency in the prices of fuel of all descriptions. Coal for manufacturing purposes is realising about 10s. per ton, and slack 5s. per ton. A good deal of anxiety is felt as to the course the miners will take with regard to the wages question. It seems almost incredible that a further advance in wages can be conceded in face of the fall in prices.

THE POTTERY TRADE.—Orders are rather more plentiful, but prices are unremunerative. There is a movement amongst the operatives to secure an advance in wages at the next "hiring" season.

CARDIFF, 4TH JUNE, 1890.

IRON AND STEEL.—The demand for pig iron is no worse. This can be looked upon as somewhat satisfactory, considering the steady decline in prices for the past five months. Ironmasters, however, have great difficulty in making both ends meet, and it is expected that other ironmasters will follow the lead of those who have damped down their furnaces. The steel rail market is fairly good, but in steel bars matters seem to be going from bad to worse. The heavy reductions agreed upon by the sellers have very little effect in bringing forward new orders. Quotations are £5 10s per ton, but business has been done as low as £5. For iron ore there is no demand, all the arrivals being under contract. Sellers maintain their quotations at about 14s. 6d. c.i.f. Cardiff or Newport, but it would be difficult to find buyers at any price.

COAL AND COKE.—The position of the steam coal trade continues extremely satisfactory, and colliery owners have reason to congratulate themselves that the wave of depression which seems to be sweeping over all other departments of industry has not, so far, affected theirs. Another large colliery—namely, Penrykyber—has been offered to the public, the capital being fixed at £35,000. The principal proprietors in the late company were Messrs. Cory Brothers, of Cardiff and Swansea, and the coal is said to be of the best. There is an eager demand for shares. Prices of steam coal range from 14s. 9d. to 15s. 3d. first quality, 13s. 6d. to 14s. 3d. second quality, and 12s. 9d. to 13s. third quality. House coal is a little weaker in tone—the natural result of the approach of summer. The exports of coal from Cardiff during the past week have amounted to considerably over 200,000 tons, notwithstanding the stoppages caused by the Whitsuntide holidays. For coke the demand is very poor, as the consumers are afraid to renew their contracts on account of the unsatisfactory position of the iron trade.

SHIPPING.—The freight market is in a state of collapse, and things are fast driving to the same position as that experienced in the years 1884 to 1886, when so many boats had to be laid up in the Tyne, Clyde, and the Tees for want of remunerative employment. Coal freights outwards to Gibraltar from Cardiff are 7s. 6d.; Marseilles, 10f.; Barcelona, 13s.; Genoa, 9s.; and Venice, 9s. 9d. Home freights from Bilbao rule at 5s. 3d. to Cardiff or Newport, and 6s. 3d. for Middlesbrough.

TINPLATES.—It is reported that the works under the proprietorship of Messrs. Wm. Williams & Co., at Upper Forest and Llansamlet, near Swansea, together with the adjoining steel works, are to be converted into a limited company. The profits, it is understood, have been exceptionally large, and there is no doubt that the excellent situation of the works, combined with the reputation which the firm has built up for itself, will induce capitalists to come forward.

BARROW-IN-FURNESS, 4TH JUNE, 1890.

HEMATITE IRON.—There is again a falling off to note in the hematite pig iron trade. The demand is much quieter, and the works are not likely to be able to maintain their present rate of output. During the week a furnace has been blown out by the Moss Bay Company, and another by the Harrington Company, leaving 45 furnaces in blast in the district, and 34 out of blast. In all probability during June three other furnaces will be blown out. Prices are easier, at 52s. 6d. per ton net for warrants, and 55s. to 58s. for makers' iron. In Bessemer mixed Nos., warrants are selling at 5s. per ton under the cost of production.

STOCKS.—A further reduction in stocks of hematite warrants is reported this week; 2,801 tons have been cleared, making a total clearance since the beginning of the year of 72,231 tons. Stocks still aggregate 308,411 tons.

STEEL.—There is a quiet inquiry in the steel trade. Rails are not in full request, and prices have gone down 5s. per ton on the week, heavy sections being quoted at £4 15s. per ton. There is a better feeling in the Siemens-Martin department, as renewed inquiries are to hand for plates and angles for shipbuilding purposes. Tinplate bars are also in better demand, but the trade, generally speaking, is lifeless. Blooms, bars, and billets are in slow demand, but hoops and wire, however, are in better inquiry. Mr. Albert Tilley, engineer for the Barrow Steel Company for many years past, has been engaged by the Martinez Rivas Palmer Company to design, lay down, and manage a new steel works at Bilbao, in Spain, for the manufacture of Siemens-Martin steel shipbuilding material for the shipyard at that place. The new works will be arranged for an annual output of 50,000 tons of finished steel.

MIDDLESBROUGH, 4TH JUNE, 1890.

PIG IRON.—The market continues dull with falling prices. Sellers want 40s. 6d. per ton for No. 3 G.M.B., and business was done at that; but as warrants could be got at less than that, the buyers would not eventually give more than 40s., and in some instances 40s. 3d. per ton. Cleveland warrants are quoted at 39s. 11d. to 40s. per ton cash, West Coast hematites at 51s. 11d. to 52s. cash, and East Coast hematites at 60s. per ton nominally, mixed numbers makers' iron, all f.o.b. The stock in Connal's stores amounted on Monday to 102,952 tons, being 3,080 tons less than on the 31st of May.

WROUGHT IRON AND STEEL.—These products are still very dull, and manufacturers cannot keep their works going full time. The holidays were largely taken advantage of, and some works are not yet reopened. Prices are drooping still more, and manufacturers are open to even less than the quoted price for a large order. Iron ship plates are at £5 7s. 6d.; angles, £5 5s.; common bars, £5 15s. per ton; steel ship plates, £6 10s.; angles, £6 5s.; steel rails (heavy section), £4 17s. 6d. per ton f.o.t. at works, all less 2½ per cent. discount. The strike at Consett has ended, the two unions having compromised matters.

IRONMASTERS' RETURNS.—Everybody expected an increase in stocks; on the contrary, there is a decrease of 12,342 tons, caused mainly by makers breaking their reserve and selling at the reduced price. The shipments were no heavier than usual, so there must have been an increased inland and local consumption.

SUNDERLAND, 4TH JUNE, 1890.

SHIPBUILDING AND ENGINEERING.—Shipbuilding and engineering establishments are increasingly feeling the result of the falling off in orders, and reductions are being made in the number of men employed. There is little likelihood that the tonnage output of the current year of the River Wear will equal that of last year, although up to the present the tonnage launched compares favourably. During the month of May eight vessels of 14,730 tons were launched, making an aggregate for the past five months of thirty-seven vessels and 81,460 tons. It is just possible that for the first half of 1890 the output will be equal to that of the corresponding period of 1889, when forty-eight vessels of 97,999 tons were launched, which was the highest record ever attained for the port. There appears to be an increasing disposition to adopt gas in place of steam as the motive power for driving shipyard machinery. Three shipbuilding establishments have now "Otto" gas engines for this purpose, the latest to have one fitted being the Sunderland Shipbuilding Company, Limited. The other firms which have adopted gas in this manner are Messrs. William Pickersgill & Sons, Southwick, and Messrs. Short Bros., Pallion.

SHIPPING.—The freight market has gone from bad to worse, and there appears to be every likelihood of a wholesale laying up of tonnage. Prompt business from the Black Sea and even in other trades must mean heavy losses on present voyages, and investors are naturally calling out for a reduction in working expenses. Bunker coals have fallen, but wages remain at the high figures to which they have been forced. In some instances the cost of insurance is unduly high, owing to vessels being covered so as to replace tonnage at the prices ruling at the close of last year. Last week there were eleven cargoes imported, consisting principally of timber, two being iron ore. Owing to the holidays the shipments of coal fell to 54,652 tons, besides which 365 tons of coke, 250 tons of patent fuel, 24 tons of nitrate of soda, and 50 tons of crystals were also shipped.

THE PETROLEUM OIL TRADE.—It is authoritatively stated that the American Standard Oil Company has purchased a site to the south of the principal wet docks, for the purpose of erecting extensive petroleum storage tanks, into which the oil will be pumped direct from oil-in-bulk steamers. The intention of the company is to make Sunderland a central distribution district. This will be a welcome addition to the not very extensive import trade of the port.

NEWCASTLE, 4TH JUNE, 1890.

THE STEEL TRADE.—A strike of steel smelters, &c., which for the past couple of weeks has caused an almost total stoppage at the Consett Steel Works, was settled on Saturday, and, though the furnaces could not be got ready for a full resumption of work on Monday morning, active preparations were in progress for the restarting of the different departments, and it was expected that before the end of the week the place would again be in full swing. The strike, it may be recollected, was the outcome of an effort by the operatives to force two or three unwilling individuals to join the Steel Smelters' Association, and thus through the merest triviality, thousands of pounds have been lost, not to speak of the serious hindrance to business caused by this arbitrary, and quite unnecessary, action of the men.

THE ENGINEERING TRADE.—Considerable dissatisfaction has been caused throughout the district by the failure of the operatives to turn in to work on Whit Tuesday in accordance with the agreement entered into with the employers by the workmen's representatives in February last, and which specified the number of holidays to be taken during the year—one only to be allowed at Whitsuntide. Though the employers were evidently disappointed by the breach of agreement, they have, up to the present, taken no steps to secure themselves against a repetition of such conduct, and it is probable that, before another holiday period has to be observed, a Conciliation Board will be in existence, by which all matters of difference can be amicably settled. In the marine engineering establishments few signs of coming slackness are yet to be noticed, but it is none the less true that very few new orders are being booked, and that unless some unlooked-for change takes place in the ordinary conditions of trade the advent of a slack time cannot be long delayed. Messrs. Noble & Lund, machine tool makers, Forth Banks, are steadily developing their business, and have now some good orders in hand from local shipbuilding and engineering firms.

GLASS WORKS, &C.—It is understood that a large number of the operatives at the Tyne Plate Glass Works have received notice of dismissal, owing to some contemplated changes in the working arrangements of the establishment. The Gateshead Stained Glass Works are very busy just now, a great many orders for memorial windows, &c., having recently been received. The glass bottle works at Blaydon are kept actively going, the weekly output being now larger than at any former time. Pressed glass works are generally busier than they were a few months ago, and potteries are also showing signs of improved business.

THE COAL TRADE.—The shipments of coal and coke at Tyne Dock for the week ending May 31st amounted to 82,990 tons, being a decrease as compared with the shipments for the corresponding week last year of 18,514 tons.

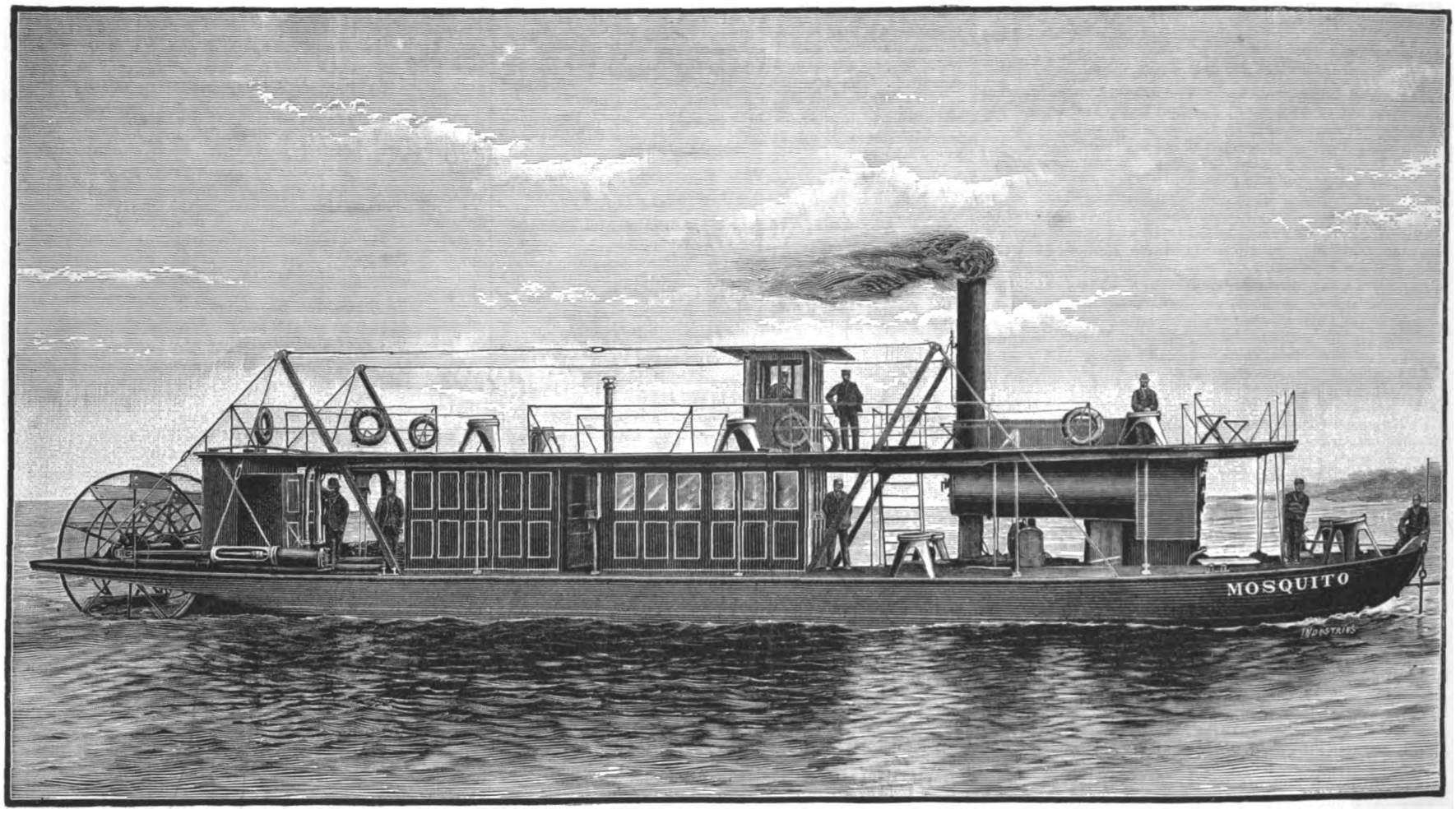
DUNDEE, 4TH JUNE, 1890.

JUTE AND FLAX TRADES.—The jute trade continues in a satisfactory condition. The market is very firm in tone, and there is a steady demand for yarns and cloth. Manufacturers are well employed, and the present briskness shows signs of continuing for some time. Advices both from Calcutta and New York are good, the improvement in the latter market being well maintained, and burlaps, 40in. 10½oz., being quoted at 5½c. per yard. A fair business has been done here in raw jute during the last fortnight. Prices have latterly been tending rather in buyers' favour. There is an active demand for jute yarns, and some good orders on foreign account were received last week. Few operations of importance in flax are reported, the advance in the rate of exchange having impeded business. Flax and tow yarns are dull of sale, and buying is chiefly of a from-hand-to-mouth character. The tendency of prices is still downwards. There is an absence of animation in the home demand for linens, but there is some inquiry from the United States in anticipation of the proposed changes in the tariff being effected.

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HER MAJESTY'S GUNBOAT "MOSQUITO."

BUILT BY MESSRS. YARROW & CO., POPLAR, LONDON.



THE JAPANESE CRUISER "CHIYODA."

THIS vessel, which was launched on Tuesday last from the yard of Messrs. James & George Thomson, Limited, of Clydebank, has many features of considerable interest as compared with vessels of a similar type at present building for our own Government. The "Chiyoda" is the outcome of a design which was submitted to Messrs. Thomson by the Japanese naval architects, who appear to have been much influenced by the example of French designers; but the original design has been greatly modified, at the advice of the builders.

The Colonial cruisers "Tauranga" and "Ringarooma," which are fitting out at the same yard, are vessels of a similar type, and of about the same displacement. They have been built from the designs of our own Admiralty officials, and we give a comparison of a few of the leading dimensions:—

	"Tauranga" Class. Ft.	In.		"Chiyoda." Ft.	In.
Length	265	0	...	310	0
Breadth	41	0	...	42	0
Depth amidships	21	3	...	23	8
Mean draught	15	6	...	14	0

It will be noticed that the Japanese vessel is 45ft. longer than the "Tauranga" class, although having only 1ft. more breadth; in this respect her designers followed the French practice, so that the vessel can be driven at full speed with considerably less horse-power than the British ships. At the same time they have sacrificed "handiness," or the power of turning quickly, which will, however, be in part preserved by the large balanced rudder with which the "Chiyoda" is fitted, on a principle patented by the builders. The "Chiyoda" will be propelled by two sets of vertical inverted triple-expansion engines driving twin-screws. The boilers are six in number, of the locomotive type, and are contained in two boiler rooms.

The armament consists of ten of the well-known 4·7in. quick-firing Armstrong guns recently introduced into our own navy. As originally designed the armament was to have been supplied by a French firm, but the more modern quick-firing guns have been substituted. They will be mounted, four on each side, on sponsons, one on the forecastle and one on the poop, with a large arc of fire. The supply of ammunition will be 200 rounds for each of the ten guns, and special appliances are being fitted to enable the ammunition to be rapidly supplied to the guns. There are also three torpedo tubes, one at the bow and one on each broadside, and the ship will carry seven torpedoes, the torpedo armament being supplied by Messrs. Schwarzkopf, of Berlin. The protection to the machinery and magazines is afforded partly by the usual means of a protective deck, and partly by a belt of armour plating, which is bolted to the skin of the ship in the neighbourhood of the water-line, a feature which is somewhat novel in a vessel of this class. The protective deck has an average thickness of one inch, and extends throughout the whole length of the ship. It is formed of two thicknesses of plating, the lower one being of mild steel and the upper of chrome steel, a material which has greater powers of resistance to the impact of a shot than ordinary mild steel. The armour belt extends for about two-thirds of the total length of the ship, and gives a thickness of side amidships of 4½in. steel, thus effectively protecting the region of the water-line from the destructive effects of the smaller class of quick-firing gun, and especially from projectiles charged with melenite or other high explosive, even when fired from guns of larger calibre. Besides the main armament, an auxilliary armament of fourteen 47-millimetre quick-firing Hotchkiss guns will be carried, as well as three Gatling guns, mounted one in each of the military tops.

The accommodation for the officers and crew, numbering 300, is especially roomy and well ventilated. The crew will be berthed on the main deck, which extends for the whole length of the vessel, and which is well lighted by sidelights on either side. The officers' cabins are situated partly on the main deck aft and partly on the upper deck below the poop, where there is also a roomy wardrobe and commander's cabin. Between the poop and forecastle there is a bulwark or hammock berthing, 7ft. high, which will afford some protection to the men working the guns, as well as from the weather when at sea. The equipment of boats will be very complete, and will include a steam life-cutter with mountings for a quick-firing gun, and also for discharging torpedoes. One of Messrs. Yarrow's petroleum launches will also be carried. The "Chiyoda" will, like all modern warships, be lighted throughout by electricity, and will be fitted with all the improvements which the experience of the Japanese officials and of the builders has been able to suggest. She may, therefore, be expected to prove a most valuable addition to the Japanese navy.

The "Chiyoda" is lighted throughout by electricity by Messrs. Mavor & Coulson, Glasgow. The plant is in duplicate. Willans' compound engines are mounted on the same bed-plates with and coupled direct to Siemens' dynamos. The whole work is being carried out to the same system as that adopted by the British Admiralty. The installation consist of about 300 lamps, including thirty 50 c.-p. lamps in special fittings for lighting the coal bunkers. Three projectors will be fitted on board.

H.M. GUNBOAT "MOSQUITO."

IN our impression of the 16th ult. we referred at some length to two gunboats recently built by Messrs. Yarrow & Co., of Poplar, named the "Mosquito" and the "Herald." As we explained at the time, these boats were constructed and made ready for service in an unusually short period of time. The illustration we give above represents the "Mosquito," which, like her sister boat the "Herald," is 77ft. in length by 18ft. beam, and has a draught of 18in. when under steam. It will be remembered that Messrs. Yarrow guaranteed that the vessel should be capable of being put together and got under steam in less than twenty-four hours. As a matter of fact, some experimental trials have proved that she can be put together in so remarkably short a time as six hours and forty-five minutes.

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

Contents.

	PAGE
The American Society of Engineers (Corres.)	529
Technical Education at Finsbury College (*Illus.*)	530
Foreign Industries (Corres.)	534-535
Electric Lighting at the Edinburgh Exhibition—I. (*Illus.*)	536
Shipbuilding Notes	537
Notices of Meetings	537
Prices Current	537
Home Industries (Corres.)	538-539
The Japanese Cruiser "Chiyoda"	540
H.M. Gunboat "Mosquito" (*Illus.*)	540
The Communication between France and England	541
Engineering in Italy	542
Our Treaties with Japan	542
The Rating of Machinery Bill	543
The Late Sir George Burns, Bart.	543
Letters to the Editor:—	
The Lane Fox Patents	543
A Letter Express	543
Piece Work	543
Can an Improved Education Prevent Strikes?	544
Compressed Air Cars	544
British Manufactures on the Continent	544
Insulation Resistances of Cables (Corres.)	544
Research Committee on Marine Engine Trials (*Illus.*)	544
The Board of Trade and Electric Lighting	546
A Swiss Condensed Milk Factory (*Illus.*)	547
The Smokeless Gunpowders	547
The Society of Chemical Industry	548
Notes	548
"Industries" Patent Record:—	
Applications and Acceptances	549-550
Illustrated Abridgments	550-552

To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," *at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.*

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Industries:

FRIDAY, 6TH JUNE, 1890.

THE COMMUNICATION BETWEEN FRANCE AND ENGLAND.

THREE distinct schemes may now be said to be claimants for the approval of the British public with a view to getting rid of the passage by water across the Channel. The first of these, and the one that has heretofore filled the largest amount of space in the popular mind, is the Watkin tunnel; but the Schneider and Hersent proposal to throw a bridge over the "silver streak" has many friends, and its sponsors are still working diligently with a view to having it taken up; while a third scheme has, within the last few days, been prominently brought forward, the *raison d'être* of which is the combination of bridge and tunnel, by throwing a pier or viaduct out into the Channel on both sides for some half a mile, and then lowering the train by a suitable lift into a tunnel or tube, which will complete the journey until the corresponding viaduct or pier is reached at the other side. This latter scheme is, however, hardly likely to recommend itself to the travelling public, inasmuch as there would be considerable trepidation, if not considerable risk, about the working of a lift in the middle of the sea. The bridge scheme retains the chief place in the affections of Frenchmen and of manufacturers, seeing that it would be open to sunlight and would involve the use of over a million tons of metal. The Yankees have done some big things in bridge building, but they would be the first to acknowledge that this bridge, if carried out, would undoubtedly "lick creation." The proposed undertaking is interesting, alike from an engineering, a political, and a financial point of view, and as such may be shortly examined at this time when the Channel tunnel scheme has been revived by Sir E. Watkin and his friends, and when interested parties are making attempts to secure concessions from the State, both in France and in England, with a view to the bridge being carried out.

The more obvious and important advantages claimed for the proposed bridge are: (1) That it would shorten the time of the journey between London and Paris; (2) that it would obviate changing places and breaking bulk, which is now inevitable in the traffic between England and the Continent; and (3) that it would promote the intercourse of England and the Continent for these and other reasons, of which the avoidance of the potent evil of sea sickness is not the least important. The countervailing arguments are (1) that the bridge would involve an outlay that would be far from commensurate with its real utility, and (2) that it would get rid of the insularity, and consequent security, which, as a "sea-girt isle," we now enjoy. It is also objected that the bridge would be a serious obstruction and danger to navigation, but this fear may turn out to be largely groundless. The whole of the piers supporting the bridge would only occupy a little over one-twelfth of the section of the Channel, and some of the spans proposed are to be from 1,500ft. to 1,600ft. wide, which would be sufficient to admit of the easy passage of a ship of the largest dimensions. It may be observed that although no engineer has declared that the undertaking is impossible, all are ready to maintain that not only would it be the most gigantic undertaking of its kind ever attempted, but it would be an enterprise into which many new conditions would be introduced. It is not alone the great length of the bridge—although a bridge upwards of twenty miles in length would, of course, be unique—but the physical conditions under which the work would have to be carried on would involve much strain, and perhaps difficulty. The greatest depth at which the work would have to be carried on would be about 160ft., midway across the Channel. In the sinking of the caissons, and the building of the foundations, it would be necessary to send workmen down to this depth. However, as the average depth would not be more than 75ft. to 100ft., the probability is that engineering resources would provide the needful means for dealing with the exceptional depth in mid-channel. There are, of course, many other engineering problems of great interest and importance concerned in the scheme, such as the floating of the caissons into position, the building up of the piers and the building out of the cantilevers, the housing and protection of the workmen employed, the wind pressures to be provided for, &c. Most of these points have been dealt with in an interesting paper which the chief promoters and engineers of the project submitted to the Paris meeting of the Iron and Steel Institute in September last, and which has since then been the subject of a good deal of controversy in engineering and military circles, both at home and abroad.

It has been asserted by the promoters of the tunnel that their project is much more feasible and likely to be regarded with favour than the bridge, because it is so much less expensive. There is no doubt that in mere first cost the tunnel would be less costly, assuming always that no unforeseen accidents happened in the course of the undertaking. This latter proviso is one that cannot be disregarded in any estimate of the merits of the two schemes, inasmuch as there is always the possibility that unexpected fissures might cause the works to be suspended. But even if the tunnel were to bes uccessfully completed at a total cost of eight to ten millions, which is the amount that has been calculated by experts—allowing for no contingencies, however—the cost of the work would not stop there. The military and naval authorities who have considered the question have expressed the belief that a tunnel would render necessary a permanent addition of some 8,000 men to the garrison at Dover. Now the British army costs, all round, over £100 per man, and if this average were applied to this estimated addition to the force required to protect our shores, it would mean an annual expenditure of £800,000, which, capitalised at only 3 per cent., would mean an addition of over twenty-six millions sterling to the real cost of the tunnel. Besides this, the tunnel would always be regarded with disfavour by the public, on the ground that it would be somewhat difficult to know what is going on inside. The workings might be flooded, or an invading army might be in possession of the structure, before any warning could be communicated; whereas it is always possible to see what is going on if a bridge is erected. Of course, the bridge, while it would require some modification of the existing military situation at Dover, and probably, also, an increase of the garrison there to some extent, would be more easily disabled, so to speak, than a tunnel. There are many simple expedients available for the demolition of a bridge, either partly or wholly, that would not be equally at command for a tunnel.

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The scheme for the construction of a bridge across the English Channel could hardly be possessed of more influential sponsors. The foundations have been the subject of a most careful and elaborate inquiry by M. Hersent, a distinguished French engineer. The plans for the superstructure have been made the subject of an equally masterly and comprehensive inquiry by Messrs. Schneider & Co., the proprietors of the great ironworks of Creusot. These gentlemen have had the efficient and cordial co-operation of Sir John Fowler and Sir Benjamin Baker, the engineers of the Forth Bridge. Finally, the French banking establishments have intimated their readiness to supply the requisite funds, provided that all the national and international guarantees are satisfactory. This being the position of affairs, the future development of this vast scheme would appear to be dependent on two considerations—the first, that of whether the consent of the maritime powers and interests of the world, including the special consent of England in respect of her paramount interest in the problem, can be obtained; the second, that of whether the bridge, if constructed, would be likely to prove the desideratum which its promoters expect and promise, and the financial success which the shareholders are entitled to look for. As regards the first of these questions, it will be at once apparent that the maritime questions involved, if they do not concern England and France alone, certainly do affect these countries to an infinitely larger extent than any other. Unitedly, these two countries possess nearly three-fourths of the effective ocean-carrying tonnage of the world. The remaining fourth is largely owned by Germany, Holland, and Italy, and to a limited extent by the United States. Scandinavia has also a considerable shipping tonnage, but a great deal of it never comes into the English Channel. The consent of England and France once obtained, it appears unlikely, having regard to the facts just stated, that any of the other maritime countries would have much effective opposition to offer.

The question of whether the bridge, if constructed, would turn out a remunerative undertaking for its proprietors is one that may now be considered. Most of the traffic, other than passenger, at present carried between England and France, is carried by coasters that usually accept low rates of freight. With these the railway could not for a moment compete as regards heavy traffic, or traffic that was not required to be delivered quickly. The cost of ocean transport is never less than four or five times, and is often twenty or thirty times, under that of transport by land. All *petite vitesse* traffic would, therefore, continue to use the sea instead of the railway; but there is a certain amount of *grande vitesse* traffic that would be likely to pass *viâ* the bridge, such as fruit and flowers from the Riviera and Southern France, and fish from Billingsgate for the supply of Paris, &c. This traffic could usually afford to pay a high rate of freight, and would, no doubt, be charged accordingly. There would, however, be only a limited traffic of this description, and the estimate of over nine millions of tons, which has recently been put forward, appears to be altogether unreasonable, unless, indeed, the railways undertook to carry almost as cheaply as the Channel coasters. On the other hand, there would be practically the whole of the passengers for Paris and the localities or countries that are usually reached through that capital, as well as, in all probability, a large part of the passenger traffic that now proceeds from our shores to other Continental ports. What this traffic would amount to in the aggregate it is not easy to say. The traffic to Paris may be taken at some half a million passengers a year, and probably all the other ports, taken together, would represent half a million more. These would, of course, contribute to the bridge in both directions, and if the special proportion of the charge for the journey assignable to the bridge were fixed at 15s. each way, the annual proceeds from passenger traffic would amount to about a million and a half, or, say, sufficient to pay a 5 per cent. dividend on a capital of thirty millions. But the estimate of the cost of the bridge put forward by its promoters is 34½ millions, and some engineers of distinction declare that it is likely to cost much more. Estimates are, as is well known, generally exceeded by results, being founded on the generally incorrect assumption that no serious casualties will occur, which could never apply to such an undertaking as this.

It would be difficult to frame even an estimate of the cost of maintenance of such a structure, but it must be considerable. As regards the income to be expected from merchandise traffic, considering that sea freights are so low, it is not likely to be very much. The main source of income must always be passenger traffic, and that traffic would require to be stimulated very much indeed before it yielded such a rate of dividend upon the enormous amount of the investment as would be satisfactory. Probably, however, the income would be an increasing one, and if the bridge did not cost much in excess of the estimated expenditure, the dividend would come to be a fairly good one.

ENGINEERING IN ITALY.

Mr. M. Yeats Brown, British Consul at Genoa, yearly sends home, perhaps, the most interesting report to engineers of any which come to the Foreign Office. His last is no exception to the rule, and we take from it some interesting information. It will be remembered that some time ago the Italian Government took steps to foster the engineering industries of the country, and foundries and metal works have consequently greatly increased in number in the Genoa district. The imports of metals, which might be expected to have largely advanced in consequence, are, however, very little different from previous years, though machinery has risen from £272,372 in 1887 to £488,640 in 1889. The import list is deceptive as regards raw materials, as a good deal comes overland. The machinery is chiefly plant for the foundries and engineering works, which will now compete with us. Some of the machinery consists of pieces of marine and other engines which these works have orders for, but which they are not yet in a position to make on their own premises. The greater part of the import was from this country. Some of the establishments have been getting steel castings and shafting from Germany, but many prefer to pay higher rates for English materials of reliable quality. Steel boiler plates of the best quality are obtained at the cheapest rate from Glasgow, but it is stated that the contracts for the heavy shell plates for boilers for the Government ships are to be given to the Terni Works, which were described in *Industries*, Vol. II., page 553, and those that require to be flanged or worked are to be ordered from Germany. Light boiler plates and ship plates are now made extensively by Messrs. Raggio and others, and thin steel plates are also made at Sestri and at Rivarolo, where an English manager is said to turn out good work for Messrs. Dufour & Co. Works for making Dick's delta metal have been erected at Cornigliano, and the owners have contracted to supply propellers for the "Liguria" and "Marco Polo" men-of-war. Galvanised iron roofing is now made at Sestri, and iron and steel wire in Turin. At Milan extensive plant has been put down for the manufacture of steel castings. Work is to be commenced shortly, and low rates are to be quoted to establish a connection. Anchors and chains have been largely imported; these come entirely from England. The imports of yellow metal are constantly declining. Tinplates have fallen off owing to large stocks in hand, but prospects of an increase are favourable. A company has been started to manufacture tinplates at Brescia. The iron works of the district have been in active work throughout the past year, and have considerable orders on hand. Messrs. Ansaldo & Co. turned out forty locomotives at Sampierdarena, besides several sets of small marine engines and the 20,000 h.p. main engines for the ironclad "Sicilia," which is being built at Venice. They have also in hand the engines for three large and four small Government vessels, three sets for the Navigazione Generale Company, and two for vessels on their stocks at Sestri. It is not mentioned whether they are of triple or quadruple expansion. They launched last year at Sestri two steel sailing ships (one of which, the "Catterina Accame," was the first steel ship built in Italy), besides several steel pinnaces for the Government, a floating crane of 120 tons for Genoa, and other important work. They have now a large number of vessels on the stocks. Messrs. Odero & Co., of Sestri, turned out three torpedo boats, four barges, and twenty-three sets of launch engines for the Government, and eight engines for mills, varying from 20 to 100 h.p. They are also well supplied with work for the current year. The great works at Savona, known as Tardy, Benecke, & Co., are now worked with German capital and are under German management. They are chiefly employed in making steel rails, but also manufacture heavy ship plates. In addition to these great works, Messrs. Cravero & Co., Balleydier & Co., Wilson & Maclaren, Dufour & Co., and others have all been busy. The Consul states that, as long as the high tariff and premiums on shipbuilding give them such ample protection, they will be enabled to compete against our cheaper prime materials and our greater experience. All other Italian industries have been eclipsed by the remarkable development of metal works and engineering establishments. At San Remo schemes are on foot for lighting the town electrically; one offer has been received from an English firm. The Pertusola lead and iron works are increasing their business rapidly, and they are extending their shipbuilding works under the direction of an English and Italian engineer. The submarine cable manufactory of Messrs. Pirelli & Co. was last year almost at a standstill after two years of great activity. A contract with the Italian Government is, however, being negotiated. Messrs. Buffico & Co.'s ironworks at Spezia have been active. The works of Messrs. Larini, Nathan, & Co. are steadily increasing their business in connection with the Italian Royal Navy and Royal Engineers. The Spezia branch of this Milanese engineering establishment is under the supervision of Mr. Nathan, the English partner, and they are prepared to carry out all orders for dock gates, pontoons, dredgers, boilers, bridge work, portable iron houses, and waterworks. The castings are made at the Milan works, where a small steel foundry has been started. It will be seen from this summary that a flourishing state of affairs exists in the Italian engineering trade, the only exception being the one firm which is dependent upon exceptional circumstances.

OUR TREATIES WITH JAPAN.

We have often referred to this subject, because we think it highly important that official neglect and red tapeism should not further be allowed to strain our relations with Japan.

The *Times* of Friday last published a very interesting letter from its Tokio correspondent, in which he says:—"An event of great importance has just occurred in Japan. On Monday, April 21st, the new Code of Civil Procedure and the first portion of the Civil Code were promulgated. They will be speedily followed by the remainder of the Civil Code and by the Commercial Code. These documents represent the outcome of fifteen years' labour by foreign and Japanese legal experts. They embody the best principles of Western jurisprudence, modified only so far as to suit Japanese conditions. Already the new Criminal Code, which went into force in 1881, has received the approval of eminent European jurists, and there can be no doubt that the Civil Codes just promulgated will also be found satisfactory. Now, therefore, Japan possesses a body of civil and criminal laws which will bear comparison with those of any country in the world. Moreover, just two months ago there was promulgated another ordinance scarcely less important, entitled the 'Law of the Constitution of the Courts of Justice.' This law, the carrying out of which involves a heavy expenditure, completely reorganises the Courts of justice throughout the Empire, and may be said to have secured the endorsement of Western Powers, for the prospect of its imminent enactment was one of the practical guarantees regarded with satisfaction by the foreign negotiators in the treaty revision conferences. With laws fully up to the standard of Western requirements, with Courts organised on an efficient basis, with police of proved competence, and with a prison system which has been favourably described by competent observers, it must be conceded that no substantial barrier stands any longer between Japan and the recovery of her judicial autonomy; or, in other words, between her present semi-isolation and the complete freedom of foreign intercourse which she desires to substitute for it."

After fully explaining the action which has been taken by the Japanese, this correspondent concludes as follows:—"The result, briefly stated, is that the Japanese Government and people are now fully sensible of the paramount necessity of concluding a treaty with England. They see that, whatever may be the goodwill of other Powers, the key of the situation lies ultimately in Great Britain's hand as surely as it lay there twenty years ago. In the negotiations now resumed Japan's whole energy will be directed to securing British acquiescence, and it is not too much to predict that if she succeeds England's influence and prestige in Japan will recover all their lost ground, and stand higher than they ever stood before. The question for Lord Salisbury to consider is whether guarantees, of

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which one never had any real value, and the other is already fulfilled, should be suffered to stand between England and Japan's friendship, and between the present commercial restrictions imposed on British subjects in Japan and the complete freedom offered by the new treaty. No sensible Englishman cares two straws whether the guarantee about foreign judges remains or disappears, while to Japan its absence means national rejoicing, its presence national umbrage and discontent. One can scarcely exaggerate the effect that will be produced if, in the sequel of all this agitation and perplexity, England comes forward and proves that, so far from ignoring or opposing Japan's claims, she, and she alone, is prepared and competent to secure their universal recognition. It does not often happen that so large a reward awaits such an easy exercise of statesmanship."

THE RATING OF MACHINERY BILL.

In writing of this Bill on a previous occasion (see *Industries* of the 13th November, 1889), we considered its general principles, and the arguments which were adduced in support of it, so that we need not again enter on these. The Bill has now been before Parliament for a considerable time, and in previous sessions it has failed to pass, owing chiefly to the pressure of other business. It was reintroduced early this session, and was read a second time on the 16th of April. Anyone who reads the speeches which were made on that occasion will be forced to the conclusion that the difficulty which has arisen in the matter is really a revival of the old one between the landed and manufacturing interests, a difficulty which has done much to influence British legislation in many ways, as is well known to every student of economic and social science. The problem now before the legislature is to decide fairly between these two interests, and at the same time remove the uncertainty which prevails regarding the actual state of the law, and the want of uniformity in different parts of the kingdom. The interpretation of the law, as at present existing, is open to various readings, or at least various meanings have been given to it, which have led to great anomalies in practice. In Scotland the engines, boilers, and main gearing alone are taxed, and the machinery and implements of trade exempted, and the Court of Session has decided that only such machinery as would go to the landlord at the termination of his lease could be rated.

The Committee stage of the Bill has been put down for the 18th inst., and we are sorry to learn that, notwithstanding the opinion strongly expressed by the House of Commons in its favour at the second reading, a determined attempt is being made by its opponents to defeat it. The chief opposition, as is to be expected, comes from the Rural Boards of Guardians, who look upon manufacturers as fair game. The Bill has not received very cordial support from the legal element in the House, for lawyers do not favour, as a rule, legislation which simplifies legal arrangements or removes doubts as to meaning. Sir Henry James is perhaps the only distinguished lawyer who has given the Bill a cordial support, although at the same time he has not hesitated to criticise and amend some of its provisions. We understand that chiefly through his influence an amendment is to be proposed which will embody the practice in Scotland and exempt all machinery which is used for manufacturing purposes, that is, machinery only fixed to the building with the object of steadying it, and which can be removed without affecting the building and does not require any special arrangements—in other words what may be called the tenant's machinery, as distinguished from the landlord's, will be exempt from rating. A little common sense is all that is required in carrying out such an enactment as this, and we trust that the compromise will be accepted by both sides. This is a question which affects both manufacturers and workmen, and we would strongly advise that all possible influence be brought to bear on members of the House of Commons before the 18th inst., so that the measure may be passed into law.

THE LATE SIR GEORGE BURNS, BART.

The death of Sir George Burns in his ninety-fifth year, which took place on Monday afternoon at Wemyss House, on the Clyde, recalls to our minds the early days of the steam shipping industry, of which he was one of the founders. The son of a well-known Glasgow minister, he was all his life closely associated with Glasgow, and although he retired from active business thirty years ago, he retained his interest in many of the public affairs of the city. Three years ago he assisted at the laying of the memorial stone of the New Barony Church, and gave some interesting reminiscences of the Old Barony, of which his father had been minister for sixty-eight years. Till almost the very end he enjoyed excellent bodily health and unimpared mental vigour. The former was shown by his ability to read and write without spectacles and by his activity, and the latter by the interest he took in scientific and other subjects.

He was born in 1795, and in 1822 he married the eldest daughter of Dr. Cleland, the well-known statistician, by whom he had seven children, only two of whom survive. In 1818, along with his brother James, he commenced business in Glasgow as a general merchant. Some years later he took an interest in some sailing ships, and in 1824 they engaged in steam navigation between Glasgow and Belfast, and shortly after they extended this to the Glasgow and Liverpool trade. In 1830 this was amalgamated with the business of the Messrs. MacIver, of Liverpool, and the trades thus organised included branches between Glasgow and Liverpool, Belfast, Londonderry, Larne, and the West Highlands, all of which are still managed by the Messrs. Burns, except the last, which was disposed of in 1852 to Mr. David Hutcheson. The local arrangements, however, were not sufficient to employ all the energy of Sir George, and he became in 1838 one of the founders of the Cunard Line, which has now attained great magnitude. The capital of the new company was £270,000, and the first contract was with Her Majesty's Government for the conveyance of mails once a fortnight between Liverpool and Halifax and Boston. Gradually the other shareholders were bought out, and the whole concern became exclusively vested in the three families of Cunard, Burns, and MacIver, until it was converted into a limited liability concern a few years ago. The Glasgow business, however, has always been conducted under the names of G. and J. Burns.

Letters to the Editor.

THE LANE FOX PATENTS.

To the Editor of "Industries."

Sir,—As some misapprehension appears to exist in the mind of the public as to these patents, we wish to point out that they are at present held by the Lane Fox Electrical Company, Limited, subject to licences granted to the Brush Electrical Engineering Company (as successors of the Anglo-American Brush Electric Light Corporation), the Edison Swan United Company, and certain other persons abroad.

In the case of one patent, No. 3988** of 1878, for distribution, Messrs. Crompton & Co. and the Swan United Company have obtained an exemption from proceedings for infringement of the patents prior to December, 1882.

The Lane Fox Electrical Company, Limited, has been formed not merely, as has been alleged, to collect royalties; but to carry on a general electrical and incandescent lamp manufacturing business. If the company is fairly met in the question of royalties, but a small charge will be imposed, and it is anticipated that when the question is more fully understood, the reasonableness of the company's charges will be appreciated by the industry.

It should be borne in mind that the Lane Fox patents are in no way invalidated by the long period during which they have been, or appear to have been, in suspense; nor, on the other hand, has that suspense been the fault of Mr. Lane Fox, or designed by him with a view of entrapping companies into their use.

At an early period the Lane Fox patents were disposed of by Mr. Lane Fox, to be worked with other patents, to the British Electric Light Company, Limited, and subsequently to the Anglo-American Brush Electric Light Corporation. Those who are conversant with the early history of electric lighting will know that until recently the principles of incandescent electric lighting were not generally understood, and though Mr. Lane Fox himself well knew the value of his patents, they were not properly appreciated by the companies who held them, and were mixed up and entangled with the claims of other patents held by the same companies for other and competing objects.

In illustration of the general contemporary ignorance of the principles now stated to be obvious, it may be mentioned that when first enunciated by Mr. Lane Fox they were received with ridicule and decried as impracticable, and that such staunch supporters of the system as Messrs. R. E. B. Crompton and W. H. Preece were at first opposed to them; even so great an authority as Sir William Thompson had, for a time, his doubts as to their theoretical soundness.

This opportunity may be taken to correct an impression which, to our great surprise, appears to prevail—namely, that Mr. Lane Fox confined himself, some twelve years ago, to shadowing forth the bare outlines of a scheme the essential details of which were laboriously worked out by others. This is not true. Not only were the principles of incandescent electric lighting distinctly enunciated by Mr. Lane Fox as stated above, but all details necessary to their efficient application were worked out, by him independently, or through his agency, during the years 1878 to 1883. Thus in his hands the system became a thoroughly working system; installations were put up at home and abroad, and when Mr. Lane Fox temporarily abandoned electric work at the end of 1883, his system, which was ridiculed as late as 1881, was accepted and largely used.

After many abortive attempts to regain possession of the patents, attempts giving rise to "agreement" after "agreement" (each, as it was subsequently found, adding to, rather than removing the confusion), an agreement was finally come to upon the conclusion of the recent litigation between the Anglo-American Brush Electric Light Corporation and the Edison Swan United Company, Limited. By this agreement, dated 3rd December, 1889, each of the two litigating companies obtained a licence to use the patents in the future, and an indemnity in respect of the past; but subject thereto, and to certain licences affecting the foreign patents, all the patents were assigned absolutely to Mr. Lane Fox.

In February of this year the Lane Fox Electric Company, Limited, was formed to carry out the long-postponed designs of Mr. Lane Fox, and to vindicate his position as the inventor of the true principles of incandescent electric lighting. The company, however, do not propose to charge vindictive royalties, or in any way to attempt to impede the progress already made, even by the unauthorised use of the Lane Fox patents.

Many times in the course of his prolonged negotiations with the Anglo-American Brush Electric Light Corporation Mr. Lane Fox was invited by competent financiers to join in the formation of a "ring" to control to their own exclusive advantage the electrical industry. Mr. Lane Fox declined. He wished to liberate and not to strangle the industry. Such still is his wish; and the wish of the Lane Fox Electrical Company is the same; but as true liberty consists in justice, and not in injustice, the company will vindicate the patents, and insist upon the payment of royalties in respect of them.

In pursuance of this purpose the company have formulated proposals, the terms of which will in due course be advertised; the pith of these proposals being that if those now using the patents will accept the proposed terms, or such modification of them as may be agreed upon by the middle of June next, no royalties will be claimed for the use of the patents prior to the 31st December, 1889.

It is confidently hoped that the companies, and the electrical industry generally, will see the fairness and reasonableness of the terms proposed, and will co-operate in giving Mr. Lane Fox the position he can fairly claim in the electrical world.

Yours, &c.,
C. A. Stephenson,
Managing Director Lane Fox Electrical Company, Limited.

66, Victoria Street, London, S.W.,
31st May, 1890.

A LETTER EXPRESS.

To the Editor of "Industries."

Sir,—I have the honour to hold a memorial which is about to be forwarded to the Postmaster-General asking for the establishment in this country of a "Letter Express." This memorial already includes the signatures of the Lord Mayor of London (Sir Henry Isaacs), Lord Randolph Churchill, Cardinal Manning, the Bishop of London, Lord Wolseley, and Sir John Lubbock (Chairman of the London Chamber of Commerce).

Will you kindly permit me, through your columns, to invite the opinion on the subject of mayors of towns, members of Parliament, heads of commercial corporations, and of the public generally (the opinions of the Press also would be most valuable), so that the whole may be transmitted, with the memorial, to Mr. Raikes.

Yours, &c.,
Francis George Heath.

Underwood, Kew Gardens,
3rd June, 1890.

The following is a copy of the memorial:—

"To the Right Honourable Henry Cecil Raikes, M.P.,
Her Majesty's Postmaster-General.

"Sir,

"We the undersigned, expressing, as we believe, the opinions of a very large number of persons, beg to call your especial attention to the importance of establishing a 'Letter Express' as an adjunct to the service of the Post Office in this country.

"Amidst the great mass of letters hourly passing through your department, there must be a very considerable number of such importance to the senders that they would gladly pay a small extra fee for immediate delivery. The requirements of such persons are not sufficiently met by the telegraph service, as the cost of a lengthened urgent communication would oftentimes be too great to admit of its being incurred; but as short telegrams would often be sent intimating that express letters were being despatched, the proposed service would tend to augment the telegraph revenue.

"An Express Letter Service of the kind indicated is in successful operation in the United States of America, in Germany, in Belgium, and in Switzerland, and delivery of letters can, we understand, be made within twenty minutes of their reaching the despatching office. As a distinct staff is employed for the work, it is performed without any detriment to the ordinary deliveries.

"If a charge for express delivery of, say, threepence, were made upon each letter, and prepaid by the sender, we believe it would prove to be a source of very great benefit to the general public.

"Trusting that your earnest and immediate attention may be given to this matter,

"We beg to subscribe ourselves, Sir,

"Your obedient servants,

"Henry E. Card. Manning.
"Henry A. Isaacs (Lord Mayor).
"Randolph S. Churchill.
&c. &c.

PIECE WORK.

To the Editor of "Industries."

Sir,—Your leading article of the 16th ult., in which you asked the question, "Can an improved education prevent strikes?" has raised a discussion on the subject of piece work, which, however, appears to be rather one-sided. As a former mechanic I should like to state the opinions I have formed on the subject, as the result both of personal experience and observation. With a conscientious employer piece work is no doubt the fairest method of payment, but there are few men able to withstand temptation when their financial interests are directly opposed to their duties, and the consequence is that piece work in almost all cases becomes mere task work. The workmen at first put all their energy into their work, and continue for some time at a pressure which would soon kill them. They realise large wages, and thus attract competitors, and the employers take the opportunity of lowering prices. A few months of over-exertion reduce the strength of the work-

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men, while the increasing competition brings down wages almost to the limit of subsistence. Moreover, the system tends to engender a selfishness which prevents apprentices being taught the elements of their trade, and their time is wasted on unskilled work and in carrying messages, and their five years' apprenticeship only results in turning them out handy labourers. This I believe to be the cause of the recent great cry for technical education. If the masters and the men did their duty to the apprentices, that cry would seldom be heard.

Your question, "Can an improved education prevent strikes?" must of course be answered in the affirmative, if we understand education in the proper sense of the term—education both of masters and men, not only in the technical details of their work, but also in their duties to each other—in short, education in "honesty." When we have that, the questions of piece work and day work will settle themselves, and both parties will see that their best interests are bound up together, and can only be advanced by a hearty co-operation which will make strikes impossible.

Yours, &c.,
Glasgow, 2nd June, 1890. A Former Mechanic.

"CAN AN IMPROVED EDUCATION PREVENT STRIKES?"

To the Editor of "Industries."

Sir,—I notice in your issue of the 23rd ult. a letter from "J. W. D.," who answers the above question, raised in your recent leading article, in the affirmative.

If I may venture an opinion on the subject, I would say that undoubtedly a better education would tend to prevent *unreasonable* strikes, but I do not consider that it would either do away with or even lessen the *genuine* strikes, by which I mean the strikes which emanate from the men employed, and where there is a real grievance. I do not think that anything will do away with these, as there will always be unreasonable and unjust employers, and, under such circumstances, the strike seems to me to be the natural, and, perhaps, the proper, check against oppression, deplorable as its results may be.

But it is rare nowadays for us to be treated to a genuine strike. As a rule now, men are "drawn out" without being consulted in the matter, and often quite against their wishes and interests. They do not know what their grievance is, nor whether they have got one. Nor have they the least idea what they are to expect from striking. In such "strikes" as these a better education would tend perhaps to make the men discriminate a little more between the men that have their interests at heart and those that have not, and to insist on the former being placed at the head of their unions.

It has always been my endeavour, when I have had occasion to write on the labour question, to point out that the self-interested and semi-educated men, and the well-meaning fanatics who, as a rule, at present "run" the unions, hold a power which they use dead against the interests of the working man. I think that the only way to effectually protect the working man from his union leaders, and so bring strikes down to their legitimate bounds, would be for legislation to make the trades unions responsible to the law for the fulfilment of all contracts they may enter into with their members or with anybody else. Till this is done they will never know the real wishes of the working man, and strikes alike against the interests of man and master will continue to take place.

The working man should be the master of his union officers. At present he is their slave, and one who sees no probability of freedom.

Yours, &c.,
South Kensington, S.W., 4th June, 1890. J. Stafford Ransome.

COMPRESSED AIR CARS.

To the Editor of "Industries."

Sir,—In Gilbert and Sullivan's "H.M.S. Pinafore" the Bo'sun, referring to Dick Deadeye, says, "What's to be done with this here hopeless chap?" After Messrs. Hughes & Lancaster's last letter I must admit that I similarly wonder what is to be done with them. They either do not understand plain English, or go out of the way to misinterpret it, for they utterly pervert what I have written in previous letters.

It is evidently little use, under such circumstances, to repeat what I actually said. I may mention, however, that I am quite aware that most of the American lines are run on the overhead wire system. I also know that Mr. Reckenzaun has got accumulator cars working successfully in Philadelphia. I also note in your current issue that Mr. Jarman's company are going to run accumulator cars in the south of London at 4½d. or under.

I am always pleased to hear of briskness of trade, and am therefore glad that Messrs. Hughes & Lancaster are so exceedingly busy. When they have fitted up a line on a working basis, and find it run economically, I hope they will find sufficient time to give a record in your columns.

Yours, &c.,
Portsmouth, 2nd June, 1890. Car.

[This correspondence must now cease.—Ed. *Industries.*]

BRITISH MANUFACTURES ON THE CONTINENT.

To the Editor of "Industries."

Sir,—The fact cannot be ignored that with some of our staple productions there is not that success attending their exploitation that might be naturally expected from their intrinsic merits in markets quite close to our own shores. In far off directions like Japan, Australia, South America, &c., we hold the principal position against all comers in nearly every department. With many of the large consuming countries of the Continent, however, the Belgians, the Swiss, and the Swedes surpass us in railway plant, fixed engines, steamers, and certain other details. Neither of these items can be built cheaper elsewhere, nor can we look to charges of exportation for the difference, and duties would be the same in any given case. Yet that Swedish steamers go largely to Russia, and Belgian machines to Germany, is common knowledge. In short, the Continent is almost like one vast compact country in itself, where a great interchange of manufactured goods takes place. Germany and France are celebrated for war material, and generally may be said to supply the bulk of these plants to the other Powers of Europe, including guns, torpedoes, and torpedo *boats*; Switzerland is celebrated for its engines, both locomotive and fixed; while Belgium has a notoriety in the way of steel goods, and Holland and Sweden do well with special classes of steamers.

What accounts, then, for the backwardness on the part of British manufacturers in these fields of trade? Is it the lack of that enterprise which has hitherto characterised us, to which we can attribute any failures to compete with our neighbours on their own ground? Probably our very insular position, the cause of our success as colonisers, is the answer to the above question.

The typical Englishman is not at home with the suave manners he finds, say, in Russia. The customs outside his own islands are very different to what he is accustomed to, whereas amongst all Continental peoples there is a similarity of style. Can nothing, therefore, be done to break down the barrier standing between us and these markets? Are we to believe that for ever these gates are closed to our trade? Here it must be allowed that where commerce is to be carried out trained hands are wanted for doing it. The simple fact that an article is the best suited for its particular purpose is not enough. Intelligent men, acting as go-betweens from the manufacturers to the consumers, are absolutely necessary. These England does not possess in sufficient numbers as far as the Continent is concerned. A very wide field is opened up by this remark. It virtually means that, after the vast sums spent in education, we still lack certain elements.

I do not suggest that every youth should be trained to speak French, German, Russian, &c. Certainly, however, it would be in the interest of manufacturers to initiate schools of languages in every district, so that those who had any aptitude might obtain scholarships, and thus be met half-way in their studies. An aspirant, as it is now, meets with too many difficulties in the pursuit of what he desires. We have institutions for everything in these days, but this question of thorough and systematic teaching in living languages still remains to be solved.

The ever-ready Teuton is ahead of us with the College for Oriental Languages in Berlin. It behoves us, therefore, to bestir ourselves in this matter, though probably, with native races, other points in our system outweigh any disabilities in this particular.

Chambers of Commerce have been very active in recent years, but laurels are yet waiting to be grasped by enterprising bodies who have our industrial supremacy at heart. In the direction of languages lies, in my opinion, the kernel of our future position in the world's trade. Given an army of young men, capable of speaking two or three foreign languages, the quality of our wares will do the rest.

"Trade follows the flag" is a motto well known to Englishmen. On the Continent, however, we may justly say that to make known the various classes of British manufactures requires an exponent of intelligence equal to what is found on the spot. Any expenditure would be well laid out in seeing that we were not behindhand in this department. Moreover, it is becoming an ever-increasing question whether we are not already suffering in over-sea markets by our extreme apathy in this matter of languages, for the population embraces a larger proportion than ever of Germans in one colony, Italians in another direction, and so on through the list of the emigrating nations. Many of these traders in other lands require to be communicated with in their own tongue. Until, therefore, this link in the great chain of our commercial relations has been forged, we cannot be said as a nation to have done all that might be expected from us as a practical people.

Yours, &c.,
London, 3rd June, 1890. Trader.

INSULATION RESISTANCES OF CABLES.

(*From an American Correspondent.*)

On Saturday, the 24th of May, a representative of the *New York Electrical Review* visited an electric light installation by the United Electric Improvement Company at their works in Gloucester, New Jersey; and also witnessed some interesting tests of the insulation of the underground main conductor, which is a No. 0 gauge drawn into a wrought-iron pipe buried some 2ft. below the surface of the ground, and insulated by the Brook system, carrying a current of 2,700 volts and 9 amperes, feeding the current to 50 arc lamps. The insulation tests by the ordinary galvanometer method showed something over 1,000 megohm miles, but a more satisfactory test was by a Holtz machine, which produced a spark 6in. in length. This failed to puncture the insulation or affect it in any way.

It is now pretty well known that an insulation which may test very high galvanometrically with the potential of 200 to 500 elements, may, when subjected to the pressure of 2,000 or more volts, be easily broken down or disrupted. Mr. Wm. Maver, Jun., recently stated that a cable measuring 20,000 megohm miles of insulation in the factory, broke down by a dynamo current of 600 volts, after being drawn into a conduit. Drs. Warren de la Rue and Hugo Muller published the following figures as the striking distance between a point and a disc:—0·5in., 11,700 volts; 1in., 23,400 volts; 2in., 46,700 volts; 3in., 70,100 volts; 4in., 93,500 volts; 5in., 116,800 volts; 6in., 140,200 volts; 7in., 163,600 volts; 8in., 186,900 volts; 9in., 210,300 volts; 10in., 233,700 volts; 20in., 467,300 volts; 30in., 701,000 volts; 40in., 734,700 volts; 50in., 1,168,300 volts. It is stated that these experimentors used a battery of eleven thousand cells as a basis for obtaining the foregoing figures.

The Gloucester cable is insulated with a semi-liquid preparation, which is comparatively cheap, and an increase of insulation does not proportionately increase the cost per conductor. There is another feature of this method of insulation. The pipes are laid in the grounds and the conductors drawn in and insulated afterwards. In this respect it differs from all other modes. Cable, insulated in factories, and afterwards coiled, uncoiled, and drawn into conduits, are liable to injury by that operation, especially so if employed for arc-lighting purposes. There were at Gloucester a variety of specimens of arc-lighting cables, the insulation of which was easily punctured by a spark of less than 1in. in length. Many authorities quote dry air as the highest insulating medium, and it is probably correct as tested by ordinary methods, but for high voltages it certainly does not compare with liquids. Bearing upon this point was a statement by Mr. Foudersmith, the electrician of the Pennsylvania Railroad Company, who was present and witnessed these experiments, to the effect that of the fifty-three conductors laid by Mr. Brooks three years since on the Pennsylvania Railway, not one of them had ever been interrupted by atmospheric discharges or any other cause, though lightning was a great source of trouble and interruption to all other kinds of insulation used for underground and river crossings, and that the insulation of this Brooks cable, one and one-third miles in length, was at this day thousands of megohm miles, and as high or higher than when first laid.

RESEARCH COMMITTEE ON MARINE ENGINE TRIALS.*

1. Trial of the S.S. "Fusi Yama."

Steamer.—This steamer was tested as a good example of an ordinary trading vessel working under the usual conditions. She belongs to Messrs. Gellatly, Hankey, Sewell, & Co., to whom the committee are much indebted for giving them every facility for making the experiments. She is a vessel of 214·3ft. in length between perpendiculars, 29·3ft. beam, and 20·5ft. depth. Her registered tonnage is 632 net, and her gross tonnage 994, under deck 899 tons. Her displacement on the day of the trial, when the mean draught was 18ft. 11¾in., was 2,175 tons. The trial was made upon the 14th and 15th November, 1888, on a run from Gravesend to Portland. The ship left Gravesend, where her compasses had been adjusted, about six o'clock on the afternoon of the 14th November, and the trial started at 8.51 p.m. on that evening. It lasted until 11 a.m. on the 15th. The run was continuous, with the exception of stoppages amounting in all to 12 minutes between 3.10 and 3.25 a.m. when landing the pilot off Dover. In addition to this the engines were running slow for about 13 minutes between 3 and 3.30 a.m. The reading of the counter was entered at each change of speed or stoppage during this time.

Engines.—The "Fusi Yama" is fitted with compound surface-condensing engines, made by Mr. Martin Samuelson, of Hull, in the year 1874. They had been thoroughly overhauled by Messrs. Rait & Gardiner, under the superintendence of Mr. Frederick Edwards, immediately before the trial, and were in thoroughly good working order. The cylinders' diameters are 27·35in. and 50·3in., measured from gauges. Their common stroke is 33in. The diameter of both piston-rods is 4·9in. There are no tail rods. The cranks are at right angles, the low-pressure leading. The cylinders are not jacketed. The clearances of the high and low pressure cylinders as measured on the drawings are respectively 7·6 and 5·0 per cent. Each cylinder is provided with a single slide-valve worked by the ordinary link-motion gear. The throttle and stop valves, and the link-motion, were sealed up at starting. The link-motion, however, was opened out a little at 1.24 a.m., and remained in its new position during the rest of the run. The screw propeller is four-bladed, having a diameter of 13ft., and a mean pitch of 16·37ft.

Boilers.—Steam is supplied by one boiler 13ft. 3¾in. mean diameter, 11ft. long, and containing three furnaces. The total grate surface is 52 square feet, and the total heating surface 2,257 square feet, the ratio between the two being 1 to 43·4. The mean diameter of the flues is 2ft. 11½in. The fire-bars are of the ordinary description, and there are 17 bars in the width of each furnace, and therefore 34 in each grate. There are 232 tubes of 3¾in. external diameter, and 7ft. 5in. long between plates, equivalent to a total tube surface of 1,689 square feet, which is 32·5 times the grate surface. The internal diameter of the funnel is 4ft. 6¼in., and its total height is 43ft. 2in. above the centre of the lowest furnace. The total weight of the engines and boiler, including water in condenser pipes and boiler, and all mountings, is about 100 tons. The net volume of the boiler is about 1,681 cubic feet.

Duration of Trial.—The duration of the trial from start to finish was 14 hours 9 minutes. Deducting the 12 minutes of stoppage, the running time was therefore 13 hours 57 minutes, or 837 minutes.

Coal Measurement.—The same method was used for weighing the coal as was employed upon the "Meteor" trial. About 70lb. of coal were weighed in each bucket, and about nine buckets were weighed on to the stoke-hold floor at one time. The trial was started with a clean floor. The time was noted at which each lot of weighed coal was put upon the fire, and no more coal was weighed out until the floor was again clear. The line of coal consumption plots out as shown upon the diagram, Fig. 1. The fires were not cleaned during the run. The ashes were weighed after the trial was over. The coal was West Hartley Tyne coal, costing 15s. 9d. per ton. It was somewhat irregular in quality, but a sample collected at different times during the run, and

* Report prepared by Professor Alexander B.W. Kennedy, F.R.S., Chairman of the Committee for the Institution of Mechanical Engineers, and read at the meeting of the Institution on the 1st ult.

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afterwards well mixed and pounded, gives the following analysis, which has been made by Mr. J. C. Wilson:—

	Coal as Used.	Dry Coal.
Carbon	70·85 per cent.	77·52 per cent.
Hydrogen	4·71 „ „	5·15 „ „
Moisture	8·60 „ „	0·00 „ „
Ash	5·11 „ „	5·59 „ „
Nitrogen, sulphur, oxygen, &c., by difference	10·73 „ „	11·74 „ „
	100·00	100·00

The calculated calorific value of this fuel as used is 12,760 thermal units per lb., which is equivalent to the evaporation of 13·21lb. of water from and at 212° Fahr. The equivalent carbon value of this fuel as used is 0·878lb. per lb. The total coal used was 13,768lb. in 849 minutes. As, out of the whole time of running, the engines were stopped for 12 minutes, during which period, of course, the fires were more or less damped, it may be taken that the actual time of firing was equivalent to about 840 minutes; but in order not to confuse matters, the boiler time will be taken as equal to the engine time—that is to say, to the time during which the engines were actually running, namely, 837 minutes. The total coal was therefore 16·45lb. per minute, or 987lb. per hour. The weather was fair until reaching Dover, but became very rough during the last part of the trial, which was brought to an end somewhat sooner than was intended, because of the great difficulty of obtaining further accurate measurements. Up to the actual point of ceasing observations, however, the weather did not affect their accuracy, although it rendered difficult the estimation of the water-level in the boiler at the end of the trial. The roughness of the weather at the end of the trial prevented accurate measurements being made as to the amount of clinker obtained from cleaning the fires. The actual amount of ash weighed off from under the grates was only 278lb., or about 2 per cent. of the total weight of the fuel.

Furnace Gases.—The temperature of the chimney gases was observed 15 times during the trial, and its average value was 578° Fahr.; the highest reading being 617°, and the lowest (which was just after starting) 500°. Two samples of furnace gases were collected and analysed; the analyses of these by weight and by volume are given in Table I.

The mean chimney draught, which was measured by a U gauge-glass at the place where the furnace gases were collected, was 0·28in. of water.

Feed-water Measurement.—The feed-water was measured in the same way as for the "Meteor," on its way from the hot-well to the feed-pump of the engine. The tanks used for weighing it (which held about 260lb. each) were placed on the upper engine-room platform; their contents were carefully tested by weighing water into them, and they were at the same time ascertained to be free from any leakage. The necessary correction having been made for the temperature of the feed, the total water used amounted to 109,800lb. (its mean temperature being 129·5° Fahr.), over a total time of 850 minutes. The last feed-tank was emptied at 11·1 a.m., or one minute after the last reading of the counter, so the engine was actually running during 838 minutes of this time, so that the mean consumption of water per minute (engine time) was 131·0lb., or 7,860lb. per hour. The continuous consumption of feed-water is shown in Fig. 1. All the steam made by the boilers went to the main engine, steam being kept up in the donkey boiler for any other purposes that were required.

Power Measurement.—Indicator diagrams were taken at about half-hourly intervals throughout the whole of the trial, 26 sets or 104 cards being taken in all. A pair of Darkes' indicators were used on the high-pressure cylinder with ¼th springs, and a pair of Richards' indicators on the low-pressure cylinder with ¼th springs. The following are the mean effective pressures in the two cylinders in pounds per square inch:—

Cylinder.	Top.	Bottom.	Mean.
High-pressure	31·06	30·41	30·74
Low-pressure	10·43	11·30	10·87

These pressures correspond with the following indicated horse-powers:—

High-pressure cylinder	168·2
Low-pressure cylinder	203·1
Total indicated horse-power	371·3

One set of cards was taken during the time when the engines were slowed down (13 minutes), and the proper allowance has been made for this in the preceding averages. The maximum indicated horse-power given by any one set of cards was 402·2, which occurred at 5·30 a.m., with 57·5 revolutions per minute, and 59lb. of steam. The minimum indicated horse-power by any one set of diagrams at full speed was 313 at 11 p.m., with 53 revolutions per minute, and 49lb. of steam. From the 104 diagrams which were taken during the trial a mean diagram has been plotted for each of the two cylinders, and these are given in Fig. 4. The continuous variations of boiler pressure and cylinder mean effective pressures are shown in Fig. 2; and of horse-powers and speeds in Fig. 3.

Speed.—The counter read 8,507 at 8.51 p.m. when the trial commenced, and 55,033 at 11 a.m. when the trial ended. The total number of revolutions made by the engines was therefore 46,526 in a total running time of 837 minutes, which gives an average rate of 55·59 revolutions per minute. The maximum number of revolutions per minute for any half-hour was 57·5, and the minimum number (except when slowed down) was 53.

Pressures, &c.—The mean barometic pressure during the trial was 30·1in. of mercury, or 14·8lb. per square inch. The mean boiler pressure was 56·84lb. per square inch above the atmosphere, measured on the gauge in the stoke-hold. On the engine-room gauge the mean pressure was 55·2lb. per square inch. It will be seen from the diagram that the pressure was fairly constant, except during about two hours towards the beginning of the run, and during the time when the engines were slowed down. The pressure-gauge in the stoke-hold was read every quarter of an hour during the trial, and the other gauges were read every half-hour alternately with the counter readings, and at the same time as that at which the indicator cards were taken. The mean reading of the vacuum gauge was 25·40in. of mercury, or 12·48lb. per square inch below the atmosphere. The mean initial pressure in the high-pressure cylinder (from measurement of diagrams) was 50·3lb. per square inch above the atmosphere; and the mean back-pressure in the low-pressure cylinder was 10·9lb. per square inch below the atmosphere, which corresponds to an absolute back-pressure of 3·9lb. in the cylinder.

Boiler Efficiencies.—The rate of combustion in the furnaces was 18·98lb. of coal per square foot of grate surface per hour, or 0·437lb. per square foot of total heating surface per hour. The evaporation was at the rate of 7·96lb. of water per lb. of coal. As the feed entered the boiler at a temperature of 129·5° Fahr., and as the temperature corresponding to the mean steam-pressure was 304° Fahr., each lb. of steam must have taken up 1,077 thermal units; so that the equivalent evaporation from and at 212° Fahr. was 8·87lb. of water per lb. of coal, or about 10·10lb. per lb. of carbon-value in fuel. The equivalent amount of heat utilised per lb. of coal was 8,570 thermal units, or, say, 67·2 per cent. of the whole calorific value of the fuel, which percentage, therefore, represents the actual boiler efficiency. The total nominal calorific value of the fuel burnt per minute was 209,900 thermal units. Assuming that the two samples of furnace gases analysed gave a fair average value, it appears that the weight of dry air per lb. of coal was about 22·8lb. The loss of heat in raising the temperature of the furnace gases from 55° Fahr., allowing for the steam due to the combustion of the hydrogen in the fuel, works out to 2,995 thermal units, or 23·5 per cent. of the whole calorific value of the fuel. There was no loss by formation of carbonic oxide. The loss due to evaporation of the moisture in the fuel would be 0·9 per cent. These quantities add up to 91·6 per cent. of the whole heat of combustion, the balance of 8·4 per cent. including all losses by radiation. The weight of water evaporated per square foot of total heating surface was 3·48lb. per hour. The average rate of transmission of heat through the material of the boiler was 3,750 thermal units per square foot of total heating surface per hour.

Coal Consumption.—The total coal burnt—namely, 987lb. per hour—corresponds to 2·66lb. per indicated horse-power per hour. This is equivalent to 2·33lb. of carbon value per indicated horse-power per hour.

MARINE ENGINE TRIALS.

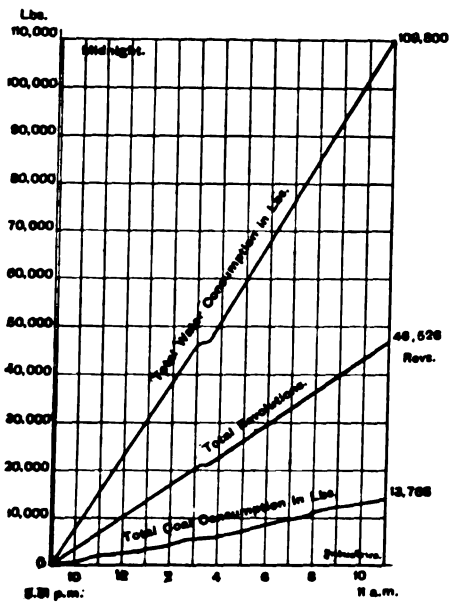


FIG. 1.

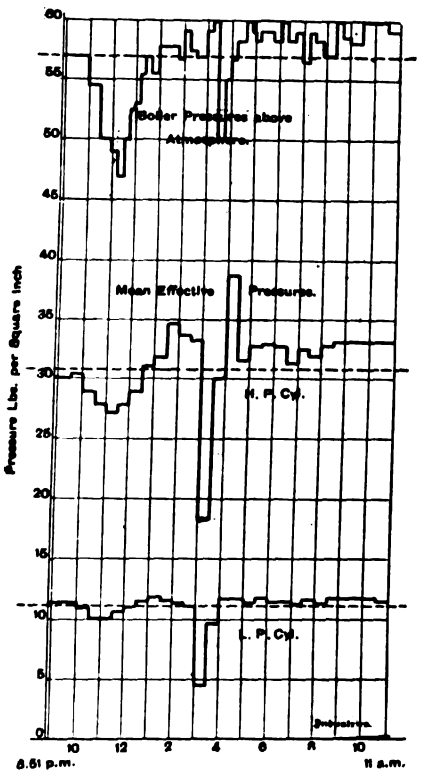


FIG. 2.

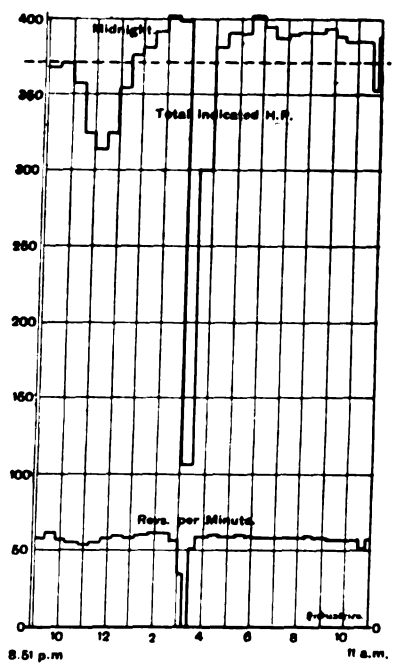


FIG. 3.

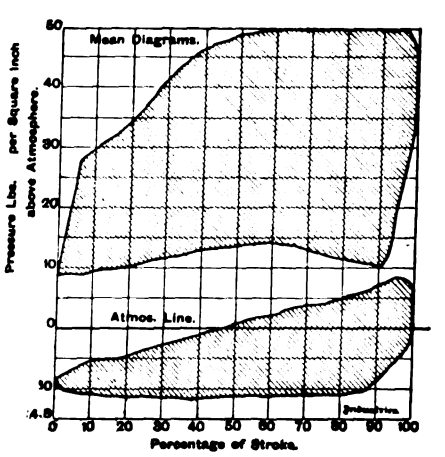


FIG. 4.

TABLE I.

Constituent.	No. 1.		No. 2.		Mean.	
	By Volume.	By Weight.	By Volume.	By Weight.	By Volume.	By Weight.
Carbonic acid	6·93	10·30	8·14	12·04	7·53	11·17
Carbonic oxide	0·00	0·00	0·00	0·00	0·00	0·00
Oxygen	12·14	13·13	11·00	11·84	11·57	12·48
Nitrogen	80·93	76·57	80·86	76·12	80·90	76·35
	100·00	100·00	100·0	100·00	100·00	100·00

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Engine Efficiencies.—The measurement of feed-water shows that the quantity used per indicated horse-power per hour was 21·17lb. per hour. The actual heat received by the feed-water per minute was 141,100 thermal units, or 380 thermal units per indicated horse-power per minute, which is 67·2 per cent. of the whole heat of combustion. The absolute engine efficiency, or ratio of the heat turned into work to the total heat received by the feed-water was 11·25 per cent.

Total Efficiency.—The combined efficiency of the boiler and engines, or the ratio of the heat turned into work to the total heat of combustion of the fuel, was 0 672 × 0·1125, which is equivalent to 7·6 per cent.

Steam from Indicator Diagrams.—The following are the results of measurements made upon all the indicator diagrams taken to ascertain the proportion of steam accounted for by them. The actual weight of feed-water used per revolution was 2·357lb.:—

Proportion of Steam accounted for by Indicator Diagrams.	Lb. per Revolution.	Percentage of Total Feed.	Percentage present in Cylinder as Water.
Steam present in high-pressure cylinder after cut-off, when the pressure was 45·2lb. per square inch above the atmosphere	Lb. 2·08	Per Cent. 88·2	Per Cent. 11·8
Steam present in low-pressure cylinder near end of expansion, when the pressure was 4·8lb. per square inch below the atmosphere	1·66	70·7	29·3

(To be continued.)

THE BOARD OF TRADE AND ELECTRIC LIGHTING.*

The first attempt to deal with the question of electric supply on the part of the Legislature was the Act of 1882. As notice had been given of many private Bills to be brought in to acquire the necessary powers for a general supply, proceeding on very varying lines, it was thought that the time had come for a general Act dealing with the subject. The two principal objects of this Act were: (1) To empower electric supply companies, or persons, or local authorities desirous of undertaking this supply for their own districts, to lay their mains in the public streets, and conduct the business of supply generally in a manner recognised by law; (2) to recover charges for supply made to consumers. At the same time proper regulations and conditions were imposed upon the undertakers to secure the safety of the public and the adequacy of the supply; while the fear of creating a new perpetual monopoly was evidently present in the minds of the framers of the Act. This Act is so familiar that a short sketch of its provisions will be sufficient. It sets out by detailing the various ways in which statutory powers can be obtained. These are: (1) By licence; (2) by Provisional Order; (3) by special Act.

The issue of licences is left entirely in the hands of the Board of Trade, but the consent of every local authority affected must first be obtained. The original period for which a licence is granted must not exceed seven years, but it may be renewed with the like consents. A licence may be for "public purposes" or "private purposes." "Public purposes" only allows supply for electric lighting of streets, public places, buildings, theatres, &c.; while "private purposes" allows general supply, not only for lighting, but for any other purpose, except the transmission of any telegram. The Board of Trade is empowered to make such regulations and conditions in a licence as it may think expedient.

Provisional Orders in this Act may be granted without requiring the previous consent of the local authorities affected, but have no force unless and until confirmed by Act of Parliament. The period of an Order may be limited, or it may be unlimited in duration. There appears to be very generally diffused a mistaken idea on this point. Many people appear to think that a Provisional Order only lasts for 42 years, or 21 years under the old Act. This was stated in the *Times* the other day as a fact It is, however, quite a mistake. The Orders granted by the Board of Trade, and confirmed by Parliament, have hitherto been, without exception, I think, unlimited in duration. There are various provisions for sale or transfer of the undertaking, including, in the case of a company, compulsory sale to the local authority; but these provisions may never be acted upon, and even if they are put in force, do not extinguish the powers granted. Section 6, with respect to regulations, is so important that it will be better to give the exact words—

"6. The undertakers shall be subject to such regulations and conditions as may be inserted in any licence, Order, or special Act affecting their undertaking with regard to the following matters:—(*a*) The limits within which and the conditions under which a supply of electricity is to be compulsory or permissive; (*b*) the securing a regular and efficient supply of electricity; (*c*) the securing the safety of the public from personal injury, or from fire or otherwise; (*d*) the limitation of the prices to be charged in respect of the supply of electricity; (*e*) the authorising inspection and inquiry from time to time by the Board of Trade and the local authority; (*f*) the enforcement of the due performance of the duties of the undertakers in relation to the supply of electricity by the imposition of penalties or otherwise, and the revocation of the licence, Order, or special Act where the undertakers have, in the opinion of the Board of Trade, practically failed to carry the powers granted to them into effect within a reasonable time, or discontinued the exercise of such powers; and (*g*) generally with regard to any other matters in connection with the undertakings. Provided always that the Board of Trade may from time to time make such regulations as they may think expedient for securing the safety of the public from personal injury or from fire or otherwise, and may from time to time amend or repeal any regulations which may be contained in any such licence, Order, or special Act in relation thereto: and any regulations so made or amended by the Board of Trade shall, from and after the date thereof, have the like effect in every respect as though they had been originally inserted in the licence, Order, or special Act authorising the undertaking; and every regulation so repealed shall, from and after the date thereof, be repealed accordingly, but such repeal shall not affect any liability or penalty incurred in respect thereof prior to the date of such repeal, or any proceeding or remedy which might have been had in relation thereto. Any local authority within any part of whose district electricity is authorised to be supplied under any license, Order, or special Act may, in addition to any regulations which may be made under the preceding provisions of this section for securing the safety of the public, from time to time make, rescind, alter, or repeal bye-laws for further securing such safety; and there may be annexed to any breach of such bye-laws such penalties, to be recovered in a summary manner, as they may think necessary: Provided always, that no such bye-laws shall have any force or effect unless and until they have been confirmed by the Board of Trade and published in such manner as the Board of Trade may direct."

The proviso enabling the Board of Trade to make regulations from time to time, and to amend or repeal any regulations, is certainly a wise provision, and it has been largely carried into effect. The power conferred upon the local authority of making bye-laws for further securing the safety of the public should also be noted, and that this may be exercised even where they are themselves the undertakers. In the case of local authorities being undertakers, power is given for them to contract for the execution and maintenance of any works, or for the whole business of supply; but they are forbidden to transfer or divest themselves of any legal powers or liabilities without the consent of the Board of Trade. As regards overhead wires, undertakers must get the express consent of the local authority for their erection along, over, or across any street, and the local authority may remove any electric line placed above ground without such consent, and, even where such consent has been given, a court of summary jurisdiction may order the removal of any electric line, on the ground of public safety. It must be noticed, however, that nothing in this Act empowers any interference on the part of the Board of Trade or any other authority with electric lines erected by persons who are not undertakers. The undertakers are not allowed to prescribe any special form of lamp, or to interfere with the use made by any consumer of the supply given to him; but no consumer is to deal with his supply in such a manner as to unduly or improperly interfere with the supply to other consumers; and any dispute as to this is to be determined by arbitration. There are provisions against undue preference on the part of the undertakers in their supply and charges. I take the meaning of these sections (19 and 20) to be this—that the undertakers may make any agreement as regards price, hours of supply, &c., provided that the price is not in excess of the maximum rates laid down; but that, where they have made any such agreement with any private consumer, any other private consumer may demand a similar agreement, where the conditions are similar; and so in the case of street lighting authorities; but not that a private consumer could demand to be supplied at the same rate as is agreed upon for the street lighting or for lighting a large theatre. Supply may be cut off for neglect of payment of charges due, but only until these charges and any expenses incurred in cutting off the supply are fully paid. Any unlawful and malicious injury of electric lines and works is made a felony, and any person who maliciously or fraudulently abstracts, causes to be wasted or diverted, consumes or uses, electric energy is declared to be guilty of simple larceny—in fact, to have stolen it. The purposes for which the officers of the undertakers may enter premises of consumers are strictly defined, and they have no legal right of entry for any other purpose—*e.g.*, to inspect the electric lines and fittings of the consumer. The Board of Trade has, however, so framed the Orders and Safety Regulations as to make it unlikely that any consumer would refuse entry to a properly authorised agent of the undertakers, if required by them to make an inspection of these electric lines and fittings.

In the section of the Act providing for the protection of the Postmaster-General, it is curious to note that a distance of 10 yards was apparently considered as the outside limit of distance within which a telegraph line might be affected by an electric supply line. The section dealing with compulsory purchase by the local authority after 21 years has been made the scapegoat for the failure of the electric lighting "boom" of 1883. It is questionable, however, whether it had so much effect as is attributed to it in preventing capitalists from coming forward to support electric lighting schemes, and also whether whatever checking influence was really due to it has not in the long run been as beneficial as a nipping frost in early spring in restraining youthful impetuosity. And I may remark that this clause did not excite any serious opposition at the time; in fact, the Bill was sent up from the Commons with a fifteen years limit, and extended in the Lords to twenty-one years, which was considered an ample time even by the persons best qualified to judge, as is amply demonstrated in the minutes of evidence given before the Parliamentary Committee.

In the amending Act of 1888 the first section has two important provisions—"1. Notwithstanding anything in the Electric Lighting Act, 1882, no Provisional Order authorising the supply of electricity by any undertakers within the district of any local authority shall be granted by the Board of Trade except with the consent of such local authority, unless the Board of Trade, in any case in which the consent of such local authority is refused, are of opinion that, having regard to all the circumstances of the case, such consent ought to be dispensed with; and in such case they shall make a special report, stating the grounds upon which they have dispensed with such consent. The grant of authority to any undertakers to supply electricity within any area, whether granted by licence or by means of a Provisional Order, shall not in any way hinder or restrict the granting of a licence or Provisional Order to the local authority, or to any other company or person within the same area." The second section repeals section 27 of the former Act, and substitutes forty-two years for twenty-one, as the time to elapse before compulsory purchase can be enforced. Section 3 gives power to the Board of Trade to vary the terms of compulsory sale in accordance with any agreement between the local authority and the undertakers. Section 4 is very important, as it empowers the Board of Trade to make regulations for the protection of the public safety and of telegraphic and telephonic lines in the case of any electric lines used for the supply of electric energy, however laid or erected, and whether under statutory powers or not. Perhaps I had better give the first part of this section—"4. (1.) Where in any case any electric line or other work may have been laid down or erected in, over, along, across, or under any street, for the purpose of supplying electricity, or may have been laid down or erected in any other position for such purpose in such a manner as not to be entirely enclosed within any building or buildings, or where any electric line or work so laid down or erected may be used for such purpose otherwise than under and subject to the provisions of a license, Order, or special Act, the Board of Trade, if they think fit, may, by notice in writing under the hand of one of the secretaries or assistant secretaries of the Board of Trade, to be served upon the body or person owning or using or entitled to use such electric line or work, require that such electric line or work shall be continued and used only in accordance with such conditions and subject to such regulations for the protection of the public safety and of the electric lines and works of the Postmaster-General, and of other electric lines and works lawfully placed in any position and used for telegraphic communication, as the Board of Trade may by or in pursuance of such notice prescribe; and in case of non-compliance with the said regulations, then the Board of Trade may require such body or person to remove such electric line or work: Provided that nothing in this sub-section shall apply to any electric line or work laid down or erected by any body or person for the supply of electricity generated upon any premises occupied by such body or person to any other part of such premises." Sub-section (2) provides for the Postmaster-General taking action himself in the case of lines not laid under statutory powers, in the event of actual interference with his telegraphic lines, provided that these lines are not already regulated by the Board of Trade. The general purport of the section is to place the responsibility for the proper regulation of electric supply wires generally on the Board of Trade.

We now come to the dealings of the Board of Trade with the subject, and I propose to consider in the first place the various forms of Provisional Orders granted under the general Acts As licences differ very slightly in form from Orders of the same date, it will not be necessary to discuss them. There are up to the present time four forms of Orders, differing materially from each other in important respects, and showing, I consider, progressive improvement in the treatment of the subject as experience was gained. These are—1st, The 1883 form, of which Bradford is, I think, the only one now actually being worked, but some other local authorities are preparing to start under old Orders; 2nd, The Chelsea Order of 1886, and St. Austell Licence of 1885; 3rd, The London Orders of last year, which form, I may point out, is only applicable to metropolitan districts under the London County Council; 4th, The model forms of Orders for this year, which are even now being modified in certain clauses, and will not attain finality until some points have been determined by the action of Parliament. There are slight variations in form among individual Orders, generally due to some local considerations, and in every case there are considerable differences between Orders granted to local authorities and those granted to companies.

The first matter in all the Orders is the interpretation clause. In this, last year an innovation very important to electricians was introduced—viz., the definitions of "energy" and "power"—"The expression 'energy' shall mean electrical energy, and for the purposes of applying the provisions of the principal Act to this Order electrical energy shall be deemed to be an agency within the meaning of electricity as defined in the Electric Lighting Act of 1882." And "the expression 'power' shall mean electrical power, or the rate per unit of time at which energy is supplied." They hang upon the definition of electricity in the principal Act as "electricity, electric current, or any like agency." Rather a general definition, you see. Now the use of the term "energy" has, I consider, materially improved the language of the Orders, both from a scientific and a legal point of view. Under the old forms of Orders the undertakers were authorised to supply "electricity," and continual reference is made to this as the quantity supplied. Now this word has, or had, many meanings, but in this case it could only mean electrical energy. But when we turn to the "Price" clauses we find that energy is expressly mentioned as differing from electricity, and that there, at all events, the latter meant what we now call "electrical quantity." There really was here some confusion of language, distressing to the electrician and opening up grand possibilities of endless talk to lawyers. The proposed amendment was referred to your Council and concurred in by them, and I am glad to notice that the use of the term "electrical energy" is gradually working its way. I am not yet satisfied, however, with our word for what used to be the particular meaning electricity. It is rather absurd to call it "electrical quantity," since so many other things are electrical quantities. I almost think we want a word for this even more urgently than for electrical locomotion, over which so much ingenuity has been lately expended. The worst of it is that, as nobody knows what it is, or to what extent its existence is an objective reality, it is difficult to find an appropriate word. At any rate, it was impossible in the Orders to call it "electricity" any longer, as the Act says that is what is to be supplied; so that we had to define "energy" as what was meant by electricity in the Act, and use "electrical quantity" for the particular meaning for want of a better word. This also necessitated an alteration in the title. There is a slight further alteration in the new model title. As regards the definition of "power," this was necessary to avoid a difficulty in modifying a few clauses in the old Orders which dealt with the maximum current to any consumer to render them applicable to tranformer systems.

The definition of "main" has been materially altered. Thus it used to mean the conductor alone, then a continuous electric line, defined in the Act as follows:—"The expression 'electric line' means a wire or wires, conductor, or other means used for the purpose of conveying, transmitting, or distributing electricity with any casing, coating, covering, tube, pipe, or insu-

* Paper read by Major Cardew before the Institution of Electrical Engineers on the 17th inst.

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lator enclosing, surrounding, or supporting the same, or any part thereof, or any apparatus connected therewith for the purpose of conveying, transmitting, or distributing electricity or electric currents." And, lastly, the word "continuous" has been omitted as unnecessary in the case of transformer systems. The definition of "service line" has been altered in the same way. "Distribution main" has not been altered. It is a very important definition, as follows:—"The expression 'distributing main' shall mean the portion of any main which is used for the purpose of giving origin to service lines for the purpose of general supply." Difficulties may arise in interpreting this, as, for instance, in cases where the same conductor is at one part a feeder and at another a distributing main; but it is one of those things which must be left to custom and precedent.

The other definitions need not detain us now, except that two important ones have been added in the new forms—"The expression 'consumer' shall mean any body or person supplied or entitled to be supplied with energy by the undertakers." "The expression 'consumer's terminals' shall mean the ends of the electric lines situate upon any consumer's premises and belonging to him, at which the supply of energy is delivered from the service lines." The consumer's terminals are the point of demarcation between the possessions of the undertakers and their customers; they need not be binding posts.

In the clauses headed "Area of Supply," an important novelty was introduced last year, and has been retained in the new model for companies, expressly prohibiting the undertakers from supplying outside the area granted to them without further statutory powers. This is a sacrifice of their common law rights which they are required to make in consideration of the special privileges they acquire. This provision is being carried out by mutual agreements between the London companies. The old Orders, and the Liverpool and Swansea Orders of last year, provided for the division of the whole area into two districts, scheduled A and B respectively; the A district alone being the area for which powers are immediately granted, and in which supply is compulsory; while the B district was intended to be added piece by piece, practically at the option of the undertakers. The general effect of this was to induce undertakers to apply for very large districts, the greater part of which were in the B schedules, over which they thereby acquired a sort of prior right of occupation without incurring any liability. This was altered last year and a single district substituted, to the whole of which the "Compulsory Works'" clauses apply.

(To be continued.)

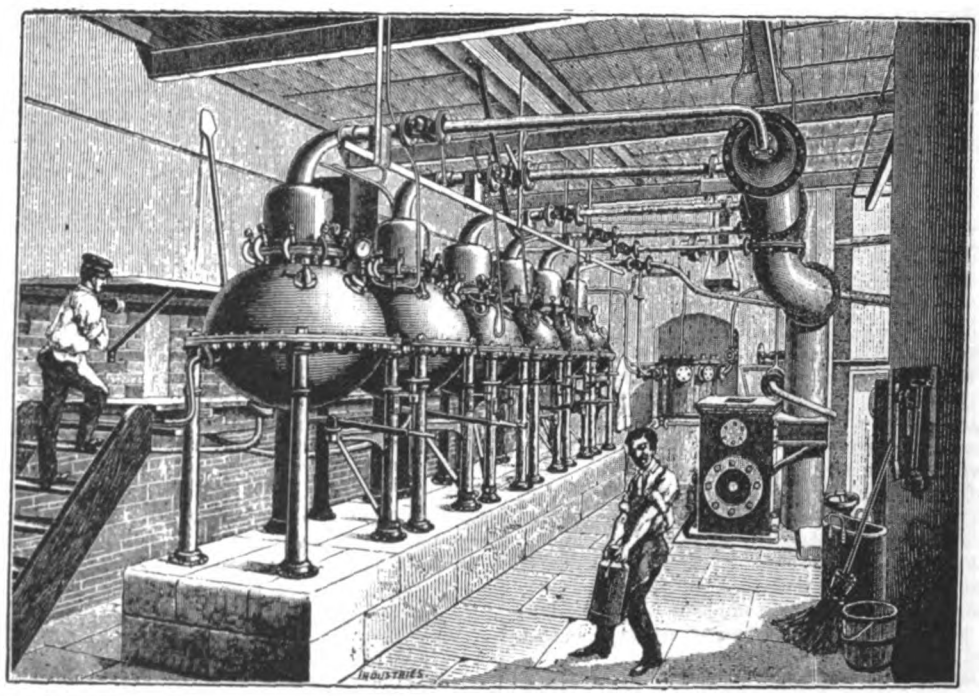
A SWISS CONDENSED MILK FACTORY.

We give herewith an illustration of the interior of one of the largest condensed milk factories at Vevey, in Switzerland, for a description of which we are indebted to our French contemporary *La Nature*. The manufacture of condensed milk has been considerably developed in Switzerland during the last few years, and two large factories belonging to the Anglo-Swiss Milk Company have been erected at Cham and Guin, while the Nestlé Milk Company have worked at Vevey, Bercher, and Payerne. The export in 1887 reached the large total of 494,720 cases, containing four dozen tins each, and in 1888 of 520,000 cases, while last year the total was greatly in excess of this latter number. Some 15,000 cows belonging to the peasants of 250 villages contribute the milk to the several centres, where the fresh milk is cooled in large refrigerators and bought by the manufacturers. It is then removed to the factory, where it it is first heated over a large water bath, and subsequently in large copper vessels, to a temperature not exceeding 80° C. These copper vessels are arranged in series, as shown in our illustration, and are connected with pipes leading to a vacuum exhausting apparatus similar to those used for the evaporation of beetroot juices in the manufacture of sugar. The milk is sweetened by the addition of 13 per cent. of refined sugar, which is aspirated into the copper vessels through a siphon at the beginning of the operation. The condensed milk, as soon as it reaches the requisite degree of concentration, is removed from the copper vessels, cooled, and placed in large receivers surrounded by running water, and thence transferred to the small tins, which are at once soldered hermetically.

THE SMOKELESS GUNPOWDERS.

The secrecy of manufacture of smokeless powders by the different European Government officials has given an unusual interest to the various patents relating to this subject, and it will be in the recollection of our readers that Sir Frederick Abel, in his recent lecture on "Smokeless Explosives" at the Royal Institution, pointed out that the question of the ultimate adoption of smokeless powders for military and naval purposes was only a matter of time. The so-called "amide powder," formed from a mixture of potassium and ammonium nitrates, was at one time the most important of these new explosives. Unfortunately, it was found to deteriorate when stored in a confined space, and hence a new material was desired. The French produced a powder for their Lebel rifle which contained picric acid, and last year it was believed that the manufacture of this explosive in France would confer a considerable benefit on the manufacturers

A SWISS CONDENSED MILK FACTORY.



of picric acid, as this material had hitherto few commercial applications. At present the smokeless powders which give the best results are those obtained from different nitro-celluloses or modifications of gun-cotton. Nobel obtained from gun-cotton by dissolving it in nitro-glycerine, a powder which was both smokeless and unaffected by water, but as this explosive gives no solid products when detonated, there seems to be a difficulty in using it for the purpose for which it was devised, since no lubricant is produced in the bore of the gun to reduce the friction of the metal on metal. The composition of this Nobel powder is as follows:—

Nitro-glycerine	100
Nitro-cellulose	50–200
Camphor	10–25

The camphor is first dissolved in the nitro-glycerine, and then, after the addition of 200–400 parts of benzene or amyl acetate, the nitro-cellusose is stirred into the solution. On evaporating the benzene at a temperature of 50°-60° C., the explosive is left in a gelatinous sheet, which can subsequently be cut into small cubes. As camphor is a very volatile body, the explosive made in this way is not of uniform composition; and more recently M. Nobel has proposed a mixture of 50 parts nitro-glycerine with 50 parts of dinitro-cellulose, the latter being made to dissolve in the former by means of benzene. He claims for this modification of his original powder that it is of uniform composition and permanent in moist air. The Nobel powder is of a brown colour, and is one of the smokeless explosives which has recently been experimented upon by the German Government.

The French smokeless powder already alluded to is known under the name of "poudre vieille," and has been in use in the French army since 1887, but the secret of its composition has been so well guarded that no other Government has been able to produce a similar powder. It possesses many good qualities, and has been kept for a considerable length of time without undergoing any deterioration.

In Belgium the powder manufactory of Wetteren have produced a smokeless powder by dissolving nitro-cellulose and barium nitrate in amyl acetate. It is known as "No. 32," and is sent into the market in thin sheets resembling brown paper. The Austrian firm of Wolf & Co. have also introduced one of these new explosives. Their compound consists of gun-cotton which has been partially dissolved in acetic ether or nitro-benzene, and subsequently dried by driving off the solvent at a low temperature. In this way each particle of gun-cotton is coated with a glazed surface, which retards its decomposition and renders it available for use in firearms.

Maxim has also patented a modification of gun-cotton, which is obtained by first saturating the cotton with acetic ether vapour, when it can be compressed into any desired shape, and subsequently obtained in granules or powder by gently evaporating off the solvent.

The well-known Hengst powder is obtained by nitrating straw, and then digesting the nitro-cellulose so formed in a hot bath of the following composition:—

Water	1,000
Saltpetre	12·5
Potassium chlorate	3·125
Zinc sulphate	12·5
Potassium permanganate	12·5

After this treatment for some hours the material apparently absorbs some of the salts present in the water, and when dried by pressure can be obtained in the form of a fine powder. In an amended patent of last December the patentee has made some slight alterations in the method of manufacture. In America, gellite, or emmensite, so called from Dr. Emmens, of New York, is now being experimented with. It is a nitro-cellulose saturated with ammonium picrate, and was first introduced to the American market in 1888. The nitro-cellulose used in its manufacture is prepared from paper, care being taken that the nitro-product does not contain any trace of free nitric acid. It is then warmed with picric acid, and a current of ammonia gas passed through the liquid to convert the acid into the ammonium salt. Other powders of lesser importance containing nitro-cellulose have been patented by Turpin in 1888 and Gaens in 1889. The Gaens powder is being manufactured at Hamburg; it has the fellowing composition:—

Nitro-cellulose	25
Potassium nitrate	60
Ammonium ulmate	15

This mixture is dissolved in acetic ether, and the mass compressed and granulated; it is then carefully dried. The ammonium ulmate, which is the novel ingredient in this formula, is obtained by digesting peat or turf with ammonia; the ulmic acid present in the vegetable mould is thus dissolved, and from the solution so obtained the ammonium ulmate is prepared. It is difficult to see what especial virtue this material has over other organic acids of more definite constitution.

In this country, although apparently the official experiments have not been sufficiently decisive to warrant a new departure of any magnitude, considerable progress has been made. Among the earlier patents we find that Sir Frederick Abel, in 1886, laid claim to a smokeless explosive consisting of nitro-cellulose powdered and dried, and mixed with one-tenth to one-half its weight of dried ammonium nitrate. The mixture is then moistened with petroleum ether and moulded into small cubes, which are finally dried by gentle heating. The powder is then treated with a solvent which attacks the surface of the nitro-cellulose. On again drying, each granule is found to be coated with a superficial layer of varnish, which protects the ammonium nitrate from absorbing moisture from the air. Sir Frederick Abel has also produced an explosive named "cordite," which is similar to that patented by M. Nobel, but is obtained in filaments of a light brown colour.

Johnston and Borland have also patented an explosive which is obtained by dissolving nitro-cellulose in a solution containing camphor. After gentle heating the solvent is driven off, and an intimate mixture of the nitro-cellulose with the camphor is obtained. On heating this mixture in a closed vessel, the camphor being

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volatile produces a sort of glazed film on the surface, which renders the mass hard and suitable for use.

More recently, Colonel Noble has succeeded in producing at the gunpowder factory at Waltham Abbey a new smokeless powder, termed "Walthamite," which has already given satisfactory results when fired in the new magazine rifle at the Government ranges at Enfield Lock. Its composition is at present not made known, but it is understood that peat is used in its manufacture, and that therefore it may contain as one of its ingredients ammonium ulmate similar to the Gaens powder, to which we have have already alluded.

THE SOCIETY OF CHEMICAL INDUSTRY.

LONDON SECTION.

At the meeting on Monday, the 2nd inst., Messrs. Cross and Bevan read a paper, entitled "Some Considerations on the Chemistry of Hypochlorite Bleaching," in which they advanced evidence in support of the following points:—

(*a*) Bleaching by means of the hypochlorites is attended with chlorination of the fibre.

(*b*) That there is less chlorination of the fibre when magnesium hypochlorite and electrolysed magnesium chloride are employed instead of bleaching powder.

(*c*) That chlorination of the fibre takes place is proved by the presence of organic chlorides in the washed pulp, and in the amount of soluble chloride and free base being less than should be the case if no such change takes place.

It consequently follows that bleaching by bleaching powder is a different chemical action from that in which permanganates and hydrogen peroxide are employed.

The authors show that bleaching by means of hypochlorites includes the three chemical changes of hydrolysis, oxidation, and chlorination, and point out that these changes are influenced by the temperature at which the bleaching is performed, by the quantity of base present, and by the strength of bleaching solution employed.

Bleaching by means of sodium hypochlorite is very similar to that effected by bleaching powder, the amount of base retained by the fibre and extent of chlorination being nearly the same. The chlorination appears to be due to the presence of organic substances of the nature of ketones in the fibre, and the organic chloride produced in this way has no doubt feeble acid characteristics which bring about the retention of the basic constituents of the bleaching liquid by the bleached fibre.

Notes.

THE BRITISH ASSOCIATION.

The sixtieth annual meeting of this Association will commence on Wednesday, the 3rd of September, at Leeds, under the presidency of Sir Frederick Augustus Abel. The following are the presidents of the various sections:—Mathematical and Physical Science, Mr. J. W. L. Glaisher; Chemical Science, Professor T. E. Thorpe; Geology, Professor A. H. Green; Biology, Professor Milnes Marshall; Geography, Colonel Sir Lambert Playfair; Economic Science and Statistics, Professor Alfred Marshall; Mechanical Science, Captain A. Noble; Anthropology, Dr. John Evans. The local secretaries are Messrs. J. Rawlinson Ford and Sydney Lupton and Professors Miall and Smithells.

THE INDUSTRIES OF BAVARIA.

Upper Bavaria has a population of 1,006,761, who are chiefly engaged in the cattle-rearing industry. At Munich there are the famous breweries, whose products are exported to all parts of the world under the name of Munich beer. There still exist artificial flower, colour, mathematical and optical instrument factories, tanneries, and paper mills. Clock wares are highly wrought, and at Munich also railway locomotives and waggons are made. Lithography there is of high repute, and painting, sculpture, and ornamenting give employment to numerous artists. Lower Bavaria has a population of 660,802, engaged especially in agriculture and in trading in products of the soil. There are, however, several factories of ceramic and glass articles, and peltries. The snuff consumed in the kingdom is chiefly prepared in Lower Bavaria. The Palatinate contains 696,375 inhabitants. The products of the soil are wheat, tobacco, wine, beets, and various fruits; cotton yarn, cotton velvet, cloths, plushes, glassware, nails, iron stoves, and chemical products are also manufactured. The Upper Palatinate has 537,990 inhabitants, devoted principally to agriculture; however, it also produces cloths, paper, porcelain, glassware, and alcohols. Upper Franconia has 576,703 inhabitants, almost exclusively agricultural, and occupied particularly with market gardening and the culture of table fruits. There are also cotton mills and weaving sheds. Musical instruments and the famous Venetian pearls are also made there. Central Franconia is peopled by 671,966 inhabitants. The products of its soil are principally tobacco, hops, and wheat. Lower Franconia, with 619,436 inhabitants, produces celebrated wheat and wines. Swabia, with 650,166 inhabitants, exports large quantities of cheese, and supplies cotton and woollen yarns, sewing threads, typographic machines, paper ware, brass, watch springs, saw blades, and matches.

MANUFACTURE OF PAPER IN THE UNITED STATES.

Americans are beginning to compete with this country in the paper trade. The English Consul at Boston, in reporting on the commerce of his district during the past year, states that the manufacture of paper, though not very profitable, owing to the competition of the increasing number of factories, has been brought to such a high state of development, and reduced so much in cost of production by improved machinery and the successful use of wood pulp under a special process, that it has become possible to establish a large export trade, not only in rivalry with, but directly to, the United Kingdom. A market has also been found in Australia and elsewhere.

PROFIT SHARING.

The policy of a firm or company sharing profits with the men employed seems on the face of it to be an equitable and just arrangement, and calculated to have good effects. A great deal of noise is being just now made in the American papers over a scheme put forward by the Illinois Steel Company, to pay to their workmen who have been with them a year 1 per cent. on their wages, 1¼ per cent. after eighteen months' service, and ¼ per cent. additional for every six months up to five years, when no further advance will be made. Any cessation from work during the period will disqualify for the benefits. This our American friends term "profit sharing," but this is a perversion of the English language. The basis of reward is the wages paid, and not the profits made by the company. Under such an interpretation, everyone who has wages paid him is a profit sharer, which is manifestly absurd. The system is merely one of giving a premium for continuous service and good behaviour.

THE McKINLEY TARIFF BILL.

In referring to this Bill, which passed through the House of Representatives on the 21st ult., our American contemporary, *The Iron Age*—in the issue just to hand—says: "So far as the iron and metal trades are concerned the Bill presents only a few modifications which will be of widespread influence. This, of course, is particularly true of the tinplate duty, which will create a great industry and will largely increase the consumption of raw material. It is probable that a sharp contest between the American and Welsh makers will soon follow, so that an interesting and momentous period lies before that particular trade. It is not improbable that the greater part of the stock abroad will be rushed over to this country as soon as it becomes certain that the Bill will become a law. In the metal trades the reduction in the duty on copper is of very little consequence, the only really important feature of the measure being the duty on foreign lead ores, which will keep Mexican free lead out of our markets. Even now the price of the metal has risen materially. Whether the frontier smelters will find it possible to handle any quantity of Mexican ore under the drawback system remains to be seen. The contest in the Senate, and the compromises in subsequent conferences of both Houses, are likely to deal with other parts of the Bill than the metal schedule, so that, with the exception of minor modifications, the McKinley rates are likely to prevail."

ODORISING WATER GAS.

Dr. Lewkowitsch, in a recent note in the *Chemical News*, suggests the use of thio-acetone for odorising water gas. This compound can be readily prepared, and has a characteristic penetrating odour, which would render it possible to detect the escape of very small quantities of water gas odorised with it. Like mercaptan and several other compounds which have been suggested for this purpose, this body contains sulphur, and may therefore not be so suitable as acrolein, which the author also suggests for the same purpose. The removal of the poisonous carbon-monoxide itself, and the substitution of an equal volume of hydrogen gas, has been patented by Professors Crookes and Ricarde-Seaver, but we have not been able to ascertain whether the process has been tried on a sufficiently large scale to demonstrate its advantages. They pass the water gas over red-hot soda-lime, and the action of the soda-lime on the gas may be thus expressed—

$$2NaOH + CO = Na_2CO_3 + 2H.$$

Carbonate of soda, it will be noticed, is reproduced in the process, and only requires recausticising with fresh lime for a subsequent operation. The cost of lime has, therefore, to be added to the cost of manufacture of the gas, but, on the other hand, the calorific value of hydrogen is much greater than that of the carbon-monoxide it replaces. The low density of hydrogen makes it more liable to diffuse than even carbon-monoxide through leaky fittings, so that it would apparently be still of advantage to odorise the hydrogen.

THE TRADE OF DAMASCUS.

It is really a comfort to find a British consul who says that our merchants do well, many seeming to consider it necessary to grumble at them each time that they write to the Foreign Office. Consul Dickson of Damascus gives a gratifying account of our trade there, for out of imports of the total value of £670,760 our share last year was £354,027, an increase of £119,356 compared with the previous year. "The activity of British firms, in making themselves known by advertisements, circulars, and correspondence with local merchants, has helped somewhat to promote business relations with England and to increase the demand for articles of British manufacture." The import of cotton goods has greatly increased; so has yarn. Iron has also improved, but hardware and glass have fallen off to a slight extent.

POLISH TRADE.

Improvements in Custom House arrangements will facilitate trade between Dantzig and Warsaw, and consequently have a beneficial effect on British trade with the latter district, which is mainly carried on through Dantzig. Last year's foreign trade showed a considerable improvement on the whole. The import into Warsaw of woollen textiles advanced to a marked extent, and raw wool also advanced. Steel and iron goods also increased. The cause of this improvement was largely a more favourable rate of exchange. The industries of Poland have made substantial progress, wool weaving and spinning mills, cotton mills, and other manufacturing establishments increasing in number. The industrial centre in which the advance is most prominent is the town of Lodz and its neighbourhood, in the Government of Pietrokow.

IMPORTS AT BARCELONA.

The total quantity of raw materials imported last year at Barcelona are reported by the British Consul there to have been 593,645 tons, an increase of 34,155 tons over the previous year. Of this 395,495 tons came from Great Britain and our Colonies. Textile materials from England and India showed little change compared with the previous year. The falling off in the quantity of pig iron, steel, and smelting iron amounts to 5,897 tons; the total amount is not given. The cause is that native iron from Gijon and other parts of the North of Spain is taking the place of English and Scotch iron. The total weight of manufactured goods imported in 1889 was 52,742 tons, against 51,862 tons in 1888. There was an increase in the importation of the following articles—viz., worked marble, colouring extracts, chemical and pharmaceutical products, soap, candles, cotton and linen threads, linen and wool textures, silk threads, paper, leather goods, engines, machinery, toys, and indiarubber goods. There was a slight decrease in the following articles of import—viz., porcelain, hardware, copper, brass and zinc articles, palm oil, starch and corn flour, and paste-board and card-board. About 17,790 tons, or one-third of total amount, came from Great Britain, and consisted of glass, bricks, hardware, drugs, chemicals, cotton and wool textiles, textures, machinery, and paper. It is reported that there is no increase in the imports of spun yarn from the United Kingdom. The trade in wet spun yarns has been lost, owing to Belgium, Germany, and Austria being able to supply them at lower rates.

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Patent Record.

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

19th May, 1890.

7747. Anthony & Henry ..... Feeding marine boilers.
7750. Nicol, T. ..... Watertight doors.
7751. Frater, T. ..... Washing machines.
7752. Muschamp, P. ..... Ball-bearing pedestal.
7753. Horne, W. ..... Utilising tides for motive power.
7758. Evans, T. ..... Tubular boilers.
7759. Macnaughton, J. ..... Breechloading firearms.
7761. Sloan & Barnes ..... Manufacture of wood wool.
7762. Barber, T. W. ..... Self-centering chucks.
7763. Wood & Whitaker ..... Boiler furnaces.
7772-3. Martin, E. ..... Filtering machinery.
7782. Boultbee, F. R. ..... Feed and guide for saw benches.
7791. Brining & Lister ..... Nail-driving machines.
7793. Smith, W. ..... Machinery for grinding plate glass.
7797. Hood, W. ..... Pile-driving machines.
7798. Simpson, G. ..... Locomotive engines.
7802. Hayes, G. ..... Metallic lathing.

20th May, 1890.

7807. Davis, G. D. ..... Rotary engines.
7813. Goude, Goude, & Goude Baling press.
7817. Orton, W. ..... Paring machines.
7820. Bates, F. G. ..... Cementation process.
7823. Sagar & Sagar ..... Carving machinery.
7826. Locher, E. ..... Transporting passengers and goods by air pressure.
7829. Hemingway, W. ..... Carding engines.
7833. Hochedez, A. J. ..... Safety bolt.
7843. Weaver, I. D. ..... Switch points.
7846. Byers, W. L. ..... Anchors.
7848. Palmer & Ware ..... Candle-moulding apparatus.
7849. Jobling, J. A. ..... Pots for melting glass.
7852. Boult, A. J. ..... Computing machines (*Sharpe*).
7856. Cherry, H. J. ..... Heeling machinery.
7857. Jennings & Byrne ..... Washing machines.
7861. Monro, C. E. ..... Typewriting machines.
7863. Bartlett & Keuffel ... Crank connections.
7864. Stuart, S. ..... Channel iron.
7865. Kadzidtoroski, A. R. ... Detachable link toothed chains.
7866. Williams, W. P. ..... Street indicators for tramway cars.
7869. Smith, C. R. ..... Seamless gold-plated wire.
7870. Hale, G. C. ..... Portable water towers.
7872. Marzin, L. ..... Steering apparatus.
7873. Perry, F. J. ..... Embroidery machines.
7879. Lycoudio, P. S. ..... Ordnance.
7881. Szeniowski & Piatkowski ..... Centrifugal machines.
7885. Bilgram, H. ..... Machines for manufacturing cigarettes.

22nd May, 1890.

7886. Norman & Simpson ..... Furnaces.
7888. Shipman, J. T. ..... Tubular boilers.
7892. Atterton, J. ..... Machines for washing roots.
7898. Jones, J. ..... Hangers for belt guide pulleys.
7899. Collis, A. B. ..... Engine governor.
7904. Hall, O. S. ..... Looms.
7906. Wootton, J. ..... Circular saws.
7909. Smith, M. ..... Printing machines, &c.
7911. Moore, E. ..... Ironing machine.
7912. Cordes, H. ..... Shot-making apparatus.
7915. Anderson, R. ..... Steam engines.
7919. Douglas, G. ..... Machinery for pressing and finishing textile fabrics.
7920. Bennett & Hides ..... Gas engines.
7929. Galloway & Beckwith Water tube boilers.
7933. Bellach, H. ..... Stamping sheet metal.
7957. Clayton, Shuttleworth, Shuttleworth, Clark, & Gamble ..... Thrashing machines.
7942. Edwards, E. H ..... Cement kilns.
7950. Robinson, G. W. ..... Cork-cutting machines.
7952. Lever, Holland, & Todd Steam boilers.
7953. Lever, Holland, & Todd Boiler furnaces.
7955. Williams, J. ..... Hydraulic engines.
7957. Montbith, J. ..... Rotary engines.
7959. Smith & Smith ..... Locks and bolts.
7964. Baker, W. ..... Breechloading small arms.
7966. Jones, J. ..... Rotary bookcase-making machine.
7967. Weir & Weir ..... Steam-heated evaporators
7969. Agnel, A. ..... Hammerless gun.
7973. Haddan, H. J. ..... Grinding discs (*Snissaert*).
7974. Fowler, A. B. ..... Boot treeing machines.
7980. Meunier, Père, & Meunier, Fils ..... Spinning machines.
7985. Barclay & Duncan ..... Lock nuts.
7995. Thompson, W. P. ..... Steam engines (*Schaefer*).
8003. Cole, W. ..... Centrifugal machinery.
8005. Lake, H. H. ..... Ingots for plated wire (*Smith*).
8006. Westbrook & Burns ... Dies and stocks for cutting threads.
8010. Broadbent, E. W. ..... Sewing machines.
8011. Gastrell, J. P. H. ..... Levers and linkages.
8012. Gastrell, J. P. H. ..... Linkages for transmitting motion.
8017. Wolseley, F. Y. ..... Universal joint for shafts.
8021. Hale, J. M. ..... Ships' boats, &c.
8022. Marr, J. N. ..... Clearing tramway lines.
8024. Chadwell, C. ..... Tramway points.

23rd May, 1890.

8038. Kelly, R. ..... Bending pipes, &c.
8039. Glinsmann, H. C. ..... Washing machines.
8041. McGregor, A. ..... Reaping and mowing machines.
8045. Bayly, J. P. ..... Nut lock (*Thompson*).
8050. Torkington, J. ..... Smoke-consuming apparatus.
8053. Booth, W. A. ..... Sectional warping machines.
8060. Stott, J. ..... Printing machines.
8061. Cooper, E. W. ..... Looms.
8063. Boardman, J. W. ..... Standards for wire fencing.
8065. Eastman, M. ..... Permanent way.
8067. Foxwell, J. B. ..... Hollow fire-bars.
8069. Douglas, S. ..... Apparatus for propelling vessels, raising water and other liquids, and compressing gases.
8071. Seddon, F. ..... Valves.
8074. Woods & Woods ..... Crushing mill.
8078. Martin, A. ..... Apparatus for clipping animals.
8079. Hartmann, E. ..... Railway brakes.
8080. Lederer & Plouhy ..... Carding machines.
8092. Williams, J. N. S. ..... Sugar cane slicing machines.
8093. Odell, J. B. ..... Type distributing apparatus.
8101. Preece & Bass ..... Hauling apparatus.
8107. Wilson, G. ..... Propelling vessels.
8108. Sarg, F. ..... Concrete arches, floors, &c.

24th May, 1890.

8120. Paine, E. ..... Cleaning bottoms and sides of vessels.
8122. Rushforth, W. ..... Brick-making machinery.
8126. Wignall, T. H. ..... Consuming smoke.
8130. Tattersall, J. ..... Sizing machines.
8132. Pearse, T. ..... Agricultural rollers.
8134. Sykes & Sykes ..... Machinery for dyeing, &c.
8136. Brown, A. F. G. ..... Metallic packing.
8142. Hunter, R. ..... Steam engines (*Hunter*).
8145. Wright, J. ..... Heating water, &c., and condensing steam.
8152. Thompson, W. P. ..... Tube rolling machines (*Kellogg*).
8154. Livesey & Gill ..... Looms.
8156. Atkinson, W. ..... Reducing valve.
8159. Parmiter, P. J. ..... Horse rakes.
8162. Bayly, J. P. ..... Illuminating harbours (*Solmans*).
8163. Bayly, J. P. ..... Railway cars (*Elliott*).
8167. Moffatt & Stuttaford Consuming smoke.
8168. Moffatt & Stuttaford Furnaces of steam boilers.
8173. Walker, A. T. ..... Apparatus for washing sand, &c.
8176. Chaudet, E. ..... Heating apparatus.
8177. Beecroft, W. ..... Apparatus for finishing fabrics.

ELECTRICITY.

20th May, 1890.

7821. Toomey, A. M. ..... Telephone call stations.
7836. Stitzel, Weinedel, Schwartz, Reutlinger, Egelhoff, & Kreiger ..... Electric semaphores.
7853. Thompson, W. P. ..... Welding metals electrically (*Coffin*).
7867. Lake, H. H. ..... Electric motors (*Giant Electric Motor Company*).
7871. Hart, O. W. ..... Electrical signal circuits.
7876. Lake, H. H. ..... Electric furnaces (*Colby*).

22nd May, 1890.

7932. Elmore, F. E. ..... Electrolytically deposited tubes.
7981. Sechehaye, E. ..... Dynamos and motors.
7988-9-90-91-92-93-94. Coffin, C. L. ..... Welding metals electrically. (6th November, 1889, &c.)
8031. Radcliffe, R. D. ..... Printing telegraphs.

23rd May, 1890.

8036. Eddison, R. W. ..... Insulated electric conductor (*Niemetz*).
8076. Wilkinson, G. ..... Distribution of electric energy.
8086. Bailey & Warnes ..... Secondary batteries.
8110. Forbes, G. ..... Electric regulators and meters.

24th May, 1890.

8114-5. Parfitt, G. ..... Electric light fittings.
8116. Binswanger & Franke Electrical switches.
8141. Nichols, H. G. ..... Electric lamp.
8153. Holmes, A. B. ..... Accumulators.
8172. Melhuish, A. G. ..... Regulation of motors.

CHEMISTRY.

19th May, 1890.

7754. Allen & Staveley ..... Metallic compounds of phenoloids.
7757. Ehmann, C. P. E. ..... Gas from naphtha.
7764. Playfair, D. J. ..... Cyanides and ferrocyanides.

20th May, 1890.

7827. Fox, S. ..... Water gas.
7830. Sykes & Blamires ..... Conversion of solid into gaseous fuel.
7851. Rowman, R. D. ..... Oxygen.
7854. Rehnström, A. W. ..... Soap.

22nd May, 1890.

7889. Dyson, W. ..... Making gas.
7916. Thomas, F. T. ..... Cleaning metal plates.
7926. Johnson, J. Y. ..... Dioxynaphthaline carbon acids (*Von Heyden*).
7983. Butterfield, Batchelor, & Fairley ..... Ammonium nitrate.
8004. Lake, H. H. ..... Amalgamator (*Actiengesellschaft Grusonwerk*).
8032. Dowland, W. H. ..... Gold and silver.

23rd May, 1890.

8064. Fullarton, R. ..... Purifying phosphatic minerals.
8077. Allen, G. ..... Soap.
8090. Pennock & Bradburn ... Bleaching powder and caustic soda.
8109. Freund, E. ..... Manufacture of gas.

24th May, 1890.

8150. Leith, J. ..... Treatment of alkali waste.
8170. Clark, W. ..... Illuminating gas.

MISCELLANEOUS.

19th May, 1890.

7749. Howat, A. ..... Miners' safety lamps.
7789. Newton, A. N. ..... Rockets (*Nobel*).
7792. Olson, E. G. ..... Belting.

20th May, 1890.

7816. Loudon, J. A. ..... Peat fibre for paper.
7818. Brough, J. R. ..... Fire escape apparatus.
7840. Young, W. C. ..... Purification of water by distillation.
7874. Lindley & Bolt ..... Extinguishing fire.

22nd May, 1890.

7902. Lea, F. B. ..... Recording measuring apparatus
7962. Watkins, R. ..... Portland cement.
7963. Lodge, J. W. ..... Treating sewage water.
7976. Hall, A. T. ..... Refining vegetable oils.
7999. Gray & Thompson ..... Purification of cotton seed.
8025. Ollier & Sansom ..... Storing explosives.
8033. Skelsey, G. H. ..... Cement.

23rd May, 1890.

8066. Summer, W. ..... Spindles and collars.

24th May, 1890.

8155. Livesey & Gill ..... Fire alarm gongs.
8175. Hill, J. ..... Fire extinguishers.
8180. De la Roche, Vicomte C. Scouring textile fibres.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form of such opposition.

Year 1889.

3107. Wilcher.
8282. Silk.
8304. Edouard Henri Allain.
8513. Hughes.
8694. Fischer.
9380. Hornsby & Innocent.
9507. Weir.
9725. Huxtable.
9816. Clarke.
9879. Green.
9992. Thomson.
10022. Norman & Coates.
10059. Mack.
10279. Evenden.
10306. Hamer.
10395. Lambert.
10740. Larsen.
10987. Tánczos.
11294. Rosoman.
11382. Sharples.
11443. Rickards.
11479. Cochrane.
11560. Harfield.
11600. Brown.
11652. Garvey, Tattersall, & Jones.
11638. Peck.
11646. Norris.
11664. Abel & Dewar.
11707. Parker & Robinson.
11800. Bartlett.
11810. Tillcock.
11847. Siemens Bros. & Co., Ld. (*Siemens & Halske*).
11959. Stenner, Hamlin, & Stenner.
12031. Imray (*Farbwerke vormals Meister, Lucius & Brüning*).
12481. Worrall.
13193. Hooper & Moore.
13271. Smith.
14075. Lariviére.
14694. Telford.
15940. Chennell.
17410. Howat.
18886. Bennett.
18994. Thompson (*Beaudry*).
20161. Dürr.
20786. Hirst.
8265. Bruce, Gibson, & Reeve.
8335. Sowter.
8545. Gilson.
8989. Southcombe.
9430. Newell.
9692. Graemiger, Whitehead, Mason, & Leigh.
9984. Jakins (*Jakins*).
9995. Wilder, Wilder, & Wilder.
10084. Spittle & Millington.
10285. Harris.
10333. Thornalley.
10401. Rowell.
10782. Melvin.
11257. Thomson & Thomson.
11320. Hawksley.
11389. Sutton.
11449. Morton.
11517. Hopkins.
11565. Childs.
11627. Rawcliffe & Eastwood.
11635. Whiteley & Whiteley.
11642. Malcolm.
11659. Fenn.
11675. Askham.
11786. Procter & Peel.
11808. Shanks, Burnside, & McCorkindale.
11864. Barclay.
11917. Newton (*Good*).
11979. Lake (*Gilbert*).
12029. Rinecker.
12134. Pendred.
12311. Shapley.
12312. Lea.
12851. Wortmann.
13206. Smith.
13330. Reinhold.
14108. Rankin.
14832. Jones.
15965. Beetham.
18778. Smith & Ewen.
18897. Cunnington.
19481. Moore.
20253. Ancizar.
20940. Martin.

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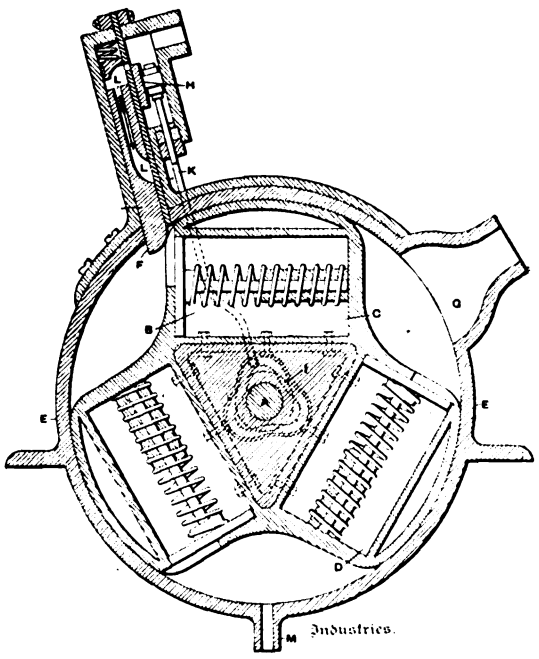
1890.

855. Carl Emil Gebüher & Bruno von Bültzingslöwen.
2753. Woodward.
3263. Hinks, Hinks, & Son, Ld.
3665. Papendick.
3670. Thompson.
4254. French.
4484. Munslow & Munslow.
4538. Gauger.
4741. Gibbs.
4848. Edwards.
5021. Rittenhouse & Dresher.
5169. Kucbinka.
5203. Moncrieff & Moncrieff.
5272. Stempel.
5654. Allison (*Edgar*).
5747. Martin.
5894. Boult (*Bookwalter*).
5965. Tomlinson.
6017. Rau.
6029. Abbe & Rudolph.
6050. Morton.
6092. Jensen (*Stout & Underwood*).
6106. Wood & Houston.
6120. Kintner.
6122. Watrous.
6139. Evans.
6175. Thomson.
6199. Curtis.
6218. Jones & Bridger.
6231. Fielding.
1213. Grant.
1778. Read.
2535. Staley.
2848. Eyre.
3338. Prestwich & Prestwich.
3682. Hinks, Hinks, & Son, Ld.
4306a. White. (19th March, 1890.)
4670. Imray (*Gilbert*).
4809. Johnson (*Duclos*).
4883. Shoebotham.
5067. Heskier.
5198. Rauhe.
5219. Anderson.
5269. Jennings.
5402. Ockendon.
5701. Amiguet.
5814. McGrady (*Crandall*).
5964. Borradaile.
6016. Meili.
6028. Rudolph.
6040 Lake (*Goodrich*).
6051. Chadwick.
6097. Day (*Bousall*).
6103. Douse.
6107. Mewburn (*Peck*).
6121. Lake (*Gray & Soby*).
6130. Boult (*Smith*).
6140. Baker.
6190. Oettli.
6212. Haddan (*The Bissell Carpet Sweeper Company*).

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

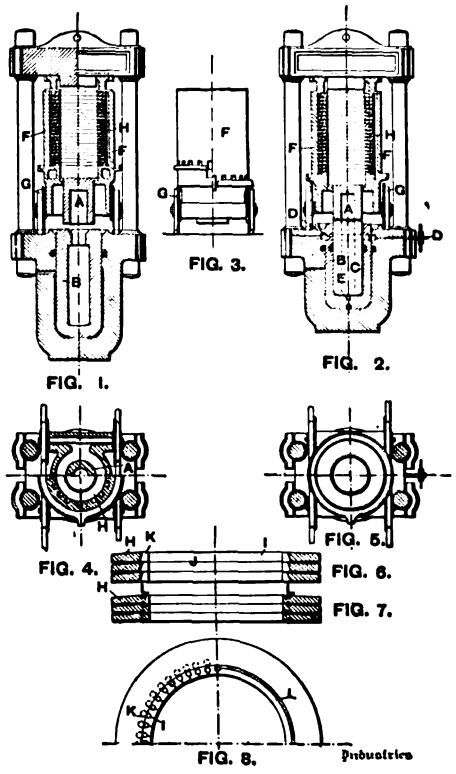
ENGINEERING.

Rotary Engines.—*G. J. Clarkson, Stockton-on-Tees.* (*R. C. Fisher, Ontario, Canada.*) The illustration shows a sectional elevation of this improved rotary engine. Upon the driving shaft is secured the three cylinders B, C, and D. These cylinders are fitted with pistons which are pressed against the partially open ends of the cylinders by coiled springs. The cylinders B, C, and D are enclosed in a chamber E, which has a steam inlet F and exhaust G. The steam inlet is fitted with a slide valve H worked by a bowl travelling in the groove I; the inlet is also fitted with a sliding piece J. The action is as follows: The shaft is first revolved by hand; this causes the rod K to draw the valve down and admit steam into the space L. The



block J is thus forced downwards, and its rounded edge pressing against the framing of the cylinders causes them and the shaft to revolve. When the block J has descended sufficiently to expose the passage L the steam enters the space between the case E and the piston of the cylinder B. The piston is then pressed into its cylinder against the resistance of the spring, and the cylinders are thus caused to rotate. Before the head of the cylinder reaches the port G and the steam is exhausted, the supply is cut off and the steam used expansively. The opening M is the outlet for condensed steam. Four claims are made.—No. 19110. November 28th, 1889. 8*d.*

Presses for Extracting Oil.—*W. P. Thompson, Liverpool,* (*A. Schumacher & C. Tschiffeli, Marseilles.*)—To secure a large return from oil mills it is proposed to treat the articles to be pressed in metal cages, and under a much greater pressure than formerly. The increase of pressure in this system is attained by diminishing the area of the cages in proportion to that of the pistons of the presses; the greater difference of area the greater will be the pressure. Fig. 1 is a vertical section of one form of press constructed according to this invention; Fig. 2 is a similar view of a modification; Fig. 3 is an elevation of the cage of the improved press; Fig. 4 is a section; Fig. 5 is a sectional plan of Fig. 2; Figs. 6, 7, and 8 are details. The piston of the press being of too great a diameter to penetrate into that part of the cage where the materials to be pressed are placed, recourse is had to one or the other arrangement of pistons here mentioned, namely:—First, to terminate the bottom of the cover of the cage by a pressure cylinder A of a certain height having a vacant



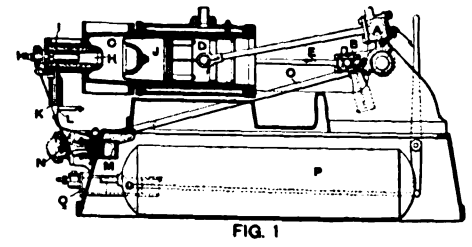
space around its lower end in which the piston B can lodge when raised (see Fig. 1). Second, to employ a second piston C resting inside the first B (see Fig. 2). The inner piston C rises first, the outer one B being held stationary by a brake D. A lifting valve E is provided. At the commencement of the pressure the brake D holds the large piston B immovable until the small piston has produced its effect. The brake is then released, and, the valve closing itself by its own weight, the two pistons rise together. The cage F is composed of a metal case mounted on rollers or wheels G. In the inner side of this cover or case is a number of vertical grooves destined to allow the expressed oil to escape. In the interior of the above-named cage is piled, one above the other, a number of horizontal rings H or rundles of circular or rectangular section, or of any other suitable shape. These rundles are placed one above the other, and, as shown, are connected by horizontal joints J, to which is given more or less play according to the nature of the grain to be treated. The rundles are pierced with a number of vertical holes K with vertical openings I, destined to provide, in addition to the filtering horizontal joints, as many vertical filtering joints as desired. These rings or rundles preferably taper slightly from top to bottom, in order to facilitate the discharge of the oil bags. For the treatment of certain grains and oleaginous fruits, between the parts of the rundles which are in contact semi-circular channels L are formed, and, in order to prevent the pulp under the action of the pressure coming out with the oil, the channels thus made are filled with a little packing of hair, aloes, or any other filtering material, or even with a metal circle covered with one of these filtering materials. Five claims are made for the method of adapting presses to work at higher pressure, and for the manner of constructing the cage.—No. 8740. May 27th, 1889. 8*d.*

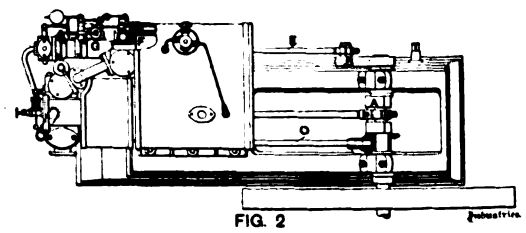
Compressing Plastic Substances.—*J. Price, London.*—In the moulds used in this class of machine difficulty has sometimes been experienced in removing the pressed material from the mould without effecting its shape, sharpness of outline, &c. In the manufacture of blocks and slabs of artificial stone this is an important feature. To prevent these defects the inventor constructs a mould as follows:—The head and bed plate of the press are fitted with loose plates to form the top and bottom of the mould, the plates having any pattern upon them required. The sides of the mould may be formed of one or several pieces. When the material has been compressed in this mould the plunger of the press is secured by means of any suitable mechanical device, and the sides of the mould are then slidden upwards or downwards, clear of the compressed material and the loose plates. The block of material, with the top and bottom plates adhering, is removed from the press and dried. When the block is sufficiently dry the plates are removed. Claims:—(1) In a hydraulic press, a mould of which the sides are capable of being moved independently of the top and bottom of the mould; (2) in a hydraulic press, a mould of which the sides are capable of being moved in combination with means for securing the plunger of the press during such movement; (3) a hydraulic press, in which after the material has been compressed the plunger is secured, the sides of the mould are moved away, the material is held between an upper and lower plate and then removed fixed between the said plates; (4) a hydraulic press constructed as and for the purposes described.—No. 6861. April 24th, 1889. 8*d.*

Ribbed Glass, &c.—*A. Drummond, Glasgow.*—Under the present system of manufacture, designs upon glass are produced by passing a roller, upon which the design is cut, over the glass when it is in a ductile state, or by pouring the glass upon the table in which the required design is cut. To facilitate the construction of the designs is the object of the present invention. The designs are cut or embossed in thin sheets of metal by presses, punches, and dies. This thin sheet, with the pattern so formed, is laid upon the table or bent round the roller. In the latter case the edges of the sheet are brazed together, and beween the pattern sheet and the roller is interposed a sheet of asbestos or other soft fire-resisting body. Claims: (1) In the manufacture of glass the application and use of sheets having designs or patterns impressed, stamped, cut, embossed, or perforated on them, said sheets being either made into cylinders and fitted on a smooth roller or core, or fitted on the surface of the glass casting table; (2) the combination with the roller or core of a casting table of a lining of asbestos or other heat-resisting material, interposed between the said roller and a cylinder, with the designs or patterns on it; (3) the combination with a glass casting table of a sheet, having designs or patterns on it, and secured to the table by means of rods or their equivalents.—No. 8760. May 27th, 1889. 8*d.*

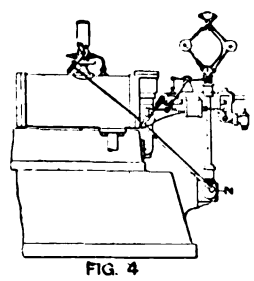
Petroleum Motor Engines.—*O. Imray, London.* (*F. C. Glaser, Berlin*).—These improvements relate to the arrangements for effecting the supply of petroleum to the engine cylinder. The explosive mixture is produced and introduced into the cylinder of the engine by a jet of air which passes the orifice of the petroleum conduit and takes up a certain quantity of petroleum. The petroleum mixes with the jet of air in the form of a spray, and is thus delivered into the heated cylinder bottom. The cylinder is vertical, and has near its lower end a small chamber communicating by a valve directly to the cylinder. Pipes conducting the air current, petroleum, and extra air supply lead to this chamber, the air current pipe being at right angles to the axis of the cylinder, and the others parallel to it, and their openings just below that of the air current supply. When the valves are opened the current of air is forced directly into the cylinder and sucks in with it the petroleum and extra supply of air. Three claims are made.—No. 8778. May 27th, 1889. 8*d.*

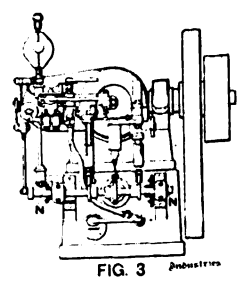
Gas Engines.—*E. & H. Crowe, Middlesbrough.*—Improvements are made in the method of burning and mixing the gases, and in the construction of the valves, combustion chamber, and regenerator. Two pumps are worked by the engine, one compressing the combustible gas, and the other the air necessary for the combustion of the gas. The gases enter the combustion chamber and cylinder at the full pressure of the pumps, and are ignited by a flame produced by passing a small quantity of the explosive gas and air through a tube heated to redness. In the illustration of this invention Fig. 1 is a side elevation partly in section, Fig. 2 a plan, Fig. 3 an end elevation, and Fig. 4 another side elevation. There are two cranks, one, A, being the motor crank, and B the pump crank. The pumps F and G are in the same straight line, and have their pistons suitably coupled and driven by the connecting rod E. The motor cylinder C terminates in a combustion chamber H, which is surrounded by refractible material I, so that the heat developed by one charge may be utilised to heat the succeeding charge. D is the motor piston with a hollow chamber J. The ignition tube K is heated





by a burner L, and gas is passed through the tube by a small pump M driven by an eccentric upon the countershaft N. The shaft N is driven off the crank shaft by gear wheels and the shaft O. The action is as follows:—Assuming the pump pistons to be in and the motor piston receiving an outward impulse, then the pump piston will draw in through suitable valves a charge of air and gas. When both cylinders are full, the pistons return





and compress their charges, and towards the end of the stroke deliver them to the combustion chamber. Just before this, however, the pump M sends a quantity of inflammable mixture through the ignition pipe K. This flame meets the explosive charge as it is delivered by the pumps to the combustion chamber, and the charge is thereby burnt slowly, forming a gradual impulse. To start the engine the reservoir P is first charged with compressed air by a hand pump Q. This air is passed to the engine cylinder, and by its pressure gives to the engine sufficient motion to bring the other parts into work. Eight claims are made.—No. 7594. May 7th, 1889. 8*d.*

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WIRE STRAIGHTENING AND CUTTING MACHINES.—*T. J. Crossley, Middleton Junction, Lancashire.*—Improvements are here made in these machines to permit thinner wires to be straightened and cut into equal lengths than is possible in the ordinary machines. The accompanying illustrations show a side elevation, plan, and end elevation of the improved machine. At the back of the headstock A, a pair of feed rollers I take in the wire W from a reel and push it through the spindle C, where, by passing through the eyelets of the bolts D, which are set out of centre, it is bent backwards and forwards and straightened in the usual way. The wire, on issuing from the spindle, passes between a pair of cutters mounted on a slide N. One of the

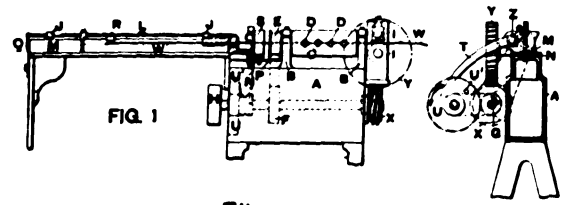


FIG. 1

FIG. 3

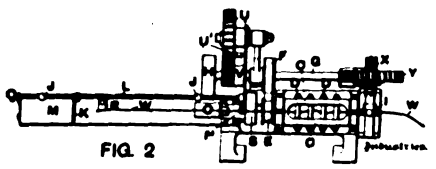
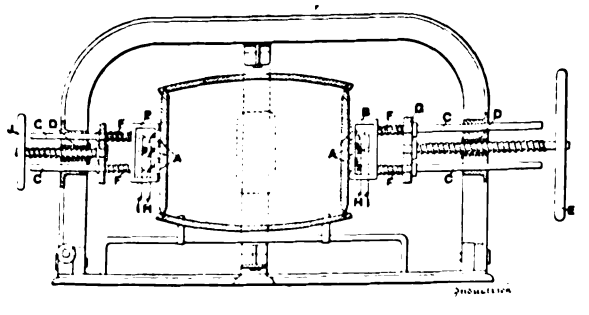


FIG. 2

cutters is attached to a lever T, and it is operated by a pin U¹ lifting the end of the lever as the disc U is revolved. The disc U is driven off the main shaft by suitable connections. The wire, as it passes from the cutters, is conducted along the top of an inclined table M by a bracket O until it strikes against the stop K. The stop K is adjustably connected to a sliding rod L, which is attached to the slide N carrying the cutters. When the end of the wire, therefore, strikes the stop K, the cutters commence to move with the wire, so maintaining a constant distance between the cutters and the end of the wire, until the end of the lever T engages with the stud U¹, and the knives are operated. The wire is then discharged and rolls down the inclined table M to a receptacle, whilst the cutter slide, stop, &c., are returned to their normal positions by the spring P. If the wire is thin, it is supported, as it is pushed along the table, by a number of brackets similar to R. Claims: (1) In wire straightening and cutting machines the arrangement of an adjustable fence K, on a sliding rod L, connected to the cutter slide S, as described and illustrated; (2) in wire cutting and straightening machines placing the cutter slide N at such a distance from the striker wheel U that the cutter slide connected to a sliding rod carrying a stop fence cannot be drawn against said striker wheel by means of the wire pushing the stop fence before the striker has struck the cutter lever T and cut the wire, and employing a long stud U¹ as striker, as described and illustrated; (3) in wire straightening and cutting machine the arrangement of angle brackets R for curving and stiffening the wire substantially as hereinbefore described; (4) the general arrangement of wire cutting and straightening machine as described and illustrated.—No. 9037. May 31st, 1889. 8*d.*

BRANDING MACHINES.—*G. P. Nightingale, London.*—The machine is designed for branding casks, cases, crates, &c. The accompanying illustration shows a sectional elevation of the apparatus. The branding letters A are arranged in the face of a metal frame B. The frame B is supported upon rods C, which slide in the framing of the machine and are operated by a screw D and hand-wheel E. To make the connection flexible between the screw D and branding irons, the springs F are interposed between the cross-head G and frame B. The branding irons are heated by gas burners supplied with gas by pipes H and air by the pipes I. All that is necessary in branding a cask is to place it between the branding irons and screw up the hand-wheel E, the hand-wheel J being for adjustment. Claims: (1) A

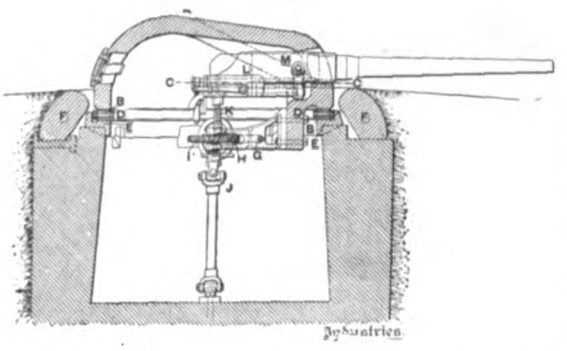


machine for branding casks, cases, and the like, comprising one or more pairs of branding plates, one plate of each pair being capable of adjustment and the other movable for and during branding, with a rest or support for the cask, case, or the like, and spring cushions to the branding plates, substantially as and for the purpose set forth; (2) the machine having two hinged frames substantially as illustrated and described with pairs of branding plates and means for adjustment of one plate of each pair and for movement of the other plate during branding—No. 4019. March 14th, 1890. 6*d.*

BOILER FURNACES.—*H. J. Haddan, London.* (*F. F. Amoroso, Venice, Italy.*)—This invention refers to a method of burning liquid fuel in boiler furnaces. In the furnace is an open tray or tank of convenient shape and size to cover the area of the furnace, and of sufficient depth to hold a moderate quantity of the liquid fuel. Over this tray are journalled horizontally revolving perforated cylinders or rotary bodies provided with radiating wicks of asbestos. The wicks, as they revolve, dip to the required distance into the fuel, and so become saturated. As the wicks emerge from the fuel, the fuel upon them ignites from that burning upon the preceding wicks. The rotation of the wick holders may be done by the engine driven by the steam from the boiler, or by an independent engine or motor. While steam is being raised in the boiler heated by the improved furnace, the wick holders may be revolved by hand or by an independent engine. The wick tank is in connection with a fuel reservoir, the communication being controlled by a ball cock or float. Claim: The means for burning oil consisting of an open tank or tray for receiving said oil, and a system of rotary wick holders dipping into said tank or tray as and for the purpose described.—No. 10392. June 26th, 1889. 6*d.*

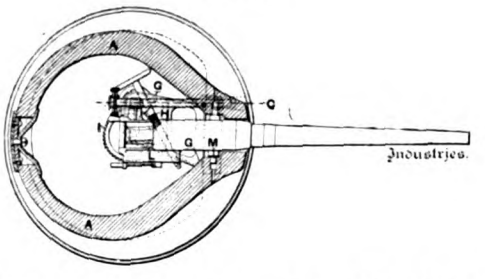
TURRET MOUNTING FOR GUNS.—*T. Nordenfelt, London.*—The turret is not intended to be lowered level to the ground in critical moments, but always maintained at the same height. The shape given to the turret and the mounting renders it safe against hits. A sectional elevation and plan of the turret is given in the accompanying illustrations. To keep the turret A as low as possible, the sights C are placed beneath the gun. The turret rests on a number of rollers B kept in position by rings D, and running upon the base ring E. A massive iron ring F protects the base of the turret. Beneath the gun is a bracket G carrying the turret gearing; the turret is rotated by a worm H and worm-wheel I. The bearings in which the worm is carried are on the bracket G, and they always retain the same position in relation to the turret, whose vertical axis coincides with that of the worm-wheel. The worm-wheel is mounted on the bracket G, so that it can yield to shocks resulting from rough treatment to which the turret may be exposed, and if the turret be slightly displaced it carries the worm-wheel and worm with it. The worm-wheel, however, is prevented from turning, its spindle being connected with the foundation of the turret by a double universal joint J. The bracket, however, is able to rotate around the wheel. The elevation and depression of the gun are effected by means of a common screw K, the top end of which is connected to the cradle L by a ball and socket, whilst its lower end runs through a nut

FIG. 1.



provided with trunnions, the bearings of which are placed in the above-mentioned bracket G. The cradle is carried by trunnions M, which project into the turret. Claims: (1) A fortification turret mounting of substantially the peculiar form described and supported upon rollers beneath its edge; (2) a fortification turret mounting supported upon rollers beneath its edge and turned by

FIG. 2.



gear flexibly connected to the foundation; (3) a fortification turret mounting supported upon rollers beneath its edge and carrying a worm and worm-wheel by which it can be turned, the worm-wheel being prevented from revolving by a flexible connection with the foundation; (4) a fortification turret mounting carrying the gun at the top of the turret, the embrasure being so formed and the gun being so fitted that the line of sight is beneath the gun; (5) fortification turret mountings substantially as described and shown.—No. 9498. June 7th, 1889. 8*d.*

WATER VELOCIPEDE.—*E. F. Bour, London.*—The framing of this apparatus is somewhat similar to that of an ordinary road tricycle, the wheels being here replaced by floats of a torpedo shape. To the rear end of the front float is mounted a small screw propeller; its shaft enters the float and is geared by mitre wheels to a vertical shaft passing out at the top of the float through a journal by which the float is secured to the frame. The vertical shaft is geared to a horizontal shaft in the framing, and is rotated by treadles of the usual volocipede construction, the treadles being geared to the horizontal shaft in a suitable manner. Seats and steering bars similar to those used upon velocipedes are provided for the navigators. The steering is performed by the rotating of the front propelling float about its vertical axis. Claims: (1) A water velocipede having three or more torpedo-shaped or equivalent floats arranged as described, with propeller and driving gear in one or more of the said floats; (2) a water velocipede having a pivoted leading float and two or more fixed trailing floats, shaped and connected by a backbone or framing as set forth, a screw propeller at the end of the leading float, and gear for operating said propeller and for steering the velocipede; (3) a water velocipede as described having pillars and attachments for slinging hammocks thereon; (4) a water velocipede having three torpedo-shaped floats arranged and connected as at the apices of a triangle, and a triangular netting, webbing, or grating slung or supported on a frame between the floats to serve as a flooring; (5) in a water velocipede, a leading float having a resilient fore part telescopically sliding therein and held projected by a spring to minimise the force of a collision.—No. 7256. May 1st, 1889. 8*d.*

LIQUID METERS.—*J. Lacoste, Paris.*—The meter is constructed with a single cylinder, the liquid being made to pass in alternately at opposite ends, and the flow being controlled by a combined arrangement of valves actuated by the piston at the end of each stroke. Referring to the illustrations, Fig. 1 is a longitudinal section, Fig. 2 a sectional plan on X X, Fig. 3 an end elevation, and Figs. 4, 5, and 6 details of the meter. The piston

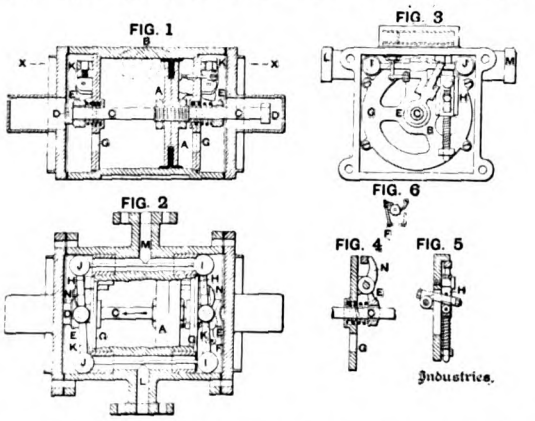


FIG. 1 FIG. 3 FIG. 2 FIG. 6 FIG. 4 FIG. 5

A has a double-ended rod C, upon whose ends are secured the collars D. The collars D at the end of each stroke press against levers E, which are held normally outwards by the springs F. On the levers E are projections N, which strike against the beams K as the levers E are depressed, and operate the valves I J carried by the beams K. The valves are spherical in shape, and control the inlet and outlet openings L M in such a manner that as the piston finishes its stroke to the right the outlet valve I is closed and the inlet valve opened, whilst the reversed effect is produced upon the other valves J. To hold the valves in the positions they are placed at the end of each stroke for the whole length of time of the succeeding stroke, use is made of the spring bolts H. Claims: (1) A liquid meter wherein a measuring cylinder containing a reciprocating piston has two longitudinal passages, the one serving for supply of the liquid, and the other for the discharge, which passages open into each end of the cylinder and are provided with four valves so connected together that at the end of each stroke of the piston the positions of all four valves are simultaneously reversed; (2) in a liquid meter such as is referred to in the preceding claim, mounting the supply and discharge valves at each end of the cylinder upon the opposite ends of a rocking beam, and connecting the two supply valves respectively together by a rod, whereby the simultaneous movement of all four valves is effected when one of the rocking beams is actuated by one of two spring levers, the other spring lever being depressed by a head on the piston rod at the end of a stroke, so as to relieve the other beam of its action; (3) in combination with the arrangement of valve gear referred to in the preceding claim, the use for locking the valves in position of two spring locking bolts, the end of one of which is made by its spring to project beneath the raised end of the one rocking beam so as to keep it in that position, the bolt being withdrawn by an arm acted upon by the piston at the end of its stroke, when it is required to reverse the position of the valves; (4) the construction of fluid meter combined and operating as herein described with reference to the illustrations.—No. 4393. March 20th, 1890. 8*d.*

ROTARY SHUTTLES FOR LOOMS.—*W. P. Thompson, Liverpool.* (*J. H. Mahr, Flensburg, Germany.*)—One or more of these shuttles are arranged in a loom for the purpose of conducting the woof or weft from one side only into the warp, whilst the ordinary shuttles, which have a reciprocating motion, are conducting the woof from both sides into the warp. Fig. 1 is an elevation of this apparatus, and Fig. 2 a section. The under part of the shuttles engage in guides A, which are of circular form, and resemble the letter I in cross section. On the guides are fixed toothed racks B, which engage in tooth-driving wheels C, and thus give the shuttles their motion. D is the groove in which the ordinary shuttle travels. The guide A and rack are formed with a recess E, which allows the shed to be formed. A hole F is formed in the supporting plate of the apparatus, through which

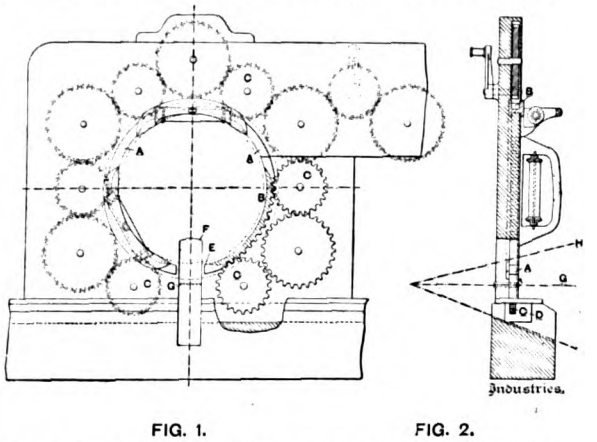


FIG. 1. FIG. 2.

the warp threads are led. The warp beam is at one side of the plate, and the cloth beam at the other. The method of employment is as follows:—The warp threads G normally lie preferably rather below the periphery of the rack and guides A. When the apparatus is in the position shown in the illustrations the shed is formed by raising a certain number H of the warp threads and depressing the remainder I. The number and order of the threads raised will of course depend upon the pattern desired. The series of rotating shuttles is now passed through by means of the gear wheels actuating the rack, and the apparatus again assumes the position shown. The reciprocating shuttle or shuttles may also be passed if desired, or the shed may first be reformed and then the reciprocating shuttle passed. Claim: The

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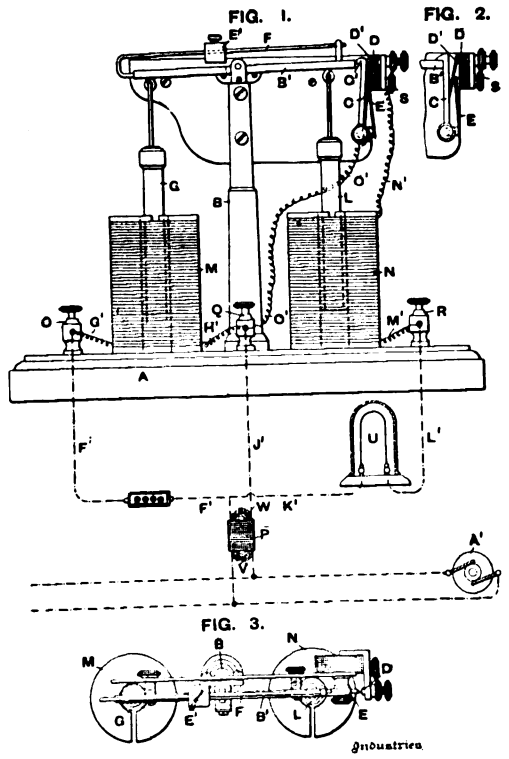
arrangement of one or more shuttles in a circular guide, which shuttles are adapted to be driven in one direction by wheels arranged either within or without the said guide, substantially as and for the purposes set forth.—No. 6519. April 16th, 1889. 6*d*.

PROPELLING CANAL BOATS.—*W. J. Griffiths, Greenwich.*—The boats are propelled by an endless chain mounted upon the boat and made to revolve with its lower half resting upon the bottom of the canal. The chain runs over a series of rollers arranged upon one side of the boat, and it is driven by a motor fixed in the bow of the boat and geared to one of the pulleys, over which the chain passes. As the chain is revolved its lower part has a tendency to be dragged along the bottom of the canal in a direction from the bow to the stern. The frictional resistance, however, between the chain and canal bottom prevents or partially prevents this action, and the boat is instead propelled forwards, the chain being lifted up at the stern and lowered again at the bow. If at any place the depth of water increases the chain will then assume a catenary curve at the bow and stern, and the length lying on the bottom of the canal will be shorter, but owing to the pulley at the bow being above the level of the top of the boat, and that at the stern level with the bottom, the difference in height ordinarily met with will not appreciably affect the resistance of the chain to moving on the bottom. Claim: The propulsion of canal boats by the frictional resistance on the bottom of the canal of an endless chain which is rendered capable of adjusting itself to moderate variations of depth of the canal by the pulleys on the boat being arranged as described.—No. 10260. June 24th, 1889. 8*d*.

STEAM VACUUM PUMPS.—*J. Brindley, Wolverhampton.*—This pump is of the type in which steam acts directly upon the surface of the water, the steam, after completing its work, forming a vacuum by condensation, so causing the pump to be recharged. The simplest form of this pump is constructed with a pear-shaped chamber of cast iron, terminating at its base with an enlarged portion to accommodate the suction and delivery valves. The steam-controlling valve is dispensed with, so that there are but two valves, one for the inlet and the other for the outlet. With a pump chamber constructed and fitted with valves as described, and with a continual flow of steam into it from the top, the water being pumped is driven out to the lowest level in the following manner. The steam acting upon the surface of the water forces it down and out at the discharge valve. As the surface of the water increases, due to the shape of the chamber, the steam rapidly expands and condenses in the lower part of the chamber. The water now rushes into the lower part of the chamber, and by its momentum refills the chamber, causing the action described to be repeated. When more economical working and a steady discharge are desired, a second chamber is used in conjunction with the first, and a valve controlling the admittance of steam to the chambers added. The valve is worked automatically so as to supply steam to one chamber as the other is refilling. Ten claims are made.—No. 10720. July 3rd, 1889. 8*d*.

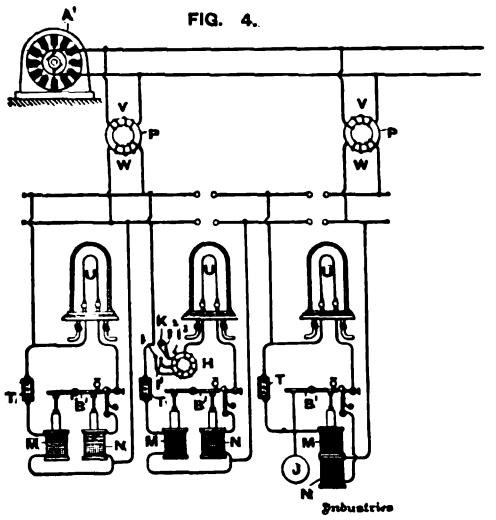
ELECTRICITY.

INTERRUPTING ELECTRIC CIRCUITS.—*W. P. Thompson, Liverpool. (The Westinghouse Electric Company, U.S.A.).*—It has been found that carbon filaments may be treated with advantage by alternating electric currents, and it is desirable that, after the treatment has proceeded to a certain point, the circuit should be automatically interrupted, so that all the filaments after treatment shall have the same resistance. This invention is designed o provide a circuit controlling device which shall insure that the circuit leading to the filaments shall be interrupted, and the



treatment terminated when the resistance of the filament has decreased to a certain predetermined point. The invention is illustrated by the accompanying figures. Fig. 1 is a front elevation, Fig. 2 a detail, Fig. 3 a plan, and Fig. 4 a number of these devices worked from one dynamo but arranged slightly different. Referring to the Figs. 1, 2, and 3, upon a balance lever B¹ are suspended the cores G L of two solenoids M N. The balance lever is retained in a horizontal position by a hook C. A¹ represents any suitable source of electric supply. In the circuit of the electric source is the primary coil of a converter P. The secondary coil of the converter has two circuits, one leading through an adjustable resistance to the post O, from O to the solenoid M, and then back to the coil through the post Q; the second circuit includes the filament U, the solenoid N, the contact device D D¹, and the post Q, which is in connection with the coil. When the filament is inserted and ready to be treated, the end of the lever B¹ carrying the core L is lifted, the arm C being pressed back against the spring E. The end of the catch or projection C¹ then rests against the smooth end of the lever B¹. This holds the spring D¹ against the point D, and completes the circuit, including the filament. Now, as the treatment proceeds, the resistance of the carbon becomes less by reason of the deposit from the surrounding atmosphere of hydrocarbon, and, therefore, more current passes through the solenoid N until the pull upon the core L exceeds that upon the core G sufficiently to draw the end of the lever B¹ downward across the point of the catch, thus allowing the arm C to be forced backward, separating the spring D¹ from the point D, and thus interrupting the circuit through the filament. As the current employed is an alternating current, no injury is done to the contact points by the interruption of the circuit, and, moreover, there still remains a closed secondary circuit through the coil M. It will be noticed, however, that the catch C¹ prevents the lever B¹ from immediately tilting in the opposite direction under the influence of the solenoid M acting upon the core G. Claims: (1) In an apparatus for treating filaments by means of the alternating current, the combination of two solenoids acting upon one or more cores in opposition to each other, a carbonised filament in circuit with one solenoid, and an automatic circuit interrupter in series

FIG. 4.

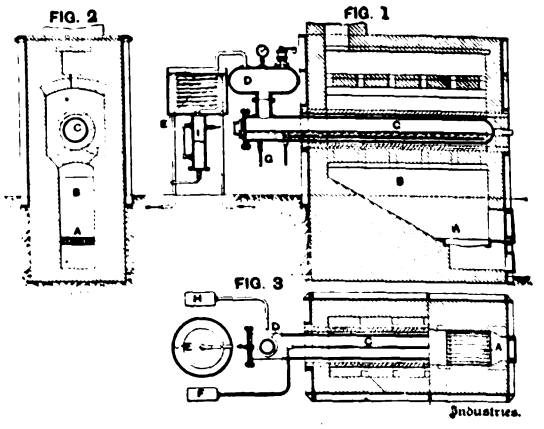


with only the last-named solenoid and the filament, the whole arranged in such manner that the circuit through the carbon filament shall be broken the moment it arrives at the predetermined resistance; (2) the process of treating filaments which consists in dividing an alternating current into two parts, each passing through a separate solenoid, one passing also through the filament to be treated, and a circuit interrupter and the two solenoids acting in opposition to each other on the same core, or on two cores mechanically united, and so arranged that when the two branches reach a certain ratio the one to the other, the circuit containing the filament shall be automatically interrupted; (3) the improved apparatus for treating filaments as described and illustrated.—No. 8815. May 28th, 1889. 8*d*.

ELECTRIC TRAMCARS.—*T. D. Hollick, London.*—The wheels of the tramcar are connected to the electromotor by the use of friction gearing. To prevent the loss of power caused by the necessity of obtaining sufficient pressure between the friction gearing to make them act, the inventor utilises for this purpose the weight of the body of the tramcar. The car is carried, with the intervention of suitable springs, upon the bearings in which the spindle of the electromotor revolves. This spindle is arranged transversely across the car directly above the wheels of the latter which are to be propelled, and upon the spindle are fixed two wheels or pinions of metal, indiarubber, or other material, which press upon the tires of the car wheels and set them in motion. The axles of the car wheels revolve in axle boxes of the usual kind, fitted to horn plates upon the framing which carries the electromotor. To permit of the adjustment of the pressure upon the friction gearing, the inventor arranges one or more cams, actuated by a screw under the control of an attendant, so that the horn plates, electromotor, and car can be raised or lowered to a small extent, and the pressure upon the gear so decreased or increased. Two claims are made.—No. 8468. May 21st, 1889. 8*d*.

CHEMISTRY.

DISTILLATION OF OILS.—*J. Dewar, Cambridge, & B. Redwood, Finchley.*—In distilling mineral oils, such as natural petroleum, or similar oil made from shale, coal, or other bituminous substances, in order to separate the lighter oils, suitable for lamps or other purposes, from the heavier oils, there is frequently a very large residue of heavy oil. The invention refers to an improved motion of obtaining lighter oils from such residue. The illustrations show one form of the apparatus for this purpose. Fig. 1 is a longitudinal, Fig. 2 a transverse, and Fig. 3 a horizontal section of the apparatus. A is the fireplace and B the combustion chamber of a furnace for heating the retort C. The front part of the retort communicates freely with a still head D which in turn communicates with a condensing coil E. A pump F forces the oil to be treated into the retort, and a pipe G provides the means of discharging the contents from the retort. The retort C being partly charged with oil, and the remaining space and the still head charged with air from the air pump H, the retort is heated and the oil vaporised under pressure. The oil vapour as it is developed passes to the condenser E and collects in the vessel I, from which it may be drawn off as desired. The less volatile vapours are condensed in the still head D and fall



back into the retort. Claims: (1) The herein-described method of distilling mineral oils and like products by vaporising them and condensing the vapour generated under a regulated pressure of air or gas; (2) for operating in the manner referred to the combination of a retort or boiler, a condenser, an oil pump, and an air or gas pump with their communicating pipes, as described. —No. 10,277. June 24th, 1889. 8*d*.

MISCELLANEOUS.

GLASS TANKS.—*J. Armstrong, London.*—The tanks are constructed for holding acids for the purpose of electric battery cells, &c., the object of the invention being to make them from rolled plate, or sheet glass. In a specially constructed kiln, heated by gas or fire, is placed a mould of the form of the tank to be constructed. Previously to placing the mould in the kiln, the glass sheet or sheets of the requisite size and shape to form the tank are placed upon the mould. The kiln is heated, and the flames made to play upon the glass, so softening it and causing the sides to bend over into and upon the mould. The flames are then directed upon the edges of the glass until they are heated to fusing point, when an apparatus is made to enter the mould and press the sheets into the shape of the mould. Another instrument is used to rub up and down the edges and weld them together. The mould is then reversed, and the tank removed into an annealing oven. The moulds and other parts of the apparatus are made hollow to admit cooling agents to keep them at the proper temperature. Wirework may be pressed into the glass at the time of pressing it into the shape of the mould. Claims: (1) Making boxes or tanks of glass from sheet or plate glass, by welding the corners or angles, with or without the wirework inserted; (2) in a furnace for making boxes of glass by process of welding the joints as described; (3) in a furnace for making boxes of glass by process of welding the joints, the use of a gas jet or hot flame to impinge upon the joint to be welded; (4) in the process of making boxes of glass, a tool used with pressure or an apparatus to unite the edges of the glass; (5) in a furnace for making boxes of glass, moulds made and constructed as described; (6) in a furnace for the purpose of making glass tanks the use of rails for sliding the moulds upon; (7) the general plan and arrangement of the furnace and apparatus for the purpose of forming glass tanks.—No. 7346. May 2nd, 1889. 6*d*.

APPARATUS FOR THE DIFFUSION OF DISINFECTING FLUIDS.—*A. R. Upward, London.*—The apparatus is adapted to be worked by the opening and closing of a door at the entrance to the room or closet in which the spray is to be diffused. The spray is caused by an air-forcing appliance either attached to the door or to the door frame, and operated by the opening and closing of the door. A tube of convenient length leads from the air-compressor to a spray nozzle of ordinary construction, and supplies the nozzle with the necessary blast of air. The feed pipe of the nozzle is immersed in a tank or vessel containing the disinfectant. To ensure the proper working of the air-compressor, it may be worked by a spring which is compressed by the opening or closing of the door, but released before the expiration of either movement, so that in its sudden recoil it forces the air to and through the spray nozzle. The force of the air supply is thus not dependent upon the rate at which the door is moved. Claims: (1) A spray-producing apparatus operated by the usual motion of the door; (2) a spray-producing apparatus, consisting of an air-compressing device, operated by spring pressure, the elastic extension or compression of the spring being set up and suddenly released by the motion of a door or other equivalent movement, the sudden exhaust of the air operating any form of blast spray nozzle for the dispersion of liquids; (3) in such a spray-producing apparatus a spring pressed air-producing device in combination with a rotating disc having projections which gradually reinforces and suddenly releases the spring of the air-compressing device; (4) in such a spray-producing apparatus an actuating disc and projections in combination with a pawl and driving ratchet wheel upon a drum, rotated by a line, cord, or band against the recoil, reaction of the internal spring by the motion of the door; (5) in such a spray-producing apparatus the combination with a spray nozzle feeding from a small reservoir containing the liquid to be dispersed of an auxiliary liquid supply cistern.—No. 7978. May 14th, 1889. 8*d*.

Copies of the British specifications may be obtained on application to H. READER LACK, Esq., ***Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every*** 10*d*. ***or fraction of*** 10*d*. ***Remittances exceeding one shilling must be made by Post Office Order.***

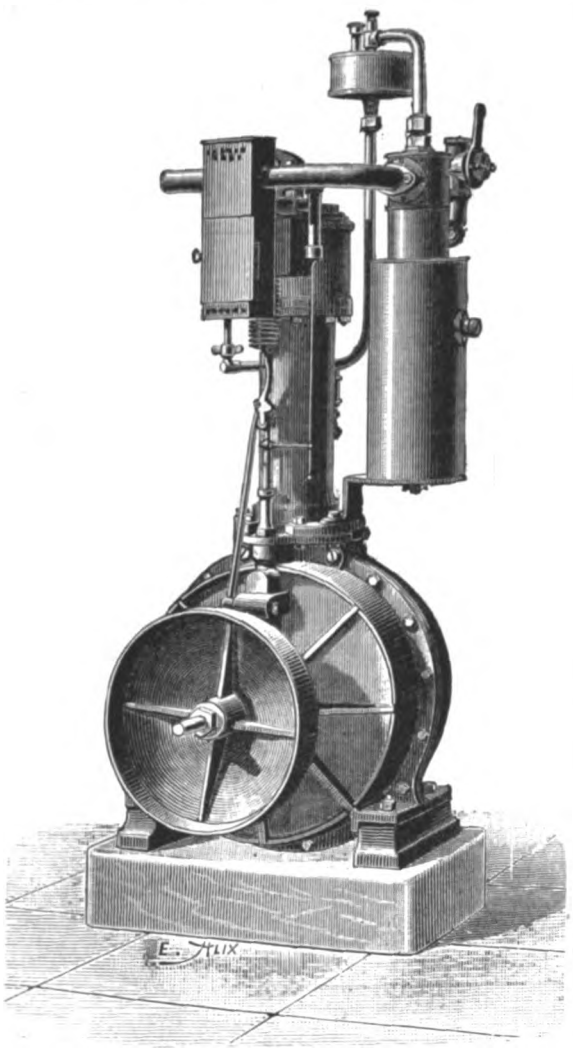
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COKE CRUSHING MACHINE.

We illustrate herewith a machine for crushing coke, which is being made by Messrs. Francis B. Welch & Co., Atlantic Works, City Road, Manchester. It is specially adapted for use in connection with smiths' fires, and it can be worked either by hand or by steam power. The crushed coke falls upon an inclined screen placed under the machine for the purpose of removing the dust and finer particles.

THE DAIMLER PETROLEUM MOTOR.

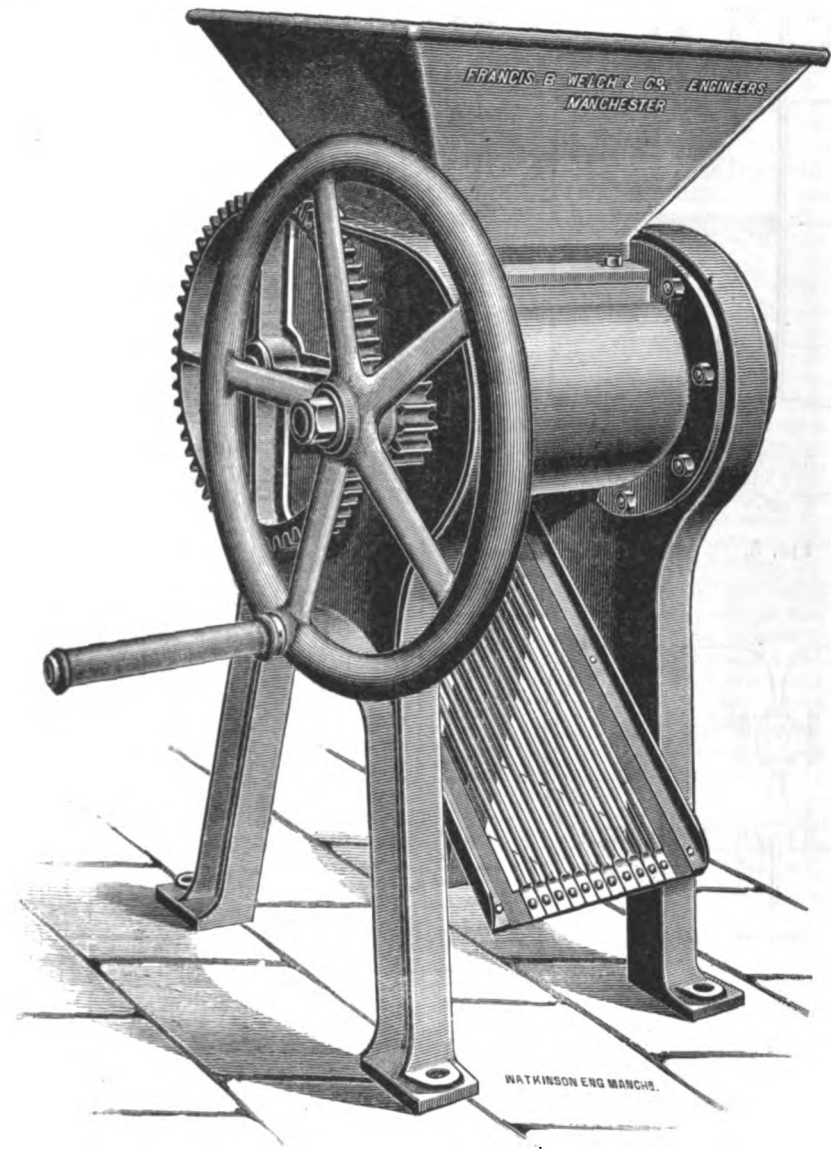
It is claimed that the motor we illustrate below is distinguished from other gas motors by the employment of a more powerful gaseous mixture, and by its high rate of speed. The explosive mixture is formed from gasoline, and the carburetter, where the mixture is prepared, is shown on the right of the illustration. An engine of 1 horse-power consumes about half a litre of gasoline per hour. The speed is regulated by a very sensitive governor acting on the escape valve, and regulates the number of explosions proportionately to the power required. The ignition is effected by a platinum capsule heated to a red heat by an exterior flame. There are, therefore, no slides or electrical spark used. The lubrication of the principal parts of the motor, which are enclosed in the framing, is done by a lubricator placed on the cylinder. The



engine is started by moving a small handle placed on the fly wheel, and which, as soon as one explosion has taken place, throws itself out of gear. The inventor has aimed at producing a motor of light design so as to be easily transportable. This has been done by reducing the number and weight of the working parts, and it is therefore claimed to be especially adapted for electric lighting. pleasure launches, fire engines, and the propulsion of tramcars. As stated in our issue of the 2nd May, a line is being used in the centre of Vienna, in connection with the Lands and Forests Exhibition, to accommodate a new car driven by one of these motors. The Daimler motor is made with one or two cylinders, and can be worked either by petroleum or gas. In the latter case the carburetter is unnecessary. The motor is manufactured by Messrs. Panhard & Le Vassor, of 19, Avenue d'Ivry, Paris. We are indebted to our contemporary *La Revue Universelle des Inventions Nouvelles* for the above illustration.

IMPROVED COKE CRUSHER.

CONSTRUCTED BY MESSRS. FRANCIS B. WELCH & CO., ENGINEERS, MANCHESTER.



RESEARCH COMMITTEE ON MARINE ENGINE TRIALS.*

(*Continued from page 546.*)

2. TRIAL OF THE S.S. "COLCHESTER."

Steamer.—This vessel is the latest of those built for the Great Eastern Railway Company for carrying their passenger traffic between Harwich and Antwerp. The committee is very greatly indebted to the Great Eastern Railway Company, and especially to Mr. Holden, the locomotive superintendent of the line, and to Captain Howard, the company's marine superintendent, for the facilities which they gave throughout for the carrying on of the trial. The "Colchester," which is driven by twin-screws, is a vessel of 281ft. in length, 31ft. beam, and 15·2ft. in depth. Her gross registered tonnage is 1,160, her net registered tonnage being only 517 tons, the remainder of 643 tons representing space occupied by machinery, seamen, &c. Her draught at Harwich at the end of the trial was 13ft. 7in. aft and 10ft. 6in. forward, corresponding to a displacement of 1,675 tons. The trial was made upon the 9th of November, 1889, on a run from the Humber to Harwich. The ship had been lying in the Humber, where her machinery had received a thorough overhauling by the makers, Messrs. Earle's Shipbuilding and Engineering Company, Hull. Steam was got up on the morning of the 8th November, and the engines were turned round about 3 p.m. on that day. The steamer left her moorings about 3 a.m. on the 9th November, and the trial started at 5 a.m. on that morning. It lasted until 4 p.m. exactly, the boat being taken a little south of the Stour estuary in order to prolong the trial somewhat. The furthest south point was reached at 3 p m. on the 9th November. The engines were stopped about seven minutes during this time to allow the pilot to leave the ship, and they were also slowed down for five minutes about the same time. The counter was read at each of these changes of speed, all of which occurred before 5.40 a.m.

Engines—The "Colchester" is fitted with two compound surface-condensing engines, driving the two screw shafts. The engines are entirely separate, and are placed slightly inclining from the vertical, the space between them being taken up by a condenser which is common to the two. They were built by Earle's Shipbuilding and Engineering Company in 1888-9. The vessel had been on her station running to Antwerp and back twice every week from the end of February to the middle of September, 1889, and had run a total distance of about 16,530 miles during that time; and had undergone her first overhaul at the makers, as already mentioned, during the week before the trial. The engines and boilers therefore were in thoroughly good order. The diameters of the cylinders are 30in. and 57in. respectively. An opportunity has not occurred to gauge them. Their common stroke is 36in. The diameter of all piston rods is 6in., and of all tail rods 4·5in. The cranks of each engine are at right angles, and the high pressure cranks lead. The cylinders are not jacketed. The clearances of the high and low pressure cylinders as given by the owners are 9·39 and 6·23 per cent. The valve gear is of the ordinary link motion type. The surface-condenser contains 3,000 square feet of tube surface in 1,176 tubes, 1in. external diameter, and 9ft. 11⅞in. long over plates. The screw propellers have cast-steel blades and boss; each is 11ft. 6in. diameter, and 20ft. 4½in. pitch, with a surface of 45½ square feet.

Boilers.—There are two iron boilers, each double-ended, 13ft. mean diameter, and 18ft. 3in. long; each boiler having six furnaces of 3ft. 4in. internal diameter. The total grate surface is 220 square feet; the length of each surface on bars being 5ft. 6in. The total heating surface is 5,820 square feet, of which 4·770 square feet is tube surface. There are 784 tubes, 3¼in. external diameter, and 6ft. 9in. long over plates. The total heating surface is therefore 26·5 times, and the tube surface 21·7 times the grate surface. The boilers have been designed to work safely with a pressure of 90lb. of steam, but are ordinarily worked, as during the trial, with a pressure from 5lb. to 10lb. less. There are two double funnels, one for each stoke-hold; the internal diameters of their outer and inner shells are respectively 6ft. 7in. and 5ft. 5in., and the total height of each funnel is 47ft. above the centre of the wing furnaces. The total weight of the engines and boilers, including water in condenser, pipes, and boilers, and all mountings is about 395 tons. The net volume of the boilers is about 4,980 cubic feet.

Duration of Trial.—The duration of trial from start to finish was 11 hours exactly. Deducting the 7 minutes of stop, the running time was therefore 10 hours 53 minutes, or 653 minutes.

Coal Measurement.—The coal was weighed in each stoke-hold by spring balances as before. From 500lb. to 760lb. of coal was put down at one time on each side of each stoke hold. The trial was started with clean floors in each stoke-hold. The time was noted at which each lot of weighed coal was put upon the fire, and no more coal was weighed out until the floor was again

* Report prepared by Professor Alexander B.W. Kennedy, F.R.S., Chairman of the Committee, for the Institution of Mechanical Engineers, and read at the meeting of the Institution on the 1st ult.

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RESEARCH COMMITTEE ON MARINE ENGINE TRIALS.

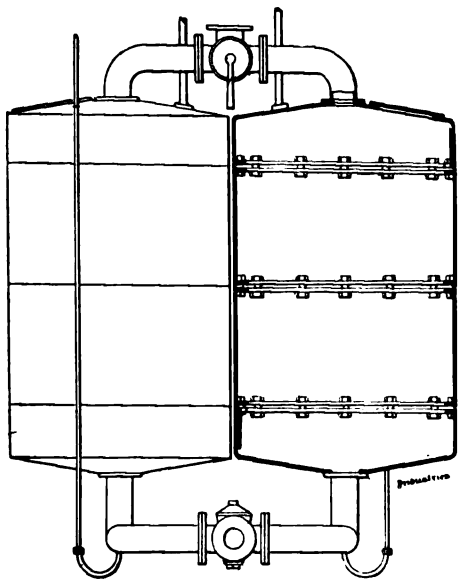


FIG. 5.

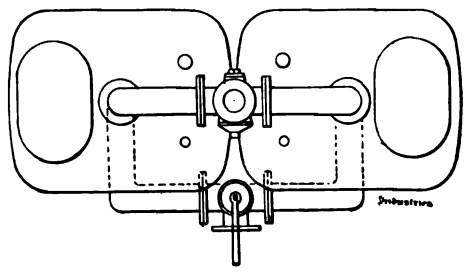


FIG. 6.

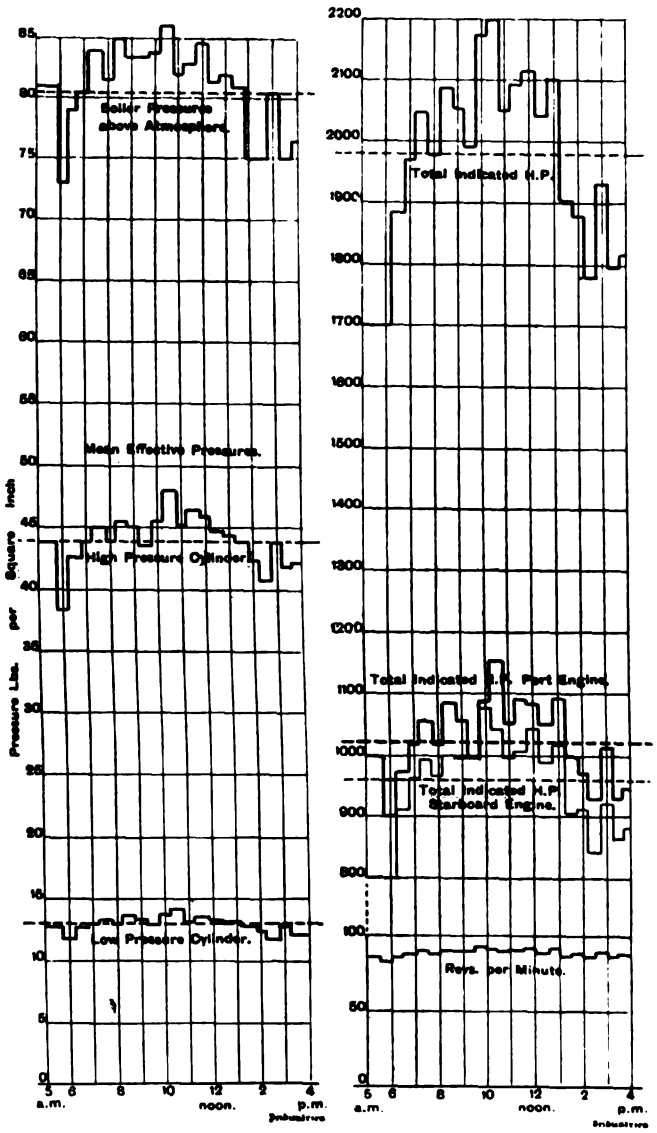


FIG. 8. FIG. 9.

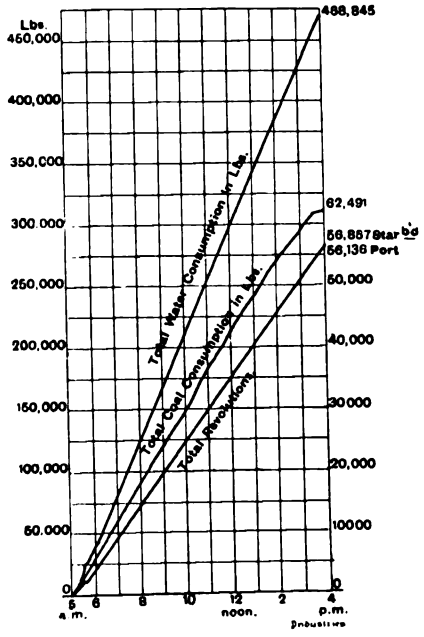


FIG. 7.

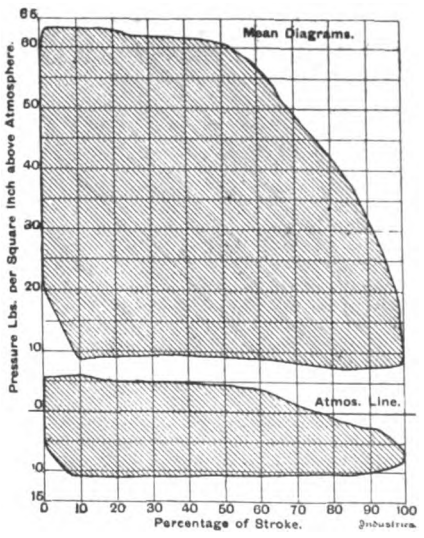


FIG. 10.

TABLE II.

Analyses of Funnel Gases by Volume.

	No. of Sample.	Carbonic Acid.	Carbonic Oxide.	Oxygen.	Nitrogen.
		Per Cent.	Per Cent.	Per Cent.	Per Cent.
Forward Funnel.	1	8·13	0·00	11·20	80·67
	3	10·55	1·84	6·59	81·02
	5	12·47	0·00	6·43	81·10
	7	7·98	0·00	11·79	80·23
	9	12·37	1·64	5·39	80·60
	11	9·89	0·00	9·72	80·39
	13	11·18	0 00	8·30	80·52
	15	10·60	0·00	9·17	80·23
	17	11·80	0·00	6·45	81·75
	19	11·27	0·00	7·67	81·06
	Mean	10·62	0·35	8·27	80·76
After Funnel.	2	7·75	0·00	11·27	80·98
	4	8·93	0·00	10·66	80·41
	6	8·72	0·00	11·21	80·07
	8	6·18	0·00	13·46	80·36
	10	6·33	0·00	13·69	79·98
	12	3·01	0·00	17·66	79 33
	14	9·97	0·00	9·72	80·31
	16	12·08	1·15	5·90	80·87
	18	9·90	0·00	10·37	79·73
	20	5·94	0·00	14·09	79·97
	Mean	7·88	0·12	11·80	80·20
Mean of both funnels		9·25	0·23	10·04	80·48

TABLE III.

Analyses of Funnel Gases by Weight.

No. of Sample.	Carbonic Acid.	Carbonic Oxide.	Oxygen.	Nitrogen.	Time of Collecting.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	
1	12·02	0·00	12·05	75·93	5.20 a.m.
3	15·50	1·72	7·04	75·74	6.20 ,,
5	18·14	0·00	6·80	75·06	7.20 ,,
7	11·80	0·00	12·68	75·52	8.25 ,,
9	18·03	1·52	5·71	74·74	9.40 ,,
11	14·52	0·00	10·38	75·10	10.40 ,,
13	16·33	0·00	8·82	74·85	11.40 ,,
15	15·52	0·00	9·76	74·72	12.40 p.m.
17	17·22	0·00	6·85	75·93	2.5 ,,
19	16·47	0·00	8·15	75·38	3.5 ,,
Mean	15·56	0.32	8·82	75·30	—
2	11·48	0·00	12·15	76·37	5.50 a.m.
4	13·16	0·00	11·43	75·41	6.50 ,,
6	12·86	0·00	12·02	75·12	7.55 ,,
8	9·21	0·00	14·59	76·20	9.10 ,,
10	9·42	0·00	14·82	75·76	10.10 ,,
12	4·54	0·00	19·36	76·10	11.10 ,,
14	14·63	0·00	10·37	75·00	12.10 p.m.
16	17·62	1·07	6·26	75·05	1.35 ,,
18	14·52	0·00	11·06	74·42	2.35 ,,
20	8·85	0·00	15·28	75·87	3.35 ,,
Mean	11·03	0·11	12·73	75·53	—
Mean of both funnels.	13·59	0·22	10·78	75·41	—

clear. The line of coal consumption plots out as shown in Fig. 7. The fires were not cleaned during the run. The ashes were weighed after the trial was over; but the weight of the ashes given below includes the ash formed while steam was being raised during the time the fires were banked up before the start, and during the two hours' run before the trial actually commenced. The fire-grates were fitted with Henderson's fire-bars, with the object mainly of rendering possible a somewhat large rate of combustion, so as to get the greatest possible duty out of the boilers. The coal used in the forward stoke-hold, and during the first half of the run in the after stoke-hold, was Monk Bretton (Yorkshire) coal. For the second half of the run a mixed coal, chiefly Hucknall and Shireoaks (Nottinghamshire), was used in the after stoke-hold. Coal samples were taken frequently during the run from both stoke-holds, and mixed together, and finally pounded; so as to obtain as representative a sample as possible for analysis. The analysis was made as before by Mr. C. J. Wilson, who gives it as follows:—

	Coal as Used.	Dry Coal.
Carbon	71·89 per cent.	74·08 per cent.
Hydrogen	5·42 ,, ,,	5·66 ,, ,,
Moisture	4·25 ,, ,,	0·00 ,, ,,
Ash	4·08 ,, ,,	4·26 ,, ,,
Nitrogen, sulphur, oxygen, &c., by difference	14·36 ,, ,,	15·00 ,, ,,
	100·00	100·00

The following is an analysis made by Mr. Wilson of a sample of the clinker and ash:—

Loss on ignition (= Carbon)	43·73 per cent.
Mineral matter	56·27 ,, ,,
	100·00

The ash, therefore, contained about 43·7 per cent. of carbon. The calculated calorific value of the fuel as used is 13,280 thermal units, which corresponds to the evaporation of 13·75lb. of water from and at 212° Fahr. The equivalent carbon-value of 1lb. of the fuel as used is 0·913lb. The total coal used was as follows:—

After stoke-hold,	port side	16,020lb.
,, ,,	starboard side	15,426lb.
Forward ,,	port side	15,509lb.
,, ,,	starboard side	15,536lb.
		62,491lb.

This amounts to 95·7lb. per minute, or 5,742lb. per hour, taking the running time of 653 minutes. As a check upon the coal consumption it has also been worked out from a time after the stoppage, at about 5.40 a.m., to the end of the trial; and over this period it comes to 95·9lb. per minute—that is to say, the same as before within the limits of measurement. The weather was very fine during the whole of the trial, but a little foggy towards the end, which made the captain of the steamer reluctant to continue

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the run longer, as it was originally intended to do. The actual amount of clinker and ash weighed off under the conditions already mentioned was 2,890lb. It may be taken roughly that of this quantity 2,200lb., or 200lb. per hour, was made during the actual run, which is about 8½ per cent. of the total quantity of coal.

Furnace Gases.—A sample of the furnace gases was collected over mercury by Mr. Wilson each hour from each funnel, there being twenty samples in all. The analyses of these samples are given in Tables II. and III. This set of analyses and the corresponding set for the "Tartar" trial are perhaps the most important and complete which have ever been made under such conditions, and merit very close examination. The "mean" figures in the table show that 3·8 per cent. by weight of the dry furnace gases is carbon, from which it follows that, allowing for the combustion of the hydrogen of the fuel, 18·5lb. of dry air passed through the furnace per pound of coal burnt. The chimney temperatures were read in each funnel every quarter of an hour during the whole of the trial, from a mercury thermometer containing compressed nitrogen over the mercury. This thermometer reads up to 860° Fahr., but in a very large number of cases (about three-eighths of the whole) the temperature rose somewhat above the maximum reading of the thermometer. It was obvious from the motion of the mercury that the true temperature was not much above the limit of the thermometer, but of course its exact value is unknown. Assuming that the mean value of these readings was 20° Fahr. above the limit of the thermometer, or 880° Fahr. (which is probably true within an error of 10° either way), the mean temperature in the forward funnel was 828° Fahr., and in the after funnel 842° Fahr., the mean of both being therefore 835° Fahr. The mean chimney draught, measured by U gauges, was 0·38in. of water in the forward, and 0·34in. in the after funnel.

Feed-Water Measurement.—The feed-water was measured in the two tanks, of which details of construction are shown in Figs. 5 and 6. These tanks have been made specially for feed measurement, in a form as adaptable as possible to the conditions of various steamers, and in parts of such a size that they can be readily got down into the engine-room of a steamer and erected and jointed there. It was found possible to put them together in an extremely confined space in the "Colchester," and again in the "Tartar," at a somewhat later date, and it is thought that the details of their construction may therefore be interesting. Each tank held about 2,200lb. of water at 64° Fahr. between the upper and lower cocks. Their contents were carefully tested by weighing water into them when jointed and connected before placing them on board the steamer. Each tank lasted in the "Colchester" about three minutes. The total amount of water used was 468,845lb., over a total running time of 654 minutes. (The last feed tank was finished at 4.1 p.m. instead of 4 p.m.) This amounts to 717lb. per minute, or 43,020lb. per hour, the mean temperature of the feed being 113° Fahr. The continuous consumption of feed water is shown in Fig. 7. The feed pump of one of the engines only was employed to pump throughout, the other pump not being used. All the steam made by the boilers went to the main engines; the steam for the circulating-pump engine, the steering engine, and dynamo engine, and any steam for heating that was required, was taken from the donkey boiler, to which special steam connections were made for the purpose. The water-level was practically the same at the beginning and end of the trial.

Power Measurement.—Indicator diagrams were taken every half hour from each engine. There were thus twenty-two sets of diagrams, or 176 single cards, taken in all. The six indicators used were all made by Messr. T. S. M'Innes & Cairns, of Glasgow, and kindly lent by them to the Committee. These indicators are very simple in construction and handy in use, and their vulcanite sheathing is attended, at sea especially, with much convenience in manipulation. The following are the mean effective pressures in the cylinders in lbs. per square inch:—

Cylinder.	Top.	Bottom.	Mean.
Port, high-pressure	43·34	47·96	45·65
„ low-pressure	13·25	13·58	13·42
Starboard, high-pressure...	38·45	45·68	42·07
„ low-pressure ...	11·68	13·15	12·42

These pressures correspond to the following indicated horse-powers:—

Port engine; high-pressure cylinder.....	490·3	
„ „ low-pressure cylinder	532·2	
		1,022·5
Starboard engine; high-pressure cylinder	457·9	
„ „ low-pressure cylinder	499·8	
		957·2
Total indicated horse-power		1,979·7

The maximum indicated horse-power given by any one set of cards is 2,194·2, which occurred at 10.15 a.m., with a mean speed of 88·6 revolutions per minute, and 86lb. of steam. The minimum indicated horse-power by any one set of cards was 1,699·6, at 5·45 p.m., with a mean speed of 83·2 revolutions per minute, and 73lb. of steam. From the 176 diagrams which were taken during the trial, two mean diagrams have been plotted, one for the two high-pressure and one for the two low-pressure cylinders, and these are given in Fig. 10. The continuous variations of boiler pressure and cylinder mean effective pressures are shown in Fig. 8; and of horse-powers and speeds in Fig. 9.

Speed.—The counters for the two engines were entirely separate. The total number of revolutions made by the port engine was 56,136, and the total number of revolutions made by the starboard engine was 56,857; which totals correspond respectively to 86·0 and 87·1 revolutions per minute. The maximum number of revolutions per minute for any half hour was 89·9 for the port, and 91·7 for the starboard engine; and the minimum number, except when slowed down, was 82·9 for the port, and 84·0 for the starboard engine.

Pressures, &c.—The mean barometric pressure during the trial was 30·6in. of mercury, or 15·0lb. per square inch. The mean boiler pressure was 80·5lb. per square inch by the pressure-gauge in the stoke-hold, and 78·2lb. per square inch by the pressure-gauge in the engine-room. It will be noticed from the diagram (Fig. 8) that the pressure was falling both at the commencement and at the end of the trial. The mean vacuum by gauge was 25·4in. of mercury, corresponding to 2·5lb. per square inch of absolute back pressure. The mean pressure in the receiver of the starboard engine was 8·0lb. per square inch above the atmosphere, and in that of the port engine 8·8lb. per square inch above the atmosphere. The mean initial pressures in the high-pressure cylinders were 64·3lb. per square inch above the atmosphere in the port engine, and 59·4lb. in the starboard engine. The mean back-pressures in the low-pressure cylinders were respectively 4·4 and 4·5lb. per square inch absolute.

Boiler Efficiencies.—The mean rate of combustion in the furnaces was 26·1lb. of coal per square foot of grate surface per hour, or 0·987lb. per square foot of total heating surface per hour. The evaporation was at the rate of 7·49lb. of water per lb. of coal. The feed entered the boiler at a temperature of 113° Fahr., and the temperature corresponding to the mean boiler pressure was 324° Fahr., so that each lb. of steam must have taken up 1,100 thermal units; hence the equivalent evaporation from and at 212° Fahr. was 8.53lb. of water per lb. of coal, or about 9·34lb. per lb. of carbon-value in fuel. The equivalent amount of heat utilised per lb. of coal was 8,240 thermal units, or say 62 0 per cent. of the whole calorific value of the fuel, which percentage therefore represents the actual boiler efficiency. The total calculated calorific value of the fuel burnt per minute was 1,271,000 thermal units. The weight of dry air per lb. of coal, calculated from the furnace gas analyses, works out to 18·5lb., so that the total weight of furnace gases per lb. of coal would be about 19·4lb. Their specific heat may be taken as 0·238, and they have been raised in temperature from, say 55°Fahr., the temperature of the outer air, to 835° Fahr., the temperature of the chimney gases. This corresponds to a loss of 3,714 thermal units per lb. of coal, or 28·0 per cent. of the whole calorific value of the fuel, including the raising through the same range of temperature of the steam formed by the combustion of the hydrogen in the fuel. The loss due to evaporation of the moisture in the fuel works out to 0·4 per cent., and that due to imperfect combustion to 1·3 per cent. These quantities add up to 91·7 per cent. of the whole heat of combustion, leaving a balance of 8·3 per cent., which includes all losses by radiation unaccounted for. The weight of water evaporated from and at 212° Fahr. per square foot of total heating surface was 8·42lb. per hour. The average rate of transmission of heat through the material of the boiler was 8,130 thermal units per square foot of heating surface per hour.

Coal Consumption.—The total coal burnt—namely, 5,742lb. per hour—corresponds to 2·90lb. per indicated horse-power per hour. This is equivalent to 2·65lb. of carbon-value per indicated horse-power per hour.

Engine Efficiencies.—The total indicated horse-power being 1,980, and the total feed water used per hour being 43,020lb., the feed water used per indicated horse-power per hour was 21·73lb. The actual heat received by the feed water per minute was 788,700 thermal units, or 898 4 thermal units per indicated horse-power per minute; which is 62 per cent. of the whole heat of combustion. The absolute engine efficiency was 10·7 per cent.

Total Efficiency.—The combined efficiency of the boilers and engines, or ratio of the heat turned into work to the total heat of combustion of the fuel, was 0·62 × 0·107, which is equivalent to 6·6 per cent.

Steam from Indicator Diagrams.—The following are the results of measurements made upon the indicator diagrams taken to ascertain the proportion of steam accounted for by them. The actual weight of feed water used per revolution was 8·28lb:—

Proportion of Steam accounted for by Indicator Diagrams.	Lbs. per Revolution.	Percentage of Total Feed.	Percentage present in Cylinder as Water.
	Lbs.	Per Cent.	Per Cent.
Steam present in high-pressure cylinder, port engine, after cut-off, when the pressure was 51lb. per square inch above the atmosphere	3·11		
Steam present in high-pressure cylinder, starboard engine, after cut-off, when the pressure was 51lb. per square inch above the atmosphere	2·88	71·7	28·3
Steam present in low-pressure cylinder, port engine, near end of expansion, when the pressure was 7lb. per square inch below the atmosphere	2·19		
Steam present in low-pressure cylinder, starboard engine, near end of expansion, when the pressure was 7lb. per square inch below the atmosphere	2·20	53·0	47·0

Speed of Vessel.—The following notes from the log book of the ship may be of interest:—

	Time.	Distance in Nautical Miles.
Left Hull Roads	3·15 a.m.	... 0
Spurn Light	4·40	... 24
Dudgeon „	7·45	... 54
Cromer „	9·5	... 75½
Cockle „	10·35	... 97
Corten „	11·15	... 108
Shipwash „	1·25 p.m.	... 140
Sunk „	2·20	... 151
Long Sand Head Light	2·40	... 158½
Cork Light	4·0	... 173
Parkeston Quay	4·35	... 178½

The mean speed between Dudgeon and Cork Lights, which includes nearly the whole of the trial except that portion when the vessel was slowed down and stopped, was therefore 14·4 knots.

The "Colchester" is a vessel built rather to attain a maximum of power and speed over a short journey than a maximum of economy. Looked at from this point of view, it may be interesting to compare the relation between power developed and the size of the machinery in her case, and in those of the other steamers tested. The net volume of her boilers is about 4,980 cubic feet, or at a rate of 2·5 cubic feet per indicated horse-power. This ratio in the case of the "Meteor," "Fusi Yama," and "Tartar" is respectively, 2·7, 4·53, and 4·34 cubic feet per i.h.p.

(To be continued.)

THE INSTITUTION OF CIVIL ENGINEERS.

The annual general meeting of corporate members—"to receive and deliberate upon the Report of the Council on the state of the Institution, with the annual statement of the accounts, and to elect the Council and officers for the ensuing year"—took place on Tuesday, the 3rd inst., Sir John Coode, K.C.M.G., the President, being in the chair.

This meeting was held on the sixty-second anniversary of the incorporation of the Institution by Royal Charter. At that time the number of members was 156, and the gross annual receipts were £447. At the close of the past financial year the number of members was 5,872, and the gross receipts for the twelve months amounted to £22,478. This increase—thirty-seven-fold in numbers and fifty-fold in amount—sufficiently indicated the position which the Institution had taken in connection with the profession it was designed to promote. It should always be borne in mind that a large rate of increase was by no means desirable. There was no object, however, in limiting the numbers, as was the custom in some exclusive bodies, for the Institution had always opened—and it was hoped always would open—its doors to all engineers who had an honest title to be entered on its register; but it refrained from augmenting its numbers by the admission of persons who were merely attracted to it for their own advantage. Above all things, the Council desired it to be understood that membership in the Institution should be a real guarantee of the professional standing, and (as far as possible) also of the personal character, of those on whom it was conferred. For these reasons, the Council repeated the recommendation, often previously made, that every member should take care not to attach his signature to any proposition-paper unless fully satisfied as to the truth of the representations it contained and as to the general eligibility of the candidate.

During the past year there were elected three honorary members (Sir Henry Bessemer, F.R.S., Sir William Thomson, LL.D., F.R.S., and General Edward Frome, R.E.), thirty-two members, 263 associate members, and three associates, while the name of one member was restored to the list. On the other hand, 138 names had been removed from the register, eighty-seven of which were losses by death. Among the latter, the Council recorded with regret the names of three honorary members—the King of Portugal, Dr. John Percy, F.R.S., and General Edward Frome, R.E., who died shortly after his election. The roll of the Institution therefore showed a net increase of 164, the number of members of all classes (irrespective of students) being now 4,903. This represented an increase at the rate of about 3½ per cent. per annum. Owing to more stringent regulations as to the admission of students, there had been a decrease of twenty in the number of that class. The admissions had included 156 students, and one was restored to the list, while seventy-three had been elected associate members and 104 had passed out of the list.

At the ordinary meetings, papers on important constructive engineering works had been read, and also on many branches of mechanical and electrical engineering. It was hoped that some branch of metallurgy might have been brought forward, but in that hope the Council had been disappointed. It was, however, confidently believed that the omission would be made good next session. For two of the papers the Institution was indebted to Mr. Lyster, Member of Council, and to Sir Frederick Bramwell, Bart., D.C.L., F.R.S., Past President. In conformity with long-established usage, these communications were not taken into consideration in the adjudication of the premiums.

Since the last annual meeting four volumes of Minutes of Proceedings had been issued. The Council trusted that the members would continue to contribute to this part of the work of the Institution, as being that which was of the greatest permanent importance. It was intended, shortly, to issue a pamphlet of about 60 pages, enumerating those public educational establishments in the British dominions which included special preparation for the engineering profession.

The abstract of receipts and expenditure showed, on the credit side, income £17,677 13s. 10d.; capital (that was admission fees and life compositions), £3,794 14s.; trust fund receipts, £1,005 6s. 9d. (including the Crampton Bequest of £500 and the Trevithick Memorial Donation, £100 0s. 9d.), making a total of £22,477 14s. 7d. On

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the other side of the account, the general expenditure had been £14,696 6s. 3d.; the investments on account of capital, £6,090 19s.; and payments or investments of trust funds, £1,049 2s. 4d. At present the Institution investments in Consols, Metropolitan Board of Works Stock, and Railway Debenture Stocks aggregated £43,500; the freeholds of the three contiguous houses in Great George Street, £40,000; the Whitworth legacy, £5,400; and trust funds, £15,286 0s. 10d., making a total of £104,186 0s. 10d.

In conclusion, the Report referred to the visit, last summer, to Europe, of a representative body of members of the American Societies of Civil, Mining, Mechanical, and Electrical Engineers, which their Institution had the honour of entertaining for six days. Many and various were the means which the Reception Committee took to arrange for the amusement and recreation of the visitors. On the whole, the visit might be considered to have been a great success, and was one full of pleasant memories for the hosts.

The adoption of the Report was moved, seconded, and carried, and it was ordered to be printed in the Minutes of Proceedings. Cordial votes of thanks were then passed to the President, to the Vice-Presidents, and other members of the Council, to the auditors, to the secretaries and staff, and to the scrutineers.

The ballot for Council resulted in the election of Sir John Coode, K.C.M.G., as President; of Mr. G. Berkley, Mr. H. Hayter, Mr. A. Giles, M.P., and Sir Robert Rawlinson, K.C.B., as Vice-Presidents; and of Mr. W Anderson, D.C.L., Sir Benjamin Baker, K.C.M.G., Mr. J. Wolfe Barry, Mr. E. A. Cowper, Sir Jas. N. Douglass, Sir Douglas Fox, Mr. J. Clarke Hawkshaw, M.A., Mr. C. Hawksley, Sir Bradford Leslie, K.C.I.E., Mr. G. Fosbery Lyster, Mr. J. Mansergh, Mr. W. H. Preece, F.R.S., Sir E. J. Reed, K.C.B., F.R.S., M.P., Mr. W. Shelford, and Mr. F. W. Webb, as other members of the Council.

The session was then adjourned until the second Tuesday in November, at 8 p.m.

The following is a detailed list of the awards made for communications submitted during the past session:

FOR PAPERS READ AND DISCUSSED AT THE ORDINARY MEETINGS.

1. A Telford Medal and a Telford Premium to John Robinson, M.Inst.C.E., for his paper on "The Barry Dock Works, including the Hydraulic Machinery and the Mode of Tipping Coal."
2. A Telford Medal and a Telford Premium to Charles Ormsby Burge, M.Inst.C.E., for his account of "The Hawkesbury Bridge, New South Wales."
3. A Telford Medal and a Telford Premium to Frederick Thomas Granville Walton, C.I.E., M.Inst.C.E., for his description of "The Construction of the Dufferin Bridge over the Ganges, at Benares."
4. A Telford Premium to Sydney Walker Barnaby,* M.Inst.C.E., for his paper on "The Screw Propeller."
5. A Telford Premium to William Henry Wheeler,† M.Inst.C.E., for his paper on "Bars at the Mouths of Tidal Estuaries."
6. A Telford Premium to James Price, Jun., B.E., M.Inst.C.E., for his account of "Lough Erne Drainage Works."
7. The Manby Premium to William Paul James Fawcus and to Edward Woodrowe Cowan, Assoc.MM.Inst.C.E., for their joint paper descriptive of "The Keswick Water-Power Electric Light Station."

FOR PAPERS PRINTED IN THE PROCEEDINGS WITHOUT BEING DISCUSSED.

1. A Telford Premium to Charles Hopkinson, B.Sc., M.Inst.C.E., for his paper on "Hydraulic Packing-Presses."
2. A Telford Premium to Herbert Gurney Sheppard, Assoc.M.Inst.C.E., for his paper on "The Reclamation of Lake Aboukir, near Alexandria, Egypt."
3. A Telford Premium to Wilfrid Airy, B.A.,‡ M.Inst.C.E., for his papers "On the Action of Quicksands" and on "The Probable Errors of Surveying by Vertical Angles."

FOR PAPERS READ AT THE SUPPLEMENTAL MEETINGS OF STUDENTS.

1. The Miller Scholarship to Charles Frewen Jenkin, B.A., Stud.Inst.C.E., for his paper on "Some Applications of Electricity in Engineering Workshops."
2. A Miller Prize to Charles Henry Wordingham, A.K.C., Stud.Inst.C.E., for his paper on "Telephonic Switching."
3. A Miller Prize to Alfred Ernest Young, Stud.Inst.C.E., for his account of "The Deflection of Spiral Springs."
4. A Miller Prize to Lucien Alphonse Legros, Stud.Inst. C.E., for his paper on "Economy Trials of a Compound Mill-Engine and Lancashire Boilers."
5. A Miller Prize to Frank Paul Reynolds, A.K.C., Stud.Inst.C.E., for his description of the "Roof over the Carlisle Markets."
6. A Miller Prize to George Hale, Stud.Inst.C.E., for his description of the "Hydraulic Station and Machinery of the North London Railway at Poplar."
7. A Miller Prize to George Harrison Sheffield, Stud. Inst.C.E., for his paper on the "Principles of Iron Foundry Practice."

It has been determined to print the first three students' papers, either in whole or in part, in the Minutes of Proceedings.

* Has previously received a Watt Medal and a Telford Premium.
† Has previously received Telford Premiums.
‡ Has already received Telford and Manby Premiums.

THE AMERICAN SOCIETY OF ENGINEERS.

(From our New York Correspondent.)

(Continued from page 530.)

AT the third day's meeting of the Cincinnati meeting of the American Society of Mechanical Engineers, held on the 15th of May, Mr. R. C. Carpenter, of Lansing, read a paper on "The Comparative Test of a Hot Water and a Steam Heating Plant." The test was undertaken to decide whether the better method of heating green houses was with low-pressure steam or with hot water. Two buildings, each 50ft. by 19½ft., were erected side by side, extending north and south. The heaters were made by the same manufacturer, and have the same amount of heating surface, grate, and external dimensions. The total heating surface was 45·18 square feet and the grate 1·89 square feet. In the steam house the heating surface was 200 square feet, the total space 6,174 cubic feet, and the ratio of heating surface to glass 1 to 5½. In the hot-water house the heating surface of the pipes was 275 square feet, and the ratio of the heating surface to the glass surface 1 to 4. The pressure on the hot water system was maintained uniform by an expansion tank 12in. diameter and 18in. high, located 18ft. above the water in the lowest return. The tests began December 21st, and lasted until March 1st. Coal was fired in 25lb. lots at 6 a.m., 4 p.m., and 9 p.m. Temperatures were taken at 6 a.m. and 9 p.m. inside and outside, and the maximum and minimum daily readings were recorded. The average coal consumption and temperatures are given in the following table:—

	Dec.	Jan.	Feb.
Outside temperature, 6 a.m. ...	31·8	27·7	22·0
" " 9 p.m. ...	35·1	27·2	
HOT-WATER HOUSE.			
Average temperature, 6 a.m. ...	54·9	54·1	54·4
" " 9 p.m. ...	60·3	54·8	56·0
Coal per 24 hours in lbs.	75·0	90·3	99·1
STEAM HOUSE.			
Average temperature, 6 a.m. ...	53·9	52·5	54·1
" " 9 p.m. ...	54·9	53·8	53·5
Coal per 24 hours in lbs.	93·2	112·1	121·4

So far as variation or range of temperature is concerned the two heaters were practically the same, and in no case did this exceed 4° when the fire was carefully attended to.

Mr. Emery objected to the paper as not giving any general data on which to base a comparison as to the relative advantages of the two systems, as hot-house practice was very different from house heating, to which the systems were generally applied.

Mr. Mason said that the results might have been predicated from the method of fitting up and the apparatus used.

The next paper was by the same author, on "Notes on Kerosene in Steam Boilers," and gave the author's experience on removing scale by the use of kerosene, by which scale ⅜in. thick was entirely removed from a battery of boilers. The kerosene seemed to work in between the shell and the scale in such a manner as to loosen large flakes of the scale, sometimes fully 1ft. in length. The amount used was two quarts for a cylindrical tubular boiler 4ft. in diameter by 12ft. long, each week, and three quarts in a 5ft. boiler. The oil was introduced into the suction side of the feed pump. The cost was not over $2 per annum per boiler. The water used contained 325 parts of solid matter to 1,000,000, of which 206 parts were $CaCO_3$, 78$MgCO_3$, and 22 parts $FeCO_3$, with traces of sulphates and chlorides of potash and soda.

The next papers presented were on shaft governors, and were read together. They were "A Use for Inertia in Shaft Governors," by Mr. E. J. Armstrong, of Syracuse, New York; "A Governor for Steam Engines," by Mr. Jesse M. Smith, of Detroit, Mich.; and "The Effect of an Unbalanced Eccentric or Governor Ball on the Valve Motion of Shaft Governed Engines," by Mr. John E. Sweet. In the first paper the author states that inertia, instead of being a disturbing element, can be, and is, made the reverse, even to performing the function of a dash pot. Any considerable friction in a governor becomes a serious fault, but a small amount, such as is present in nearly all governors under the most favourable circumstances, would seem to be rather an advantage; the friction and inertia of the valve and its connections are usually sufficient to keep up a slight vibratory movement in the governor, and when this is the case the fly-weight will move very easily if it only moves slowly, the friction coming into full effect should the weight attempt a more rapid change of base. Mr. Smith's paper was a description of a governor designed and applied in 1883.

The next paper was by Mr. W. W. Bird, of Worcester, Mass., on "An Open Mercury Column for High Pressures." The object of the author was to design an open column which would read to 200lb. per square inch; it should be sufficiently accurate for engineering purposes, cheap, and, if possible, should provide for taking readings at one convenient point. In Fig. 1, A A is a column of small iron pipe made in four sections, each of sufficient length to give 50lb. pressure. *a*, *b*, *c*, and *d* are overflow pipes which can be closed off by the cocks shown. These pipes discharge in the cistern F, from which the mercury pump M takes it to and discharges it into the column A A again. The bottom of the column is connected to the glass tube B long enough to indicate 50lb. To the top of this tube is connected a water pump W and a flexible tube C connecting with the gauges G G. The stop cocks *a*, *f*, and *e* being open, mercury is pumped into A and B until it overflows at *a*. On the glass tube this gives the zero point. Cock *e* is closed and water pumped in to fill the top of B, C, and D. By pumping in more water the level in B can be lowered to any desired amount, *a* being constant; and by sliding D along the upright E E the water column can be balanced. Closing *a* and opening *b* will add 50lb. to the reading on the glass scale B, and in this way the pressure to 200lb. or over, if desired, can be read in the length of the glass tube B very conveniently.

The next paper was by Mr. George I. Alden, of Worcester, Mass., on "An Automatic Absorption Dynamometer." The dynamometer is a friction brake, in which the pressure causing the friction is distributed over a comparatively large area, thus giving a low pressure between the rubbing surfaces. The pressure is produced by the action of water from the town main. Enough water is allowed to pass through the machine to carry off the heat due to the energy absorbed. The rubbing surfaces are finished smooth, and run in a bath of oil. A valve, operated by the slight angular motion of the dynamometer, varies the supply of water, and consequently the pressure between the frictional surfaces, thus securing automatic regulation. In Fig. 3, A is an iron disc keyed to the crank-shaft B. The sides of this disc are finished smooth, and each side has one or more shallow radial grooves, as shown at X, Fig. 2. The outer shell consists of two pieces of cast iron C C, bolted together, and held at fixed distances apart by the iron ring D of the same thickness as A, and by the edges of the copper plates E E. Each of these plates at its inner edge makes, with the cast-iron shell a water-tight joint by being spun into a cavity in the iron and held by driven rings F F. Water is admitted between the cast-iron shell and the copper plates at G, and passing to the opposite compartment through passages shown at O is discharged through a small outlet at H. The chamber M N N is filled with oil, which finds its way along the grooves X. The shaft is free to revolve in the bearings of the cast-iron shell C C. The shell has an arm carrying weights as shown in Fig. 2. This arm has its angular motion limited by the stop P and Q. The regulating valve is simply two tubes one inside the other, one being stationary and the other revolved by the movement of the brake. Holes parallel to the axis allow the water to pass into the brake. Figs. 5 and 6 show a longitudinal and a cross-section of the valve. The dynamometer is operated as follows:—The chamber N N M is filled with oil, and weights are suspended from the arm to give the desired load. The engine is started up, and when up to speed a valve is opened in the water-pipe, admitting water to the automatic valve V, Fig. 3. Water passes through this valve and forces the copper plates against the sides of the revolving disc A, causing sufficient friction to balance the weights upon the arm. This motion operates the automatic valve regulating the friction on the disc. The arm is found to stand midway between the stops with only slight and slow vibration, so that there is no sudden vibration of the arm, and the load is practically constant.

The fourth session of the Convention was held on Wednesday evening at 8 p.m. The following papers on chimneys and draft were read:—"Pictet's Treatment of Chimney Draft" and "The Mechanical Theory of Chimney Draft" by Mr. J. B. Webb; "Chimney Draft," by

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Mr. De Volson Wood, and "Tests of Recent Formula for Chimney Draft," by Mr. William Kent. The next two papers were by Mr. De Volson Wood, on "Graphic Representation of Thermodynamic Quantities" and "Test of a Refrigerating Plant." The secretary presented for Professor R. H. Thurston a paper on "Hirn and Dwelshauver's Theory of the Steam Engine, Experimental and Analytic," which was mainly historical.

Mr. George H. Barrus, of Boston, Mass., presented a paper on "A Universal Steam Calorimeter." The apparatus is represented in Fig. 7. The principal parts of the instrument consist of a chamber A, or "drip-box," as it is called, and the "heat-gauge," consisting of the orifice I and the two thermometers M and N. The instrument is connected to the main steam pipe G, which carries the steam to be tested, by means of the perforated pipe F, and this pipe extends across the full diameter, in order to obtain a sample of the steam tested. The orifice I opens into a pipe which is in free communication with the atmosphere, the opening being about $\frac{1}{8}$in. in diameter. The parts below the plate R are entirely insulated from those above by the use of some non-conducting material, as it is necessary to prevent any transfer of heat from the high to the low-pressure side of the plate. The range of the "wire drawing" part of the instrument or "heat-gauge" is from 3 to 4 per cent. of moisture with steam at 80lb. It is unnecessary to use the drip-box unless the quantity of moisture is in excess of 3 per cent. The unions P and Q are, therefore, made interchangeable, and a preliminary trial will show whether A should be used or not. In the complete apparatus the condensed water from the drip-box is drawn off by means of the valve D into a bucket on scales or through a condensing coil. This quantity is of course to be added to that passing through Z to determine the moisture in the steam. The amount of radiation must be allowed for also. In order to compute the amount of moisture from the loss of temperature shown by the heat-gauge the number of degrees of cooling of the lower thermometer is divided by a coefficient representing the number of degrees of cooling due to 1 per cent. of moisture. This coefficient depends upon the specific heat of superheated steam, which, according to Regnault's experiments, is 0·48. The author's experiments show that this quantity is not constant, but varies from 0·42 to 0·51, and it seems that the specific heat is more or less constant until the temperature by the lower thermometer approaches the point of saturation for the low-pressure steam, while beyond this point the specific heat rapidly increases.

Thursday, the 15th of May, was the Excursion Day. A special train was furnished by the Cincinnati, Hamilton, and Dayton R.R., and a party numbering nearly three hundred went to Hamilton, Ohio, on a visit to the Niles Tool Works. This is one of the largest manufacturing establishments of machine tools in the country. The establishment is rapidly increasing in size, and is equipped with the best appliances for rapidly producing machine tools of all descriptions.

On returning to the city the members were entertained at a reception in the Art Museum in Eden Park, which contains one of the finest collections in the United States.

The last session was held on Friday morning. The first paper was a short but interesting one by Mr. D. K. Nicholson, of the Pennsylvania Steel Company, of Steelton, Pa., on "Heating Furnaces." A Siemens furnace probably required, he said, less repairs than any other kind of reverberatory furnace. The gas and air do not unite until they have reached the hearth. By the time the flame reaches the outgoing ports it is pretty well spent, and does little injury to the brickwork. The bricks are not subjected to the cutting action of flames as in a coal furnace. It is necessary to work the furnace with an outward pressure when it is charged, to fill the furnace with flame and keep the cold air from drawing in at the doors. In the Smith furnace the regenerators are built at the ends of the furnace. The checkers are entirely open at the top, and on a level with the bridge of the furnace, which is at the same time one wall of the gas chamber. This furnace is generally used for quick heating. The advantages of it are: Cheapness, the ease with which the checkers can be taken out and cleaned, and that the bottom of the conduits and chambers are so little below the surface that they are not likely to become choked with water in low ground. The gas will probably come into the furnace under less pressure than in an ordinary Siemens furnace unless the gas pipe from the top of the producer stack is correspondingly higher. To do good and careful heating the bottom of the furnace must have plenty of attention. With good fire sand and care there is no trouble in maintaining a clean hard bottom gradually sloping towards a tap-hole at the back of the furnace midway from the end.

In heating high carbon steel the metal must be gradually brought up to a working heat. To charge cold steel of high carbon into a warm furnace is disastrous to the metal. A very fine steel, not too high in carbon, will scale off in sheets, while the scale from high carbon steel will break up into fine powder as it comes off. This can be more readily seen under the hammer than the rolls. Gas which contains steam oxidises the steel, and makes a good deal heavier scale, ordinarily 1·25 to 2 per cent. on ingots charged hot. The furnace crown that gives the most satisfaction is a roof that dips about 5 degs. at each end for one quarter the whole distance, and then is straight across, with the necessaryarch sideways for support. The height of the crown for cold metal is generally from four to five times the thickness of the piece.

Too high a temperature in the furnace renders the metal unfit for hammering or rolling. This may be remedied, partly at least, by lowering the temperature of it and again heating it to the right degree. At its best, however, the metal is treacherous, and on any account it should not be used where much depends on strength. Vertical or pit furnaces are only used to reheat ingots brought to them soon after being cast. These furnaces save labour, but are not equal to the horizontal furnace for heating the ingot evenly. Their greatest trouble is to get rid of the cinder, especially with low carbon steel. Tapping through the bottom is the best way, if the tap-hole could be easily opened and closed. The material is not likely to roll so well from a soaking pit as that which is heated in a furnace with fuel supplied to it. The inside is softer than the outside, and throws more strain on the outside while being hammered or rolled than its share. In ordinary running at least 90 per cent. of the ingots from the Bessemer could be cared for by soaking pits, which is a considerable saving of fuel, labour, first cost, and practically no repairs.

The next paper was by Mr. H. H. Suplee, of Philadelphia, on "Equilibrium Arch Curves," in which he presented the method of Mr. Thomas J. Lovegrove for determining the shape of the equilibrium curve. The method described a ready means by which the curve could be laid down, and the author showed by models that an arch made in this way with blocks of wood for voussoirs would stand, while a semi-circular arch of the same size would fall. In arches built upon equilibrium curves, with joints at all points normal to the curve, no bending moment or tendency to open at the joints can occur, and the material is subject to compression only as is the case in a vertical wall. The theory of the "middle third," which is sometimes opposed to the use of equilibrium curves, does not properly apply at all under the above conditions, as it was deduced entirely from conditions which only obtain when the joints are not normal to the equilibrium curve. Instead of drawing an arch to a curve selected arbitrarily, and then attempting to investigate the position of the curve which its load may produce, the curve should first be drawn from the height, span, and load given, and then any desired form which will include this curve within its figure may be used with safety. For sewers and for the construction of subways the equilibrium curve is by far the strongest and most economical, and objections against its appearance to the eye do not hold.

The next paper was by Mr. Thos. C. Clarke, on the Kinzira Viaduct, built in 1882. After describing the viaduct, method of construction, &c., the author gave illustrations of a section taken from one of the Phœnix columns, showing that no corrosion had taken place in the interior of the column.

Professor J. Burkitt Webb presented a paper on "Length of an Indicator Card," which was a continuation of the paper presented by him at the last meeting.

The next paper was by Professor Jacobus, on "Influence of Steam Jackets of the Pawtucket Pumping Engine." His conclusions are: (1) The effect of jackets on the form of expansion curves of both the high and low pressure cylinders is so small that the errors involved in the most accurate measurements of the indicator diagram make it impossible to show any difference in the laws governing the same; (2) the economy of the plant when working under the three sets of conditions is about 1·7 per cent. in favour of using the flue reheater, and 2·5 per cent. in favour of using both jackets and flue reheater, over that obtained when neither the flue reheater or jackets are used: the duty when both jackets and flue reheater were in use was 121,560,000 ft.-lb. per 100lb. of coal; (3) there was very little re-evaporation during expansion in either the high or low pressure cylinder, the average for all the tests being 0·4 per cent. for the high-pressure cylinder, and 2·9 per cent. for the low-pressure.

The last paper of the session, on "The Effective Area of Screws," by Professor Jacobus, consisted of some deductions made from the tests of two tug boats, and compared the results with those obtained by Professor Denton on the "Homer Ramsdell" and the "Bergen," as presented at the last meeting of the Society.

At various times during the different sessions of the meeting a number of topical queries were taken up, but there was little of interest in the discussions.

The Committee appointed to memorialise Congress on the establishment of a Government Bureau of Mechanical Standards, reported that a Bill had been drafted, presented in Congress, and had been referred to the Committee on Patents, which had promised a favourable report, and the matter there rested.

The usual resolutions of thanks were passed, and the meeting adjourned to meet at the call of the Council in November, probably in Richmond, Pa.

THE AMERICAN SOCIETY OF ENGINEERS.

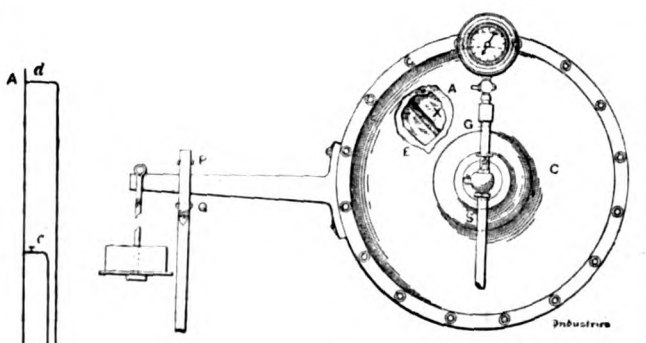


FIG. 2.

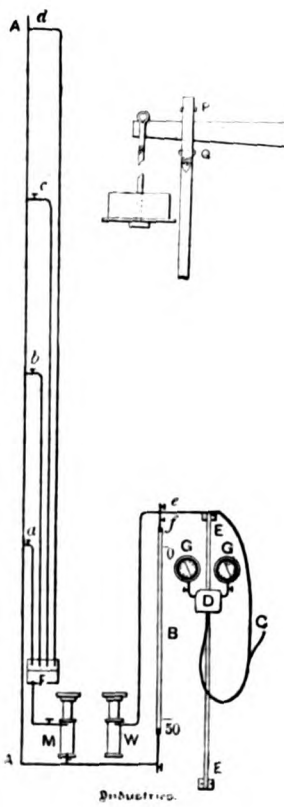


FIG. 1.

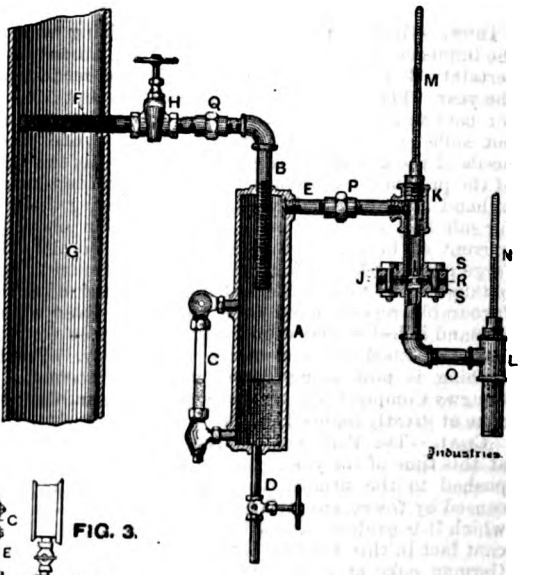


FIG. 7.

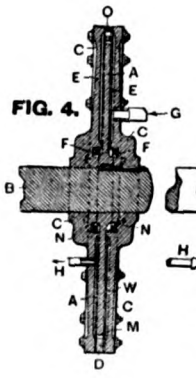


FIG. 4.

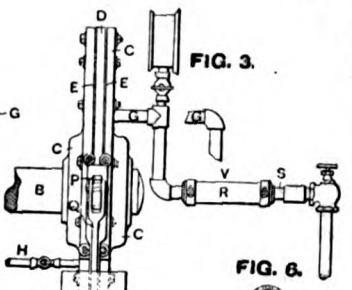


FIG. 3.



FIG. 6.

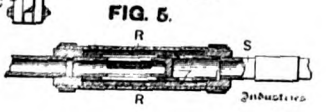


FIG. 5.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 10th June, 1890.

Iron.—The iron market is gradually giving way under the influence of unfavourable reports from abroad and the certainty that coal will be cheaper in the second half of the year. The Paris merchants readily accept 152s. a ton for bars and 154s. for joists. But even these prices are not sufficient to tempt buyers to deal beyond the bare needs of the moment. A weak tone pervades the markets of the provinces. Merchants who have considerable stocks in hand are growing alarmed, and by pressing their goods for sale they have weakened confidence and checked the current of business. In the Meurthe-et-Moselle 56s. for forge pig and 64s. for foundry are the maximum prices now obtainable. From all the other ironmaking districts unfavourable reports have been received. Everywhere the demand is feeble and diminishing, and prices for finished iron and steel are constantly giving way. Practically nothing is now being done on export account. The Longwy Comptoir is buying largely of German blast furnace coke at greatly reduced prices.

Coal.—The Paris coal market is very quiet, as is usual at this time of the year. In the North production is being pushed to the utmost to make up for the interruption caused by the recent strikes and to profit by present prices, which it is evident cannot be long maintained. A significant fact in this relation is the purchase of 50,000 tons of German coke at a price that is some 20 per cent. below those now current for French produce. The labour disturbances in the Centre and the South have come to an end, and the output of the pits is now but little restricted in those districts. Several of the German delegates at the recent Miners' Congress at Joliment are now in the North of France seeking to promote the project of an International Miners' Union.

Centralisation of Industry.—Another step in the centralisation of industry (a system that seems to be growing in favour) has been made here by forming a central Comité des Industries Nationales de la Soie et de la Laine. This *comité central* represents, to start with, nine departmental associations—four from the silk industry existing at Lyon, Saint-Etienne, St. Chamond, and Calais, and five from the woollen industry existing at Roubaix, Tourcoing, Reims, Fourmies, and Paris. M. Georges Berger, Deputy for the Seine, has been elected president.

Malting Barley.—At the Brewers' Congress held at Lille last week the annual production of barley in France was stated, in round numbers, to be 50,000,000 bushels, an average of 50 bushels per hectare (20¼ bushels per acre). The colony of Algeria produces some 55,000,000 bushels. According to M. Dubernard, the chemist, a good malting barley should contain a maximum quantity of starch with a minimum of nitrogenous organic matters; it should have but little husk, show a farinaceous fracture, and hold a sufficient quantity of phosphoric acid and potash to produce a good fermentation, and consequently a good yeast. To obtain these qualities M. de Geyter recommended a careful selection of seed, and the use of a manure rich in phosphates and as free as possible from nitrogenous matters.

The Paris Metropolitan Railway.—For a good many years past many schemes have been proposed for a city railway in Paris, but on examination it has been found that none of these have been of a sufficiently practical nature. Plans have been made out by M. Ives Guyot and M. Eiffel, which, it is thought, will be found acceptable. According to the present plans, there will be a central line from Puteaux to the Gare de Lyon, by way of the Arc de Triomphe, the Place de l'Opéra, Place du Château d'Eau, and Place de la Bastile, with a second line branching off from the Place de l'Opéra towards the Gare d'Orléans and the Gare de Lyon, and running for some distance parallel to the Rue de Rivoli. In addition to these two main lines, there will be two branch lines, one of which will connect the Northern railway terminus with the Place de l'Opéra, and the other with the Central Market. It is not proposed to ask the State either to make a grant or a guarantee in connection with the railway, the whole of the cost being borne by the companies of the Nord, the Est, the Paris-Orléans, and the Paris-Lyon-Méditerranée.

BERLIN, 9th June, 1890.

Iron.—The languor of the markets in Western Germany is beginning to tell on the trade of Upper Silesia. The animation of last week has in large measure disappeared. Buyers are holding back, in expectation of a considerable reduction in prices when the syndicate meets next week. That this expectation is likely to be fulfilled is shown by the readiness of the merchants to accept offers several shillings a ton below the syndicate minimum. As all manufacturers have plenty of work in hand for several months to come, there is no anxiety for the near future. The Berlin trade is far from active. Joists are in fairly good demand, but buyers haggle long over prices. Here as elsewhere founders are not only very busy on old contracts, but are encouraged to maintain their prices firmly by a steady current of fresh orders. Engineering firms, especially makers of machinery, have plenty to do in the present and bright prospects in the near future.

German Iron Abroad.—The returns of the export trade in German iron for the month of April compare favourably with those for March, the total being 71,393 tons, against 68,413 tons; but there is a heavy falling-off relatively to the same month of last year, which gave a total of 93,095 tons. The following classified statement of the trade of the first four months shows in what directions shrinkage has taken place, the figures in parentheses representing the quantities in the corresponding portion of 1889:—Pig iron, 45,530 (66,212) tons; old and scrap iron, 9,570 (11,814) tons; half-wrought iron and steel, 4,558 (7,667) tons; finished iron and steel (angles, bars, and plates), 67,024 (103,878) tons; wire, 36,484 (60,162) tons; wire nails, 11,365 (17,279) tons; rails, 41,933 (34,754) tons; other railway iron, 19,574 (17,548) tons; heavy castings, except ordnance, 7,635 (4,959) tons; and other manufactured goods, except machinery, 39,761 (36,986) tons. Total, 283,434 (361,259) tons. It will be observed that the falling off is particularly heavy in finished iron and steel, and in wire and its derivative, wire nails. The quantities of wire and wire nails shipped to Great Britain in the four months were 11,603 tons for the former and 3,731 tons for the latter.

Metals.—There is a steady though not strong current of business in metals, and the markets continue to be characterised by an upward tendency. To what this tendency is due it is not easy to discover. It seems to arise solely out of the speculative operations which are forcing up the prices of copper. The latter metal constantly advances under the influence of these "bulling" transactions, and tin and lead are firmer in sympathy. Spelter is itself the object of speculative operations, and moves slowly upward. The W. H. brand is quoted as high as £26.

The Foreign Coal Trade.—In the present circumstances of the coal markets, when the conditions of trade have turned against the coal producers, and prices are rapidly declining, the customs returns showing the movements of the foreign trade in coal in the first four months of the current year are specially interesting, because the existing state of things is largely due to the changes which have taken place in that trade. These returns show an increase, relatively to the corresponding period of last year, of 27·6 per cent. in the imports, 3,427,836 tons, against 2,680,465 tons, and a decrease of 7·2 per cent. in the exports, 3,081,853 tons, against 3,321,805 tons. These statistics, considered in conjunction with the effects of the calm which has overspread the iron trade, justify the attitude of consumers, who, in anticipation of much lower prices, refrain from purchasing beyond the bare needs of the moment.

German Industry in La Plata.—The Government of La Plata recently held a competition for a considerable quantity of machinery for hydraulic works in the port of La Plata, including steam engines, boilers, pumps, accumulators, compressed air pipes, cranes, elevators, capstans, and a floating rotary crane. Among the makers competing were Sir W. G. Armstrong, Mitchell, & Co., Limited, Newcastle on-Tyne, and Mr. G. Luther, Brunswick. The decision was in favour of the latter, who has in consequence received the order.

An Electrical Testing Station.—An electro-technical testing station for North Germany has just been established at Magdeburg, on the lines of the similar institution at Munich. Experiments and tests for public officials and private individuals will be there conducted, to enable them to gain a clear idea of the cost and practicability of electrical undertakings, and the opportunity will be afforded to electrical works to have their machines, apparatus, &c., tested. A well-known electrician —Dr. M. Krieg, editor of the *Elektrotechnisches Echo*—is chief of the station.

Sheep Shearing Machines.—An attempt was recently made to introduce from England into Germany sheep shearing machines working by hand or steam power. A trial shearing was conducted by an English shearer, with a Wolseley shearing machine with twenty-four shears, at the Congress of Pomeranian Wool Growers in Stargard, but it was a failure. The machine in question could be worked by a traction engine or by a steam engine. After an operation lasting uninterruptedly for an hour and a half, the lamb experimented upon emerged from the hands of the shearer in rather a damaged condition. After this result there does not appear to be much prospect of the machine being introduced into Germany.

German Fisheries in the North Sea.—The German deep sea fisheries in the North Sea are slowly but steadily growing. From the official returns it appears that on the 1st of January, 1890, there were 440 fishing vessels in the German Empire, exclusive of coasting vessels, against 440 in 1889, and 425 in 1888. The number of steamers increased more rapidly than the total of both sailing vessels and steamers. Of the latter there were only six at the beginning of 1888, ten in 1889, and eighteen in 1890. It is thus seen that steam is beginning to play an important part in fishing. The vessels were divided among the several States on the 1st of January last as follows:—Prussia, 262 (12 steamers); Oldenburg, 2; Bremen, 4 (2 steamers); and Hamburg, 177 (4). The regular crews numbered 1,161 hands, as compared with 1,641 in 1889, and 1,539 in 1888.

The Breslau Machinery Market.—The twenty-seventh international machinery market opens at Breslau to-day. The exhibits are said to be exceptionally good, nearly every firm of note in Germany and many foreign manufacturers being represented. As a collection of agricultural machinery, the Breslau Exhibition could hardly be surpassed.

The Glass Bottle Trade.—In consequence of the forty-four glass bottle makers having formed themselves into a "ring," and raised the price of bottles 10 per cent., the principal wine merchants have formed themselves into a syndicate to establish new works for the manufacture of such bottles.

VIENNA, 9th June, 1890.

The Iron Market.—The stagnation which was visible for a short time in the iron market has entirely disappeared. Last week large transactions took place, and new increases of prices are to be noted. Tinned sheets increased by 2fl. per 100 kilog. In the Hungarian market also the situation has become better, and pig iron especially is in good request. Rolling mills have as much as they can do to complete the old orders; but during the last week or two they received a large number of new ones. This month the new Hungarian gun manufactory will deliver the first part of the Government order consisting of 40,000 rifles. A short time ago this establishment was visited by the English engineer, Mr. Greenwood, at whose recommendation several improvements will be made. The joint-stock company, formally Danek, of Prague, is issuing its annual report, which shows that its works were more busy last year than ever before. The company declared a dividend of 10 per cent. The Kronstadt Mining Company held its general meeting last week. The joint stock of this company amounts to two million florins, and the profit last year was 245,000fl.

The Coal Market.—No change worthy of notice has happened in the coal market since last report. The market continues animated, and prices are so high that the industries depending on them are very oppressed. There is an extraordinarily brisk export by the Elbe.

Metals.—The Bleiberger Bergwerks-Union, which is one of the chief lead producers in the empire, held a meeting last week. A dividend of 5 per cent was declared.—A good idea of the metal traffic is to be seen from the following table, where the numbers indicate 100 kilos.:—

Imports.

Metals.	1889. Jan.	1889. Feb.		1890. Jan.	1890. Feb.
Lead	2,524	4,170	...	10,108	5,804
Copper, rough	5,441	7,143	...	25,079	31,096
Copper, refined	928	934	...	1,144	1,906
Zinc	4,567	6,705	...	3,995	5,393
Tin	5,518	6,409	...	6,791	8,517

Exports.

Metals.	1889. Jan.	1889. Feb.		1890. Jan.	1890. Feb.
Lead	33,023	31,300	...	29,163	26,958
Copper, rough	6,037	5,646	...	5,791	8,369
Copper, refined	2,207	3,296	...	3,531	4,111
Zinc	40,363	36,279	...	39,497	53,551
Tin	238	273	...	132	446

BRUSSELS, 10th June, 1890.

Iron.—Though there are yet no indications of improvement in the iron market, manufacturers have begun to hope for better things. This hope is based chiefly on the fact that matters have not grown worse in the course of the last fortnight. That the bottom of the depression has been reached is probable, since it is now evident that the present level of prices for coal cannot be much longer maintained. The pig iron market continues weak in tone, and prices are irregular, ordinary forge being dealt in between 48s. and 52s. a ton. At the latter price the Athus Company has sold 15,000 tons for delivery in the second half of the year, a transaction which disposes of its production down to the end of September. The market for finished iron and steel is lifeless. There is a feeble demand for joists, but other classes are utterly neglected. Few of the works are now running more than four days a week. No. 2 bars are quoted 136s. at works and f.o.b. Antwerp. Angles are offered at the same price, and No. 2 plates may be bought for 144s. a ton. These prices are, however, little more than nominal, since there is practically nothing doing.

Coal.—The coal market is just now the chief point of interest in this industrial centre. The colliery owners, having succeeded in strangling the iron trade of this country, and thereby crippling their best customers, now find themselves face to face with German competition under circumstances not foreseen. The Westphalia coke syndicate has got the better of them in the markets of the Meurthe-et-Moselle, and already 50,000 tons have been disposed of to the Longwy Comptoir, and German coke is being sold to Belgian consumers at prices much below those current here. English coke, too, is making its appearance in our markets. The consequences may be estimated with precision. Belgian coke must be reduced to at least the level at which the foreign produce now stands. This means the much-needed relief asked for by the ironmasters to enable them to compete with English iron. Moreover, English coal is driving Belgian coal out of the markets of Holland, so that the downward movement cannot be long delayed. The home demand for coal is now very light. For the moment, quotations remain unaltered; but the tone of affairs is decidedly weaker.

Glass.—The situation of the market for glass has undergone but little change in the course of the last two or three

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weeks. The extinguishing of several furnaces has given a slightly firmer tone to business, but the demand continues weak and irregular. The latest reports from the United States are not encouraging for the immediate future of the trade.

DÜSSELDORF, 10th June, 1890.

Iron.—The iron market is becoming more and more depressed. The prospect of cheaper coal leads buyers to defer every order to the latest possible moment, and as consumers have for the most part bought well ahead, business is almost at a standstill. In pig iron there is nothing doing; scarcely has a ton changed hands in the course of last week. As prices are in such circumstances merely nominal, it is useless to quote them. It is, however, worthy of mention that ordinary spiegel pig is freely offered at 95s. a ton, and Siegen forge at 78s. Production is being restricted to some extent, but it is far above present requirements. The imports of pig and scrap iron in the first four months of the year amounted to 145,478 tons, against 15,599 tons in the corresponding portion of 1889, an increase of 129,879 tons. As the exports fell off to the extent of 22,926 tons, the difference in favour of the present year is 152,805 tons. There is a fairly good demand for joists, but in all other classes of iron and steel the business is very slack. The wire and wire nail industry is greatly depressed.

Coal.—The coal question continues to occupy attention almost to the exclusion of everything else. Two remedies for the disproportion which now exists between the demand and the supply are under consideration, one to reduce the number of hands employed in and about the pits, the other to cease work altogether one day a month. The latter seems most in favour. Consumers generally have large stocks in hand. The Westphalian Coke Syndicate has, it is said, sold 50,000 tons of coke for export to France at the price of 19s. a ton. Considerable quantities have also been sold of late to Belgian and Spanish consumers, so that the tension has been greatly relieved and the market is firmer.

Westphalian Coal at Hamburg.—The consignments of Westphalian coal to Hamburg and its neighbourhood in the month of May amounted to 65,490 tons against 29,960 tons in the same month of last year. Relatively to April there was a falling off of nearly 3,000 tons To compete successfully with the importers of English coal, the merchants are now offering Westphalian produce at prices which involve a loss on the transaction. As coal had advanced 128 per cent. and coke 260 per cent. in the course of twelve months, there is nothing surprising in the collapse which has occurred in the market. Consumers are holding back in expectation of still better terms. The firm attitude of the English merchants keeps the market steady.

LILLE, 10th June, 1890.

Iron.—Weakness continues to be the dominant note of the iron market in this locality. Buyers hold aloof in expectation of easier terms. They are encouraged in this attitude by the prospect of cheaper fuel, and by the action of some of the merchants who are underselling the manufacturers. The latter affect to believe that business will revive after the turn of the year; but it is difficult to discover the grounds on which this opinion is based. The rates now current are 148s. a ton for bars and joists, 180s. for common plates, 200s. for boiler plates, and 200s. for mild steel plates. Concessions on these prices are easily obtained in orders of some importance.

Textile Manufactures.—The market for linen goods gradually becomes less active as the season advances. There is, however, a good average trade, so that the situation is to be regarded as satisfactory. Prices remain without change. At Roubaix the calm in the woollen goods trade is becoming serious, and occasions much anxiety. Manufacturers are sufficiently occupied in working off the March and April orders. Since the first of May, when the labour disturbances began, no fresh orders of importance have been received. The prospect is decidedly gloomy. German competition, always formidable, has gained much by recent strikes. Those disturbances have done incalculable injury to the trade of the Roubaix district.

Flax and Yarns.—The situation of the flax market has changed somewhat in the course of the last week. The prospects of the new crop not being good, consumers are disposed to buy more largely. The demand is very brisk for home-grown flax, and the market in Russian is decidedly more active. Higher prices have been paid all round. There is a moderate demand for tows. Yarns are more sought after. Business having become brisk, spinners advanced their prices. The rise seemed to stimulate rather than check the demand. Jute yarns are being freely bought at constantly advancing prices.

AMSTERDAM, 9th June, 1890.

Railways.—The State Railways Company has issued its report for 1889. This company works 1,488 kilometres of railways belonging to the State at a certain percentage of profit, and also a number of private railroads. Including these, the gross receipts reached 13,787,752 guilders last year, against 13,537, 940 in 1888, whilst the working expenses were 6,766,097 guilders (49·07 per cent.), and the total disbursements 12,076,778 guilders, against 11,898,873 guilders in 1888. The amount available for dividend was 1,374,470 guilders; of this the shareholders received 777,331 guilders on a share capital of 12,883,000 guilders, and the State got 597,139 guilders. The number of travellers was 6,181,491, against 5,866,494 in 1888.

The North Sea Canal.—The Second Chamber of the States-General has passed the Government Bill abolishing the canal dues on this important waterway.

Dutch South African Railway.—This undertaking has just made another successful issue of its four per cent. debenture loan, at Amsterdam and Berlin, the amount offered (1,878,000 guilders) at 99 per cent. being subscribed several times over. The loan is repayable in forty-three years, and is required for the construction of further sections of the road between the Portuguese frontier and Pretoria.

New Steamer.—The launch has just taken place at Feyenoord of the new screw steamer "Carpentier," built by the Royal Steamboat Company for the Royal Mail Packets Company, and intended for the subsidised mail service between Holland and Insuland. It is a vessel of 1,200 tons register, having a length of 235ft., and a breadth of 32ft. The engines and boilers have been constructed at Feyenoord also. The engine is 1,250 h.p., and will enable the vessel to keep up an average speed of thirteen knots an hour. The vessel is lit by electricity, and is fitted up most luxuriously.

COPENHAGEN, 7th June, 1890.

Paper Industry in Norway.—The rebuilding of the Drammenseloen's paper works, close to the Gjethus waterfall, which was burnt down last year, is progressing satisfactorily, the mild winter having materially assisted the builders. It is expected that the paper manufacture will recommence in August or September. The new buildings are on a larger scale than those destroyed by fire, and are remarkably well constructed. The wood pulp manufactory, which was not burnt down, produces about 10,000 tons of wood pulp annually. The new works will have two large machines of the most approved type. The new electric light installation comprises two dynamos, with four arc lamps and 375 incandescent lamps.

The Peat Industry.—The peat industry is attracting more and more attention in Scandinavia. It is not only being used for sanitary and stable purposes, &c., but it is also becoming a far more important fuel. A number of experiments have been going on in various directions, and both in Sweden and Norway such good results are said to have been attained that peat may soon be used as fuel for steamers, locomotives, &c.

The Vigsnes Copper Works.—The prospects for the continuation of these works appear to be more favourable. The Board have decided to continue the working of the pits with a reduced staff. The managing director has published a statement, in which he complains of several unfavourable circumstances attached to mining enterprises in Norway. Among others, stress is laid upon the fact that wages for such work are about 45 per cent. higher in Norway than on the Continent.

Merchant Steamers in Norway.—The merchant fleet of Norway comprises 6,697 sailing vessels, with an aggregate tonnage of 1,396,998 tons, and 536 steamers with an aggregate tonnage of 137,542 tons. The principal owners reside in Christiania, Arendal, Stavanger, Bergen, Drammen, Frederiksstad, Kragerö, Grimstad, and Tönsberg.

Seal Hunting.—The seal catching vessel "Vega," which arrived at Vardö on the 30th ult., reports that the whole fleet was fast in the ice at Jan Mayn from the end of March to the 8th of May, so that the year, so far as catching young seals was concerned, was a complete failure. The "Vega" had caught 1,300 seals.

New Telegraph Cable.—The Great Northern Telegraph Company is contemplating laying down one or two new telegraph cables between Scandinavia and England. A cable will be laid between Gothenburg, on the Swedish side of the North Sea, and Newcastle-on-Tyne on the other side. This will be the first direct cable between Sweden and England. This new cable is expected to bring about a material increase in the Swedish telegraphic intercourse, as a large number of telegrams are likely to be sent by the new line from Russia and Northern Asia to England.

MADRID, 9th June, 1890.

Tinplate Works at Bilbao.—The tinplate works of Messrs. Goitia are doing well at present; they are favoured partly by the heavy import duty, and by the quality of the steel billets made at the works of La Viscaya. They are now making 200 boxes per day, but they consider that their works should be able to produce 300 boxes with the same plant.

La Robla and Valmaseda Railway.—The Bill for this railway has now passed both Houses, and most likely the works will begin this summer, and will be proceeded with as fast as possible. The engineer has decided to have all his rolling stock made in England instead of Belgium or Germany.

Ore Exports.—The Bilbao strikes, together with the falling of prices in England, have been against the continuance of the rapid shipment of ores which has existed for the last two or three months. As the freights are rather low, the deficiency may, however, be made up in the summer months. The pig iron market is very irregular, and no one knows exactly the price at which pigs may be bought.

Phosphates.—The Caceres phosphate mines have stopped altogether, as the ores are too poor for export even after hand picking. The company established a plant to make superphosphates, but it seems that they are not doing well. Great efforts are now being made to make a railway to what is considered a rich district for phosphates in Logrossan in the south of Estremadura. In the province of Murcia, the mines of Jumilla are supposed to contain excellent apatite, but it is very doubtful whether it occurs in such quantities as to warrant the large investment that a Belgian company has made in plant to concentrate their mineral.

NEW YORK, 1st June, 1890.

The Iron and Steel Trade.—The iron market has been considerably unsettled, and some very low prices have been offered. There has been little doing in pig iron; prices are steady, and there is much less disposition to allow concessions. No. 1 foundry iron can be had in almost any quantity at $18 to $18·50 per ton, No. 2 at $17 and grey forge at $15·50 to $16. Southern irons can be had from 50c. to $1 less per ton, but consumers are not taking much of it in Eastern markets. Advices from the South however, indicate a better feeling, and a general movement towards better prices is expected in a short time. Manufactured iron has not improved, although prices are generally well maintained, and in a few instances better rates have been secured. A moderate increase in the demand would quickly result in higher prices. Several important contracts are in negotiation, and it is more than likely that the mills will have plenty of work by the end of the month.

The Coal Trade.—The anthracite trade has not altered. The trade in Philadelphia is dull, while in New York business is fairly good, and the inquiry for some sizes of coal is improving. The impression is now general that within the next two months the demand for coal will begin to increase, and that for the remainder of the year trade will be brisk.

Connecting the Americas.—Representative McCreary, of Kentucky, introduced a Bill the other day to provide for a survey to be made to encourage the construction of an inter-continental railway to connect North and South America. The Bill authorises the President to invite the several Governments of Mexico, Central and South America, to co-operate with the United States in the appointment of an international commission to examine the possible routes, costs, and advantages, and to make a survey for the railway. This commission of engineers is to meet in Washington as soon as practicable, and will be composed of not more than three engineers from each nation. The construction and operation is to be at the cost of the concessionnaires, and the expenses of the surveys, salaries of commissioners, &c., are to be borne by the nations accepting the proposition.

Heliographic Signalling.—The greatest achievement in heliographic work in this country was accomplished during practice in the department of Arizona last week. Lieutenant Witteweyer succeeded in signalling a message by a single flash 125 miles, from Mount Reno, near Fort McDowell, to Mount Graham, near Fort Grant, where it was received by Captain Murray. The latter, by turning his instrument, flashed the message to Fort Huachuaca, a distance of 90 miles, making a distance of 215 miles with a single intervening station. The longest distance heretofore made with a single flash is said to be about 75 miles.

A Large Packing Plant.—A party of capitalists, on which Mr. P. D. Armour, of Chicago, is the head, have obtained nearly 2,000 acres of land at Hunter's Point, of the southern extremity of San Francisco, on which they will establish a large pork packing and beef canning plant. The capital of the new enterprise is $2,000,000. A number of Sioux City capitalists recently secured a large tract of land on the opposite side of the bay for the establishment of a packing house of the same kind.

PHILADELPHIA, 30th May, 1890.

Labour Troubles.—The strike at the National Tube Works at McKeesport has ended by the men going back to work. They demanded an increase of wages, but the company offered a satisfactory compromise. Several thousand men were involved in the strike, as the National Rolling Mill was also shut down. The miners employed at Scott's works and along the Youghiogheny River have been out on a strike for the Columbus scale. The firm offered 1c. less than the scale, which was accepted by the men.

Rapid Transit.—The problem of rapid transit in our cities has usually been approached in a haphazard manner. generally no well-digested plan being formed beforehand, To provide such a plan for Philadelphia a Rapid Transit Commission has been created. The Commission is directed to consider the various methods of rapid transit which have been suggested, and to evolve from them a system which will meet the demands of every section of the city. The work must be completed by October, and the scheme determined upon is then to be reported to the city councils. The Commission consists of the Mayor, Presidents of both branches of Council, chairmen of the committees on railroads, finance, highways, city property and surveys, presidents of the Pennsylvania, Philadelphia, and Reading, and of the Belt Line Railroads, of the principal street railway companies, and numerous prominent citizens. Committees were appointed to obtain information, and it is hoped that the labours of the Commission will result in a practical solution of the problem.

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IMPROVEMENT OF THE LIVERPOOL SOUTH DOCKS.

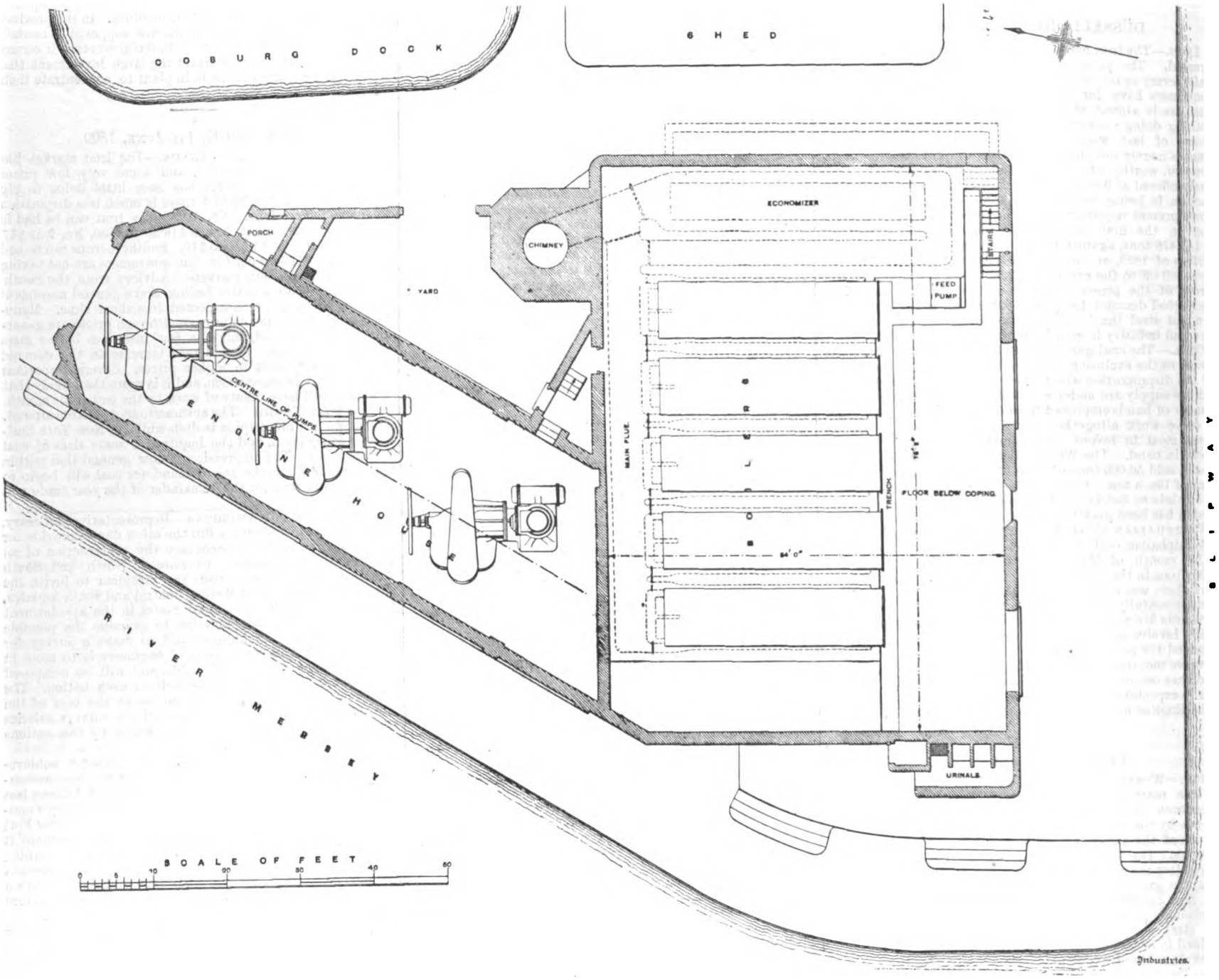


FIG. 1.—PLAN OF BUILDINGS AND PUMPING PLANT AT ENTRANCE OF COBURG DOCK.

IMPROVEMENT OF THE LIVERPOOL SOUTH DOCKS.

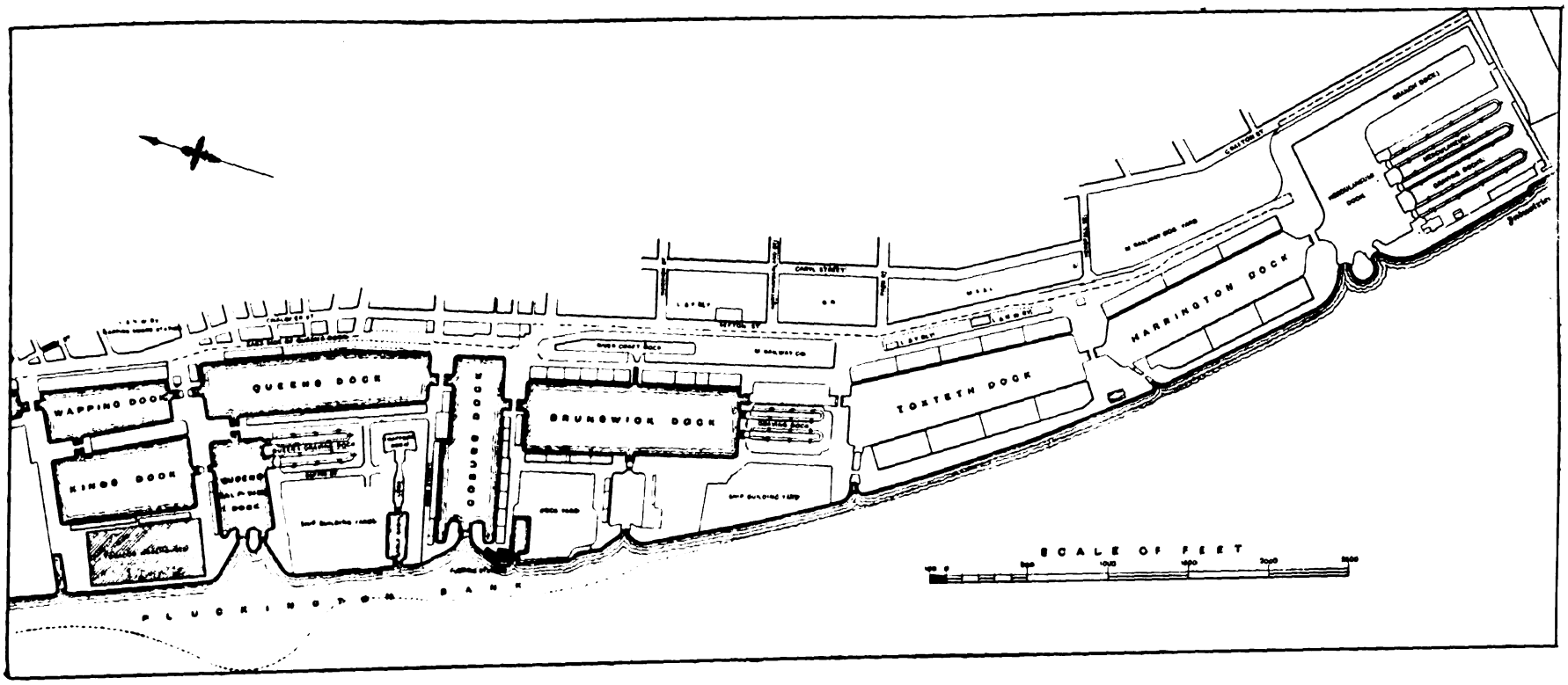
WE are enabled to lay before our readers, through the courtesy of Mr. George Fosbery Lyster, M.Inst.C.E., Engineer-in-Chief to the Mersey Dock Estate, an illustrated description of an important scheme for the improvement of a number of the docks at the south end of the Liverpool dock system, which has been in successful operation for several months. Although these docks were constructed for the accommodation of the largest steamers and sailing vessels afloat at the time of their construction, within the last few years the steamers have attained such enormous proportions, both as regard tonnage and draught, that the depth of the sills quite prevent them from entering the docks in question, except during favourable tides near high-water time. As these favourable conditions only occur at high spring tides, it was necessary, to make the docks available for all classes of shipping at all tides, to either rebuild the entrances and increase the depth of the sills and the dock bottom generally, or to provide some other means of gaining access to the docks. As the tail of the Pluckington Bank unfortunately lies across the entrance to many of the south docks, it was considered useless to construct entrances with deep sills, seeing that they could not possibly be approached. Even if they could, the cost of deepening the docks and underpinning the walls would be very great. Mr. Lyster, therefore, conceived the idea of impounding the waters in the various docks and using powerful pumping machinery to assist as far as might be necessary in maintaining the abnormal level by making good the losses due to locking, leakage, filling graving docks, sluicing, &c. Large vessels could then enter the newer or southernmost docks which have deep sills at a part of the river not obstructed by the Pluckington Bank, and thence be locked into the older docks with the shallow sills. This pumping system had already been tried on a smaller scale with the Sandon Dock, in order to give access to an important series of graving docks there; and as it had been so very successful it was decided to adopt it on a more extensive scale at the south docks.

By referring to Fig. 2, page 561, which shows a portion of the south dock system, it will be seen that the Wapping, King's, Queen's, Coburg, and Brunswick Docks are connected together, and, by the Union Dock—serving as a lock—to the Toxteth, Harrington, and Herculaneum Docks. The sills, however, of the first five docks do not in any case exceed a greater depth below datum than 6ft., while those of the three latter, including the entrance to the river at the Herculaneum Dock, are 12ft. below datum. The average high-water mark of ordinary spring tides, excluding the equinoctial tides, is 18ft. 10in. above datum, the average high-water level of neap tides being 11ft. 7in. above datum; it will be seen, therefore, that a vessel drawing 23ft. or 24ft. of water could enter the Toxteth, Harrington, and Herculaneum Docks during any tide of the year, while with ordinary conditions it could only enter the other five docks during high spring tides. By pumping the water into these five docks to an increased depth of 6ft., an effective depth of sill corresponding to that of the other docks can be given. Large vessels, therefore, wishing to enter the shallow sill docks, enter the Herculaneum Dock, pass through the Harrington and Toxteth Docks, and are then locked through the Union Dock into the Brunswick-Wapping dock system.

When this system of pumping was decided upon, Messrs. J. & H. Gwynne, engineers, of Hammersmith, were consulted, and it was left to them to design the necessary machinery for pumping the specified volume within a given time—that is, for raising an area of about 50 acres to a depth of 6ft. The machinery and arrangement of it are so clearly shown in the several illustrations that no description is necessary beyond giving a few of the leading particulars. Fig. 1 above shows the plan of the machinery, boilers, buildings, &c., as fixed at the entrance to the Coburg Dock, and indicated on Fig. 2. The pumps are of the well known "Invincible" type made by Messrs. Gwynne, and are shown in detail in Figs. 3 and 4, page 564. The disc or fan of each of the river pumps is 90in. in diameter, the pump casing being 16ft. 6in. diameter; the suction and delivery pipes are 54in. diameter, and have bell-mouth ends, as shown in the illustrations. Each pump is driven direct by a compound vertical engine with cylinders 40in. and 22in. diameter respectively, with a stroke of 30in., and running

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PLAN OF THE LIVERPOOL SOUTH DOCKS.



90 revolutions per minute. The whole of this plant was constructed by Messrs. J. & H. Gwynne, at the Hammersmith Ironworks. Steam is supplied from five steel boilers of the Lancashire type, 30ft. long, 7ft. 6in. in diameter, each of the flues being fitted with four Galloway tubes, the working pressure being 100lb. per square inch. The boilers were made by Messrs. Joseph Foster & Sons, Preston. The feed water is passed through a Green's economiser having five groups of 64 pipes in each—360 pipes in all. The boilers are fitted and mounted according to the most modern practice, and to the full requirements of the steam boiler insurance companies. The machinery has now been in operation for some months with most satisfactory results, and at the first official trial, when approximate gaugings were taken, it was found that the quantity of water delivered by the pumps was greatly in excess of the specified quantities.

A similar system of raising the dock water level, so as to make the shallow sill available for vessels of deep draught, has just been completed by Mr. Lyster in the Birkenhead Docks. The machinery in this case was also designed and supplied by Messrs. J. & H. Gwynne, and at the recent trials the results were eminently satisfactory. These pumps will enable deep-draughted vessels to use a dock system of 130 acres on a tide, when they can pass over a 12ft. sill.

Trials of the engines, boilers, and pumps, of both the Liverpool and Birkenhead stations, are shortly to be made, when we hope to lay the detailed results before our readers.

PRICES CURRENT, 11TH JUNE, 1890.

Quotations at per ton, unless otherwise specified.

METALS.

Spelter:	Ordinary	£24	0	0	to	24	5	0
Copper:	British Cakes and Ingots	64	0	0	,,	65	0	0
,,	Chili Bars, G.O.B.'s	57	10	0	,,	57	17	6
,,	Other sorts, G.M.B.'s (equal to Chili Bars)	57	10	0	,,	57	17	6
,,	Manufactured (strong)	70	0	0	,,	.....		
Lead:	Common Pig	13	12	6	,,	13	15	0
,,	English Sheet	14	7	6	,,	14	10	0
Tin:	Straits	96	17	6	,,	97	5	0
,,	Australian							
,,	English Ingots	101	0	0	,,	.....		

Messrs. Carrick & Brockbank, Manchester, report as follows:—

COPPER has been very excited during the past week, and values of raw have advanced about £4 a ton, a large business having been done at prices ranging from £54 10s. to £58 15s. for cash. There has been an increased speculative inquiry on American account, principally in three months' metal, the demand for consumption there being very active for electric purposes, &c. There has also been a very large demand for sulphate of copper in France for the vineyards. The Customs' returns just issued are of interest, showing that the imports for this year are far less, and the exports considerably greater, than for the same period last year, viz.:—

	From Jan. 1 to May 31.			May only.	
	1890.	1889.		1890.	1889.
Imports, total tons	53,908	62,482	...	11,041	13,090
Exports, ,,	36,513	16,218	...	7,968	5,885

These returns have helped to strengthen the market. A somewhat easier feeling is observable to-day in Chili bars, quotations being £57 10s. to £57 17s. 6d. cash, with good business. Manufactured has been advanced to £70 sheets, £73 bottoms, and a fair business has taken place recently.

TIN has been strong all the week, and prices have advanced considerably. The decrease of about 580 tons in stock during May, and the light shipments from the Straits, have induced large buying, at advancing rates.

LEAD steady, and without change in price. An improved demand is reported, and values are likely to be firmer.

SPELTER very firm and advancing, the stocks being everywhere small, and makers sold forward for some months.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	5 12 6	.....	6 2 6	f.o.t. wks.
,, Angles	5 7 6	.....	5 17 6	,,
,, Plates	5 10 0	.....	6 0 0	,,
Staffordshire Bars (cheaper makes)	7 10 0	.....	8 0 0	London.
,, Angles	7 10 0	.....	8 0 0	,,
Crown Sheets	7 2 6	.....	7 12 6	,,
,, Hoops	7 0 0	.....	7 10 0	,,
"Siemens-Martin" Steel Boiler Plates			7 17 6	,,
,, Ship and Girder			6 17 6	,,

Market quiet.

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	67/-	..... 57/-

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

PIG IRON.

Middlesbro' Warrants, No. 3.	41/-	Cash
Scotch Warrants, m/n	44/1½	,,
Hematite Warrants, m/n	50/3	,,

Stocks in Stores	Scotch	732,486—Dec. for week	6,765	Tons.
	Middlesbro'	100,223—Dec. ,,	2,257	,,
	Hematite	302,080—Dec. ,,	4,866	,,

Exclusive of stocks in makers' yards.

	No. 1.		No. 3.		
Coltness	62/6	.....	57/-	f.o.b.	Glasgow.
Gartsherrie	59/6	.....	55/6	,,	,,
Langloan	62/6	.....	57/-	,,	,,
Summerlee	61/-	.....	56/6	,,	,,
Glengarnock	60/6	.....	54/-	,,	,,
G.M.B. ex Store	44/6	.....	44/3	,,	,,

CHEMICALS.

		£	s.	d.		£	s.	d.
Acid:	Carbolic Crystals ..... lb.	0	0	8½	to	0	0	10
,,	,, Liquid ..... gal.	0	1	2	—	.....		
,,	Citric ..... lb.	0	1	4	—	.....		
,,	Oxalic ..... ,,	0	0	4	—	.....		
,,	Sulphuric ..... ton	1	12	0	—	.....		
,,	Tartaric ..... lb.	0	1	4	—	.....		
Alum:	Lump (powder 10/- ex.) ... ton	4	17	6	—	.....		
Ammonia:	Carbonate ..... lb.	0	0	3½	—	.....		
,,	Muriate (Grey) ..... ton	22	15	0	—	.....		
,,	,, (White) ..... ,,	26	10	0	—	.....		
,,	Sulphate ..... ,,	11	10	0	—	.....		
,,	Liquor ..... lb.	0	0	3¾	—	.....		
Antimony ..... ton		.....			—	.....		
Bleaching Powder ..... ,,		4	15	0	—	4	17	6
Bisulphide of Carbon ..... ,,		13	10	0	—	.....		
Borax ..... ,,		30	0	0	—	.....		
Benzole (90 %) ..... gal.		0	3	10	—	.....		
,, (50/90 %) ..... ,,		0	2	10	—	.....		
Copper Sulphate ..... ton		25	0	0	—	.....		
Copperas ..... ,,		2	0	0	—	.....		
Kieserit ..... ,,		.....			—	.....		
Lead:	Nitrate ..... ,,	22	10	0	—	.....		
,,	White Sugar ..... ,,	24	0	0	—	.....		
,,	Brown ,, ... ,,	19	0	0	—	.....		
Potash:	Bichromate ..... lb.	0	0	4	—	.....		
,,	Caustic ..... ton	22	0	0	—	.....		
,,	Carbonate ..... ,,	19	10	0	—	.....		
,,	Chlorate ..... lb.	0	0	4½	—	0	0	4½
,,	Prussiate (Yellow) ..... ,,	0	0	9½	—	.....		
,,	Sulphate (Basis 90 %) ..... ton	9	10	0	—	.....		
Precipitate:	Red ..... lb.	0	3	1	—	.....		
,,	White ..... ,,	0	3	2	—	.....		
Salts: Epsom	Bags ..... ton	3	0	0	—	.....		
	Casks ..... ,,	3	15	0	—	.....		
,,	Glauber ..... ,,	1	10	0	—	.....		
Sulphur:	Sublimed Flowers ..... ,,	9	0	0	—	.....		
,,	Recovered ..... ,,	4	10	0	—	.....		
Soda:	Ash ..... deg.	0	0	1¾	—	.....		
,,	Caustic (White 70%) ..... ton	7	17	6	—	.....		
,,	,, 60% ..... ,,	6	17	6	—	.....		
,,	,, (Cream 60%) ..... ,,	6	12	6	—	.....		
,,	Crystals ..... ,,	3	2	6	—	3	5	0
,,	Bicarbonate ..... ,,	6	5	0	—	.....		
,,	Hyposulphite ..... ,,	6	5	0	—	.....		
Solvent Naphtha ..... gal.		0	4	0	—	.....		
Tartar, Cream of ..... cwt.		5	12	6	—	.....		
Zinc Sulphate ..... ton		7	10	0	—	.....		

Messrs. S. W. Royse & Co., Manchester, report as follows:—

CHEMICALS: A moderate business has been passing in alkalies, but prices of caustic soda and bleaching powder are a little lower. Bicarbonate of soda is also easier. Soda ash is steady, and soda crystals are in demand. Chlorate of potash very quiet. The inquiry for carbolic acids is slacker. Benzoles are unchanged. Fair business doing in sulphate of ammonia. Oxalic acid is active, and tartaric and citric acids are firm.

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HOME INDUSTRIES.

LONDON, 12th June, 1890.

The Money Market.—Money has been much scarcer this week, as the payments on account of an issue of Treasury bills have cleared the market of its surplus supplies. The considerable demand arising out of the Stock Exchange settlement has also tended to make money dearer, and as much as 2¼ per cent. has been charged for accommodation for short periods. The discount market has moved more in the direction of ease, the Paris cheque rate having risen in our favour and considerable sums in gold having come into the Bank. The stock markets have been rather depressed this week, and the settlement has occupied most attention. Prices gave way just before the close of the account, as many speculators for the rise desired to realise their profits. Home railways have been quiet, with the exception of Caledonians, which have been strong on the passage of the Bill for splitting the stocks. The other stocks affected by conversion Bills are less active, and therefore attention was concentrated on Caledonians. The mineral lines have been rather neglected, and the southern railway stocks have been out of favour. American railroads have been steady, without any distinguishing feature. Mexican Central securities have been very prominent at considerably higher prices, but the stocks of the Mexican Railway (Vera Cruz) have fallen greatly, the traffic returns being consistently unfavourable. Foreign stocks, after a long period of firmness, gave way on Tuesday, Paris withdrawing the support given to them from that quarter for some weeks. The close of a campaign against the "bears" of copper shares was witnessed this week. Gold mining shares have been neglected, and there has been no feature of importance in industrial and miscellaneous securities

Companies.—The following companies have been registered since our last report:—Sumatra Exploration Co., Ld., with a capital of £250,000; The Vulcan Patent Smoke Consumer and Fuel Economiser Corporation, Ld., with a capital of £70,000, to carry on the business of engineers, &c.; Steam Cylinder Lubricator Co., Ld., with a capital of £10,000; Patent Multiple Engraving Machine Syndicate, Ld., with a capital of £6,000; Briton Ferry Patent Carbon Fuel Co., Ld., with a capital of £10,000, to carry on business as patent fuel manufacturers, iron founders; The Glenrock Co., Ld., with a capital of £225,000, to carry on mining operations, &c., in New Zealand; The Penrikyber Navigation Colliery Co., Ld., with a capital of £350,000; St. George (Queensland) Gold Mining Co., Ld., with a capital of £55,000; Blackpool Brick Manufacturing Co., Ld., with a capital of £2,000; The San Jacinto Estate, Ld., with a capital of £505,000, to purchase mines and mining property in California; Drachenfels Banket Gold Mining Syndicate, Ld., with a capital of £25,000; Suyapa Silver Concession, Ld., with a capital of £10,000; Ratcliff & Horner, Ld., with a capital of £20,000, to carry on business as mechanical engineers; Bishop's Stortford Electric Light and Steam Laundry Co., Ld., with a capital of £10,000; Puiel Estate and Exploration Co., Ld., with a capital of £40,000; Hull and Liverpool Red Oxide Co., Ld., with a capital of £75,000.

The Board of Trade Returns.—The total value of the exports for the month of May amounted to £22,940,779, as compared with £20,421,394, in May last year, being an increase of £2,519,385, or 12½ per cent. In May last year the exports showed an increase of 5½ per cent., so that there has been a very decided improvement on the two years. It must also be taken into consideration that the Whitsuntide holidays interfered with trade in the last week of the past month, which makes matters still more satisfactory. The exports of yarns and textile fabrics were £9,344,807, as compared with £8,622,509 in the same month of last year; the exports of metals and articles manufactured therefrom, except machinery, were £4,278,321, as compared with £3,620,679; machinery and mill work amounted to £1,601,857, as against £1,295,046; and chemicals and chemical preparations, £828,279, as against £697,892. The imports again show a decrease, being £33,341,005, as against £34,835,408 in May of last year. Metals amount in value to £1,888,375, as compared with £1,694,075; chemicals and dyestuffs to £649,493, as compared with £810,562; oils to £460,957, as compared with £438,509; raw materials for textile manufactures to £5,907,126, as compared with £7,776,424. The total value of the exports for the five months ending 31st May were £106,023,148, as compared with £100,712,988 for the five corresponding months of last year. The imports for the five months of this year were £174,084,463, as compared with £178,661,794.

The Royal Agricultural Show.—The fifty-first annual Exhibition of the Royal Agricultural Society of England will be opened at Plymouth on the 21st inst., and close on the 27th inst. The machinery in motion shedding will be 1,291ft. in length, as compared with 2,496ft. last year; the ordinary shedding 6,117ft., as compared with 10,378ft.; and the special shedding (including seeds, models, &c.) 1,670ft., as compared with 2,728ft. The total entries of live stock also show a decrease.

Society of Engineers.—Arrangements have been made for the members and associates of the Society and their friends to visit the Thames Ironworks, Blackwall, and inspect the ironclads in course of construction, on Tuesday, the 17th inst. The party will travel by the London and Blackwall Railway to and from Blackwall. The following is the time table:—2.10 p.m., leave Fenchurch Street Station; 2.35 p.m., arrive at Blackwall Station; 2.45 p.m., inspect works; 5.0 p.m., leave works; 5.20 leave Blackwall Station; 5.35 p.m., arrive Fenchurch Street Station.

The American Meetings of the Iron and Steel Institute.—The programme for the visit of the members of the Iron and Steel Institute to the United States has recently been issued. There will be three different sets of meetings—the first, the meetings of the American Institute of Mining Engineers (the most prominent technical body in the United States), which take place in New York on the 29th and 30th of September; the meetings of the Iron and Steel Institute, which take place in the same city on the 1st, 2nd, and 3rd of October; and the international meeting promoted jointly by those two Societies, which will take place about the middle of October at Pittsburg. The excursions which have been planned by the American reception committee, of which Mr. Andrew Carnegie is chairman, provide for about 3,000 miles of free transportation through the United States. The principal excursions will take place to the iron ore and copper regions of Lake Superior, to Philadelphia, Harrisburg, and Chicago, where there are large iron and steel engineering works to be inspected, and to the new iron-making district of Alabama, which has lately come very prominently to the front, and in which English capital has become very largely interested. About 300 members of the Iron and Steel Institute and 100 German ironmasters have intimated their intention of taking part in the meetings, and already many have booked passages in the Hamburg-American Packet Company's "Normannia," leaving Southampton on the 12th of September. The meetings and excursions will last over a month, and will practically embrace every point of interest in the United States within a distance of 1,500 miles of New York. A number of important papers have been promised for the meetings by such well-known scientists as Sir Lowthian Bell, Sir Nathaniel Barnaby (the late chief constructor to the Navy), and Sir Henry Roscoe. Amongst others who have intimated their intention of being present at the meetings are Sir James Kitson (president of the Institute), Lord Edward Cavendish, Sir John Alleyne, Sir James Bain, Mr. Hingley, M.P. (president of the Iron Trade Association), Mr. Theodore Fry, M.P., Sir J. J. Jenkins, Sir Thomas Story, Mr. A. Windsor Richards, Mr. Snelus, F.R.S., and Mr. Ed. Pellartin.

The Electric Lighting of New Scotland Yard.—The new central offices of the Metropolitan Police on the Embankment are being fitted throughout with the electric light. Altogether some 1,260 incandescent lamps will be employed to light the 300 rooms and corridors. The wiring is arranged with alternate lamps on different circuits supplied by separate engines and dynamos. It has been determined to put down a special generating plant. The plant will consist of three Lancashire boilers and four sets of engines and dynamos having a combined capacity of some 160 electrical horse-power. They will be placed in an underground engine-house excavated outside the main building. There will also be a battery of accumulators capable of maintaining 200 lights for nine hours when the engines are at rest. The installation, which will be one of the largest and most complete of the kind in London, is being carried out to the specification of Mr. A. A. Campbell Swinton.

Electric Lighting.—Following the example of all the new theatres in London, the latest addition to the music-halls of the metropolis—viz., the Tivoli—has been lighted electrically. The arrangement of glow lamps is effective, and the fittings neatly designed. The hall, which is in the Strand, nearly opposite the Adelphi Theatre, is supplied with current from Messrs. Gatti's installation. The whole of the fittings have been carried out by Messrs. Rashleigh, Phipps, and Dawson.

Churchill's Marine Governors.—Messrs. Durham, Churchill, & Co. have received an order for two marine engine governors for the "Polar Star," the new yacht for His Imperial Majesty the Czar; also two governors and compound attachments for the new Russian ironclad "Azof," of 11,500 i.h.p.

Jeyes' Disinfectant Fluid.—We are informed that Jeyes' Sanitary Compounds Company has obtained an order to supply their disinfecting fluid to Chinese passenger ships.

MANCHESTER, 12th June, 1890.

Railway Rates.—In a letter addressed to various trade associations in Lancashire, the representatives of the spinners before the recent Commission have reported the result of their efforts. The charges as proposed by the railway companies raised the cost of carriage of 578,174 tons of cotton—which is the amount brought into the district in a year—from £240,000 to £440,000. The representatives recommended the following rates for pressed cotton bales. For each mile, 2d. per ton, with a terminal charge of 2s. where services are rendered by the companies. This is equal to a charge of 3·20d. per ton per mile when the distance carried is twenty miles. These charges would considerably increase the revenue of the companies.

The Linen and Jute Trades.—In nearly all of the warehouses quietness prevails in the heavy departments. Tuesday was a fair day for the fancy branches, and considering that no one expects to do much at this time of the year in coarse goods, linen sales were not unsatisfactory. Retailers are stocked for a little ahead, and the wholesale houses are giving out very few orders just now. German manufacturers have been pushing their fancy goods for the Christmas trade, even at this date. They will take a three months' bill in payment, and seem fond of booking as far in advance as possible. Their goods being specialties, in which competition on the part of British or Irish firms is practically *nil*, buyers have been found willing to accommodate them in this way. Home manufacturers are not so fortunate, the tendency being to put as many strains upon them as possible, by purchasing in a hand-to-mouth fashion. The most notable feature of the linen trade at the present time is the rush on the part of shippers to stock the New York market as much as possible before the new tariff legislation can have effect. The activity prevailing from this cause alone is exceptional and of a character rarely seen. The United States is far and away the leading market for linen, and the probability that it will shortly be partially closed amongst European exports is a serious matter for producers. There is no change in linen threads, and jute goods are in the same condition as linens.

Wages in the Cotton Trade.—A conference of representatives of the employers and employed in the weaving industries was held on the 10th inst., to endeavour to come to some understanding with reference to the proposed standard wages list. It is stated that an agreement is likely to be come to, and the threatened great strike of operatives is for the present postponed.

Rope Driving.—We have recently inspected a system of rope driving which is devised to overcome some of the difficulties of the ordinary method. Instead of using a number of separate ropes a single rope is used, which is spirally passed round the pulleys as often as possible. The slack is taken up by a compensating arrangement applied to the last coil, and all the remaining coils are kept tight, both back and front, there being none of the bagging of the slack side usually noticed. The effect of this arrangement is to ensure a uniform diameter throughout the life of the rope, and so prevent the unequal engagement of it in different grooves which is observable in the ordinary system. The drag set up by ropes being unequally geared is entirely obviated, and a perceptible improvement in the steadiness of the ropes is noticed. This system is also applied to self-acting mules with success, and it is claimed that much of the loss of power usually existing is prevented.

GLASGOW, 12th June, 1890.

Pig Iron.—A rather remarkable change has come over the pig iron market here within the last few days. While the accounts published in all the papers are of the most doleful character, all pointing to the necessity of lower prices before fresh business can be expected to come on, speculative purchases on a large scale have been made at rapidly advancing prices. Warrants for Scotch, hematite, and Cleveland iron are almost entirely out of the hands of dealers, and seem to have been absorbed by a numerous class of investors, whose principal reason for buying and holding is that iron cannot be made at present prices, and that the cost price cannot be appreciably reduced. The "bears," on the other hand, have rather overshot the mark, and have possibly made out things worse than they are; they get uneasy whenever a little rise shows that the downward course is not a certainty; so that there was a great deal of anxious buying when Scotch warrants had been carried up to about 44s. 9d. and 45s.

Shipbuilding.—At Renfrew Messrs. Wm. Simons & Co. are busy with a large number of dredgers. They are building a large one for the Manchester Ship Canal Company, which will be launched in a few weeks, one for the Nicaragua Canal, two for Santos, two for Durban, and one for Spain. They have also sold a dredger of their well-known type to the Japanese Government, for service at Yokohama. This dredger is ready for despatch. The same firm are fitting upon one of their dredgers a sand pump plant for the Mersey Harbour Board. The pump is one of Messrs. Simons' patent centrifugal pumps, and is capable of throwing about 400 tons of sand per hour. It is intended to be employed upon the bar of the River Mersey.—Messrs. Russell & Co., Port Glasgow, are building two steel vessels for Messrs. Thomson, Dickie, & Co., Glasgow. The vessels, which will be named the "Culmore" and "Templemore," are to have a registered tonnage of 1,685 tons, and carry over 2,800 tons each. They were contracted for some time ago at £19,750 each.—Messrs. Fleming & Ferguson, shipbuilders and engineers, Paisley, have received an order from Mr. Christen Thorbjornsen, of Christiania, to supply a set of their patent improved quadruple-expansion engines, to indicate 500 h.p., for his s.s. "Erling," these engines being substituted for the compound now in the "Erling." This will be the twenty-sixth set of this type of engines constructed by Messrs. Fleming & Ferguson.

A New Method of Printing on Handkerchiefs for Embroidery.—A new method of printing designs on handkerchiefs for embroidery work has just been patented by Mr. Hugh A. McColl, designer, Glasgow. The process is exceedingly simple, and consists of a roller whose circumference is exactly ¼in. larger (forming the baulk) than the size of the handkerchief to be printed. The lines of the design are drawn upon paper in the usual way and in the required colours, and are then transferred to the roller. The handkerchief, or web of handkerchiefs, is then passed under the roller, when the various colours of the design are printed on it in clear and clean lines. It will thus be seen that any number of colours may be printed at once and from a single roller—an obvious advance on the old method of perforating or block-cutting the design and

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then stencilling it on to the handkerchief. This is one of the advantages claimed for the process, besides the rapidity with which the designs are printed. Several of the largest manufacturers in the trade have already seen it at work, and consider it a great advance in the right direction. It will be at once seen that the amount of colour absorbed by the roller must in time become expended when it is necessary to replenish it. This would mean considerable expenditure of time, but, we believe, Mr. McColl has under consideration a method for obviating this difficulty, by which, without any appreciable loss of time, the roller is again filled with colour and ready for work. Or, if more than one roller was in use, the printing could go on almost without interruption as, when one roller got used up, another could be substituted, and so on. The composition of the roller is such that, if laid aside unused for some time, the colours sink, and a new design can be placed over the old one without in any way letting the two designs become mixed.

(From our own Correspondents.)

LIVERPOOL, 11th June, 1890.

The Furniture Wood Trade.—There has been a distinct improvement in the tone of the market during the past month, and for some classes of timber there was an advance in the prices realised at the sales. The stock of Honduras mahogany is very light, and there have been no recent sales. The stock consists of a portion of two cargoes. The stock of Tabasco is light, and is in active demand, a cargo of Laguna wood realising advanced prices at a recent sale. Minatitlan is in active demand, and prices are well maintained. There is a good opening for Tlacotalpam and Tecolutla, the market being bare. Logs of St. Domingo mahogany are in request, and good prices are realised. Curls of good quality are in demand, and meet with ready sales, but for second quality there is no demand. There is only one cargo of Cuba mahogany in stock to meet the steady demand; of African the market is bare, and there have been no recent sales. The demand for Honduras and Mexican cedar has improved, and fair prices are obtained for sound wood. The consumption of pencil cedar is limited, and the stock is light. There is a good demand for American walnut, and as the import has been small the prices have improved. The demand for Italian and Circassian is, however, very limited. The large arrivals of white wood have made the prices easier, dealers not caring to have too large a stock at this time of the year. The high price of rosewood has restricted the sale. Satinwood is in request, prices being high and the market bare. Lignum vitæ is in demand at fair prices, and the stock is reduced to a few tons.

SHEFFIELD, 11th June, 1890.

Iron and Steel.—There is a good demand for merchant iron of all classes, and local houses are fully employed, mainly in the production of best brands. Pig iron of all grades has fluctuated considerably in value lately. Rolling mills are well employed. Armour plate mills are fully employed on work for the British Government, which will last some time yet. A great change is quietly coming over the file trade owing to the introduction of machinery, which has now reached great perfection. Files are now forged, ground, cut, and finished by machinery, and are undoubtedly superior to any goods produced by hand. Germany is much the best customer, and is, in some cases, the only one to take advantage of these improved methods.

Coal and Coke.—A very quiet tone prevails throughout this district. There is no doubt that the demand for coal of all kinds has fallen off considerably during the last month, and merchants find it difficult, if not impossible, to maintain last month's rates. Railway companies, who buy largely in this district, find themselves called upon to pay from 2s. to 3s. per ton more for coal than when last year's contracts were made. Gas companies have had to pay a much higher price than usual for their supplies; but owing to improved methods of coke-making, and the high market value of that commodity, they have been able to make handsome profits.

NORTH STAFFORDSHIRE, 11th June, 1890.

The Iron Trade.—The opinion is gaining ground that the autumn will bring with it a substantial improvement in the state of the iron trade. Consumers are holding back orders, which will then no doubt have to be placed. In the meantime, there is little if any profit for producers, and mills and forges are working short time. Ironworkers have agreed to a reduction of 3d. per ton for puddling until the next ascertainment of prices under the sliding scale. Pig iron shows further weakness in the matter of price.

The Coal Trade.—At this time of the year some heavy contracts for local consumption in the pottery trade are entered into for the next twelve months. Though prices obtained show a considerable increase on last year's figures, they are not proportionately higher taking into account the enhanced cost of production.

LEICESTER, 11th June, 1890.

Wool Spinning and Yarn Trades.—Business in the local wool market goes very slowly, and buyers hesitate to go beyond their pressing wants. Prices are fairly firm, but holders of stocks do not press sales at current rates, as they feel somewhat uncertain as to the prices likely to rule when the new clip is on the market. Spinners, considering the time of the year, are fairly well off for business. They might do more were they disposed to accept the new business tendered, but the quotations, considering the prices for raw material, are very unsatisfactory.

Hosiery Trade.—There is a slight improvement nearly all round, but trade is certainly not above the average at this period. Some of the branches of the fancy trade are much affected by the prevalent taste for furs, which are now offered at such low prices. Trade is better in the heavy plain woollen department, and some good shipping orders are on hand.

SWANSEA, 11th June, 1890.

The Electric Light at Llanelly.—Notwithstanding the opposition of the gas company the local board have granted permission to the Llanelly Electric Light and Power Company, Limited, to apply to the Board of Trade for a licence to supply certain districts of the town with electricity. Mr. J. C. Howell is the moving spirit of the company, which has a capital of £15,000.

The Barry Dock.—The recent rumours regarding a dispute with the executors of the contractor, the late Mr. T. A. Walker, have culminated in a claim for extras, caused by the necessity for providing for a much larger traffic than the company originally contemplated, which, including the balance of retention fund, amounts to £204,454 14s. 5d. Should the directors and the executors be unable to come to an agreement, Mr. T. Wolfe Barry will act as arbitrator between the parties in accordance with the contract.

CARDIFF, 11th June, 1890.

Iron and Steel.—There is a slightly better tone in the pig iron trade, which may possibly be the natural outcome of the general belief that the lowest figures possible have been reached, considering the position of the labour and fuel market. Hematite iron is quoted at 53s. to 54s. Steel rails are quiet, and for bars there is no change in the position. In the iron ore trade arrivals have been numerous, and, as freights are low, merchants are taking the opportunity of bringing over as much ore as possible. Prices in Spain keep very firm, Rubio ore being quoted at 14s. 6d. c.i.f. Cardiff and Newport, 15s. 6d. Tees, and 15s. 9d. Glasgow. Freights from Bilbao to Cardiff and Newport are 5s. 3d.

Coal and Coke.—The steam coal market is active, and another week of large shipments has to be chronicled. Prices have exhibited no fluctuation of moment, and can be indicated at—for first quality, 14s. 6d. to 15s. 3d.; second, 13s. 6d. to 14s.; third, 12s. 9d. to 13s. 3d. The demand for small steam coal continues strong, and the high price has been sustained longer than most people expected. Quotations are 9s. 3d. to 9s. 9d. f.o.b. Cardiff, according to quality. Business in coke is quiet, and no new contracts are reported. The capital required for the Penrikyber Colliery, £350,000, has been fully applied for. It is noteworthy that the shares in Messrs. D. Davis & Sons, Limited, which was floated about a month ago, are now quoted at £2¾ to £3¼ for the £2 paid shares.

BARROW-IN-FURNESS, 11th June, 1890.

Hematite Iron.—The trade in hematite pig iron is quieter, and the prospects all round are not of a cheerful character. The output of the works has been restricted to a considerable extent, and additional furnaces will be blown out within a few days. Prices are easier, at 50s. 6d. per ton for hematite warrants and 51s. to 55s. per ton for parcels of mixed Bessemer numbers net f.o.b. There is no reason to expect any improvement in consumption until a larger demand is experienced for pig iron from steel makers generally.

Steel.—There is less life in the steel trade this week. Rails are quiet, and the inquiry shows no life on home or on foreign account. Heavy sections are quoted at £4 10s. to £5 per ton, light sections at £6, and colliery sections at £7 per ton. Steel shipbuilding material is quiet, but prices are quoted firm, at £7 for plates and £6 10s. for angles. Billets and slabs are quiet at £5, and blooms have a slow sale at £4 17s. 6d. Tinplate bars are quiet at £5 10s. delivered at works.

Hematite Stocks.—The stocks of hematite held in the district have again been further reduced, and stand this week at 302,779 tons, being 5,632 tons less than in the previous week, and 77,865 tons less than in the first week of the year. It is felt that no permanent improvement can be looked for in the iron trade until these stocks have been largely disposed of, and makers, with this view, are not in any instance making for stocks.

MIDDLESBROUGH, 11th June, 1890.

Pig Iron.—Quite a change for the better has come over the pig iron market during the last day or two. No. 3 Cleveland G.M.B., which had been declining since last Wednesday, has suddenly gone up 1s. to 1s. 6d., so that now it cannot be had under 41s. 6d., some makers asking as much as 42s. The favourable returns and increasing shipments were bound to make an impression. Altogether, the prospect is much more hopeful than it was. Connal's stores have been freely drawn upon during the week, for the stock, which stood a week ago at 102,952 tons, now stands at 100,237 tons, being a decrease of 2,715 tons. Cleveland warrants are also advancing in price being quoted at 41s. cash. In hematite East Coast brands are quoted at 57s. per ton, and West Coast, 50s. 11d. for mixed numbers makers' iron f.o.b.

Manufactured Iron and Steel.—Iron and steel are rather more cheerful in tone this week, although prices are not affected by it yet. Iron ship plates are at £5 7s. 6d.; angles, £5 5s.; bars, £5 12s. 6d. per ton; steel ship plates, £6 10s.; angles, £6 7s. 6d.; rails (heavy sections), £4 17s. 6d. per ton, all less 2½ per cent. on trucks at manufacturers' works.

Shipments of Pig Iron.—The shipments have improved considerably. Up to the 9th of the current month inclusive they amounted to 22,728 tons, against 17,392 tons to similar date in May, and 20,440 tons to similar date in June last year. Germany and Holland and other foreign countries are taking more than they have done hitherto. The shipments coastwise have rather fallen off.

NEWCASTLE, 11th June, 1890.

The Iron Trade.—A firmer tone is beginning to be manifested in the pig iron trade, shipments having somewhat increased, and the supplies in the hands of local consumers having become, in many instances, well nigh exhausted. Prices, however, are still stationary, though the feeling is pretty general that an advance may soon take place. Finished iron manufactories continue to be fairly well employed, but the works would generally be busier were customers a little less anxious to postpone the delivery of material contracted for at the end of last year. Manufacturers of ship and engine forgings are now short of orders, and work is eagerly sought for at considerably lower prices than were prevalent a few weeks ago. Business in the iron foundries still keeps brisk, but the proprietors of bolt and rivet works have found it necessary to largely diminish their production.

The Coal Trade.—Since the end of May no change of consequence has occurred in the condition of the coal trade, but it is noteworthy that miners have ceased to press for advances of wages, and the fact appears to have been brought home to them that a time of declining trade is not favourable for the successful prosecution of such claims. The shipment of coal and coke at Tyne during the week ending June 7th amounted to 111,647 tons, being an increase of 3,695 tons as compared with the corresponding week of last year.

Engineering.—The works of Messrs. H. Watson & Sons, High Bridge, are just now exceedingly busy, the demand for their steam pumps and other specialties having largely increased. Messrs. Allen & Robson, the Newcastle agents of Messrs. A & J. Stewart & Co., Clydesdale, have recently obtained for their principals a large order for steel tubes, to be used in connection with the further development of the salt mining industry in Cleveland. Messrs. Abbot & Co., Gateshead, will deliver, in the course of a few days, the last of the phosphor-bronze castings—sixteen in all—that were ordered from them by Messrs. Armstrong, Mitchell, & Co., for two large cruisers now building at Elswick. These castings, some of which weighed as much as 11 tons, were all put through a careful test, and several were found capable of standing a tensile stress of 20 tons per square inch, besides showing satisfactory elongation, and going successfully through the ordinary bending tests.

BELFAST, 11th June, 1890.

Shipbuilding and Engineering.—Both these trades continue fairly busy, and there are no empty stocks in any of the yards. Messrs. MacIlwaine & McColl have received an order from Mr. Samuel Lowther, of Belfast, for two screw steamers, each to have a carrying capacity of 750 tons. The vessels are intended for the cargo-carrying trade between this port and Liverpool. They will run in opposition to the Belfast Steamship Company, and the competition is expected to have a good effect in reducing the present rates. Although there is no immediate prospect of dulness, workmen are much more plentiful and are easier to deal with than they were some months ago. Messrs. Harland & Wolff are still working a night shift in their engine department in order to keep pace with their work, and they are adding 100ft. to their magnificent fitting and erecting shop.

Irish Light Railways.—The Treasury have sanctioned a free grant of £115,000 for the construction of a railway between Donegal and Killybegs. This is the second scheme that has reached that stage under the recent Act.

The Linen Trade.—The Belfast linen merchants are now fully alive as to the probable effects of the American Tariff Bill, and business has already been seriously affected by it. Yarn sales have not been large, and the prices still remain firm. Cloth sales have also been small, but notwithstanding the small demand manufacturers do not seem inclined to reduce their prices. The shipment of goods to America has been considerably less this week. The flax crop so far promises to be very good this year, the weather ever since sowing having been all that could be desired.

Building Trade.—Upwards of 500 carpenters are at present on strike in Dublin for an advance in wages, but as many of the employers are inclined to concede to the men's requests, it is not expected to be of long duration.

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IMPROVEMENT OF THE LIVERPOOL SOUTH DOCKS.

(*For description see page* 560.)

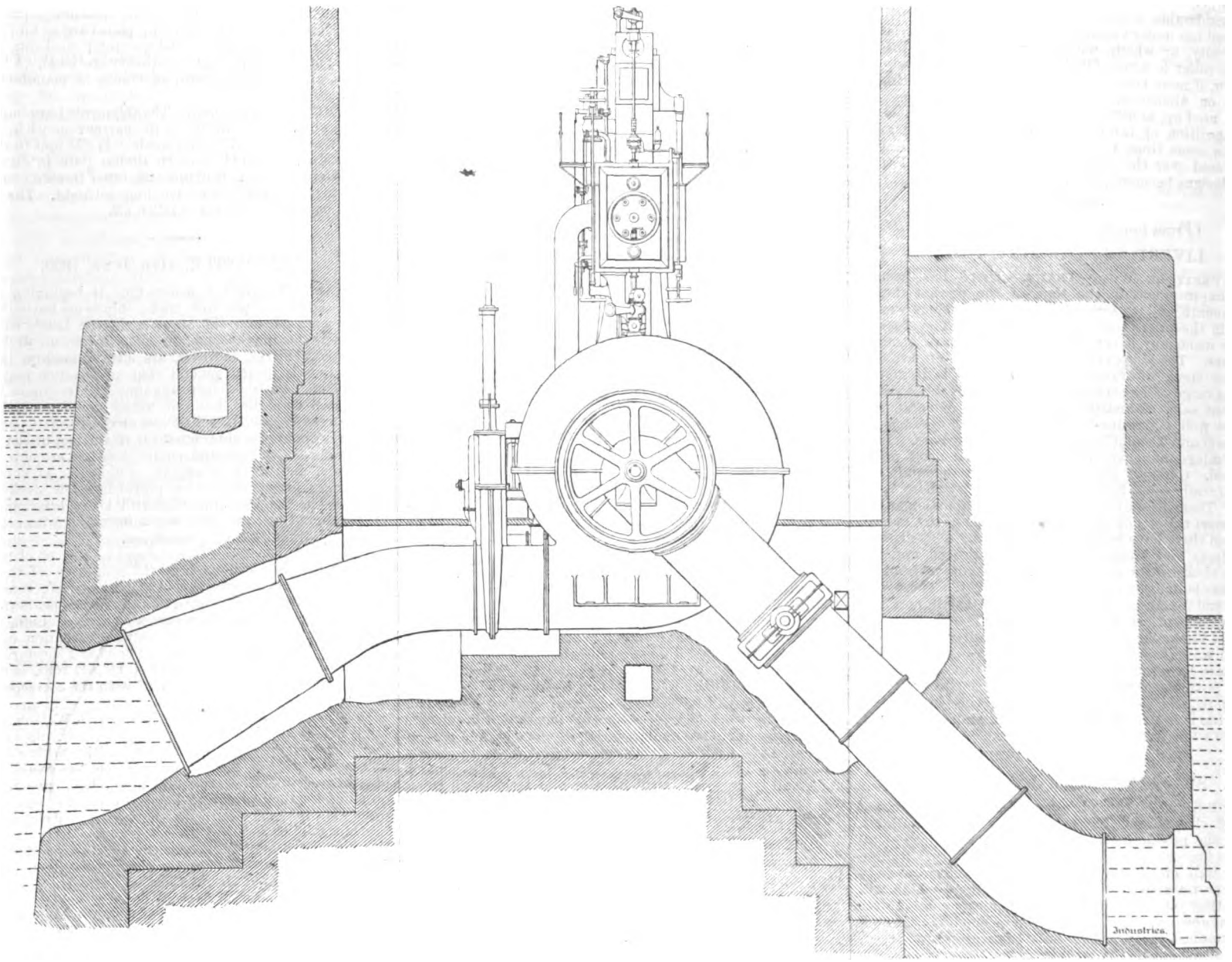


FIG. 3.—VERTICAL SECTION THROUGH PUMPING ENGINE HOUSE.

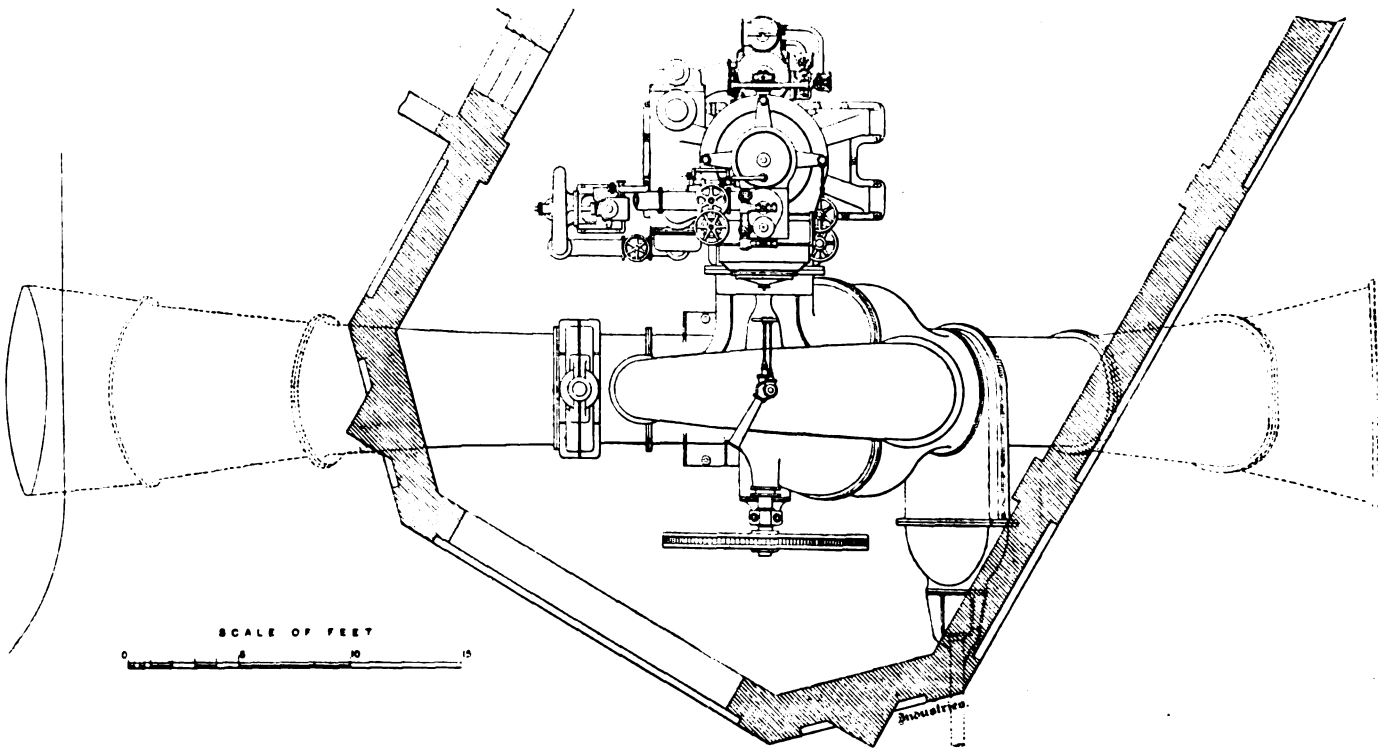


FIG. 4.—SECTIONAL PLAN OF PUMPING ENGINE HOUSE.

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" INTERNATIONAL NEWS CO., 83 and 85, Duane-street, New York.

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As we go to press early with certain of our advertisement pages, all Alterations to Standing Advertisements should reach the Publisher not later than 2 o'clock on Wednesday afternoon in each week.

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

Contents.

	PAGE
Coke Crushing Machine (*Illus.*)	553
The Daimler Petroleum Motor (*Illus.*)	553
Research Committee on Machine Engine Trials (*Illus.*)	553
The Institution of Civil Engineers	555
The American Society of Engineers (Corres.) (*Illus.*)	556
Foreign Industries (Corres.)	558-559
Improvement of the Liverpool South Docks (*Illus.*)	560
Prices Current	561
Home Industries (Corres.)	562-563
Syndicated Industries	565
An Imperial Penny Post	566
The International Congress on Inland Navigation	566
Accident to the S.S. "City of Rome"	567
Rapid Bridge Erection in Glasgow	567
Letters to the Editor:—	
The Lane-Fox Patents	567
British Manufactures on the Continent	567
Piece Work	567
Reviews	567
Legal Proceedings	568
Agricultural Show at Rochester	568
Improved Screwing Machine (*Illus.*)	569
The Mannesmann Process for Making Seamless Tubes	569
Lightning Conductors from a Modern Point of View	570
The American Institute of Electrical Engineers (Corres.)	571
The "Infant" Dynamo (*Illus.*)	572
The Society of Chemical Industry	572
Notes	572
"Industries" Patent Record:—	
Applications and Acceptances	573
Illustrated Abridgments	574-576

To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

We cannot undertake to return manuscripts or drawings, and must request correspondents to keep copies.

BOUND VOLUMES OF **Industries**,

In half calf, gilt lettered, may be obtained at our London, Manchester, and Glasgow Offices, Price 20s. each.

Industries:

FRIDAY, 13TH JUNE, 1890.

SYNDICATED INDUSTRIES.

THERE is evidently a pause in the movement which threatened, a short time ago, to force upon us artificial prices for many of the commodities that are used in arts and manufactures, due to the acquisition or control of such commodities by combinations of capitalists. A year or eighteen months ago this movement was at its high-water mark, and seemed likely to attain even more formidable proportions. Syndicates had been formed for the purpose of dominating the trades in steel rails, in copper, in tin, in flour, in pottery, in salt, and in many other commodities; while a combination of the coal owners of the United Kingdom, with a view to raising the price of coal, was seriously talked about. With the advent of better trade the occupation of the syndicate mongers seemed, however, to have gone. Prices improved nearly all along the line by the natural process of a larger demand. Some of the more promising syndicates, such as the copper ring, have meanwhile come to grief. The two influences, working together, and largely related as cause and effect, scared, at least for a time, the adventurous individuals who were seeking to get behind economic laws, and we will probably hear very little more of such syndicates for some time to come. It is well that this should be so. The new departure of syndicated industries and commerce threatened to deprive consumers of the benefits of the millennium of business that it promised to introduce. The history of the copper ring, which was terminated by a criminal trial, and by sentences that were certainly sufficiently severe to be deterrent, may be expected to point a moral that will affect the proceedings of syndicates and rings in the time to come. But the law of France is unlike that of most other countries, and the Code Napoléon visits with penalties, that are practically unknown elsewhere, any attempts to interfere with the natural and legitimate course of prices. It might be well if similar penalties were imposed in our own country on bodies of speculators whose sole mission in life appears to be to get up "rigs" and to make "corners," to found "trusts" and to establish "pools"—all of them designed and calculated to benefit a few individuals at the expense of the general public.

The recent considerable fall of prices in the iron and other trades is leading to new proposals, projects, and combinations, that aim at the regulation of prices or the monopolisation of commodities. Both in European countries and in the United States these organisations still continue to flourish, chiefly in the form of "rings," but also as "rigs" or "corners." The essential differences between these different forms of the species may be briefly examined. A "ring" usually differs from a "rig" or a "corner," in so far as it need not necessarily be speculative. The object of the corner is to secure large profits by a piece of financial or speculative engineering, at the expense either of the individual or of the community, and usually of both. The object of the ring may be simply that of regulating production—that is, of keeping supply and demand as nearly as possible abreast of each other—and so avoiding the violent fluctuations of prices that usually result from a different state of things. This was the plausible object of the ring known as the "regulation of the vend," which existed for a quarter of a century in the coal trade of the North of England. All the large coalowners pledged themselves, under that arrangement, to send to market only a certain quantity of coal, and while the declared aim of the combination was that of regulating supply it only affected prices incidentally. Prices were necessarily kept up by the limitation of supply, but not as a consequence of any definite agreement or pledge as to what they should be. Stated in its broadest and most comprehensive aspect, the design and aim of the ordinary ring or syndicate is to benefit the individual at the expense of the general community. From this point of view, the machinery, the processes, and the objects of a ring are alike indefensible. Of course, there are rings and rings, and the individual may be benefited without any ultimate detriment, but, on the contrary, with substantial advantage to the community. The community is made up of units, and while it does not, of course, follow that the gain of the unit implies the gain of the mass, it will be found in a general way that the welfare of the community is the welfare of the units that compose it. This is certainly true of the general results of industry and commerce. Let us take, as a case in point, syndicates or combinations for the purpose of regulating the production of manufactured commodities. If there is no over-production—if the demand just meets the supply—such a ring is quite uncalled for, and may probably do harm. But if the production exceeds the consumption by ever so small a quantity, there is an inevitable tendency to reduce prices beyond the paying point. Over-production is undoubtedly one of the great economic evils of the present day. It is not, however, entirely without compensations. So long as it stops short of reducing the profits of producers to absolute zero, it may even be a positive advantage, seeing that it secures a low range of prices for the multitude. If, as is often the case, these low prices are attended with real loss to the owners of works, mines, or factories, their advantages to the community are neutralised by the displacement of labour, the loss of employment, and the other economic difficulties which are involved. In the long run, the loss of the individual is generally the loss of the community, although the converse is not always equally the case. It is, therefore, better that prices should be so regulated as to allow of a fair margin of profit to the capitalist, than that profits should virtually cease. In the nature of things there must be an unsatisfactory end to a profitless business. Capital will be withdrawn from it, and labour will be transferred elsewhere. But at this stage the "ring" may come into play, and determine that the production shall be reduced so as to meet the demand as nearly as may be, or that the price shall be fixed at a certain minimum which brings about the same result in another way. The great objection to this process is, of course, that it is an interference with that freedom of trade which is so essential to healthy industrial development and national well-being. But it is certainly not a healthy condition of things when the production of a commodity greatly exceeds the consumption; and, being a more or less artificial malady, it may demand a more or less artificial remedy. In this dilemma, the choice has to be made between two evils. Over-production may be continued, with continued loss and ultimate disaster to the employer or capitalist, and starvation

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wages to labour, or production may be regulated in such a way as to secure fair profits to capital, and adequate employment at fair wages to labour.

Regarded in this light, "rings" do not prejudice the community, if the parties to them are moderate in their demands. But unfortunately this is not always the case. All power is liable to abuse, and the power of regulating production and prices is no exception to the rule. It is only fair, however, to say, for industrial syndicates, that they are seldom found to abuse the enormous power that successful combination places at their disposal. To do otherwise would be to jeopardise their own future. It is the interest of a manufacturer to cultivate a permanent and stable trade. He is, therefore, interested in making such terms with the public as will induce the public to buy from him on the largest possible scale. This primary object would be defeated by the secondary and subordinate one of making the largest possible profit out of the public "while the game lasted." It is the commercial "corner" or "ring," and not the industrial, that acts on the principle of a short life and a merry one. There is a broad distinction between the two, and we cannot too soon recognise, or too strongly emphasize, it. The industrial syndicate usually seeks simply protection, and acts on the defensive. The commercial syndicate preys on the general community, usually without conscience, and heedless of consequences, while its action is distinctly aggressive. The distinguishing difference between "rigs" and "corners," and "rings" or "pools," is that the former are usually contrived by speculative individuals who are not themselves engaged in the trade, and may really know little or nothing about it, while the latter are originated by manufacturers or producers, as such. The "corner" or "rig" is also, as a rule, an operation of much smaller extent. The ordinary form of the process of "cornering" consists in buying larger quantities of any given commodity than the sellers are in a position to deliver. In other words, the seller, on purely speculative grounds, sells that which he does not possess, and cannot command if the "corner" is well managed. If, under such circumstances the speculator comes to grief, we need not waste much sympathy upon him. Buyers and sellers in "rigs" and "corners" are in much the same boat. Both are engaged in operations that are calculated to do infinite harm to legitimate trade. What is important is that this system of gambling has assumed serious proportions, and ought, if possible, to be restrained. There is hardly a leading commodity that is not more or less made the dice box of the "rig" and the "corner." The gaming tables of Monte Carlo are not more alluring, not more dangerous, not more subversive of public morality, and by no means so hurtful to society at large. The violent fluctuations of prices that are caused by these speculative movements seriously interfere with the natural and healthy course of industry, and restrain the operations of commerce. While commodities are oscillating between extremes of high and low prices, there is an inevitable disinclination, and even inability, to proceed with business in the usual way. The probable life of the "rig" or "corner" becomes the dominating factor in the situation, and, this being extremely uncertain, legitimate traders must, so to speak, grope their way in the dark. The "corner," pure and simple, is a conspiracy, and under the French law it is liable to be treated as such, and severely punished. Under our own more tolerant laws, it is permitted to flourish—if it can.

Another serious evil, which does not strictly come under the category of either "pools" or "corners," is the system, that has of late years attained large dimensions, of speculating in stocks of commodities such as pig iron, cotton, tin, copper, &c., in such a way as to force up prices at one time and depress them at another. This system has had a very remarkable influence on the course of certain of our leading industries. The stocks of these commodities are a known factor; but the extent to which they are made the basis for speculative operations is practically unknown. It is believed that the actual dealings in cotton and iron exceed by twenty or thirty times the actual quantities of these commodities, so that if deliveries of nominal purchases were insisted on there would be a general bursting of the bubble. Hundreds, and perhaps thousands, of persons regularly gamble in these stocks, without the least idea of *bonâ fide* purchases, and the legitimate trader is thus made a shuttlecock of a movement that he is powerless to diagnose or to control. A remedy is much wanted, but it is difficult to provide. Within certain limits speculation induces and bespeaks confidence, and so far it is a healthy influence; but such speculation as we have described usually does more harm than good.

AN IMPERIAL PENNY POST.

"First find your madman" is a saying attributed to the late Lord Derby. In this case the madman is Mr. Henniker Heaton. The word is not used in any offensive sense, either as originally employed or as now applied, for the uses of the enthusiast are too manifest to be gainsaid. The fanaticism of Sir Rowland Hill resulted in the penny post for the United Kingdom, as the fanaticism of Mr. Henniker Heaton seems likely to result in the penny post for the English-speaking people, and may be also for the civilised world. The universal penny post is indeed within measurable distance, for it needs no prophet to foresee that the natural result of an adoption of it by England would induce or compel France, Germany, and Italy to follow suit, in the same way that the twopence halfpenny postage policy of these countries has compelled England to follow them. If the imperial penny post becomes an accomplished fact, the letter-writer will owe a lasting debt of gratitude to the man who badgered the Post Office into granting it. His victory over the proverbial shortsightedness of the typical official was made very manifest in the concession made by Mr. Goschen, who has at last agreed to make an ocean postage of twopence halfpenny, at a cost to the Exchequer which may well be called insignificant—so manifest, indeed, that the final triumph of the penny post to the colonies can only be a question of time. The discovery that the loss to the Exchequer was so trifling is indeed one of those discoveries that anybody might have made, but that everybody in the official world, at any rate, delayed to make. When one has eliminated from the statements of Mr. Heaton the element of exaggeration in which he, as a politician, is prone to indulge, there remains sufficient solid basis of fact to found excellent arguments for the imperial penny postage. The gross anomaly of the circumstance that it was cheaper to forward letters to France for transmission to India than to post them direct from England to India being removed by the establishment of the twopence halfpenny post, the way is practically open for reduction to one penny. The argument that a large part of the sums paid in the name of postal subsidies is really paid for non-postal purposes is certainly a strong one. There is no reason why a large part of the cost of maintaining a naval reserve should be defrayed by the Post Office—that is, by the letter-writer—when, as matter of fact, the benefit is general, if benefit there be. Again, there seems no insuperable difficulty in obtaining a reduction of the rate from Calais to Brindisi, which at present is 1d. per letter, though the fact that the French and Italian Governments have both to be settled with makes it impossible to compare the rate so charged with the rate for conveying a letter across the American prairies. The strongest argument of all is that reduction of postage means increase of postage. The direct economic result has nearly always been favourable, and the indirect economic result has invariably been favourable beyond calculation. This alone affords overwhelming evidence in favour of an imperial penny post. The enormous increase in actual receipts which, as matter of fact, followed the adoption of a penny postage in the United Kingdom, is indeed a final argument in such cases, and when to this is added the undoubted gain in foreign trade following upon diminution of postal rates, it is hard to find a valid argument against the reduction. It may well be doubted whether a few years ago a penny imperial post would have paid, but the rapid rate of colonial growth places it almost beyond doubt that it would pay now, or at least would pay in the immediate future. Mr. Heaton's further contention that the State should take over the ocean cables is open, however, to serious objection. There are, certainly, national contingencies in which it might be advisable that the State should own the telegraph cables binding us to our remoter dependencies, but there is much to be said for an absolute neutralisation of the cables of the world, and this could never be under a system in which the cables belonged to any one nation. Besides, the companies, though they have in some cases, perhaps, maintained high rates, have, on the whole, served the public well, and the case against them would require to be presented in a much more potent way than that attempted by Mr. Heaton.

THE INTERNATIONAL CONGRESS ON INLAND NAVIGATION.

We understand from the *Manchester Guardian* that rapid progress is being made with the arrangements for the fourth International Congress on Inland Navigation, to be held in Manchester on the 28th prox. and following days. The meeting will be of special interest, both to visitors and to the people of Manchester, in view of the approaching completion of the Manchester Ship Canal. Visitors will naturally be anxious to see something of this great engineering undertaking, and the prospects of the canal will no doubt be improved by the publicity which it will thereby attain amongst the traders and the people generally of the various nations which will be represented. The objects of the conference are to promote the improvement of inland navigation and of estuaries, to direct attention to the economic value of navigable waterways, to examine generally technical questions relating to the construction and working of canals, to receive the report of the International Statistical Commission appointed at the last Congress, and to take further steps towards the collection of statistics bearing on inland navigation. The three previous Congresses were held respectively in Brussels, Vienna, and Frankfort-on-the-Main, and they were attended by delegates appointed by the Governments of the countries represented. The Board of Trade appointed Mr. Courtenay Boyle, C.B., and Mr. E. Leader Williams, C.E., to represent England at the Congress held in Frankfort in 1888. This year's conference is under the patronage of the Prince of Wales; Sir Michael Hicks-Beach, M.P., President of the Board of Trade, is president, and Lord Balfour of Burleigh, Parliamentary Secretary to the Board of Trade, deputy president. There is a very large and representative array of vice-presidents, headed by the Earl of Sefton, Lord Lieutenant of Lancashire, and there is also a strong general committee. The executive committee, on whom the bulk of the work connected with the arrangements for the conference will fall, is composed as follows:—Sir J. C. Lee, president; Mr. E. Leader Williams, chief engineer, Manchester Ship Canal Company, vice-president; the Mayor of Manchester (Mr. Alderman John Mark); Sir Edward G. Jenkinson, K.C.B., London; Mr. Courtenay Boyle, C.B., assistant secretary, Board of Trade, London; Mr. C. M. Kennedy, C.B., Foreign Office, London; Alderman Sir John J. Harwood, Manchester; Mr. L. F. Vernon-Harcourt, London; Mr. S. R. Platt, Oldham; and Mr. William Pollitt, general manager, Manchester, Sheffield, and Lincolnshire Railway Company, Manchester. Mr. J. H. S. Crompton has been appointed treasurer, Mr. Marshall Stevens honorary secretary, and Mr. A. A. Gillies secretary. Communications have been addressed to the Governments of Germany, France, Austria, Belgium, Italy, Spain, Holland, Norway and Sweden, Denmark, Switzerland, Russia, America, Portugal, and Greece, inviting them to appoint delegates to attend the forthcoming Congress. According to the programme which has been drawn up, the work of the Congress will be divided into two sections and sub-sections, and papers will be read as follow:—

Section I.—Engineering.

Sub-section 1.—Inland Canals and Canalised Rivers:—Subject A.—(a) Welland Canal; (b) The Aire and Calder Navigation; (c) The Weaver Navigation; (d) Volga and Baltic Navigation; (e) Present condition and development of inland waterways in England. Subject B.—Traction and propulsion on canals.

Sub-section 2.—Ship Canals and Tidal River Works:—Subject A.—Ship Canals: (a) The Manchester Ship Canal; (b) The Nicaragua Canal; (c) The Baltic Canal; (d) The Amsterdam Canal; (e) The Corinth Canal. Subject B.—The Improvement of Tidal Rivers:—(a) The principles of improving tidal rivers; (b) The action of tides and estuaries. Subject C.—Dredging and excavating.

Section II.—Trading and Economy.

Subject A.—Report of the International Statistical Commission.

Subject B.—The condition, management, and cost of working of inland navigation in France, Germany, Austria, Russia, Italy, Switzerland, Sweden, Netherlands, Spain, and Belgium.

Subject C.—The present position as regards finance and traffic of inland navigation in the United Kingdom, and what means can best be taken for its improvement.

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Subject D.—The cost of transport on canals as compared with railways, and the mutual influence of railways and canals on each other.

Subject E.—The extent to which the State should assist or share in the development or management of inland navigation traffic.

The papers and the discussions which follow may be in English or French. It is intended to have on view numerous plans, maps, and models relating to inland navigation. At the Frankfort Congress a similar exhibition was held, the most valuable contributions coming from the German Government, who spent £4,000 on their preparation. It is hoped that these plans and models may be available for re-exhibition in Manchester. During the Congress excursions will be arranged to the ship canal and to a number of works and other places of interest in the North of England.

ACCIDENT TO THE S.S. "CITY OF ROME."

Another example of the utility of bulkheads has been afforded by the narrow escape of the transatlantic liner "City of Rome." On Friday last, during a thick fog, and although Captain Young and the other officers were taking every precaution, the ship struck the Fastnet Rock, situated on the west coast of Ireland. The look-out man observed the rock a short distance ahead, and the engines of the steamer were at once stopped and reversed, thus greatly reducing the force of the collision. Notwithstanding this, the shock was considerable, and created great excitement on board, which, however, was soon allayed when it was found that there was no immediate danger, the ship having backed into deep water and floating buoyantly. It was found that the stem was smashed and badly twisted, and the forward tank filled with water. On ascertaining the actual state of affairs the captain gave orders to steam ahead at half-speed, which was done in the midst of a dense fog. There were nearly 1,000 souls on board, and of these 133 disembarked at Queenstown, the majority proceeding with the ship to Liverpool, which she did at half-speed. If the ship had been going at full speed at the time she struck, or if she had been without proper bulkheads, it is probable that there would have been great loss of life. A great deal is due to Captain Young for the precautions he took, and for his skilful action in trying circumstances, and the passengers took occasion to show their appreciation of his services by presenting him with a testimonial.

RAPID BRIDGE ERECTION IN GLASGOW.

The increasing traffic in connection with the Caledonian system has made it necessary that additional lines should be laid into the Central Station. Some time ago the iron girder bridge across Argyle Street was widened, and a new station erected at Bridge Street. In order to complete the work it was necessary to widen the track in Eglinton Street, and this offered considerable difficulty. At a point about half-way down this section of the line the Caledonian is crossed by the Glasgow and South-Western Railway, and it was necessary to remove the overhead bridge and put a new and longer one in its place in twenty-four hours after midnight on a Saturday. The contract was taken by Messrs. William Arrol & Co., and the erection of the bridge was carried out under the personal superintendence of Sir William Arrol. Operations were commenced last Saturday night by the removal of the old permanent way. This part of the work was completed in about three hours. The old and the new bridges were braced together, and by means of powerful hydraulic rams both structures were simultaneously moved northwards, the old to the platform, and the new to the position formerly occupied by the old, an operation which was performed in less than four hours. The beds for the ends of the girders were then prepared, the girders lowered into their positions, and the permanent way relaid. The whole of the work was done by four o'clock on Sunday afternoon—that is to say, in about sixteen hours, or two-thirds of the stipulated time. The necessary Government inspection was made in the afternoon, and the Greenock train passed over the new bridge in the evening. The work which was thus rapidly executed is one of the most interesting pieces of railway engineering yet carried out, and shows what can be accomplished by good planning and by utilising the powerful appliances which are now within the reach of the engineer.

Letters to the Editor.

THE LANE-FOX PATENTS.

To the Editor of "Industries."

Sir,—I enclose for your information a copy of a letter which we are sending out to all undertakers using the Lane-Fox system of distribution, offering them terms for using the patents.

As to private installations, a circular will be issued shortly in much the same words, but substituting for the charges given A, B, and C, a royalty of 3s. 6d. per 16 c.p. lamp per annum.

Yours, &c.,
C. A. Stephenson,
Managing Director, Lane-Fox Electrical Company, Limited.

2, Prince's Mansions,
66, Victoria Street, London, S.W.,
10th June, 1890.

"Dear Sir,

"1. You are doubtless aware that your company is making use of the Lane Fox patent for electrical distribution, No. 3988** of 1878.

"2. This patent, together with all the Lane-Fox patents, are now held by this company.

"3. My object in writing is to inform you that this company is prepared to grant a licence to your company, as undertakers; and I have to offer the choice of the following methods of payment of royalty for the use of the patent:—

"(A) By a payment of ½d. per Board of Trade unit supplied to consumers.

"(B) By a payment of ⅛d. (one-eighth of a penny) per Board of Trade unit supplied to consumers. Such payment to continue after the expiration of the patent for such a term as would render the payment equivalent to A, taking all risks into consideration.

"(C) By a capitalised sum, payable partly in cash, partly in shares of your company; the sum to be arrived at on the basis of A.

"4. On an agreement being entered into we shall be prepared to give your company as undertakers an indemnity for having used the patents prior to 31st December, 1889.

"5. This company will also consider such an agreement as final, and will not make any further claim in respect of any patents for distribution, regulation, secondary batteries, and motor-dynamo distribution, taken out by Mr. Lane-Fox during the years 1878 to 1883.

"6. You will understand that these terms are offered without prejudice: no period is at present definitely fixed within which we shall require your acceptance; but this company reserves to itself liberty to withdraw these proposals at any time after the 16th inst.

"Yours faithfully,
"C. A. Stephenson,
"Managing Director, Lane-Fox Electrical
"Company, Limited."

BRITISH MANUFACTURES ON THE CONTINENT.

To the Editor of "Industries."

Sir,—Your correspondent "Trader" partially attributes the scantiness of business done by this country on the Continent to our customs being different from theirs. I am more inclined to reverse the theory, and say it is because their customs are different from ours. The matter lies more in Continental protective duties than the inability of British business men to push their wares.

Yours, &c.,
T. R.

London, 9th June, 1890.

PIECE WORK.

To the Editor of "Industries."

Sir,—I do not quite follow "A Former Mechanic" in his argument. That workmen overdo their strength in piece work and put forth strenuous exertions which would kill them, and are only saved from death by the fact that the employer reduces wages, and thereby causes them to work less hard, is a matter which I very much question. "A Former Mechanic," I notice, hails from Glasgow. I also am a former mechanic, and my experience was also gathered in the North—viz., in Edinburgh. I should say that such questions stood on much the same ground in both cities, but I never came across men rushing it too hard at piece work. I also do not know what he means when he says that under a bad employer piece work degenerates into task work. Time work is also task work. With the writer's expression of opinion as to the education of apprentices I can cordially agree.

Yours, &c.,
J. D. W.

Birmingham, 7th June, 1890.

Reviews.

Gas and Petroleum Engines: A Practical Treatise on the Internal Combustion Engine. By William Robinson, M.E., Senior Demonstrator in Applied Physics and Electrical Engineering in the City and Guilds of London Technical College, Finsbury; Assoc.M.Inst. C.E., &c. London and New York: E. & F. N. Spon. 1890.

This is a work which supplies a decided want in English technical literature. Gas engines, it is true, have been previously dealt with by other authors, but a coherent treatise on petroleum and like motors has not hitherto been forthcoming, nor has the subject of gaseous fuels and the modern appliances for their production been taken up in a concise and practical manner by elementary text-books. This has now been done by Mr Robinson in the work before us. With regard to gas engines, although, as we have hinted, the subject is not a new one, yet, as far as we remember, the latest book on that class of engine is several years old, and since it was published many new kinds of motors and improvements of those previously in existence have been introduced, so that the work is no longer up to date. In this latter respect we may say at once that Mr. Robinson's treatise leaves nothing to be desired.

After a short introduction in Chapter I., the author first proceeds to consider, in Chapter II., "The Action in the Otto Gas Engine." At the commencement he states that he has arrived at the conclusion that the best way of presenting the subject of internal combustion to his readers is to describe carefully the action of some particular form of gas engine, since the ordinary reader would have some difficulty in understanding the significance of certain points in the history of this class of motor unless he were acquainted with the working of one at least of the best modern forms. Accordingly, the author gives a very full account of the construction and working of the Otto engine, as made by Messrs. Crossley Bros., Limited, with numerous illustrations of the various details, general construction, and indicator diagrams. In Chapter III. "Modifications of the Otto Type of Gas Engine" are dealt with, but under this heading are comprised only the Atkinson and the "Simplex" gas engines, other modifications being described in Chapter VI. under "Classification of Internal Combustion Engines." The reason for this separation is perhaps not very evident, and seems scarcely logical, but as there is a good index the matter is unimportant.

With Chapter IV. we come to the "Uses of Petroleum in Prime Motors." Here we find descriptions of the "Priestman" and "Spiel" petroleum engines of the latest types, with copies of indicator diagrams; also of the so-called "Zephyr" launch engines, using hydrocarbon vapour both as fuel and working agent, and the "Bailey-Friedrich" petroleum steam motor, using petroleum as fuel.

The history of combustion and caloric engines is next briefly sketched, and brought up to date in Chapters V. and VI., in the latter of which modern types like the "Stockport" and "Griffin," of course, receive fuller attention than such as have now become obsolete. The author in this portion of his work refers to what he calls an "Ideal Regenerative Engine," proposed by Professor Fleeming Jenkin in a paper read before the Institution of Civil Engineers, and in connection therewith points out "that the regenerator can only store up as much of the heat left in the rejected fluid when the exhaust opens as will cool this to the temperature of the fluid entering from the pump. . . . . Of course the temperature of the incoming gases cannot be raised by the regenerator above that to which the previous charge was reduced by expansion in the motor cylinder." This being the case, we think Mr. Robinson should have added, that the best which can be effected by an ordinary regenerator is only equal to the best that is possible without it. It is, in fact, merely a device for supplementing the deficiencies due to incomplete expansion.

To the various methods of firing the explosive charges in internal combustion engines a separate chapter is devoted, the author arriving at the conclusion that ignition by the electric spark is, when properly carried out, the most satisfactory and economical. Perhaps one of the most valuable portions of Mr. Robinson's book is that in which the relative heating values of solid, liquid, and gaseous fuels are given, with particulars of the methods of production and composition of various kinds of gas, such as "Dowson," "Wilson," and oil gas of different descriptions. What is known about dissociation, rate of flame propagation, and explosion in a closed vessel at constant volume is concisely stated in Chapter XV., together with the results of Professor Witz's experiments on the cooling action of the cylinder walls when, after ignition, an explosive mixture expands while doing work.

The final portion of the book deals with trials of gas motors, and among other matters shows how a heat balance should be made out. The accounts of experiments with motors here given do not, however, include all that the author has to say upon this subject, for in various places the results of trials are quoted, more or less in detail, in connection with descriptions of different types of engines.

We have been able, within the restricted space at our disposal, to give only a very inadequate idea of the large amount of information, presented in a useful and practical form, which the author has collected within the 596 pages of his book. Those who are at all interested in gas and petroleum engines cannot do better than make themselves personally acquainted with its contents. The work forms one of the "Finsbury Technical Manuals," and is edited by Professor Silvanus Thompson.

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SPON'S ENGINEERS' DIARY AND REFERENCE BOOK FOR ENGINEERS, MACHINISTS, CONTRACTORS, AND USERS OF STEAM FOR 1890. London: E. & F. N. SPON.

This diary is likely to prove useful to the classes for whom it is intended, containing as it does a variety of useful information, but the way in which the advertisements are mixed up with the letterpress will detract somewhat from the ease of reference. It contains an engineering trades report to 30th June, 1889; calendars for 1890, 1891, and 1892; tables connected with the metric system of weights and measures, and also for thermometers and hydrometers, as well as very extensive tables giving the English values of foreign moneys, and the English values of foreign weights and measures. There are also wages tables and tabulated statements of the iron and steel trades of Great Britain, and of the iron ores raised during the years 1886 and 1887, together with imports of iron ores and countries from which they come, and tons of coal exported, with their destinations. There is an interesting article on the depreciation and valuation of factories. A list of legal decisions, relating to engineering, is given; but this is very incomplete, some of the decisions given having no special interest for engineers, and many which are of importance being left out. No decisions relating to patents are mentioned at all, and these we should expect to find under this heading. Very useful features are the lists of recent technical literature, comprising lists of books recently published on all subjects in any way connected with engineering; the list of papers presented to Parliament, including a list of the Acts of Parliament relating to engineering; lists of recent reports of the Board of Trade and Mercantile Marine, and of the Local Government Board. Under the head of Engineering and Allied Societies will be found an account of the various societies both in London and the country, with a list of the papers read recently before each society. The book concludes with information concerning the various engineering examinations, and a list of the engineering and technical schools throughout the country; the full regulations relating to the Whitworth scholarships; and tables relating to patents, designs, and trade marks in various countries. The diary is neatly bound, and of a size convenient for easy reference.

CHRONOLOGICAL, HISTORICAL, AND HERALDIC CHARTS OF THE ROYAL HOUSE OF ENGLAND FROM KING EGBERT TO THE PRESENT TIME. By I. A. Timmis, M.Inst.C.E. London: HENRY SOTHERAN & Co. 1890.

This regal volume consists of a series of chronological and heraldic tables illustrated with memoranda of historical events and notes from monumental effigies and inscriptions. Heraldry is so little studied nowadays that the means it affords of throwing light upon historical events are apt to be overlooked. Copious charts like those of Mr. Timmis are very useful to students of history, who are too apt to specialise upon a period, and are thus inclined to lose sight of the need of co-ordination. When read alongside of Mr. George's tables, those of Mr. Timmis are extremely instructive, for they show at a glance to the careful reader the line of descent of many of the chief families of England and Germany. The arms are admirably executed, and the work throughout is most carefully arranged.

Legal Proceedings.

CROMPTON AND CO. *v.* THE ELIESEN ELECTRIC LIGHTING COMPANY, LIMITED.

THIS action was tried before Mr. Baron Huddleston and a special jury. The plaintiffs claimed £384, the balance due to them under a contract into which they had entered with the defendant company to furnish plant and equip a station for the working of the defendants' system of electric traction, which was to be employed upon a part of the line of the North Metropolitan Tramways Company. The defendants admitted the claim, but relied upon a counterclaim which they made against the plaintiffs for loss of profits and injury to their trade, resulting, as they alleged, from the plaintiffs' negligence and failure properly to carry out their obligations under the contract.

The matters in dispute involved some important questions of law and fact, and the case is of interest as illustrating how very closely the functions of a contractor may approximate to those of a manager. The facts of the case, so far as they are material to the decision of the case, were as follows:—In the year 1887 the defendant company acquired the plant of the Electric Locomotive and Power Company, and also took over a contract with the North Metropolitan Tramways Company for running two tramcars between Manor Park and Stratford by electric traction. They began running the cars in the beginning of August, 1887, and continued running them until the middle of March, 1888. During that time the running of the engines had been perfectly satisfactory, not more than twenty or twenty-five journeys having been lost throughout the period. In March an understanding was come to that the system should be extended, and on the 19th of that month the running of the electric cars was stopped, because it had been found unsafe to take them over a temporary cross-over that had been made by the tramway company. It was then arranged that the running contract between the tramway company and the electric power company should be suspended, or rather it was terminated by mutual consent, but on the understanding that a new contract would be entered into when the electric company was prepared to resume operations on an enlarged scale. By way of preparation for this resumed and enlarged operation, it was arranged that the company's station should be removed to a place known as Plashet Hall, and a contract was made with Messrs. Crompton & Co. to undertake the preparation and equipment of the new station. As to the nature of this contract the first question arose. On the part of the defendant company it was contended that Crompton & Co. had undertaken as principals to do what was necessary, and had, for the purpose of enabling them to carry out their engagement, been placed in possession of the defendants' property. On the part of the plaintiffs it was contended that the arrangement amounted to no more than the undertaking by Crompton & Co. of the duties of managers of the defendants' business *ad interim*, and that the responsibilities which they undertook was a responsibility to manage with reasonable skill and care, but not a responsibility for the acts or defaults of subordinate persons who had not ceased to be servants of the defendant company.

This strange discrepancy could not have arisen had the customary precaution of drawing up a written agreement been adopted; but in point of fact the parties had been content with a mere verbal understanding. Heads of agreement had been settled between the firm and the secretary to the company, and these heads had formed the basis of a discussion which had taken place at a board meeting of the company which Mr. Crompton had attended. The results of the discussion had moreover been embodied in a minute, and both the draft and the minute were produced in court. On the part of the plaintiffs it was admitted that the draft expressed the agreement come to, and upon comparison it appeared that the minute did not materially differ from the draft. There was, however, no written agreement executed between the parties, and in this state of the evidence the learned judge left it to the jury to determine what the exact nature of the agreement was. If the position taken up by Crompton & Co. was that of managers, they would be responsible only for their own personal negligence and for errors of management. If, on the other hand, the plaintiffs' position was that of principals—that is to say, independent contractors—they would be liable in respect not only of their own negligence but of the negligence also of any servant whom they had employed.

The negligence complained of resulted in the following mishaps. When the running was resumed in September, 1888, several breakdowns occurred, with the result that the tramway company revoked the permission which they had granted to the electric supply company to recommence driving cars, and desired them to desist from so doing until their plant was in perfect order and the company prepared to undertake afresh the full responsibility of working under contract. This circumstance afforded ground for the defendants' counterclaim, and in support of it three specific acts of negligence were relied upon at the trial—(1) the motor had broken down in work through failure of the current supplied by the accumulators; (2) a pair of engine wheels had been broken in passing over the points which connected the main line with the station siding; (3) a spur or crown wheel, with which the pinion of the dynamo geared, had suffered fracture of several teeth in use, and so had become incapacitated for further employment. These various accidents had not only caused the engines to lose several journeys during the three days of experimental running, but had so disorganised the traffic as to cause the discontinuance of the experiment as above explained. Upon this basis the defendants claimed damages £10,000, being the estimated value of the damage done to their business by the unsuccessful result of the experimental working.

On the part of the plaintiffs it was contended, in the first place, as already intimated, that they were liable not as principals, but as servants or managers to the defendants; but that even if liable as contractors, they would be liable only for the immediate and not for the ulterior consequences of any breach of the contract, and in this contention they were upheld by the learned judge, who directed the jury that in a case of broken contract the true measure of damage was the cost of replacing what was injured, or of supplying what was deficient at the market price, unless it were clearly shown that some other and further consequences of the breach were clearly in the mind of the parties at the time of entering into the contract, and this on the broad ground that it was not fair that a man should be paid for performing a contract upon one basis, and mulcted for its non-performance upon another. The defendants' proof of damage was accordingly restricted to the direct and immediate loss, such as loss of earnings and cost of repairs.

In reference to the giving out of the accumulators, the plaintiffs chiefly relied upon the broad ground of their having acted as managers, and being, therefore, not liable for an act which, if an act of negligence at all, as for example, the omission to charge the accumulator properly before commencing work, was the act of a subordinate. Upon this head the jury found against the plaintiffs, determining that they had undertaken the work as contractors, and that they were, therefore, liable for the defective condition of the accumulators. On the second issue, that of the defective points, the plaintiffs contended that they were not liable for this because the point had been laid by another contractor, who was employed and paid, not by the plaintiffs, but by the defendants, and this contention prevailed, the jury finding for the plaintiffs on this issue.

The breaking of the wheel teeth gave rise to much discussion, being attributed by the defendant company to the non-use by the plaintiffs of a special reversing switch which the inventor of the Eliesen motor had provided for reversing his motors, and by the plaintiffs to inherent defects in the Eliesen design. It was, however, admitted by Mr. Chamen, the engineer put in charge of the Plashet Hall Works by Messrs. Crompton, that he had been content with repairing some of the teeth of this wheel which were obviously defective, whereas it would have been wiser for him to replace the wheel, and that had he taken this precaution the accident complained of would not have happened. The jury, adopting this view, found for the defendants upon this issue also, and in the result awarded to them £184 upon their counterclaim.

Judgment was given in favour of the plaintiffs for the balance of £200, and the costs of the claims, the costs of the counterclaim being awarded to the defendants. The counsel appearing were—for the plaintiffs, Mr. J. Fletcher Moulton, Q.C., and Mr. J. C. Graham; for the defendants, Mr. Finlay and Mr. Bousfield.

AGRICULTURAL SHOW AT ROCHESTER.

As we briefly mentioned in our London letter of last week, there was opened on the 5th inst. at Rochester the annual show of the Bath and West and Southern Counties Society for the Encouragement of Agricultural Arts, Manufactures, and Commerce. The show ground was in a very favourable position, between Chatham and Rochester.

Amongst the heavy machinery Messrs. Aveling & Porter, of Rochester, had a good display of agricultural locomotives, together with a traction engine combined with an Anglo-American Brush Victoria dynamo. This engine was of 6 nominal h.p., but the output of the dynamo was not obtainable. The same firm also showed a steam road roller weighing 10 tons when empty. The Kentish Engineering Works, Maidstone, whose title used to be Drake & Muirhead, had a large display of hop washing and other hop machinery. A new hop washing engine was shown, in which compressed air is used in combination with liquor, and the proportions being adjustable, either a moderately fine spray or an atomised mist can be produced. Among the exhibits of Messrs. Henry Bamford & Sons, Uttoxeter, Staff., were their reapers and mowers, and a large variety of corn grinding mills for various powers. Messrs. Howard, of Bedford, in addition to ploughs, harrows, and rakes, showed haymakers, a light steel frame sheaf binder, and their well-known hay trusser. A self-regulating windmill was shown by Messrs. Duke & Ockenden. The turntable is made of chilled iron, and revolves on sixteen anti-friction balls. A good display of milling machinery was shown by Mr. Simeon Howes, 64, Mark Lane, E.C., in addition to a "Little Giant" turbine. Mr. Percy J. Neate, 16, St. Margaret's Bank, Rochester, had a collection of general machinery. Messrs. Fielding & Platt, Atlas Works, Gloucester, had a vertical gas engine, which has no slide or ignition valve, and only one valve under pressure; a single cam works the valve gear. Messrs. Hornsby had a large display of engines, hay trussers, reapers, mowers, and small implements. They had also two "strawsonizers" of 1 h.p. each and one hand "strawsonizer." It will be remembered that we gave an illustration of the first one which was made in our issue of the 9th of November, 1888. A hop washing machine was shown by Mr. W. Lambert, Hazel House, Horsmonden, Kent. Special jets are used, which allow the water being dis-

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charged in a very fine spray, and the same apparatus can be used as a fire engine by the attachment of a hose. The same inventor has a steam power machine for cutting hop bines into litter. Messrs. W. & T. Avery, Digbeth, Birmingham, have some novelties in weighing machines. One of these is a combination weighing machine to carry up to 30 cwt., and another weighing machine and waggon to carry 50 cwt. If required these can be made self-registering. There was also a steelyard, in which the weight is mechanically registered on a slip of cardboard, and in combination therewith there is an electric registering indicator. The latter portion of the machine was, however, not at work at the show, as the battery had been broken in transit. In another part of the yard there was also seen a weighing crane to lift up to a ton. This crane weighs the load carried rapidly and with great accuracy.

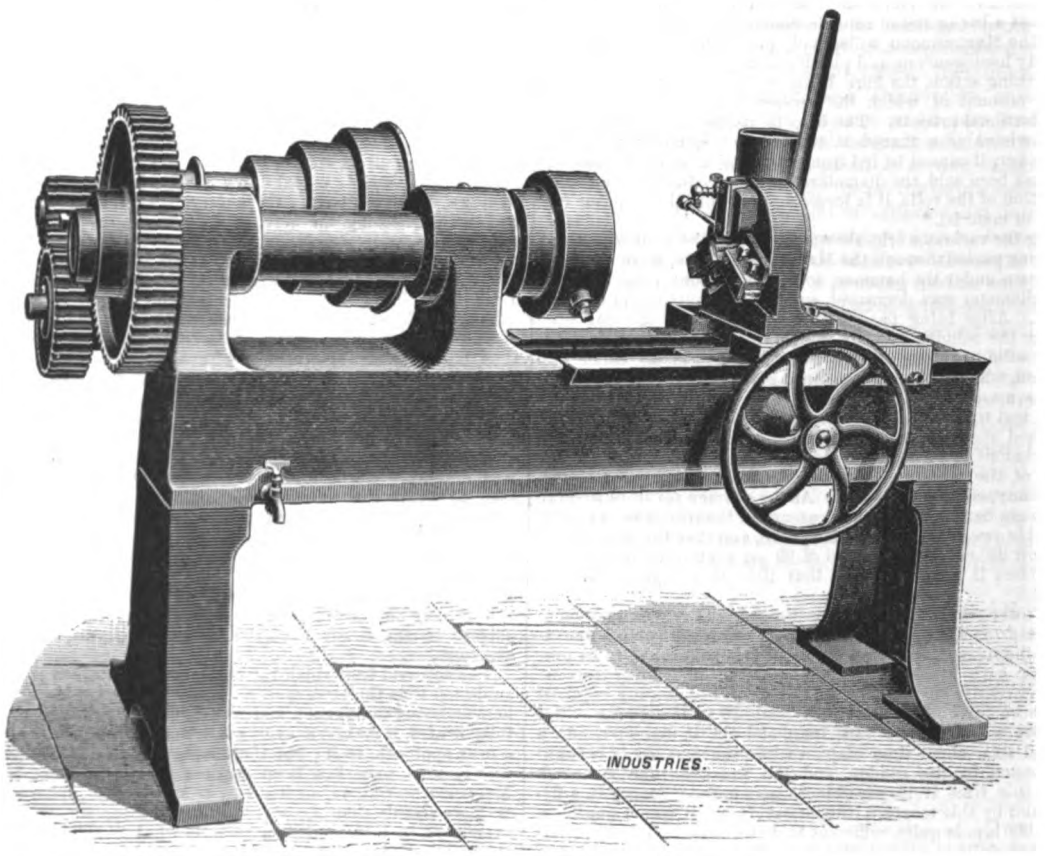
Among heavy machinery there may be briefly mentioned Messrs. Marshall, Sons, & Co., Limited, of Gainsborough, who had an 8 h.p. traction portable steam engine, thrashing machines, and chaff cutters. Messrs. Ransomes, Sims, & Jefferies, of Ipswich, had an 8 h.p. portable, a 6 h.p. agricultural locomotive, and a thrashing machine and straw trusser. Messrs. J. Fowler & Co., Limited, of Leeds, had one traction engine of 8 nominal h.p. for general purposes, of strong design. Messrs. Chas. Burrell & Sons, Limited, Thetford, had an 8 h.p. road locomotive and traction engine, and a thrashing machine, besides smaller machinery. Messrs. Wallis & Stevens made a smaller display, and Messrs. Clayton & Shuttleworth, of Lincoln, had a large stand of their ordinary productions. Messrs. E. & H. Roberts, Deanshanger Iron Works, near Stony Stratford, showed the well-known "Premier" elevator, while Messrs. Ruston, Proctor, & Co. confined themselves to an 8 h.p. traction engine and a thrashing machine. A large display of corn screens was made by Messrs. W. Rainforth & Sons, Lincoln, and Mr. Richard Batchelor, Artois Works, Chatham, had an excellent display of boring machinery for artesian wells. Messrs. Barrows & Co., of Banbury, Oxford, had a new street sweeping machine, in which a new spring clutch arrangement is conveniently placed for the driver to throw the working parts of the machine out of gear by using one lever, and without stopping the horse. Messrs. W. H. Willcox & Co., 36, Southwark Street, S.E., exhibited a drilling machine, fitted with a combined parallel vice and revolving chuck plate. The plate is divided and provided with steel jaws along the whole length of the diameter. The necks are conical, and revolve in conical sockets, which allow the jaws to grip taper or other work. The object is to supersede the usual revolving cast-iron tables, carrying a vice on one side and plate on the other, and, to do away with having to bolt parallel vice on the plate, the vice-plate is self-centreing. Mr. Sidney W. Gibson, Eynsford, Kent, shows an improved marking machine to meet the requirements of fruit growers and market gardeners. It allows of the line being cross-marked, so that in planting out the plant can be set in each corner like sets. Messrs. Henry S. & F. Tett, Preston Works, Faversham, had a simple two row one-horse drill. The front shares can be easily raised or lowered. Mr. John N. Davies exhibited a revolving divider for use in connection with all kinds of manual and heavy delivery reaping mowers and with sheaf-binding harvesters. Its object is to avoid the difficulty occasioned by tangled straw hanging on to the divider and drawing the off end of the machine into the ground. The Standard Manufacturing Company, St. Alkmund's Churchyard, Derby, had some very effective tree pruners, which were shown at work. The knives were worked by ratchet gearing from the foot of the pole, and the cuts were very rapid, cutting branches over 2in. in diameter. Messrs. Taylor & Neate, Medway Works, Rochester, had mill hursts, plunger pumps, and a specimen of the Cyclone pulveriser, which was noticed on its introduction to this country in our journal (see Vol. IV., page 566). An iron mast case for barges, which was exhibited, has winches arranged so that one side can be worked independently of the other. In the same firm's screw-cutting gear a universal trunnion joint is employed at the after extremities of the connecting rods, and in the attachment for the heavy bearing for the steering shaft.

Messrs. Balls Garrett, Medway Iron Works, Maidstone, had a large collection of machinery, a large part of which was Messrs. Richard Garrett's make, and others by Howard, Samuelson, and Hornsby. The result of both principals and agents exhibiting at the same time at the show resulted occasionally in the duplication of exhibits, which only tends to confusion. Small vertical and horizontal engines were shown by Mr. G. S. Hindley, of Bourton; gas engines by Messrs. Crossley and Messrs. Andrews; and a portable petroleum engine by Priestman Brothers.

Butter making competitions were held during the course of the show.

IMPROVED SCREWING MACHINE.

CONSTRUCTED BY MESSRS. LISTER & CO., ENGINEERS, KEIGHLEY.



IMPROVED SCREWING MACHINE.

WE give above an illustration of a new screwing machine, made by Messrs. Lister & Co., engineers, Keighley, which is capable of forming screws from ½in. to 1½in. diameter. As will be seen, the driving spindle carries a four-step cone, and is connected to the machine spindle by gearing. This arrangement allows a considerable variation of speed. The spindle is of hollow steel, with conical front bearing running in gun-metal, and having a centre grip chuck. Improvements are embodied in the die holder, the die boxes being of wrought iron case-hardened, with large wearing surfaces, and front supports as a safeguard against cutting pressure. Straight dies can pass through, fastened by set screws, so that the dies may be set up and recut many times. As they are only straight pieces cut from the bar, they require a minimum of work when recut or replaced. The dies being in front of the die-head allow the cuttings to get freely away.

THE MANNESMANN PROCESS FOR MAKING SEAMLESS TUBES.

WE described this process in our issue of the 30th March, 1888, when it was first introduced, and we now give an abstract of an interesting paper on the process by Mr. J. G. Gordon, read before the Society of Arts, on the 21st ult., as this mode of tube-making is likely to form an important industry.

For the conveyance of water, gas, oil, and steam, for warming and ventilating dwellings and other buildings, and in the construction of all sorts of engines and boilers, as well as for the transmission of power by means of water or air, and last, but not least, for the construction of all sorts of firearms, from the 110-ton gun to Colt's Derringer, tubes are indispensable; while at the same time engineers are turning more and more attention to tubular forms for many parts of structures, as they pre-eminently combine lightness with strength. Before the beginning of this century the use of tubes was comparatively small. Apart from conduits for water, which were generally made of tree trunks with a hole bored through them, as some recently dug up in Harley Street show, when they were made in the form of pipes at all, the main use of tubes, or more strictly speaking, of metallic tubes, was for parts of firearms.

The process of manufacture of welded wrought iron and steel tubes consists first in making a strip of metal of the length of the tube required, and rather wider than the circumference of the tube required. This strip of metal is heated to a welding heat, and then bent by machinery into a tubular form. It is then welded either by means of hammers, by drawing through a die, or by being passed between rolls of appropriate section, and much skill and ingenuity have been devoted to the perfecting all the details of this complicated and difficult process, with the result that now such wrought iron or steel tubes can be obtained in almost any quantities, and at prices which, compared to those which were formerly paid, are very moderate. But although the wrought iron and steel welded tubes are both cheap and good, they had, and still have, a weak point—namely, the weld. It is here that they are generally found to give way under any severe strain, besides which, above and below certain diameters—that is, below about 1in. and above about 6in. or 7in.—the difficulties of the manufacture of welded tubes are much increased. This difficulty in making tubes of large diameter has been overcome, to some extent, by riveting together plates bent into a tubular form, but this is necessarily a costly process, and considerable difficulty is experienced in making the riveted joints perfectly tight. It has therefore been the aim of many inventors for the last thirty or forty years to produce weldless or seamless steel and iron tubes, and a considerable number of processes for producing such tubes have been devised, and many patented in this and other countries, by means of some of which at the present time considerable quantities of weldless tubes of high quality are being produced. The Mannesmann process is one of these latter processes. It has already been described in a paper by Mr. F. Siemens, read before the British Association at their Bath meeting in 1888, in which that gentleman pointed out the salient features of the new process.

The Messrs. Mannesmann produce weldless or seamless tubes of steel, or any other ductile metal, such as copper, bronze, delta metal, lead, or aluminium, by rolling them in skew-rolls—that is to say, in rolls which are not parallel either to one another or to the bar or other material to be treated by them.

In the ordinary rolls, the bar to be rolled is put in at right angles to the rolls, which revolve in opposite directions. But in the Mannesmann tube-mill both rolls revolve in the same direction, and the bar to be acted upon is placed between them lengthways, while, as before mentioned, the axes of the rolls are not parallel to one another. A tube in front of the rolls acts as a guide for the bar, which is pushed in between them. These rolls revolve at about 200 to 300 revolutions per minute, and by their action on the hot and therefore plastic steel, stretch it, and make a hollow in the centre. To explain why the rolls acting in this peculiar manner have the effect on the bar of steel subjected to their action of converting it into a tube, I cannot do better than to quote from the paper by Mr. Frederick Siemens already alluded to. He says:—

"To obtain a simple forward spiral action of the bar, the length of the rolls is immaterial; it will take place when the rolls are reduced to the form of thin discs. Supposing the discs to be infinitely thin, or, what is the same thing, that their outer edges are reduced to a mathematical line and no sliding motion takes place, the bar must still move forward spirally, its spiral velocity being equal to the velocity of the outer circumference of the discs. If, instead of one pair of such thin discs, several pairs of discs of regularly increasing diameters are made to revolve on the same axis, the outer circumference of each disc will revolve with greater velocity than that of the preceding one. The same bar is, however, drawn forward through the several pairs of discs, and thus as each part of the bar enters successively a more advanced pair of discs, the velocity with which that portion of the bar rotates increases, and it is drawn forward by each succeeding pair of discs as they catch hold of it with ever-in-

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creasing speed. It will be understood that a bar passing through such a series of discs, no slipping being possible, the material of which it is composed cannot retain its original area or volume. The diameter of the bar being regulated by the discs, while simultaneously a violent stretching action is carried on, the material required can only be drawn from the inside of the bar, and thus a hollow space is formed.

"Instead of this peculiar arrangement of discs a conical, or rather conoidal, pair of rolls, which amount to the same thing as the discs, considered as joined together, may be provided. It follows that a bar or rod of suitable dimensions, which is passed through the Mannesmann rolls, will, provided its substance is sufficiently homogeneous and plastic, undergo a violent twisting and stretching action, the fibre being spun as is the fibre in a rope, on account of which the process may appropriately be called a tortional process. The bar, in its passage through the rolls, is twisted as a thread is twisted in a spinning machine. As, however, it cannot be fed from the outside as is the thread, and, as has been said, the diameter cannot be reduced on account of the action of the rolls, it is forced to draw on the interior for a supply of material."

Among the various works shown was a bar, the ends of which, before being passed through the Mannesmann rolls, were slightly drawn down under the hammer, so that for about 1½in. at both ends its diameter was decreased, so that the rolls could not act on them. After being passed through the rolls the bar was broken in the middle, and, as shown, a tube had been formed from the solid bar along all that part of its length on which the rolls acted, while both ends remained solid. A hollow produced thus in a massive steel bar should be a perfect vacuum. In order to test this, Messrs. Mannesmann sent several such tubes with closed ends to Professor Finke, in Berlin, who devised a most ingenious apparatus for testing both the pressure in the interior of the tube, and also the chemical composition of the gases, if any, contained therein. As the average result of several experiments he found that the pressure in the tube was as nearly as possible one-tenth of an atmosphere, and that the gas which the hollow did contain consisted of 99 per cent. of hydrogen, and he considers it most probable that the other 1 per cent. was nitrogen.

The power required to produce the tubes is very large, something like from 2,000 h.p. to 10,000 h.p., according to the dimensions of the tube. If a steam engine of this power had to be provided for each machine, the plant would of course become extremely costly, but, luckily, this great power is only required for a short time. For each tube made 30 to 45 seconds suffice to convert a bar 10ft. to 12ft. long, and 4in. in diameter, into a tube, and then some time elapses while the next bar is brought up, adjusted in the guides, and the finished tube removed. During this time it is possible to accumulate energy in a fly-wheel, and by this means a comparatively small steam engine of about 1,200 h.p. is quite sufficient to do the work. The fly-wheel differs materially in construction from those ordinarily in use, and was designed by Messrs. Mannesmann to guard against the terrible danger of bursting, to which accident cast-iron fly-wheels are only too subject when worked at a high speed. This wheel consists of a cast-iron hub, to which are securely bolted two discs of steel plates of about 20ft. in diameter; round the periphery of the wheel thus formed about 70 tons of No. 5 gauge wire are wound under a tension of about 50lb., thus binding the whole securely together. There can be no comparison between the resistance of a wheel so constructed to the centrifugal force and that offered to this force by a cast-iron one. This fly-wheel, of 20ft. in diameter and weighing 70 tons, revolves 240 times per minute; therefore, the periphery of the wheel has a speed of 2·85 miles per minute, or nearly three times the speed of the "Flying Dutchman." This fly-wheel works on the main shaft from which the tube mill is driven by means of helical-toothed steel wheels.

The tubes are heated in a Siemens regenerative furnace, heated by radiation, which is distinguished by its great size; it is 33ft. long by 21ft. wide, and has an area of 789 square feet.

It is one of the many distinctive features of the Mannesmann process that much greater accuracy is required in the adjustment of the rolls than was hitherto dreamed of in the philosophy of iron and steel millwrights. Hitherto, even such delicate work as rolling fine wire rods, and thin sheets for tinning and stamping, has been accomplished by machinery, comparatively speaking, of the roughest description, in which the skill of the roller-man and roll turner had to make up for the inaccurate fitting and adjustment of the rolls. But in the Mannesmann mills every part is as carefully and accurately fitted as in a locomotive or marine engine, and the screws and balances are designed to, and do, enable the foreman roller to adjust the rolls to the 1-32nd of an inch.

After the tubes have been rolled, it is generally necessary to cut screws on the ends, as this is the usual way of connecting steel and wrought-iron tubes together, for making them into gas or water mains, and other similar purposes.

There are twelve screwing machines at Landore. They are made to cut screws on tubes of any diameter, from 2in. up to 12in. The screws cut by these machines are known as the American tapered thread screws. To work these machines, instead of cutting the screw to a uniform depth, we begin by making a deep cut, which slightly diminishes with every turn, so that the end of the tube becomes slightly conical. This is an improvement on the ordinary straight thread, as every turn makes the socket fit tighter on to the tube, while when it is wanted to unscrew the tube it is more easily released.

Comparative tables, giving the strength of Mannesmann and wrought-iron tubes were given, showing the former to be 50 per cent. stronger than the latter.

The tests under compression were made to show the value of the Mannesmann tubes for use in all sorts of engineering construction; even when the tubes are completely crumpled up they do not burst or crack.

What mainly distinguishes the tubes made by the Mannesmann process from all weldless tubes hitherto made is, first, that they are made from bars of solid steel or other metal into tubes without any preliminary boring of the material; and, secondly, that the fibre of the metal runs spirally round the tube when made. In all other processes for making weldless or seamless tubes the material is either cast in the form of a cylindrical ingot with a hole down its centre, or the metal, after having been cast, forged, or rolled into the form of a cylinder, has a hole bored through its centre. The hollow cylinder, whether cast or bored, is then drawn through a series of gradually diminishing dies, and over an appropriately-shaped mandrel, on a draw-bench similar to those employed in wire drawing. This, of course, necessitates frequent annealing of the material, as otherwise it would soon become brittle.

These successive drawings tend to produce a longitudinal fibre in the metal, just as the ordinary rolling of iron and steel bars and strips does, and such a longitudinal fibre necessarily tends to make the tube weaker, especially as regards internal pressure, than the Mannesmann tubes with a spiral fibre, the quality of the metal and all other conditions being the same in both tubes. That a spiral fibre has long been regarded as a source of strength is shown by the method adopted by gunsmiths for making shot guns of good quality. As is well known, these are made by welding together the best quality of scrap iron, such as horseshoe nails. These are carefully made into small rectangular rods, which are then coiled round a mandrel and welded together, and thus forming a spiral fibre. A collection showing this process in all its stages, from the packet of scrap iron to the finished gun barrel, is exhibited in the Museum of Practical Geology, Jermyn Street. On a large scale this process is used by Lord Armstrong for making the wrought-iron coils for his celebrated guns.

For purposes of comparison, two small bottles were made out of a Mannesmann tube and a lap-welded boiler tube respectively. These were filled with boiled water, and placed in a freezing mixture. The expansion which takes place on the solidification of water to ice exerted sufficient force to burst the lap-welded tube, but the Mannesmann tube withstands this great pressure. Another Mannesmann tube, 1in. in internal diameter, and about 3-64th of an inch in thickness, was subjected to an internal pressure of 3 tons 15 cwt. to the square inch, at Messrs. Siemens Brothers' telegraph works at Charlton, when the leather washer closing one of the ends gave way. When taken out the tube was distinctly warm to the touch, but otherwise exactly the same as before the test was applied. This pressure of 3 tons 15 cwt. per square inch is equal to a tensile strain on the metal of over 70 tons per square inch. The power of resisting great internal pressure makes the tubes particulary well adapted for vessels made to contain gases at high pressures, such as oxygen and carbonic acid, which are now being largely used in the arts, and it may also serve to extend the use of compressed air, a subject to which Sir Frederick Bramwell has devoted much attention.

The severest test which the Mannesmann tube can possibly be subjected to is the process of manufacture itself. If the metal is homogeneous throughout, and well melted, well rolled, and carefully heated, it makes, as you see, a perfect tube, or, at any rate, a near approach to it; but if there is any flaw in the bar, or if the furnace man has been careless in the heating, then the Mannesmann rolls reject that bar, by refusing to make a tube of it, more sternly than the severest human inspector would. This process is, in fact, so far as regards what is called humouring the metal, to the ordinary rolling process, what the tilt-hammer is to the late Mr. Nasmyth's steam hammer, so that every tube made by this process comes into the world ready tested.

As to the uses to which the tubes can be put, they can be used for all purposes for which tubes are now used; for water-pipes, especially where water has to be carried long distances at high pressure, they are already being largely applied. Further, their lightness and the greater lengths to which they can be made, will effect a large saving in the cost of labour in laying them down and in the cost of the joints, both of which form a serious item in the cost of any pipe line. What has been said of water applies equally to petroleum and to gas and steam. Another advantage of the Mannesmann tubes, for the purposes alluded to, is that they are capable of resisting much higher internal pressure in comparison to the thickness of their shells, or, in other words, of their weight per foot. While cast iron pipes will hardly stand more than 200lb. per square inch, and welded tubes are not as a rule safe above 1,000lb. per square inch, the Mannesmann easily withstand 2,000lb. per square inch. The length up to which these tubes can be easily made was shown by a coil made of a tube 3in. in internal diameter, and about a quarter of an inch thick, by 70ft. long; it weighs about 6½ cwt. Hollow axles for railway and other waggons, especially for field-gun carriages and ammunition and other waggons, hollow shafts and poles for carriages, can be readily made from these tubes, as well as gun barrels and gun tubes, and shells. The Prussian Government have already given the German Mannesmann works large orders for military stores of various kinds, or rather, for the tubes from which to make them; for instance, the lances with which the whole of the German cavalry are about to be armed are to be made of Mannesmann tubes, and are already in course of manufacture. Some of them were recently shown at Berlin, when Professor Reuleaux read a paper on the subject of the tubes before the Berlin Society of Engineers. Messrs. Reinhard and Max Mannesmann, the inventors of the process, are the sons of Mr. Reinhard Mannesmann, file and steel manufacturer in Remsheid, which has for centuries been, in conjunction with the neighbouring town of Solingen, what Sheffield and Birmingham are to England. More than thirty years ago Mr. Mannesmann, senior, tried to manufacture steel rifle barrels by rolling down carefully-cast hollow steel ingots, but did not succeed in getting sufficiently uniform results to proceed further than the experimental stage; but he never quite gave up the idea, and when his two eldest sons left the university he told them of his experiments. They took them up, and brought the training which they got at German universities, as well as their own indomitable perseverance, energy, and determination, to bear on this problem, and have, after years of hard work, succeeding in constructing the machines and devising the process. At present there are five works making, or about to make, tubes by this process. First, the parent works at Remsheid in Rhenish Prussia, where all the early experiments were carried out; then another works in South Germany, at Bous, near Saarbrücken; the Austrian works at Komotau; a works near Duisburg, which is being specially erected for making tubes of copper and its alloys; and, lastly, the works at Landore, near Swansea, belonging to the Mannesmann Tube Company, who have acquired Messrs. Mannesmann's English patent rights. At these works, which are under the management of Mr. Charles Mannesmann, a brother of the inventors, three Mannesmann mills are now at work, and two more are in course of erection, so that the works will soon be in a position to turn out large quantities of seamless steel tubes of all sizes from 1in. up to 16in. in diameter.

LIGHTNING CONDUCTORS FROM A MODERN POINT OF VIEW.

By Prof. Oliver J. Lodge.

A lightning conductor used to be regarded as a conduit or pipe for conveying electricity from a cloud to the ground. The idea was that a certain quantity of electricity had to get to the ground somehow; that if an easy channel were opened for it the journey could be taken quietly and safely, but that if obstruction were opposed to it violence and damage would result. This being the notion of what was required, a stout copper rod, a wide-branching and deep-reaching system of roots to disperse the charge as fast as the rod conveyed it down, and a supplement of sharp points at a good elevation to tempt the discharge into this attractive thoroughfare, were the natural guarantees of complete security for everything overshadowed by it. Carrying out the rain-water-pipe analogue, it was natural also to urge that all masses of metal about the building should be connected to the conductor, so as to be electrically drained to earth by it, and it was also natural to insist on very carefully executed joints, and on a system of testing resistance of conductor and "earth" so as to keep it as low as possible. If ever the resistance rose to 100 ohms it was to be considered dangerous.

The problem thus seemed an easy one, needing nothing but good workmanship and common sense to make accidents impossible. Accordingly, when, in spite of all precautions, accidents still occurred, when it was found that from the best-constructed conductors flashes were apt to spit off in a senseless manner to gun-barrels and bell ropes and wire fences and water butts, it was the custom to more or less ridicule and condemn either the proprietor of the conductor, or its erector, or both; and to hint that if only something different had been done—say, for instance, if glass insulators had not been used, or if the rod had not been stapled too tightly into the wall, or if the rope had not been made of stranded wires, or if copper had been used instead of iron, or if the finials had been more sharply pointed, or if the earth-plate had been more deeply buried, or if the rainfall had not been so small, or if the testing of the conductor for resistance had been more recent, or if the wall to which the rod was fixed had been kept wet, or &c., &c.,—then the damage would not have happened. Everyone of these excuses has been appealed to as an explanation of a failure; but because the easiest thing to abuse has always been the buried earth connection, that has come in for the most frequent blame, and has been held responsible for every accident not otherwise explicable.

All this is now changing or changed. Attention is now directed, not so much to the opposing charges in cloud and earth, but to the great store of energy in the strained dielectric between. It is recognised that all this volume of energy has somehow to be dissipated, and that to do it suddenly may be by no means the safest way. Given a store of chemical energy in an illicit nitro-glycerine factory, it could be dissipated in an instant by the blow of a hammer, but a sane person would prefer to cart it away piecemeal and set it on fire in a more leisurely and less impulsive manner. So also with the electrical energy beneath a thundercloud. A rod of copper an inch or a foot thick may be too heroic a method of dealing with it; for we must remember that an electric discharge, like the recoil of a spring or the swing of a pendulum, is very apt to overshoot itself, and is by no means likely to exhaust itself in a single swing. The hastily discharged cloud, at first, suppose, positive, over-discharges itself and becomes negative; this again discharges and over-discharges till it is positive as at first, and so on, with gradually diminishing amplitude of swing, all executed in an extraordinarily minute fraction of a second, but with a vigour and wave-producing energy which are astonishing. For these great electrical surgings, occurring in a medium endowed with the properties of the ether, are not limited to the rod or ostensible conduit; the disturbance spreads in all directions with the speed of light, and every conducting body in the neighbourhood, whether joined to the conductor or not, experiences induced electrical surgings to what may easily be a dangerous extent. For not only is there imminent danger of flashes spitting off from such bodies for no obvious reason—splashes which, on the drain-pipe theory, are absolutely incredible—flashes sometimes from a perfectly insulated, sometimes from a perfectly earthed, piece of metal; but, besides this, remember that near any considerable assemblage of modern dwellings there exists an extensive metallic ramification in the gas-pipes, that these are in places eminently fusible, and that the substance they contain is readily combustible.

On the drain-pipe theory, the gas-pipes, being perfectly earthed, would be regarded as entirely safe so long as they were able to convey the current flowing along them without melting; but, on the modern theory, gas-pipes constitute a widely spreading system of conductors able

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to propagate disturbance underground to considerable distances, and very liable to have some weak and inflammable spot at places where they are crossed by bell wires or water-pipes or any other metallic ramification.

Above ground we have electrical waves transmitted by the ether, and exciting surgings throughout a neighbourhood by inductive resonance. Below ground we have electrical pulses conveyed along conductors, leaking to earth as they go, but retaining energy sufficient to ignite gas whenever conditions are favourable at considerable distances.

The problem of protection, therefore, ceases to be an easy one, and violent flashes are to be dreaded, no matter how good the conducting path open to them. In fact, the very ease of the conducting path, by prolonging the period of dissipation of energy, tends to assist the violence of the dangerous oscillations. The drain-pipe theory, and the practical aphorisms to which it has given rise, would serve well enough if lightning were a fairly long-continued current of millions of amperes urged by a few hundred volts, or if there were no such thing as electromagnetic inertia; but, seeing that the inverse proportion between amperes and volts better corresponds to fact, and seeing that the existence of electromagnetic inertia is emphasised by multitudes of familiar experiments, the drain-pipe theory breaks down hopelessly, and only a few of its aphorisms manage to survive it.

What, then, are we to set up in place of this shattered idol? First of all we can recognise, what was virtually suggested by Clerk Maxwell, that the inside of any given enclosure, such as a powder magazine or dynamite factory, can, if desired, be absolutely protected from internal sparking by enclosing it in a metallic cage or sheath, through which no conductor of any kind is allowed to pass without being thoroughly connected to it. The clear recognition of the exact, and not approximate, truth of this statement is a decided step in advance, and ought to be satisfactory to those who have to superintend the practical protection of places sufficiently dangerous or otherwise important to make the aiming at absolute security worth while. Similarly, for wire-covered ocean cables absolute protection is possible. But not for ordinary buildings, any more than for ordinary land telegraph offices, is such a plan likely to be adopted in its entirety. Some approximation to the cage system can be applied to ordinary buildings in the form of wires along all its prominent portions; and such a plan I have suggested, and I understand it is being carried out, for the entrance towers and part of the main body of the present Edinburgh Electrical Exhibition, Mr. A. R. Bennett having asked me to recommend a plan to the Committee as a sort of exhibit. For chimneys a set of four galvanised iron wires, joined by hoops at occasional intervals, and each provided with a fair earth, seems a satisfactory method; but it is to be noted that a column of hot air constitutes a surprisingly easy path, and that it is well to intercept a flash on its way down the gases of a chimney by a copper hoop or pair of hoops over its mouth. Mr. Goolden tells me that he has just applied this method to a new chimney at his works in the Harrow Road. For ordinary houses, a wire down each corner and along the gables is as much as can be expected. At many places even this will not be done; a couple of vertical wires from the highest chimney stacks on opposite sides must be held better than nothing or than only one.

Earths will be made, but probably they will be simple ones, entailing no great expense. A deep damp hole for each conductor, with the wire led into it and twisted round an old harrow or a load of coke, may be held sufficient. And as to terminals: rudely sharpened projections, as numerous as is liked, may be arranged along ridges and chimney stacks; but I have at present no great faith in the effective discharging power of a few points, and should not be disposed to urge any considerable expense in erecting or maintaining them. Crowns of points on chimneys and steeples are certainly desirable, to ward off, as far as they can, the chance of a discharge, but a multitude of rude iron ones will be more effective than a few highly sharpened platinum cones. I find that points do not discharge much till they begin to fizz and audibly spit; and when the tension is high enough for this, blunt and rough terminals are nearly as efficient as the finest needle points. The latter, indeed, begin to act at comparatively low potentials, but the amount of electricity they can get rid of at such potentials is surprisingly trivial, and of no moment whatever when dealing with a thundercloud.

But the main change I look for in the direction of cheapness and greater universality of protection is in the size and material of the conducting rod itself. No longer will it be thought necessary to use a great thick conductor of inappreciable resistance; it will be perceived that very moderate thickness suffices to prevent fusion by simple current strength, and that excessive conducting power is useless.

In the days when the laws of common "divided circuits" were supposed to govern these matters, the lightning rod had to be of highly conducting copper, and of such dimensions that no other path to earth could hope to compete against it. But now it is known that low resistance is no particular advantage: it is not a question of resistance. The path of a flash is a question of impedance, and the impedance of a conductor to these sudden rushes depends very little on cross-section and scarcely at all on material. A thin iron wire is nearly as good as a thick copper rod, and its extra resistance has actually an advantage in this respect, that it dissipates some of the energy, and tends to damp out the vibrations sooner. Owing to this cause a side flash from a thin iron wire is actually less likely to occur than from a stout copper rod.

The only limit is reached when the heat generated by the current fuses the wire, or runs the risk of fusing it. But in so far as oscillations are prevented, the mean square of current strength on which its heating power depends is diminished. Accordingly, a fairly thick iron wire runs no great risk of being melted. Its outer skin may, indeed, be considerably heated, for these sudden currents keep entirely to the outer skin, penetrating only a fraction of a millimetre into iron, and they make this skin intensely hot. But the central core keeps cool until conduction has time to act; and, consequently, unless the wire is so thin as to be bodily deflagrated by the discharge, its continuity is not likely to be interrupted. Thickness of wire is thus more needed in order to resist ordinary deterioration by chemical processes of the atmosphere than for any other reason.

But the liability to intense heating of the outer skin should not be forgotten, and care should be taken not to take the wire past readily inflammable substances for that reason. For instance, it would be madness to depend on Harris's notion that a lighting conductor through a barrel of gunpowder was perfectly safe, especially if said conductor were an iron wire or rod.

In the old days a lightning conductor of one or two hundred ohms resistance was considered dangerously obstructive, but the impedance really offered by the best conductor that ever was made to these sudden currents is much more like 1,000 ohms. A column of copper a foot thick may easily offer this obstruction, and the resistance of any reasonably good earth connection becomes negligible by comparison. A mere wire of copper or iron has an impedance not greatly more than a thick rod, and the difference between the impedance of copper and iron is not worth noticing.

But although, in respect of obstructing a flash, copper and iron and all other metals are on an approximate equality, it is far otherwise with their resistances, on which their powers of dissipating energy into heat depend. It is generally supposed that iron resists seven times more than copper of equal section, and so it does steady currents, but to these sudden flashes its resistance is often 100 times as great as copper, by reason of its magnetic properties. This statement is quite reconcilable with the previous statement, that in the matter of total obstruction there is very little to choose between them; the apparent paradox is explicable by the knowledge that rapidly varying currents are conveyed by the outer skin only of their conductor, and that the outer skin available in the case of magnetic metals is much thinner than in the case of non-magnetic.

Questions about shape of cross-section are rather barren. Thin tape is electrically better than round rod, but better than either is a bundle of detached and well-separated wires—for instance, a set of four, one down each cardinal point of a chimney; but it is easy to over-estimate the advantage of large surface as opposed to solid contents of a conductor. The problem is not a purely electrical one—it is rather mixed. The central portion or core of a solid rod is electrically neutral, but chemically and thermally and mechanically it may be very efficient. It confers permanence and strength; and the more electrically neutral it is, the less likely is it to be melted. Its skin may be gradually rusted and dissolved off, or it may be suddenly blistered off by a flash; but the tenacity of the cool and solid interior holds the thing together, and enables it to withstand many flashes more. Very thin ribbon or multiple wire, though electrically meritorious, is deficient in these commonplace advantages.

There were two functions attributed to high conducting power in the old days—first, the overpowering of all other paths to earth; second, the avoidance of destruction by heat. The first we have seen to be fallacious; on the second a few more explanations can be made. In so far as fusion by simple current strength is the thing dreaded, it must be noticed that a good conductor has no great advantage over a bad conductor. It is a thing known to junior classes that when a given current has to be conveyed less heat is developed in a good conductor, but that when an electromotive force is the given magnitude less heat is developed in a bad conductor. The lightning problem is neither of these, but it has quite as much relationship to the second as to the first. There is a given store of energy to be got rid of, and accordingly the heat ultimately generated is a fixed quantity. But the rise of temperature caused by that heat will be less in proportion as the production of it is slow; and though by sudden discharge a quantity of the energy can be made to take the radiant form, and spread itself a great distance before final conversion into heat, instead of concentrating itself on the conductor, yet this cannot be thought an advantage. For, just as in the old days a lightning rod was expected to protect the neighbourhood at its own expense by conveying the whole of a given charge to earth, so now it must be expected to concentrate energy as far as possible on itself, and reduce it to a quiet thermal form at once, instead of, by defect of resistance and over-violent radiation, insisting on every other metallic mass in its neighbourhood taking part in the dissipation of energy.

The fact that an iron wire, such as No. 5 or even No. 8 B.W.G., is electrically sufficient for all ordinary flashes, and that resistance is not a thing to be objected to, renders a reasonable amount of protection for a dwelling-house much cheaper than it was when a half-inch copper rod or tape was thought necessary.

A recognition of all the dangers to which a struck neighbourhood is liable doubtless prevents our feeling of confidence from being absolute in any simple system of dwelling-house protection; but at the same time an amount of protection superior to what has been in reality supplied in the past is attainable now at a far less outlay; while, for an expenditure comparable in amount to that at present bestowed, but quite otherwise distributed, a very adequate system of conductors can be erected.

Only one difficulty do I see. In coal-burning towns galvanised iron wire is, I fear, not very durable, and renewal expenditure is always unpleasant. It is quite possible that some alloy or coating able to avoid this objection will be forthcoming, now that inventors may know that the problem is a chemical one and that high conductivity is unnecessary.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

(*From our New York Correspondent.*)

At the annual meeting of the American Institute of Electrical Engineers, held in New York, on the 20th of May, Professor W. A. Anthony, of Manchester, Conn., was elected president; Mr. Francis B. Crocker, Mr. Frank J. Sprague, and Mr. Joseph Wetzler, vice-presidents; Mr. J. C. Chamberlain, Mr. P. B. Delany, Mr. H. A. Foster, and Mr. H. Ward Leonard, managers; Mr. Geo. M. Phelps, treasurer; and Mr. R. W. Pope, secretary. The report of the council showed a gratifying increase in the membership of about 30 per cent., the total number of members being 427, and including electrical engineers of the highest standing. An arrangement has been entered into by which the Institute will hereafter have its headquarters at the house of the American Society of Mechanical Engineers, at 12, West Thirty-first Street, recently purchased.

After disposing of the business, a paper was read by Mr. Gilbert Wilkes, late of the United States Navy, on "Electricity in the Navy." The preference for power for electrical purposes in the navy is for simple double-acting high-speed engines. With a given plant, the engine should be constructed to allow little variation of speed under large changes of steam pressure, in order to take advantage of the main condenser when possible. Horizontal and vertical engines are both used, the preference being due in some cases to the shape of available space. Of late years all engines for electric lighting have been high speed, the largest about 25 h.p., running at 400 revolutions. The marine dynamo should be direct-driven and compact, free from liability to injury by salt water, and not too subject to mechanical damage. The dynamo should have small effect upon the compasses, a point which has received little attention. It should run easily and be non-sparking under constant load, and also able to stand sudden large changes of load with little sparking. This is necessary, as the incandescent dynamo is now used for the search light, and the conditions are aggravated by the fact that the latter is usually regulated by hand. Thus, with a 200 ampere machine, not only are 50 to 100 amperes thrown on or off, but at the moment the operator brings the carbons together the dynamo is suddenly called upon to deliver over three-fourths its total capacity. It should maintain a constant potential at all loads, which is accomplished by compounding, and as there is but about 3 per cent. drop it is usual to compound exactly or only over-compound enough to allow for decrease in engine speed with load. It should be light, and usually a careful study of the materials and arrangement of the

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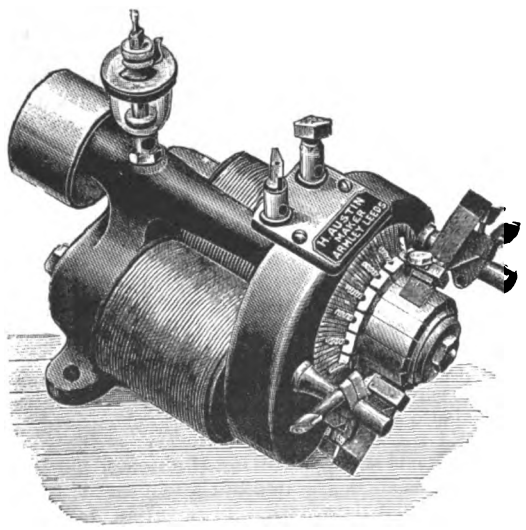
plant will accomplish more in reducing the total weight than a strict adherence to a specification of watts per pound of dynamo. No one dynamo can best fill all these conditions, and special cases arise demanding a rearrangement. On torpedo boats, for instance, high efficiency, low speed, and low heating, all give way to compactness and light weight. Experience with the Parsons turbo-electric generator demonstrated that it was so prodigal in the use of steam as to be out of the question for this service, and there is as yet no apparatus to satisfactorily fill this want. All American navy plants contain two or more similar sets, each composed of one engine and direct-driven dynamo. The standard pressure is 80 volts, having been fixed upon as the mean between the most efficient pressure for the incandescent system and the voltage necessary for the search lights. The incandescent lamps have always shown a satisfactory life, as they are used of low efficiency, 4 watts per c.p. being usually required. Search lights, of 50 volts and from 50 amperes upwards, are used, two or more being supplied, according to the size of the ship. The two-wire system has always been used, the ship never being allowed to form the return. Motors have been used only in driving fans up to ½ h.p. for hoists, and in one case for training a large gun on the "Chicago." There are numerous engines about a ship varying from 1 to 50 h.p., some of which might be replaced with advantage by motors, but it must be proved in each case that the motor not only does its duty as well as the engine, but also that it, and any attendant increase in the generating plant, is of less bulk and weight than the engine and piping. All circuits are waterproof, the cut-outs having stuffing boxes through which the lead-covered wires enter. Electric welding presents many advantages on board ship, especially at foreign stations. The man-of-war is a proper field for nearly every form of electrical application, while a navy yard is an ideal place for the erection of a central station for light and power. Good use is already being made of small motors for drilling purposes at the New York Navy Yard, where several are in constant operation, having driven out the portable steam engine, countershafting, and belting.

At the adjournment of the meeting those who intended taking part in the exercises of the 21st proceeded to Boston, Massachusetts, by the midnight train, a distance of 225 miles. The general meeting in Boston was called to order at 10 a.m. at the Massachusetts Institute of Technology, where an address of welcome was delivered by President Walker, and responded to on behalf of the electrical engineers by Past-President Elihu Thomson.

(To be continued.)

THE "INFANT" DYNAMO.

These machines are made in the small sizes, which most dynamo manufacturers find to be more troublesome than remunerative—viz., from 1,000 watts down to 100 and even 50 watts. The magnets are of annealed Swedish iron, screwed into the pole-pieces by a very fine thread, the idea being that a better contact is thus secured. The yokes have a sectional area thrice that of the magnet bars. The armature is made of No. 18 char-



coal sheet, the burrs being ground off and both sides insulated with a mixture of shellac and plaster of Paris. The armature, as shown in the illustration, is overhung, and can be easily taken out for examination. We have no information as to their performance. Good workmanship is of more importance in these small sizes than refinement of design, since it is impossible for several reasons to attain any tolerable electrical efficiency. These dynamos are made by Mr. H. Austin, 71, Amberley Road, Armley, near Leeds.

THE SOCIETY OF CHEMICAL INDUSTRY.

GLASGOW AND SCOTTISH SECTION.

At a meeting held at Glasgow, on the 3rd inst., Dr. Clark read a paper by himself and Mr. McGhie on "Transvaalite; a New Cobalt Mineral." This mineral was obtained from a mine situated about thirty miles north of Middleburg, in the Transvaal, and Mr. McGhie, having occasion in 1889 to be in that country, paid a visit to the mine, and brought home several samples, which were shown. The ore, which consists essentially of arseniate of cobalt, occurs in a vein of quartzite, and was worked for several years, after which it was abandoned, owing probably to the cost of transit and the difficulty of separating the ore from its matrix. The authors think, however, that if there were only a sufficient quantity of the mineral it would pay to export it to this country.

Mr. H. Ballantine read a paper by himself and Mr. R. T. Thomson, on "The Revision of Some Constants in the Analysis of Oils and Fats," and exhibited a table showing the specific gravity and iodine absorption per cent., which, as Dr. Clark said, would prove serviceable to public analysts, whose difficulty was to know what were genuine samples of oils and what were not.

Dr. G. G. Henderson also contributed a note on "The Purification of Artificial Salicylic Acid."

Notes.

CHEMICALS AT GENOA.

A Foreign Office report states that the imports of chemicals at Genoa have increased somewhat, and a new trade of considerable importance to us has sprung up in sulphate of copper, which is being largely used as a remedy for the vine disease. A little is made in the Alps, but most comes from Swansea. The demand is likely to increase.

MINING IN CHINA.

T'ang Chiung, ex-Governor of Yünnan, has forwarded to Pekin from Yünnan about 300 tons of copper. Mining has, however, been carried on there under difficulties, the ventilation being bad and floods occurring, while there is a want of transport, and copper has been stolen. He, however, expects better results in the future. About 1 cwt of copper is obtained from 1 ton of ore. At Ch'ingk'i, in Eastern Kueichon, machinery has been imported from Europe to smelt iron, but the works got flooded, and delay has thus been caused. Indications of copper have been found here.

DRY GOODS IN MADEIRA.

The old complaint of British Consuls as to neglected opportunities on the part of British manufacturers again crops up. This time it comes from Consul Keene, of Madeira, who asserts that the importation of dry goods is considerable, and carried on almost entirely by foreign countries other than England, the reason being that our makers send few or no commercial travellers out. "English houses applying to the Consul for information cannot cope with the foreign traveller who deals directly and on the spot with local firms and shopkeepers, and who gives long credit."

TELEGRAPHIC MESSAGES FOR ATLANTIC STEAMERS.

Arrangements are being made for carrying out a scheme proposed by Mr. McNeil, of Londonderry, for the more efficient despatch of telegraphic communication between Tory Island and the mainland, which promise to be of great advantage to shipowners and homeward-bound passengers. It is proposed that steamers passing on either side of Tory Island will throw overboard receptacles something like a small buoy, containing the messages to be sent by telegraph, and a boat's crew will be in readiness to pick them up and convey them to the nearest telegraph office. By this means it will be possible for a passenger to intimate his arrival to his friends twenty-four hours before he could do so now from Liverpool, and twenty hours before he could do so from any port on the Clyde. The matter has been taken up by Lloyd's Committee, who undertake to forward passengers' telegrams at a minimum of 1s. each, and shipowners' advices at a minimum of 6d. each. It is expected that the arrangements will be carried out by the end of August next.

TEXTILES IN CHINA.

At Ichang last year there was a general fall in the imports. Cottons amounted to £268,949, a decrease of £15,199 compared with the previous year, but cotton yarn advanced. The latter was due to the failure of the cotton crop in the province. Woollens have fallen heavily, the greatest decreases being in lastings and Russian cloth. Italian cloth (made in England), however, is rapidly extending its market. Silk piece goods from Hangchow, and ribbons from Canton, have increased. A large quantity of the imports at Ichang are merely in transit to the South-Western provinces.

SPRAGUE'S ELECTRIC CAR MOTORS.

A short paper on the Sprague motor was read by Mr. H. F. Parshall before the American Institute of Electrical Engineers on the 21st of May. The paper deals only with the magnets and their dimensions and magnetisation. The pole-pieces are slightly bell-mouthed or chamfered, and their horns are cut away on each side with the view of lessening sparking and allowing the brushes to be shifted. The shape of the pole-pieces cannot, however, be considered without reference to the construction of the armature, of which no details are given. The reason for the bell-mouthing is not clear, and the cutting away of the horns laterally seems to offer no advantage over the not uncommon practice of increasing the air space towards the tips, by several well-known methods, for the purpose, not of lessening sparking, but of reducing local heating. Curves are given showing the effect of cast-iron side brackets, which appear to reduce the total induction from 2,600,000 to 2,550,000, with the usual excitation of 14,000 ampere turns. Another curve, with an air gap of 2·85 centimetres instead of 3·2, shows the difference between cast-iron and wrought-iron pole-pieces. At the above induction the cast iron gives 2,800,000 and wrought iron 3,100,000, a difference which might easily be eliminated by a proper design of the cast-iron pole-pieces.

THE COTTON INDUSTRY.

Spinners continue to declare fairly satisfactory profits, though the margin is still poor. The results, however, are explained by spinners having in stock moderately large supplies of the raw material which were purchased some months ago. The following results for the past three months are announced :—

Mill.	Spindles.	Profit.
North Moor	80,000	£1,460
Woodstock	82,000	1,027
Shiloh.....	37,000	723
Lansdowne	52,000	750
Commercial	62,000	454
Star.....	103,400	2,025
Duchess	72,000	1,248
Central	60,000	777
Gladstone	86,000	856
Arkwright	76,000	2,155
Crawford	154,000	3,300

The margin at the present time is little more than change for a shilling. Those spinners who are not bought to the end of the season are rather concerned at the high prices now ruling for raw American cotton. Already spinners are looking forward anxiously for the new crop, latest telegrams being on the whole encouraging. It is satisfactory to report a large crop of East Indian cotton this season, the figures so far showing an increase of 300,000 bales on last year. Cloth is strong in the leading staples, owing to the unusually deep engagements of makers. India shippers have recently bought largely, some say speculatively. As in yarn, however, the margin is poor. The latest telegraphic news from India respecting the monsoon rains is satisfactory. The weavers' wages list is likely to be settled without resort to a strike. Our total shipments of cotton goods and cotton yarns for the month of May last are encouraging, the figures in each case being larger than the corresponding month in 1889 and 1888, as shown by the following table :—

	Yarn. May.	Five Months ending May 31.
1890	24,135,900 lb. ...	110,804,000 lb.
1889	21,638,500 „ ...	108,887,100 „
1888	21,874,900 „ ...	107,743,000 „
	Cloth.	
1890	470,574,400 yards	2,099,100,600 yards
1889	429,838,000 „ ...	2,158,835,500 „
1888	430,580,300 „ ...	2,077,348,300 „

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Patent Record.

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

27th May, 1890.

8181. Pennycook, J. T. ..... Pneumatic signalling apparatus.
8192. Sherwin, G. E. ..... Heating, purifying, cooling, distilling, and evaporating water.
8194. Sinnette, F. J. ..... Stockless anchor.
8200. Leinweber, H. ..... Magazine firearms.
8205. McConnell, R. ..... Winding yarn.
8209. Townson, T. ..... Slide valves.
8211. Walker & Greenwood Looms.
8220. Newman, N. ..... Car couplings.
8221. Tuquet, Boudard, & Crawley ..... Double action jacquard.
8223. Bunnett, Fache, & Nicholls ..... Magazine firearms.
8225. Bromhead, S. S. ..... Paper box machines (*Knight & Knight*).
8229. Lake, W. R. ..... Welding metal rings (*Lemp*).
8230. Elliot, H. C. ..... Cigarette machines.
8231. Kohler, E. ..... Sewing machines.
8244. Lake, W. R. ..... Magazine firearms (*Winchester Repeating Arms Company*).
8245. Scott, J. ..... Metal dies.
8247. Finckenstadt & Roy ... Compensator for ships' cables.
8251. Redfern, G. F. ..... Apparatus for scouring and wiping tinned sheet iron (*Seutter*).
8252. Henrici, W. A. E. ..... Ironing machines.
8255. Mills, C. K. ..... Keeping ordnance cool during firing (*Gathmann*).
8258. Varilla, P. B. ..... Railway communication between lands separated by water. (23rd May, 1890.)
8265. Livingstone & Cooper... Metallic fences.
8267. Allaire, Gautier, & Poulard ..... Helicoidal propeller.

28th May, 1890.

8270. Sutcliffe & Sutcliffe Apparatus for treating textile materials.
8271. Burns, D. ..... Mowers and reapers.
8275. Moss, J. ..... Boiler furnaces.
8280. Potter, R. P. ..... Metal tanks, &c.
8283. Jones & Bridger ..... Apparatus for forming boots and shoes.
8290. Mills, T. ..... Propelling vessels.
8291. Nixon & Millichamp ... Recording dynamometers.
8295. Versen, B. ..... Linings for converters.
8299. Forbery, G. V. ..... Breechloading firearms.
8301. Huelsen, C. ..... Brick presses (*Welger*).

29th May, 1890.

8309. Silbereisen, J. ..... Wells and other borings.
8312. Patterson & Gray ..... Pump.
8314. Griffiths, T. ..... Ventilation of collieries.
8319. Jopling, J. C. ..... Combustion of smoke.
8321. Stratton & Perry ..... Machinery for making barbed wire goods.
8322. Popp, V. ..... Compressed air motors.
8326. Jones, G. ..... Brakes.
8328. McKee, T. A. ..... Rotary engines.
8329. Pollard, A. W. ..... Calculating machine.
8334. Baillie, R. A. ..... Upsetting metal bars.
8341. Goltz, H. F. C. ..... Pneumatic brakes.
8342. Bentall, E. H. ..... Harvesting machines.
8343. Nightingale, W. W. ... Lifts.
8344. Shoosmith, H. ..... Punch-drawing machinery.
8346. Faure, P. P. ..... Decorticating machines.
8352. McDermott, W. ..... Apparatus for separating ores.
8353. Lake, W. R. ..... Apparatus for elevating straw (*Cyclone Manufacturing Company*).
8356. Chamberlain & Silbereisen ..... Composite pinions and gear wheels. (21st January, 1890.)

30th May, 1890.

8359. Hall, S. ..... Governing mules.
8360. Paterson, G. ..... Increasing power of wheels.
8366. Poole, W. H. ..... Metallic packings.
8367. Hoyle, W. H. ..... Knitting machinery.
8369. Popp, V. ..... Compressed air systems.
8380. Wilson, Cook, & Winter Tramway rail joints.
8382. Morrison & Harper..... Steam engines, &c.
8384. Lister & Watts ..... Grinding mills.
8385. Kerby, H. ..... Plough for draining land.
8387. Leach & Sinkinson ..... Machinery for taking threads out of laps.
8389. Remy, Kramer, & Herking ..... Colouring matters.
8395. Krais, A. K. J. ..... Purifying feed water.
8397. Gillson, S. ..... Liquid meters.
8399. Aitken, H. ..... Iron.
8406. Henniker, Bedingfeld, & Jones ..... Breechloading small arms.
8409. Wells, H. ..... Brakes.
8415. Meltzer, H. F. G. ..... Steam engines.
8418. Barnes, S. K. ..... Boiler furnaces
8419. Roegel & Von Neubronn Slitters and cutters for paper machinery.
8422. Evenstad & Senstad ... Manufacture of wood wool.
8424. Hillas, I. ..... Double lift open shed jacquard.

31st May, 1890.

8426. Neate, P. J. ..... Rotary sieves.
8429. Hurtley, J. ..... Warp balling machines.
8431. Seage & Seage ..... Gas engines.
8432. Paget, A. ..... Warp-weaving machines.
8434. Bayly, J. P. ..... Cylinder paper machines (*McNamar*).
8436. Bayly, J. P. ..... Horizontal telescopic press (*Diffey*).
8441. Harbord, J. M. ..... Railway chairs.
8443. Fielden, E. ..... Loom brake.
8448. Wilson & Pirrie ..... Steam steering gear.
8450. Ingham & Moorhouse ... Twisting machines.
8458. Walden, A. ..... Ploughs.
8463. Shepherd, J. C. ..... Axles.
8466. Cole, O. K. ..... Governor. (11th December, 1889.)
8475. Lawson, Lawson, & Dear Machines for preparing flax, &c.
8480. Childs, B. ..... Axles.
8483. Griffin, H. R. ..... Mowing machines (*Walter A. Wood Mowing and Reaping Machine Company*).

ELECTRICITY.

27th May, 1890.

8241. Jeffers, C. L. ..... Electric lamp hangers.
8242. Lake, W. R. ..... Electric welding (*Lemp*).
8253. Krieger, Stitzel, Weinedel, Schwartz, Reutlinger, & Egelhoff ..... Electric semaphores.
8254. Haddan, R. ..... Accumulators (*Pescetto*).

28th May, 1890.

8272. Wilkins, S. B. ..... Electrical fire or burglar alarms.
8286. Todman, J. T. ..... Electrical cut-outs.

29th May, 1890.

8306. Lake, H. H. ..... Electric relays (*Law*).
8325. Poncia, J. M. A. ..... Preventing injuries to submarine cables (*Kingsford*).

30th May, 1890.

8362. Dummer, E. ..... Electric locomotives.
8379. Thompson, W. ..... Connecting the telephone with the phonograph and telegraph.
8392. Thompson, W. P. ..... Conduits for electric cables (*Jacob Frères et Cie.*).
8393. Drake, Gorham, & Pringle ..... Switches.
8394. Wright, W. ..... Battery compound.

31st May, 1890.

8427. Apps, A. ..... Electric arc lighting.
8442. Forbes, Sir C. S. ..... Primary batteries.
8469. The Mining and General Electric Lamp Company, Ld., & Fitzgerald ..... Battery elements.
8471. Morgan, E. H. ..... Electric locomotives.
8474. McEvoy, C. A. ..... Switches.
8477. Beevor, S. F. ..... Switches.

CHEMISTRY.

27th May, 1890.

8215. Hall, J. ..... Colouring matters.
8233. Dowden, W. A. A. ..... Extraction of gold.
8239. West, W. S. ..... Treating sewage.
8243. Lake, W. R. ..... Colouring matters (*Leonhardt & Co.*).
8262. Sullivan, Sir E. R. ..... Manures.

28th May, 1890.

8294. Lagoutte & De Velna... Solidifying mineral oils.
8303. Johnson, J. Y. ..... Alizarine blue (*Badische Anilin & Soda Fabrik*).

29th May, 1890.

8324. Weathered & Morgans Recovering mercury and amalgam.
8332. Greenway, A. G. ..... Treatment of galvanisers' waste acids.
8357. Cowper-Coles, S. O. ..... Coating with tin.

30th May, 1890.

8364. Waddle, M. R. ..... Cleaning tinplates.
8373. Walker, E. W. ..... Manufacture of gas.
8411. Willcox, B. ..... Colouring matters (*Farbenfabriken vormals Friedrich Bayer & Co.*).

31st May, 1890.

8454. Williams & Symons..... Calcium phosphate.
8470. Koenig, J. B. ..... Soap.
8484. Hogg & Lorrain ..... Purifying oils.

MISCELLANEOUS.

27th May, 1890.

8197. Johnson, J. Y. ..... Graphophones (*Edison United Phonograph Company*).
8202. Thompson, W. P. ..... Pantographs (*Dammann*).
8238. Bell, J. ..... Dyeing and finishing goods.

29th May, 1890.

8339. Hook, C. ..... Anti-fouling compound for steam boilers.

30th May, 1890.

8413. Hartnell, J. ..... Artificial stone.

31st May, 1890.

8451. Longair, D. ..... Measuring liquids.
8452. Knecht, E. ..... Separation of textile fibres.
8455. Major, H. J. ..... Screws.
8464. Mills, L. ..... Spanners.
8481. Ward & Gregory ..... Priming and detonating composition.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form of such opposition.

Year 1889.

6882. Thomas Crisp Sanderson.
8734. Boyle & May.
9301. Gill.
9578. King (*Roberts*).
9841. Clare.
10134. Greeves & Lucas.
10608. Munday.
10654. Mackenzie & Armstrong.
10716. Rivers (*Woodhouse*).
10739. Rugg.
10854. Stott.
10921. Jensen & Busch.
11124. Klein.
11329. Wildemann.
11509. Chubb.
11626. Dixon & Pinson.
11666. Imray (*Farbwerke vormals Meister, Lucius, & Brüning*)
11820. Rushton.
11860. Causse, Stalin, & Conrads.
11882. Trivick.
11892. Cole.
11908. Wilson.
11921. Spencer.
11934. McClelland, McClelland, & Bassett.
11960. Schurmann.
11971. Maxwell-Lyte, Miles, & Ommanney.
11994. Facer.
12006. Burton.
12028. Starck.
12060. Birley & Williams.
12085. Ovens & Ovens.
12112. Treckmann.
12131. Rhodes.
12155. Abrahams & Abrahams.
12171. Wenman & Betteley.
12186. Rousseau, De Chantrac, De la Baume.
12327. Burgess, Burgess, & Wood.
12490. Samson & Benvie.
12634. Brunn.
12757. Dick.
12795. Kent.
13054. Meyer.
13228. Oates.
13737. Neil.
15922. Stables & Haworth.
16232. Townsend.
18438. Hatton.
18856. Gerrard.
20088. Brotherhood.
20554. Jones.
20749. Wolseley.
7079. Watson.
8678. Conley & Lancaster.
8973. Bosshardt (*Verdier*).
9381. Hornsby & Innocent.
9807. Upton.
10360. Maertens.
10543. Davies.
10638. Casson.
10658. Thompson (*Mason*).
10659. Thompson (*Mason*).
10728. Pease.
10770. Edwards (*Krafft*).
10917. Robb.
11091. Snyder.
11240. Thompson.
11482. Patrick.
11583. Wootton.
11662. Stansfield.
11749. Guthrie.
11798. Moor.
11813. Ferguson.
11840. Freebury.
11865. Perkins.
11878. Birks.
11886. Owston.
11903. Gilligan & Tilney.
11910. Haddan (*Chotzen*).
11931. Knowles.
11940. Simpson & Simpson.
11950. Tattersall.
11961. Gourlay.
11973. Simin & Jutschkow.
11987. Sharp.
11999. Waters.
12021. Chapman (*Matthey*).
12049. Cox.
12069. Edwards.
12098. Bennett.
12113. Bath.
12143. Cornish.
12160. Corsham.
12173. Reppmann.
12191. Kolbe.
12292. Condy.
12382. Platt & Thorp.
12447. Hoellies.
12522. Hale.
12677. Lake (*Wiman*).
12779. Von Breinlstein.
12908. Johnson.
13220. Lake (*Pain*).
13417. Montegut.
14162. De Méritens.
16125. Sanders.
17351. Higgins & Jenkins.
18785. Kollén.
19018. Barker (*Rose, Gearhart, & Allen*).
20631. Grant.
20952. Zerbe.

1890.

1055. Mitchelmore.
2352. Singleton.
2913. Bennett & Hides.
3449. Shaw.
3478. Graham & Graves.
3579. Hof (*Rübsam*).
4313. Hull.
4885. Ohlsson.
5015. Avrial.
5334. Deraismes.
5408. Paulitschky.
5525. Chasles.
5658. Wattie.
5837. Ratcliff.
5904. Lange.
6344. Singer & Judell.
6345. Dickinson.
6369. Kellner.
6373. Vonhof.
6424. Tschoepe.
6456. Braun & May.
6489. Imray (*Wildman*).
6509. Weston.
6513. Johnson (*Lewis*).
6529. Bramwell.
6573. Jackson.
6634. Thompson (*Marckwald*).
1565. Timm.
2858. Syer.
2989. Hare.
3458. Lake (*Orvis*).
3544. Patten.
4056. Williams.
4467. Carey.
5009. Unger.
5268. Jennings.
5387. Fulton (*Schmid*).
5466. Thompson (*Ribbach & Meissner*).
5798. Scheller.
5890. Thompson.
6308. Dain, Roney, & Everson.
6347. Lake (*Shultz & Alvord*).
6370. Dickinson.
6391. West.
6437. Crowe.
6478. Efrem.
6500. Thompson (*Stub*).
6511. Musgrave.
6514. Cook.
6547. Bodley.
6584. Shedlock & Denny.
6635. Tompson (*Toucey*).

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ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

PETROLEUM, &c., ENGINES.—*J. C. Bull, Belvedere.*—At present engines worked by exploding a mixture of air and combustible vapour work more advantageously with the lighter and more volatile oils. To enable the use of the heavier oils the inventor vaporises them in a closed vessel at a temperature of about the boiling point of water. The vaporising vessel is enclosed in a boiler and surrounded by water. If the temperature of the oil has to be raised above that of the boiling point of water chloride of calcium is added to raise its boiling point. Any excess of petroleum vapours is permitted to escape by a loaded valve from the vaporising vessel to a condensing reservoir, a similar precaution being also taken with respect to the steam developed in the boiler. The condensed vapour and steam can be repassed to the vaporising vessel and boiler at will. The engine is constructed to draw its supply of vapour from the vaporiser, and to admix the vapour with air or just before it enters the cylinder of the engine to be exploded. To make the apparatus perfectly safe the receiver for condensed petroleum is made of sufficient capacity to hold all the contents of the vaporiser and the receiver for condensed steam to hold all the contents of the boiler. Five claims are made.—No. 10634. July 1st, 1889. 8*d.*

PISTONS.—*J. Drury, Brighouse, Yorkshire.*—This describes an inproved packing ring for pistons and means for lubricating it. The new form of ring is illustrated in Fig. 2. The inner faces are bevelled and pressed outwards by a coiled spring. In Fig. 1 is shown the method of lubricating the rings in a vertical engine. To the piston A is screwed a tube B, whose interior communicates by an aperture with grooves cut in the piston rings. The tube extends through the cylinder cover C into a tubular chamber D nearly filled with lubricating oil. The tube partakes of the up and down motion of the piston, and is consequently kept full of oil, which flows to the piston rings. Three claims are made.—No. 8584. May 23rd, 1889. 8*d.*

FIG. 1

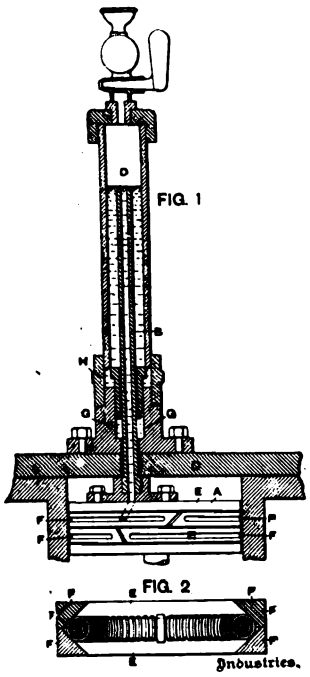


FIG. 2

ROLLED FORGINGS.—*R. C. Christie, London.*—The invention refers to the dies employed in forging screw-threads by rolling. The method of forging is as usual, one or both of the dies being made to move across the face of the other and roll the blank metal into the depressions in the dies corresponding to the screw-threads. By the construction of some old forms of dies, the metal displaced to form the thread is raised radially from the blank, so that the diameter of the finished screw is greater than that of the blank. In another class of dies, the metal displaced is made to elongate the blank; the thread is here formed by a single ridge. Both of these methods tend to distort the thread. By the improved die here described the metal is displaced longitudinally, but the thread is formed by a series of parallel ridges. The ridge nearest the shoulder is arranged to act upon the blank first, and after a complete turn has been formed the next ridge of the series commences to operate, and so on. Ten claims are made.—No. 10453. June 27th, 1889. 8*d.*

CENTRIFUGAL DRUMS FOR SEPARATING MILK.—*S. C. Hauberg, Copenhagen, Denmark.*—The inventor claims the following advantages in the drum described. Greater cheapness of manufacture; more facility for cleaning; increased strength; and better separating power. To increase the strength and facilitate the cleaning of drum, it is made of a globular shape of approximately the same thickness throughout. The bottom of the vessel does not partake of the globular form, but is bent upwards and inwards to form a cone similar to that of a glass bottle. The increase in separating power is caused by increase of speed and the peculiar construction of the wings in the interior of the drum. The milk is passed in at the top of the vessel, and flows down to the bottom. As the milk is exposed to the centrifugal force, the fatty particles separate and move to the centre. By the construction of the wings, the milk, as it is introduced, is kept from disturbing the separating action taking place in that first introduced. Four claims are made.—No. 13981. September 5th, 1889. 8*d.*

STEAM ENGINES.—*W. R. Renshaw, Kidsgrove, Staffordshire.*—The illustrations show this improved form of triple-expansion engine, Fig. 1 being a sectional side elevation, Fig. 2 a front elevation, and Figs. 3 and 4 the valve connections. There are two sets of cylinders, with three cylinders A B C and A^1 B^1 C^1 in each set. The cylinders are single acting, their pistons are connected to one piston rod, and one connecting rod couples them to the crank-shaft. The cranks of the crank-shafts are diametrically opposite. The high-pressure cylinder A first receives the steam on the upper side of its piston, and at the end of the stroke this steam passes to the intermediate cylinder B^1 of the other set; the piston of B^1 thus makes its effectual down-stroke as the high-pressure piston ascends. From B^1 at the end of its stroke the steam passes to the lower pressure C^1, and there acts upon the underside of the piston. The steam is admitted from the steam pipe D to the high-pressure cylinders by a cylindrical valve E. The axis of the valve is horizontal, and the valve receives a partial rotary motion to and fro by an eccentric F. The valve is open at the back and the steam pressure is constantly upon it. A port G in the valve allows steam to pass alternately to the high-pressure cylinders A A^1. There is a cavity H formed in the valve on either side of the steam port, and this cavity in the to and fro motion of the valve forms a communication between the steam passage leading to the cylinder and the exhaust or outlet passage I. At each movement of the valve the steam port in it passes from the passage leading to the one high-pressure cylinder to that leading to the other high-pressure cylinder, and during the same motion the cylinder which at first is supplied with steam is opened to the exhaust as the valve approaches the end of its course. The admission of the steam to the high-pressure cylinders is further regulated by a cut-off valve J, which fits into a concentric cylindrical cavity formed in the main valve E. This cut-off valve is so formed at the periphery that its acting portion consists only of two bars parallel to the axis of the valve and to the steam port. The cut-off valve is independently rotated through a constant angle first in one direction and then in the other by an auxiliary eccentric K. By this means one or other of the bars is brought to cover the steam port in the main valve at the time when the cut-off is required to take place. The anxiliary eccentric K is controlled by a governor which alters the lead of the eccentric so that when the speed increases the auxiliary valve cuts off the steam earlier. The valves of the intermediate and low-pressure cylinders are constructed similarly to the high-pressure valve. The governor is enclosed in the hollow fly-wheel L, and consists of two weights having a radial motion by which the eccentric K is shifted upon the crank-shaft. When the speed of the engine increases or decreases, the weights move outwards or inwards, and the eccentric is turned in one or the other direction upon the shaft. Claims: (1) A triple-expansion engine with two sets of three cylinders, each set having a common piston rod; (2) a triple-expansion engine with three single acting cylinders whose pistons have a common rod and valves so arranged that steam is admitted to the same end of the two higher pressure cylinders and to the other end of the lowest pressure cylinder as described; (3) a triple-expansion engine, with two sets of three cylinders, each set having a common piston rod and valves such that steam is first admitted to one end of the high-pressure cylinder of one set, then to the same end of the intermediate pressure cylinder of the other set, and lastly to the other end of the low-pressure cylinder of the last-mentioned set, as described; (4) in engines such as are referred to in claims 1 and 3 admitting and exhausting steam to and from the cylinders by means of three valves, one for each pair of similar cylinders, substantially as described; (5) the valves and gear for working the same, substantially as described; (6) the pistons, substantially as described; (7) engines, substantially as described and illustrated.—No. 9771. June 13th, 1889. 11*d.*

FIG. 1

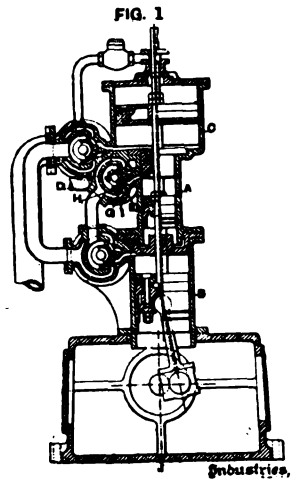
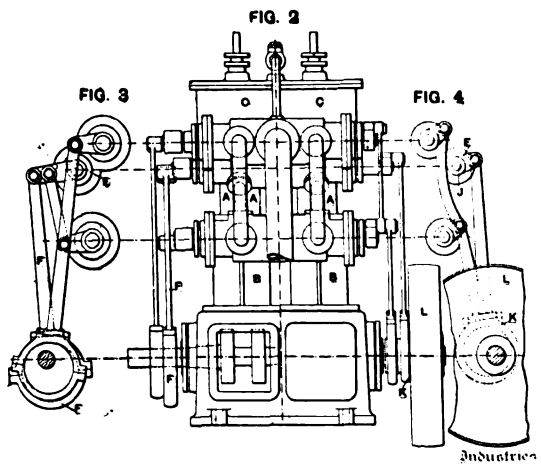


FIG. 2

FIG. 3

FIG. 4



STEAMBOATS AND OTHER VESSELS.—*W. P. Thompson, Liverpool.* (*F. W. Pool, St. Paul, U.S.A.*)—The vessel is double-prowed to enable it to be propelled in either direction. Both ends are fitted with a rudder, and the rudders are made to act in concert, so that the vessel can be turned in more limited space than by the use of a single rudder. The rudders are geared together by mitre wheels and shafts, which extend the length of the vessel, and are geared to the steering wheel. The vessel is propelled by pistons working in cylinders, which have open ends, and are situated at the ends of the vessel with their axes longitudinal. Only one piston is geared at a time to the motive power, that one which is for the time at the stern of the vessel. Water is drawn into and expelled from this cylinder through the open end by the reciprocating piston, and, as it is expelled, forces the vessel forward. Seven claims are made.—No. 9386. June 6th, 1889. 8*d.*

CLEANING MALT, &c.—*R. A. Baumgartner, Rosenheim, Germany.*—The improved machine is built upright, and consists of the following principal parts:—A suction ventilator B; a separator C, with air regulation; a compartment D, in which the material is freed from sprouts; a compartment E, for removing sprouts and husks from the material; and a polishing chamber F. All movable parts of the apparatus are operated from a vertical shaft A. The ventilator B passes the sprouts, husks, and dust immediately into the dust chamber. The separator C consists of two cylinders, telescopically displaceable one within the other, the upper one being raised and lowered by a lever G. This arrangement permits the regulation of the outer current of air between the perforated mantle H and the dust mantle I, so that radicles or other waste matter may be expelled separately. The malt to be cleaned is passed in at J to the first cleaning drum. The inlet so regulates the supply of material as to cause the interstice between the drum and mantle H to be entirely filled up. The drum is revolved at a high speed, and by the open friction and driving wings K the grains are pressed and rubbed without injury against each other and the mantle. The coarser sprouts and waste substance are expelled through the perforations of the outer mantle, and either fall down or are driven up by the current of air regulated by the adjustable cylinders C. The finer waste particles are expelled through the inner covering by the suction current. The operation in the second compartment, into which the material freed from sprouts descends through the apertures L, is the same as in the first chamber. The husks, dust, particles, &c., removed from the material are likewise eliminated by the suction current. Any residue of impurity adhering to the grains is eliminated through the polishing chamber F. The china segments M rub off the husks and fibres, these finer waste matters being removed by suction through interstices, covered with finely perforated sheet metal, as well as through the outer mantle, allowing the malt to leave the machine through the outlet O in a perfectly cleaned and polished condition. Claim: An apparatus for cleaning or polishing malt or grain, in which the material is first worked by horizontally rotating perforated drums, provided with open fans or wings K; then, by means of a polishing drum, consisting of china segments M, with intervening perforated sheet steel pieces N and wings P, provided alternately above and below, in single superposed cylinders H, separated from each other by diaphragms, and covered with correspondingly perforated metal sheets, while a current of air, adjustable by means of displaceable tubes C provided in the so-called separator, passes through the drums of the different storeys outside between the cylinder mantle H and mantle I, and also inside the sides of the drums, thereby expelling the light and heavy waste matter separately, substantially as and for the purpose set forth.—No. 8427. May 21st, 1889. 8*d.*

FIG. 1

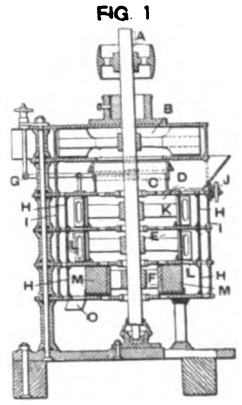


FIG. 2

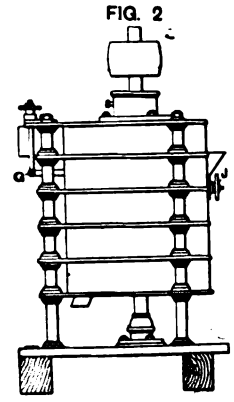


FIG. 3

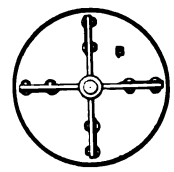


FIG. 4

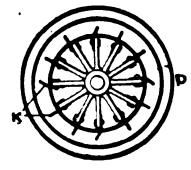
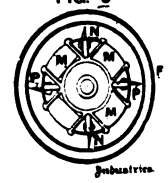


FIG. 5



BOILER FURNACES.—*E. Prime, Barrington, & W. Lee, Melbourne, Cambridgeshire.*—This invention relates to a method of more completely consuming fuel in furnaces. For this purpose heated air is introduced at the back of the bridge to mix with the inflammable gases and form combustion. The bridge of the furnace is made hollow, and open at the top, with a deflecting hood which directs the heated air from the chamber towards the flue. The air is supplied to the chamber in the bridge by a pipe leading from the front of the boiler, the inlet end of this pipe being made conical to enable a larger quantity to be drawn in, or made of a number of funnels concentrically arranged. For locomotive furnaces, the air chamber can be either fitted in the smoke-box or around it, with suitable division so that the current of air may receive a backward and forward movement, and become heated before entering the tube leading to the fire-box. Five claims are made.—No. 9758. June 13th, 1889. 11*d.*

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APPARATUS FOR CONTROLLING PRESSURE, &c.—*J. I. Thornycroft, Chiswick.*—This apparatus, besides controlling the pressure in a receptacle, may be made to indicate by pressure the speed at which a body, such as a shaft, rotates when that body is suitably connected to it. It consists of a revolving part in which there are valves actuated by centrifugal force. This revolving part is rotated by the body whose speed has to be indicated. The valves are two in number, and control three passages, which communicate to an exhauster, to the atmosphere, and to the pipe or vessel in which the pressure is to be controlled. The pressure to be controlled is below that of the atmosphere. In the illustrations,

FIG. 1

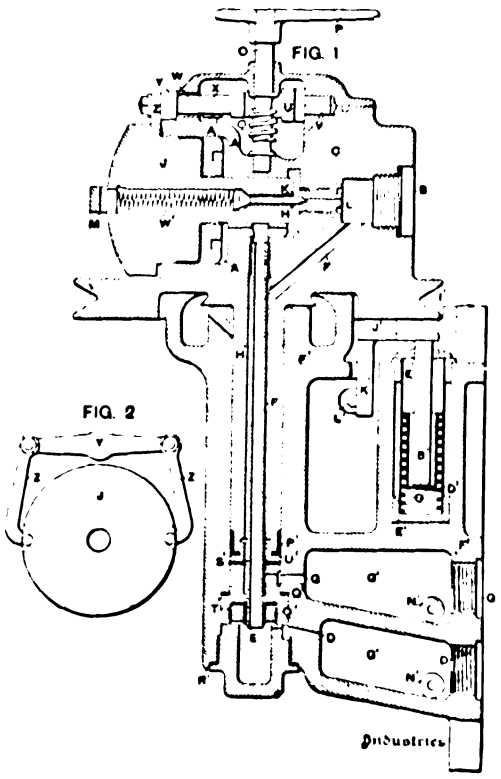
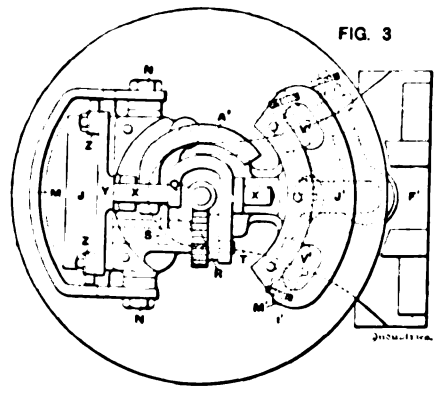


FIG. 2

Fig. 1 is a vertical section of the appliance, Fig. 2 a detail, and Fig. 3 a plan. The part C is revolved by a band passing around the pulley I¹ and the body whose speed is to be indicated. In the part C is a sliding circular plug J carrying the double valve with faces H and I. This valve closes the passage W¹ leading to the atmosphere and interrupts the communication between the exhauster G and the receptacle D in which the pressure has to be controlled. The pressure is controlled as follows: The tendency of the atmospheric pressure is to force in the plug J. If the speed of the revolving body exceeds the normal, this force is overcome by centrifugal action, and the valve is opened at H, so forming communication by the passages D, E, K, L, F, and G, between the exhauster G and the pressure chamber D, the pressure in D being thus reduced. If the speed of the body falls below the normal, then the valve will open at I and air from the atmosphere will flow in and increase the pressure in D. By suitably fitting the pressure chamber D with gauges the variation of pressure may be made to indicate the speed. To facilitate the motion of the plug J and prevent it sticking, it is made to reciprocally rotate about its axis by the rocking lever Y connected to the plug as shown in Fig. 2. The rocking lever is supported upon a spindle X, which carries a slotted lever U. A pin in a worm-wheel R works in the slot of the lever U and imparts to it a vertical reciprocating motion as the worm-wheel is revolved. A fixed worm Q gives the worm-wheel its motion

FIG. 3



as it revolves with the part C about a vertical axis. For indicating the direction of rotation a lever J¹ in frictional contact with the revolving part is constructed to partially rotate about the spindle B¹ and form electrical contact between the post K¹ and one of two stops L¹. The stops L¹ and the post are connected to an electric battery in which is placed the indicator. The posts L¹ are arranged to make the current pass in contrary directions the one to the other. Six claims are made.—No. 1077. January 21st, 1889. 8*d.*

IGNITING TUBES OF GAS ENGINES.—*H. Williams, Stockport.*—These tubes when made of iron, and subjected to the action of a very hot flame, soon oxidise, and become practically useless. The inventor has found, after a series of experiments, that the best material to make these tubes of is pure nickel. This metal gives good results, and is very durable. In making the tubes, a solid bar of nickel is bored out, so as to form a tube closed at one end, and having the required diameter and thickness of shell. Claim: An improved incandescent tube for firing the explosive charges of gas and other similar motor engines, said tube being constructed of nickel for the purposes specified.—No. 11162. July 11, 1889. 4*d.*

PETROLEUM ENGINES.—*J. M. Grob, O. Schultze, & A. Niemczik, Entritzsch-Leipzig, Germany.*—The improvements relate to the vaporising chamber of petroleum motors in which the chamber is in direct communication with the explosion chamber, so that the highly heated combustible gases may act directly on the vaporising surfaces. The motor of this invention is provided with two air inlets—one being as small as practicable, in order to avoid cooling, and serving wholly for the proper distribution of the petroleum to the vaporising surfaces; the other, and larger one, is made to supply the air required for combustion. In fitting the appliance to a vertical cylinder the cover of the cylinder is made hollow and of a conical internal shape. At the apex of the cone is the large air opening, having a valve with a motion in direct line with the axis of the piston. A spring tends to keep the valve closed against the pressure of air. On the side of the conical-shaped cover is fitted the appliance for admitting the petroleum vapour and its accompanying small supply of air. This appliance is of tubular form, and is placed horizontally, so that the petroleum vapour as it leaves the appliance enters the conical-shaped cover in a direction at right angles to the flow of the larger air supply. The valve of the petroleum supply is operated by the motion of the valve for the large supply of air. Thus, when the large air supply is opened the petroleum supply is also open. The pressure of the air supply is sufficient to open the large valve, but if there is any back pressure in the cylinder the extra pressure closes the valve. Claims: (1) In petroleum motors a double air inlet or two inlets, one serving solely for distributing the oil on the vaporising surfaces, and the other and larger one for the introduction of the air for combustion as described; (2) in petroleum engines the introduction of the air for combustion at right angles or nearly so to the entering gas jet in the manner that the gases of the same are enveloped without coming into contact with the cool surfaces.—No. 2919. February 24th, 1890. 6*d.*

BLAST ELEVATORS FOR GRAIN.—*F. W. Anchill, Northampton, & J. Walker, Ruchthuck, Bulgaria.*—The receiving part of blast elevators is here referred to, the improvements being the more effectual distribution of the blast and feeding of the hopper with grain. In the accompanying illustrations, Fig. 1 is a vertical section and Fig 2 a plan of the improved part. The part is embedded in the grain, which flows into the hopper A, and is carried up the elevator tube by a blast of air distributed in the

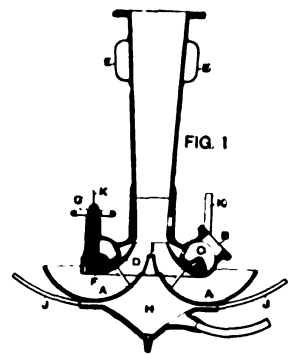
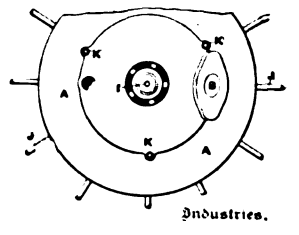


FIG. 1

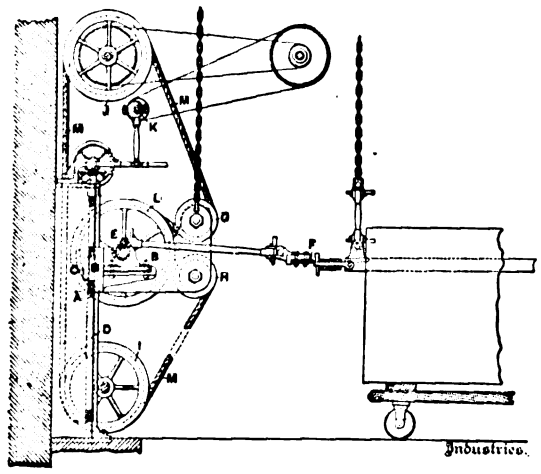
FIG. 2



following manner:—The main blast enters at B to the space C surrounding the blast-nozzle D. From C the blast flows through apertures E, arranged around the nozzle D, and passing up into the tube sucks the grain up from the hopper A. The nozzle D is screwed into the framing, and geared by a pinion F to a hand-wheel G, by which the nozzle can be rotated, and so screwed upwards or downwards, adjusting the space between it and the frame for the admittance of blast to the tube. An auxiliary pipe supplies a blast to the chamber H, from which the air escapes through a central nozzle I and assists the raising of the grain. Radiating pipes J from the chamber H convey blast to the grain surrounding the hopper, and by agitating it tends to keep the hopper full. Pipes K reach to the surface of the grain and allow streams of air to descend into the bulk of the grain to assist the filling of the hopper. Sixteen claims are made.—No. 9568. June 8th, 1889. 8*d.*

GAS RETORTS.—*F. Sanders, St. Petersburg, Russia.*—The retort has the form of an elbow or rectangular tube, the junction of the two limbs being formed of an easy curve. It is heated in a furnace of the usual construction, and its ends fitted with covers, held closed by an efficient arrangement of screws or levers. In the horizontal limb of the retort is provided a mouthpiece or closable opening for the escape of gas to the purifying apparatus. In the vertical limb of the retort are a number of inclined plates or projections, arranged step-like, one above the other. This step-like structure rests in a shallow vessel at the bottom of the retort, the vessel being supported upon pointed legs, so that only a small area is in contact with the retort, to facilitate the removal of the vessel when it is covered by adhesive substances. The retort is heated to redness, and the liquid to be evaporated is passed in through siphons arranged in the cover of the vertical limb. As the liquid enters it drips over the step-like structure, which is heated with the retort, and the liquid is evaporated. The vapours produced remain some time under the influence of a high temperature in the top portion of the vertical limb of the retort, and are transformed into a fixed gas, finally issuing through the mouthpiece in the lower limb. Four claims are made.—No. 11,125. July 10th, 1889. 8*d.*

STONE SAWING MACHINERY.—*S. & W. Dearden, Nelson, Lancashire.*—The class of stone cutter referred to is that in which a horizontal saw frame is employed, the frame being suspended upon four chains and oscillated by a crank and connecting rod. The improvement consists in making the driving mechanism to descend at the same rate as the saw and frame. For this purpose



the bracket B (see illustration) is made to slide vertically upon the post A by a nut C threaded on a rotating screw D. In this bracket B is mounted the crank-shaft E for imparting the oscillating motion to the saw frame F. The pulley L of the crank-shaft is driven by an endless belt M, which passes round the guide pulleys G, H, I and the pulley J, which is rotated by a belt from the motor shaft. Another belt drives the eccentric K, which, by means of a ratchet wheel, pawl, and mitre wheels, rotates the screw D and lowers the bracket B at an equal rate to the descent of the saw frame. Claim: In a stone sawing machine the rising and fall crank-shaft E operating as described.—No. 7525. May 6th, 1889. 6*d.*

STEAM PUMPS.—*S. Northrop, Birmingham.* (*D. Cooper, Philadelphia, U.S.A.*)—An improved method is described in this specification of working the valve of the motive cylinder. The valve is of the ordinary D type, and is worked by a solid plunger or piston having a longitudinal reciprocal motion in the steam chest. The steam chest is bored out to a cylindrical form to receive the plunger, and it is recessed at the centre on the motive cylinder side to form a flat valve seating for the slide valve. A groove is cut in the centre of the plunger to receive the back of the slide valve so that the connection between the valve and the plunger permits the latter to rotate. To work the plunger steam is admitted between it and the ends of the steam chest, so forcing the plunger first to one end of its chamber and then to the other as the piston makes its stroke. Steam is conducted from the cylinder through ports leading from the ends of the cylinder to the spaces behind the ends of the plunger to shift the plunger towards the expiration of each stroke. These ports are opened and closed by the piston of the motive cylinder passing over them, so that as the piston completes a stroke one of the ports is opened and steam admitted behind the plunger to shift the valve. Four claims are made.—No. 10168. June 22nd, 1889. 8*d.*

ROCK BORING MACHINERY.—*W. McNeill, London.*—For the purpose of obtaining the reciprocating motion of the piston rod to which the tool is secured in rock boring machinery, the inventor places between two pistons upon the piston rod a loose sleeve. In this sleeve are cut two slots, whose direction is not coincident with the axial line of the pistons and piston rod, but departs right and left of this line in a spiral direction. In one of these slots is placed the valve for distributing the motive fluid to the cylinder, and in the other slot is a stud fixed to the cylinder to give the sleeve a semi-rotating motion as the pistons make their strokes. The valve is of the ordinary D type, its surface being curved to suit the surface of the cylinder. The steam ports radiate from the centre of the cylinder, and the exhaust port is placed between the two inlet ports. Claims: (1) The use of a valve sleeve formed in one piece, with stud and valve slots shaped thereon, for imparting movement to a distributing valve as described; (2) the use of a distributing valve placed directly in the valve slot as described; (3) the use of portways in the cylinder for admitting and exhausting the motive fluid from the ends of the cylinder as described; (4) the construction of a loose cylindrical valve face with valve ports; (5) the casting of the stud for operating the valve sleeve in one piece with the cylinder; (6) the manufacture and use of the improved apparatus described.—No. 10413. June 27th, 1889. 8*d.*

PRESSURE GAUGES.—*W. Clifford, Norton Woodseats.*—This improved gauge is constructed in the shape of a metal trough, having a longitudinal division plate. The open part of the trough is covered by a sheet of glass, so forming two trough-like channels in conjunction with the division plate. These channels communicate at the lower end by a small hole in the division plate, and at their upper ends are apertures for connecting one channel to the gas whose pressure is to be measured and the other to the atmosphere; the whole thus constitutes a bend. A gauge thus prepared is partially filled with water. The water normally is at equal heights in the channels, but when pressure is exerted by the gas the water is displaced, and its height increases in that channel communicating to the atmosphere, whereas the water in the other is depressed. The difference in height can be read off by a scale upon the glass front and it indicates the pressure exerted. Claims: (1) In pressure gauges constructing the body of two combined troughs of metal or of other material, covered with glass or other transparent substance, and with or without transparent parts as described; and (2) referring to a method of connecting the inlet and outlet tubes to the pressure gauges.—No. 731. January 15th, 1890. 6*d.*

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COMPOUND STEAM ENGINES.—*R. Edwards, Grantham, Lincolnshire.*—The object of this invention is to simplify the construction of compound engines by reducing the number of connecting rods. Thus in a three or four cylinder engine each piston has its own piston rod, but only two connecting rods are used. In three-cylinder engines, in order to effect this, two of the three cylinders are placed side by side relatively to the centre line of the crank-shaft and their piston rods connected to one cross-head, so that one connecting rod then serves to couple the two pistons to one crank of the crank-shaft. To avoid any injurious side stress on the piston rods the motion blocks are rigidly connected to the cross-head, and are made longer than usual. The third cylinder is placed on one side of the other two and its piston rod connected by a connecting rod to a second crank upon the crank-shaft, or to the same crank if the cylinder is placed opposite the other two. Claims: (1) In horizontal engines having three or four cylinders of different diameters, the arrangement and combination of parts as described; (2) the combination of a locomotive type of boiler and an engine with three or four cylinders of different diameters arranged as described; (3) in horizontal engines having three or four cylinders of different diameters, placing the two smallest cylinders with the smallest at the top and connecting both pistons to one cross-head with long rigid motion blocks, and at the same time placing a third (or a third and fourth) larger cylinder (or cylinders) at the side.—No. 10984. July 8th, 1889. 8*d.*

APPARATUS FOR MAKING AND DRYING MALT.—*A. Gough, Sen., London.*—After the grain has been steeped in the usual manner, it is run into a circular chamber to germinate and to be dried. The chamber has the appearance of a large wheel, and is mounted loosely upon a fixed vertical shaft, for the purpose of being revolved when the grain and malt has to be turned. The chamber is made of iron, its sides being of metal plates, perforated sheet plates, or of woven wire. Perforated air tubes or flues are fixed vertically in the chamber, and can be opened and closed at will to regulate the temperature of the grain. The flues are placed sufficiently near so that in hot weather, with flues open, the temperature will be equal to the malt lying on a floor to the depth of six inches, and with flues closed to the depth of three feet. During hot weather a large fan is used to reduce the temperature of the malt-house. To turn and mix the malt or grain dispersers are arranged in the chamber, and they are operated by its revolution. Claim: A circular rotary aërated chamber or apparatus for germinating of grain and fo the drying and curing of malt.—No. 9276. June 4th, 1889. 6*d*

STEAM VACUUM PUMPS.—*C. Imray, London.* (*The Irrigation Pump Company, Sreeley, U.S.A.*)—This invention relates to the class of steam pumps having two closed chambers which are alternately supplied with steam, which, condensing, produces a partial vacuum in them. Improvements are made in the method of supplying the steam alternately to the chambers. The steam supply is made through a four-way valve, which, by a rotation, may be made to admit the steam alternately to the chambers. Above the valve chamber is arranged a small rotary engine, and its shaft is geared by toothed wheels to the spindle of the valve. Thus by the revolution of the engine the valve is rotated; the speed of the valve spindle, however, is considerably less than that of the rotary engine. The steam employed to revolve the rotary engine passes afterwards into the chambers to perform there the pumping action. Claims: (1) In a steam vacuum pump, in combination with the two vacuum chambers and the passages to them, a rotary valve caused to revolve slowly by a small steam engine, the exhaust steam from which, with or without additional steam, is directed by the position of the valve into one or the other of the two chambers; (2) the construction of the rotary valve above referred to and its casing.—No. 5365. April 8th, 1890. 6*d.*

LOCOMOTIVE BRAKE.—*R. Haddan, London.* (*R. Wiegel, New York, U.S.A.*)—The object of the inventor is to provide a new and improved auxiliary brake for locomotives and railway trains, one which can be applied to stop and check the entire train instantly. On the rear axle of the locomotive is a clutch which can be made by the engineer to engage with a pulley upon the centre of the same axle, and cause the pulley to rotate with the axle. Adjacent to the rear wheel of each car, truck, tender, and locomotive is hung a brake shoe in the usual manner. The brake shoe of the locomotive is connected by a chain to the periphery of the pulley upon its axle, and the other brake shoes are connected by chains to eccentrics upon the rear axles of each car, &c. These eccentrics are connected together, and to the pulley upon the rear axle of the locomotive, by connecting rods. The eccentrics are mounted loosely upon the axles by slotted holes, and are held normally upright by suspending chains secured to the body of the vehicle. Each eccentric carries a clutch which, when the brakes are brought into play, secure the eccentric to its axle. To work the brake the engineer engages the clutch upon the locomotive axle, and causes the pulley upon it to rotate. The pulley, as it commences to rotate, pulls the whole of the eccentrics over by the connecting rods. The brakes are thus drawn against the wheels, and the clutches upon the axles coming into action prevent the axles revolving, and stop the train. The suspending chains prevent the eccentrics from rotating. Five claims are made.—No. 5326. April 8th, 1890. 6*d.*

SINGLE AND DOUBLE ACTION PUMPS.—*L. Grill, Budapest, Hungary.*—In the pump of this specification the piston undergoes a modification which reduces the friction in the barrel and dispenses with the usual suction, pressure, and back pressure valves. In a double acting pump two of these pistons work in the same barrel one above the other. The upper piston is connected to the two outside cranks of a three-throw crank-shaft, and the lower piston to the centre crank of the same crank-shaft; the piston rod of the lower piston passing through the centre of the upper piston. By the revolution of the crank-shaft the pistons are reciprocated in the barrel first towards and then away from each other. Each piston has a perforated funnel or conical-shaped body whose apex is downwards and whose top edge is rather smaller in diameter than the inner diameter of the pump barrel. A rubber conical cup is placed in this perforated body, and so constitutes a valve which will open to the downward motion of the pistons, but remains closed during the upward motion. The edges of these cups overlap the bodies of the valve and thereby make a tight joint with the pump barrel. When the pistons are reciprocated and approach each other the lower piston lifts the liquid and forces that above it up through the top piston which is then descending. As the pistons separate the same top piston lifts the water and forces it on upwards, at the same time sucking it up through the lower piston. In single acting pumps a single piston of the sort described is used in conjunction with a check valve. Claims: (1) The construction and application of preferably funnel-shaped perforated pistons with lining fixed in appropriate position, but being otherwise able to move freely for covering the openings in the piston, said lining acting as valve and being firmly pressed against the interior surface of the pump barrel, thus producing a perfect packing when the piston makes its up stroke; (2) the employment of pistons as described in claim (1) in pairs in such manner that during the operation of pumping the pistons are moved towards and from each other; (3) the application of filtering material such as felt, flannel, and the like in the pumps characterised in claims (1) and (2) so that the pumps deliver filtered water direct; (4) the combination of the improved pistons as claimed with back pressure valves.—No. 5325. April 8th, 1890. 6*d.*

DIAPHRAGM COCK FOR GAS, &C.—*J. & A. Zehren, Paris.*—A fixed diaphragm, or plate, is placed perpendicularly to the axis of the conduit between two separate tubes. This diaphragm is furnished with two orifices to allow the passage of the fluid or vapour. Upon the diaphragm is a circular sliding plate, which slides upon an axis parallel to the tubes, and has pierced in it openings similar to those in the diaphragm. When these orifices correspond, the cock is opened, and can then be closed by turning the sliding plate a quarter of a revolution. To turn the plate a bevel toothed surface is attached to the sliding plate and made to gear with a bevelled toothed wheel, which can be rotated by a hand wheel on the outside of the cock. Claims: (1) The combination of two diaphragms, plane, conical, half-round, in general of whatever form, one movable, the other fixed (this last being independent of or forming part of the conduits) perpendicular to the conduit, pierced with one, two, or several orifices, the revolution of which hinders or allows passage of a fluid, said revolution being obtained either by bevel wheels, endless screw, or other mechanical arrangement; (2) the disposition which consists of employing the double system for resisting strong pressures—*i.e.*, two fixed diaphragms and two movable; (3) the employment of strips inlaid in slots dispensing with adjustment.—No. 14487. September 14th, 1889. 8*d.*

FEED-WATER HEATERS.—*A. C. Moffatt, London.*—In feed-water heaters where the tube-joints are made by indiarubber rings, some difficulty has been experienced in making the joints tight because the rings are liable to be twisted and displaced in putting the tubes in. This the inventor obviates by forming the surfaces between which the rings are compressed of a conical shape instead of at right angles to the axis of the tube. When putting the parts together the tubes will then drop into the sockets or recesses prepared for them without displacing the rings, the end of the tube being guided to its place by the conical recess. Claims: (1) The improvements in feed-water heaters which consist in making the sockets or recesses of a conical form; (2) feed-water heaters as described.—No. 9880. June 15th, 1889. 6*d.*

MARINE ENGINES.—*H. Dunsmuir, Govan, Lanarkshire.*—To obviate the use of separate sets of engines for the several propeller shafts of multiple screw steamers, and to gain the economy and other advantages resulting from the employment of triple or multiple-expansion engines, the inventor arranges a single engine athwart-ships, and connects the different pressure cylinders to separate crank-shafts which are suitably connected to the propeller shafts. In adapting triple-expansion engines to operate the propeller shaft of a single screw, the intermediate and low-pressure cylinders are each directly connected to a crank on a short shaft whilst the high-pressure cylinder is connected to a crank upon the propeller shaft; the three crank-shafts are then connected together by connecting rods. In adapting triple-expansion engines to operate the propeller shafts in a twin screw steamer the high-pressure and low-pressure cylinders are directly connected each to one of the cranks or propeller shafts whilst the intermediate cylinder is connected to a separate crank-shaft, or the arrangement may be varied, and in order that the power and speed of rotation of the two propeller shafts may be equalised and economical working ensured the three crank-shafts are connected together either by crank discs and connecting rods or by toothed or frictional gearing. Claims: (1) The arrangement of multiple-expansion marine engines with the cylinders placed in line athwart-ships, the cylinders being connected singly or in pairs to separate shafts, and the shafts connected or geared to rotate in unison as described; (2) in multiple-expansion engines the combination of a series of cylinders connected singly or in pairs to separate shafts, and a series of connecting rods for connecting together said shafts and transmitting the power from the several cylinders as described.—No. 10665. July 2nd, 1889. 11*d.*

ELECTRICITY.

ELECTRIC ALARUM FOR PRESSURE GAUGES, &C.—*A. Julian, Basingstoke.*—The alarum is constructed to be sounded when the gauge indicates a certain pressure, speed, &c. To the pointer or spindle of the gauge is secured an arm which forms one terminal of an electric circuit having an electric bell in it. In the path of the gauge is a small adjustable stop, forming the other terminal. This stop can be adjusted on the face of the gauge to any pressure. When the pointer travels round the dial and reaches this pressure, the contact arm upon it strikes the stop and completes the circuit. Claim: An attachment to pressure, vacuum, speed, and other gauges for sounding an alarum by means of electricity.—No. 7808. May 10th, 1889. 6*d.*

CHEMISTRY.

MANUFACTURE OF PHOSPHORUS.—*T. Parker & A. E. Robinson, Wolverhampton.* — The material containing the phosphorus is mixed with carbon or carbonaceous material, and the mixture is introduced into a suitable crucible or furnace containing a non-volatile metal which is brought into a state of fusion by the action of the electric current or otherwise. The non-volatile metal is kept in a state of fusion by the passage of a current of electricity through it, and the heat arising therefrom will reduce the phosphorus from the mixture. Instead, however, of passing the current of electricity wholly through the non-volatile metal, it may be conducted through the mixed materials to the metal, when the heat derived from the direct passage of the current will aid the effect of the heat derived from the fused metal. By the passage of the current from an electrode through the mixed materials to the fused non-volatile metal, the heat generated is diffused instead of being locally intense. By the action of the heat derived from the passage of the electric current, the phosphorus is reduced in a vaporous condition, and may be led away from the crucible or furnace, and condensed by well-known means. Claim: The reduction of phosphorus from a mixture containing phosphorus and carbon by the heat derived from an electric current in the pressure of a fused non-volatile metal as described.—No. 10437. June 27th, 1889. 4*d.*

TREATMENT OF TINPLATE SCRAP, &C.—*I. Bang & A. Ruffin, Paris, France.*—It has long since been attempted to separate the tin from tinplate waste and other articles containing tin in combination with other metals, in order to utilise separately the two metals, but the result has been doubtful commercially as regards the tin produced, and practically valueless as regards the utilisation of the iron, as slight traces of tin left in the iron rendered this brittle and useless. It is stated in all chemical works that alkalies dissolve tin, with liberation of hydrogen and formation of protoxide of tin, which is dissolved in the alkalies. If this were the case, the separation of the tin from the iron would be easy, as soda does not attack iron; but this assertion is not entirely confirmed in practice, for if tin is put in contact with alkalies there is no doubt produced a commencement of reaction, with solution of traces of tin, but the attack ceases almost immediately, and the solution of tin does not continue. According to the inventor's investigation, there appears to be produced a kind of polarisation on the surface of the tin, that is to say, a coating of hydrogen is formed, which, combining in the nascent state with the metal, preserves the latter from all subsequent attack. The same phenomenon is produced with the zinc plates of batteries when these are polarised. To counteract this stoppage of the attack of the alkali, and to dissolve rapidly all the tin, the inventors introduce a supply of oxygen. This may be derived from any source; thus the oxygen of the air is sufficient, the solution of the tin being effectually carried out if air in a finely divided state be introduced into an alkaline bath containing the metal to be dissolved, and if the operation be carried on under heating the solution will be sufficiently rapid. To obtain a more rapid action, however, use is made of neutral salts containing a large amount of oxygen, such as nitrate of soda. The process is by preference carried out as follows: Nitrate of soda is dissolved in a soda or potash lye, and the material to be treated is introduced into this bath. The nitrate of soda gives off by degrees all its oxygen to the tin, which dissolves in the caustic soda in the form of metastannic acid, whilst the nitrogen is transformed into ammonia at the expense of the hydrogen of the water, thus continuing the oxidising action. Thus, besides dissolving the tin, caustic soda and ammonia are produced by the above action. The tin exists in the bath in the form of metastannate of soda, and is separated from the soda by hydrate of lime, which takes up rapidly the stannic acid in soda solution and liberates the caustic soda. Claims: (1) The herein-described process for the separation of tin from other metals, in particular from tinplate, whereby the said metals are treated in the alkaline way in the presence of oxygen produced from nitrates or other sources of oxygen; (2) the separation of oxide of tin contained in the alkaline liquor by forming an insoluble stannate by means of caustic lime, and the regeneration of the alkaline liquid.—No. 70. January 2nd, 1890. 6*d.*

MISCELLANEOUS.

FURNACE SLAG.—*T. Hydes, Sheffield.*—The slag as it leaves the furnace is treated with a blast of air or steam which disintegrates it. It is conducted from the furnace to a tube placed vertically over a conical or flat block which acts as a spreader. This spreader is placed in the bell-mouthed nozzle of the blast pipe so that an ascending blast of air or steam will surround the whole block. As the slag proceeds from the tube it falls upon the spreader and drips in a thin sheet from off its edge, when it meets the ascending blast of air and becomes disintegrated. The blast nozzle, &c., are enclosed in a cooling chamber of special construction, arranged to cool the disintegrated slag as it falls after its treatment by the blast. Claims: (1) In the treatment of molten slag for various purposes, blowing the whole of the slag as it is delivered from the conductor or shoot, by means of a blast of compressed air, or steam and air combined, into a disintegrated form, and in such a manner that it will drop into, and by its gravity pass through, cooling passages or tubes surrounded by water; (2) in apparatus for treating molten slag, the construction of a blast nozzle with one or more annular openings or mouths having a central spreading block as described.—No. 10835. July 5th, 1889. 8*d.*

TREATMENT OF FURNACE SLAG.—*T. Hydes, Sheffield.*—In this case the molten slag, as it leaves the furnace, is passed between two rollers kept cool by a constant supply of cold water. It is then conducted by an inclined surface, artificially cooled, to a second pair of rollers, provided, if desired, with ribbed or indented surfaces, to form the slag into cubes or blocks suitable for use on roads, &c. The slag when passed between the second pair of rolls is consolidated, and if the rolls are smooth, it is reduced to a powder suitable for cement, &c. Claims: (1) In the treatment of slag for various purposes, passing the molten slag through rolls, said rolls being made hollow to contain water, for the purpose of chilling and disintegrating, pulverising, or granulating the slag; (2) in the treatment and preparation of slag for various purposes, causing the molten slag to pass through rolls, one or both of the rolls being ribbed, fluted, recessed, or indented, so as to form the slag as it passes through into blocks, cakes, or nodules.—No. 10836. July 5th, 1889. 6*d.*

Copies of the British specifications may be obtained on application to H. READER LACK, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every* 10*d. or fraction of* 10*d. Remittances exceeding one shilling must be made by Post Office Order.*

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JAPANESE EXHIBITION AT TOKIO.

We are surprised to observe how little note the industrial public seems to take of the Japanese National Industrial Exhibition, which was opened in April, in the beautiful park at Uyeno, Tokio. There have already been two National Exhibitions in Japan—the first in 1877, the second in 1880. The former, following almost immediately on the footsteps of the civil war in the south, necessarily fell short of the country's capacities. Still, being the first industrial Exhibition ever held in Japan, it attracted much attention. The exhibits showed Japan in a not very lovely light. Her transition period had then fairly set in, and the originality of her artisans was replaced by imitation more faithful than intelligent. This self-effacing tendency displayed itself still more conspicuously at the Exhibition of 1880. The Exhibition of 1880 served the purpose of showing that, while all the old technical skill remained, the manner of its exercise had gone entirely astray, and from that time we may date a renaissance now happily established in all directions. The specimens shown at the present Exhibition enable us to estimate how far Japan can revert to her old routes without departing too much from the requirements of her modern civilisation, and to determine the measure of her probable success in adapting her genius to the needs of the new era. The Treasury's appropriation in aid of the affair is 500,000 yen (£80,000), whereas only 180,000 were given in 1877 and 200,000 in 1880. We learn also that a thousand special tickets have been distributed among foreigners in Europe, America, and Japan, which tickets will confer on their holders exceptional railroad and steamboat facilities.

The buildings in Uyeno Park are nothing from an architectural point of view. Eight acres is the space covered by the roofs, and a visitor passing once along the front of the various stalls will have covered a distance of sixteen miles. These figures apply to the Exhibition proper—that is, to the main edifice where products and manufactures of the day are shown. There is also a fine arts gallery in a separate building on the east of the Park. The general arrangement of the Exhibition will be seen from the accompanying plan. We gave an elevation of the Exhibition in our issue of the 21st of March.

RESEARCH COMMITTEE ON MARINE ENGINE TRIALS.*

(*Concluded from page 555.*)

3. Trial of the S.S. "Tartar."

Steamer.—This steamship is owned by Messrs. Gellatly, Hankey, Sewell, & Co., and is an excellent example of modern economical engines in a cargo-carrying steamer. She was built in the year 1887 by Messrs. R. Dixon & Co., of Middlesbrough, and engined by Messrs. Thomas Richardson & Son, of Hartlepool, with triple-expansion engines, working a single screw. She is a vessel of 332ft. in length, 38ft. in breadth, and 27ft. in depth (moulded). Her gross registered tonnage is 2,389, and she is classed at Lloyd's 100 A 1. Her draught during the trial was 8ft. 6in. forward, and 15ft. 6in. aft, or 12ft. mean; and her displacement at this draught was 2,250 tons. She was practically without cargo, carrying nothing but water ballast. The trial was made upon the 27th of November, 1889, on a run from the Thames to Portland. The vessel had arrived in London on the 21st of November, after a voyage from Australia; and the boilers were cleaned, and the engines opened out and overhauled before the trial, while the ship was unloading in the docks. Steam was got up on the evening of the 26th November, and the vessel went out of dock about 5 a.m. on the 27th. The trial started at 8.25 a.m., as soon as the vessel was far enough down the Thames to run at full speed, and lasted until 6.30 p.m. The weather during the last part of the run was sufficiently rough to cause the engines to race a little, in consequence of the light draught of the ship. At the time mentioned (6.30 p.m.) the weather had become sufficiently bad to make the taking of accurate observations a matter of considerable difficulty, and it was therefore decided to end the trial, rather than to run any risk of having it spoilt by inaccuracies. In consequence of snowstorms met with going down the Channel, the engines were slowed from 9.52 a.m. to 10.56 a.m., and again for 11 minutes between 12 and 1 o'clock. During these periods the speed was about 64 revolutions per minute, the full speed at other times being about 71 revolutions per minute. Diagrams were taken at the slower speeds, so that they are properly allowed for in the averages. The engines were not stopped at all during the trial; and, with the exception of the intervals named, ran under constant conditions as to position of valve-gear, &c., namely with the main stop-valve and the throttle-valve fully open, and the link-motion slightly linked up.

Engines.—The "Tartar" is fitted with triple-expansion surface-condensing engines, the cylinders being placed in the order, high, low, intermediate, going from forward to aft. The cranks are placed in the sequence—high, low, intermediate. The diameters of the cylinders are 26·03in., and 42·03in., and 68·95in., by gauges. The piston-rods are all 5·5in. diameter. There are no tail rods. The stroke of all three cylinders is 3ft. 6in. The cylinders are jacketed, and there is a separate steam-admission pipe to each jacket. The clearances of the cylinders are given by the makers as 14·51, and 9·25, and 5·10 per cent. The valve-gear is of the link-motion type, with an independent adjustment for the cut-off. The surface-condenser contains 2,250 square feet of tube surface, in 876 tubes of ⅝in. external diameter and of 13ft. 0½in. length between tube-plates. The screw propeller has four blades, and is 16ft. 6in. diameter, with a pitch of 18ft.

Boilers.—Steam is supplied by two double-ended steel boilers with Fox's flues, designed to work at a pressure of 150lb. per square inch. The boilers are 13ft. in mean diameter, and 14ft. 9in. long, each with two furnaces at each end, there being eight furnaces in all. The total grate surface is 161 square feet, each grate being 5ft. 6in. in length and 3ft. 8in. broad. The total heating surface is 5,226 square feet, of which 4,436 square feet is tube surface. The total heating surface is therefore 32·5 times, and the tube surface 27·1 times the grate surface. There are 992 tubes, 3in. diameter outside, and 5 ft. 9in. long over plates. The internal diameter of the funnel is 7ft., and its total height 57ft. above the centre of the furnaces. The total weight of the engines and boilers, including water in condenser, pipes, and boilers, and all mountings, is about 191 tons. The net volume of the boilers is about 4,710 cubic feet.

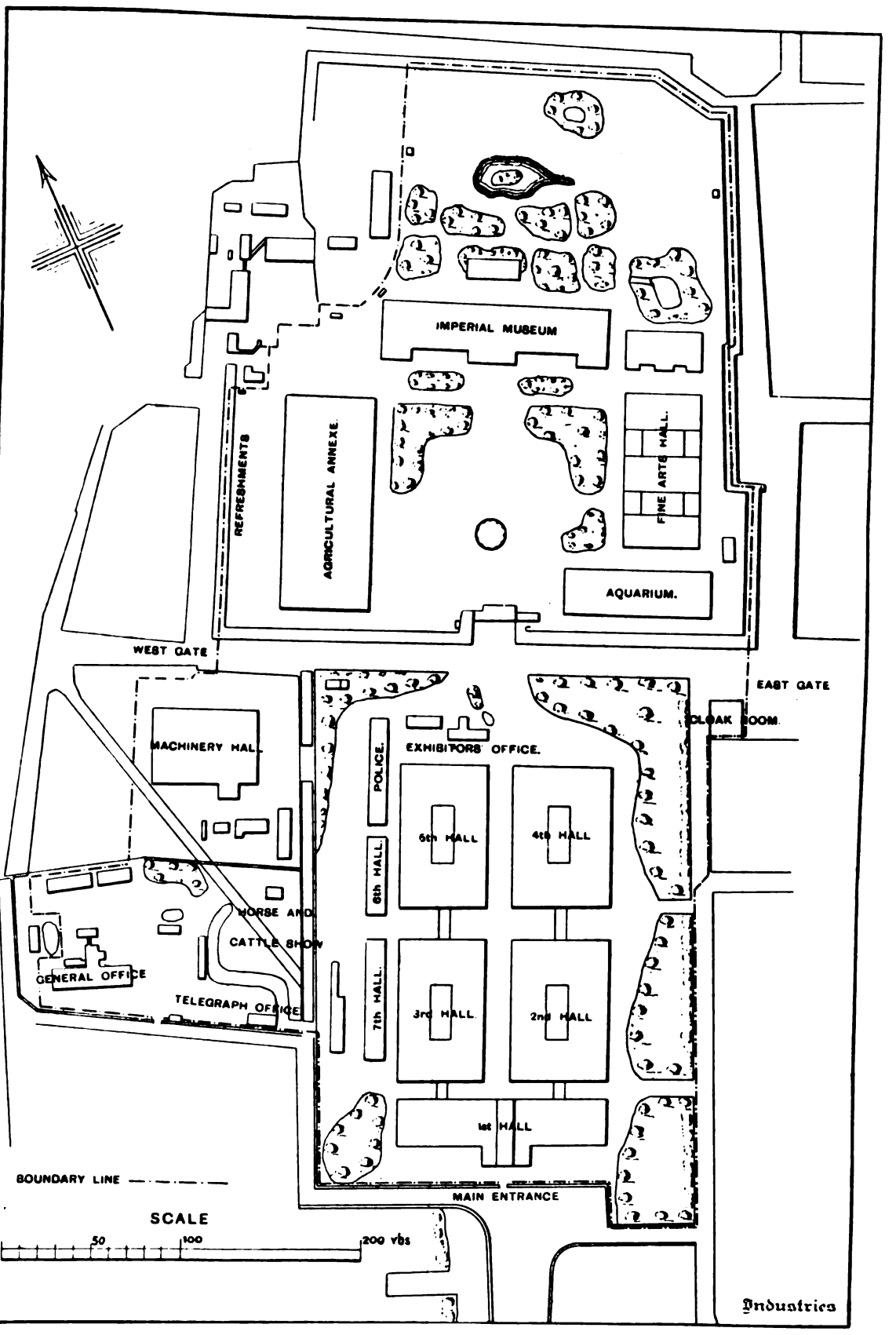
Duration of Trial.—The duration of the trial from start to finish was 10 hours 5 minutes, or 605 minutes.

Coal Measurement.—The coal was weighed as in the other cases, from 500lb. to 600lb. at a time being put down on each side of each stoke-hold. The trial was started with clean floors, and the time of first stoking from each weighed lot of coal was noted, as well as the time when the whole of the weighed coal was finished. The line of coal consumption plots out as shown in Fig. 11, page 579. The fires were not cleaned during the run. The ashes were weighed after the trial was over, the ash-pits having been cleaned a little time after it commenced. The coal used was Welsh from Perikyber (Glamorganshire) throughout. Coal samples were taken frequently during the run from both stoke-holds, and the final analysis, after a thorough mixture of all these samples, is as follows:—

	Coal as Used.	Dry Coal.
Carbon	87·98 per cent.	88·93 per cent.
Hydrogen	4·22 ,, ,,	4·26 ,, ,,
Moisture	1·07 ,, ,,	0·00 ,, ,,
Ash	3·42 ,, ,,	3·46 ,, ,,
Nitrogen, sulphur, oxygen, &c., by difference	3·31 ,, ,,	3·35 ,, ,,
	100·00	100·00

* Report prepared by Professor Alexander B.W. Kennedy, F.R.S., Chairman of the Committee, for the Institution of Mechanical Engineers, and read at the meeting of the Institution on the 1st ult.

JAPANESE EXHIBITION AT TOKIO.



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A sample of the ash was also collected, and has been analysed by Mr. Wilson as follows:—

Loss on ignition (= carbon)...	65·53 per cent.
Mineral matter.....	34·47 ,, ,,
	100·00

The calculated calorific value of the fuel is 14,995 thermal units, which corresponds to the evaporation of 15·52lb. of water from and at 212° Fahr., and to an equivalent carbon value of 1·0311b. per lb. The total coal used was as follows:—

After stoke-hold,	port side.....	5,322lb.
,, ,,	starboard side	5,052lb.
Forward ,,	port side.....	4,701lb.
,, ,,	starboard side	4,162lb.
		19,237lb.

This amounts to 31·8lb. per minute, or 1,998lb. per hour. As a check upon this consumption, and in order to see how far it might be affected by any irregularities in measurement at the end of the trial, the consumption has been worked out over a time (in average 560 minutes), at the beginning and end of which the condition of the stoke-hold floors and of the fires was identical, and for this interval the coal consumption works out to 32·08lb. per minute. It has been thought wise to assume, therefore, that the actual coal consumption was 32lb. per minute, or 1,920lb. per hour, the small difference between this and the foregoing figures being probably caused by the increasing difficulty of measurement at the very end of the trial. The total amount of ash taken from the two stoke-holds at the end of the trial was 291lb., but the ash-pits were not cleaned out until some little time after the trial commenced, so that this weight corresponds only to a portion of 6 hours 53 minutes. The ash was therefore equivalent to 0·70lb. per minute, or 42lb. per hour, which is 2·2 per cent. of the total weight of the fuel put on the bars.

Furnace Gases.—A very complete series of furnace gas samples was collected, a sample being collected over mercury by Mr. Wilson every half hour. The analyses of these samples are given in Table IV. The chimney temperatures were read every

TABLE IV.—TARTAR TRIAL.

Analyses of Funnel Gases by Volume.

No. of Sample.	Carbonic Acid.	Carbonic Oxide.	Oxygen.	Nitrogen.	Time of Collecting.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	
1	7·28	0·00	12·45	80·27	8.30 a.m.
2	7·61	0·00	11·88	80·51	9.0 ,,
3	8·22	0·00	11·38	80·40	9.30 ,,
4	6·97	0·00	13·20	79·83	10.0 ,,
5	5·91	0·00	14·32	79·77	10.30 ,,
6	6·24	0·00	13·38	80·38	11.0 ,,
7	6·94	0·00	13·10	79·96	11.30 ,,
8	6·44	0·00	13·80	79·76	12.0 noon.
9	7·70	0·00	12·10	80·20	12.30 p.m.
10	6·21	0·00	13·57	80·22	1.0 ,,
11	8·24	0·00	12·00	79·76	1.30 ,,
12	5·62	0·00	14·40	79·98	2.0 ,,
13	6·29	0·00	13·15	80·56	2.30 ,,
14	6·79	0.00	12·78	80·43	3.0 ,,
15	6·80	0·00	13·30	79·90	3.30 ,,
16	6·54	0·00	12·71	80·75	4.0 ,,
17	6·95	0·00	13·10	79·95	4.30 ,,
18	6·03	0·00	13·08	80·89	5.0 ,,
19	6·67	0·00	13·17	80·16	5.30 ,,
20	6·61	0·00	13·52	79·87	6.0 ,,
21	5·00	0·00	15·27	79·73	6 30 ,,
Mean	6·72	0·00	13·12	80·16	—

Analyses of Funnel Gases by Weight.

No. of Sample.	Carbonic Acid.	Carbonic Oxide.	Oxygen.	Nitrogen.	Time of Collecting.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	
1	10·80	0·00	13·43	75·77	8.30 a.m.
2	11·28	0·00	12·80	75·92	9.0 ,,
3	12·15	0·00	12·23	75·62	9.30 ,,
4	10·34	0·00	14·25	75·41	10.0 ,,
5	8·81	0·00	15·52	75·67	10.30 ,,
6	9·30	0·00	14·50	76·20	11.0 ,,
7	10·30	0·00	14·15	75·55	11.30 ,,
8	9·58	0·00	14·93	75·49	12.0 noon.
9	11·40	0·00	13·03	75·57	12.30 p.m.
10	9·25	0·00	14·70	76·05	1.0 ,,
11	12·17	0·00	12·89	74·94	1.30 ,,
12	8·39	0·00	15·63	75·98	2.0 ,,
13	9·37	0·00	14·25	76·38	2.30 ,,
14	10·09	0·00	13·82	76·09	3.0 ,,
15	10·10	0·00	14·37	75·53	3.30 ,,
16	9·74	0·00	13·76	76·50	4.0 ,,
17	10·32	0·00	14·14	75·54	4.30 ,,
18	9·00	0·00	14·19	76·81	5.0 ,,
19	9·92	0·00	14·24	75·84	5.30 ,,
20	9·83	0·00	14·61	75·56	6.0 ,,
21	7·48	0·00	16·61	75·91	6.30 ,,
Mean	9·98	0·00	14·19	75·83	—

quarter of an hour throughout the trial from a mercury thermometer as before. The average reading was 477° Fahr. It remained very fairly constant during the whole trial. The chimney draught was read on a U-gauge at the same time that the temperature was taken, and varied from $\frac{1}{16}$in. to $\frac{1}{4}$in. of water.

Feed-Water Measurement.—The feed-water was measured in the same tanks used for the "Colchester," and already described (see page 554). Each tank lasted in this case from five to six minutes. The total amount of water used was 217,430lb. over a total time of 605 minutes. This amounts to 359·4lb. per minute, or 21,564lb. per hour, but reasons are given later on for supposing that a considerable percentage of this quantity was not actually turned into steam. The continuous supply of feed-water is shown in Fig. 11. At first pumping was carried out by one of the feed-pumps of the engine, but for the last four hours a donkey-pump was used, as it was found to give much less trouble and to be much more conveniently under control. The steam for this donkey-pump was supplied from the main boilers. The steam made by the boilers all went to the main engines, steam being kept up in the donkey boiler for all auxiliary engines; and the pipes and connections having been carefully examined, in order to see that no unintentional communications existed. The water-level in the boilers was, on the average, 1¼in. lower at the finish than at the start of the trial. This corresponds to a total of 1,874lb. of water, or about 0·86 per cent. of the whole feed; this amount has been added to the quantities given above. It may be interesting to notice that an error of ½in. in reading the level in one boiler in a case like this would make a difference of about 375lb., or under 0·2 per cent. of the water used.

Power Measurement.—Indicator diagrams were taken every half hour from each end of each cylinder as before. There were thus twenty-one complete sets of diagrams, or 126 single cards taken in all. The indicators used were those lent by Messrs. M'Innes & Cairns, which were used also for the "Colchester." The following are the mean effective pressures in the cylinders in pounds per square inch:—

Cylinder.	Top.	Bottom.	Mean.
High-pressure.....	35·74 ...	38·04 ...	36·89
Intermediate	19·92 ...	20·23 ...	20·07
Low-pressure.....	7·19 ...	7·18 ...	7·18

These pressures correspond to the following indicated horse-powers:—

High-pressure cylinder	273·7
Intermediate cylinder.....	408·5
Low-pressure cylinder	395·2
Total indicated horse-power.....	1,087·4

The maximum indicated horse-power given by any one set of cards was 1,296·7, which occurred at 8.45 a.m., with 73·2 revolutions per minute, and 146lb. of steam. The minimum indicated horse-power by any one set of cards was 719·3, at 10.10 a.m., with 61·4 revolutions per minute, and 135lb. of steam. From the 126 diagrams which were taken during the trial a mean diagram has been plotted for each of the three cylinders, and these are given in Fig. 14. The continuous variations of boiler pressure and cylinder mean effective pressures are shown in Fig. 13, and of horse-powers and speeds in Fig. 12.

Speed.—The counter was read every quarter of an hour. The total number of revolutions made was 42,350 in 605 minutes, or exactly 70 revolutions per minute. The maximum number of revolutions per minute for any quarter of an hour at full speed was 73·8, and the minimum 70·3 revolutions per minute, while the average speed during the time that the engine was slowed down was 63·7 revolutions per minute.

Steam Jackets.—As has been already mentioned, each jacket received steam through a separate valve. The connections from the jacket-drains to the hot-well were broken, and all three jackets were made to drain into a small tank placed at the back of the engine; and the rate at which the jacket-water collected in this tank was measured fourteen times during the trial, on most occasions for nearly a quarter of an hour continuously. The water collected in this way amounted in all to 2,476lb. in 175 minutes, or 14·15lb. per minute, which is 3·94 per cent. of the total feed. This quantity is, of course, included in the total feed measured through the tanks. It was not possible to jacket the high-pressure cylinder with steam of full boiler pressure, and under these circumstances it did not appear advisable to allow any steam to pass into that jacket, which was accordingly shut off. The quantity of steam given is, therefore, from the intermediate and low-pressure cylinder jackets only.

Pressures, &c.—The mean barometric pressure during the trial was 29·6in. of mercury, or 14·6lb. per square inch. The mean boiler pressure was 143·6lb. per square inch by the pressure-gauge in the stoke-hold, and 140·4 by that at the engine. The pressures in the high-pressure, intermediate, and low-pressure valve chests, were respectively 131·4, 46·1, and 3·8lb. per square inch above the atmosphere respectively. The pressures in the steam jackets of the intermediate and low-pressure cylinders were 52·5 and 14lb. per square inch respectively. The cock admitting steam into the high-pressure jacket, although nominally shut, allowed enough steam to leak through to enable the gauge to show pressures varying from 0 to over 50lb. per square inch. The actual amount of water coming from the high-pressure jacket-drain, however, was too small to affect appreciably the quantities given in the last paragragh. The mean vacuum was 26·2in. of mercury by gauge, which corresponds to a mean absolute back pressure in the condenser of 1·7lb per square inch. The mean initial pressure in the high-pressure cylinder was 121·8lb. per square inch above the atmosphere, and the mean back pressure in the low-pressure cylinder was 10·5lb. per square inch below the atmosphere, which corresponds to an absolute back pressure of 4·1lb. per square inch in the cylinder.

Boiler Efficiencies.—The mean rate of combustion in the furnaces was 11·93lb. of coal per square foot of grate surface per hour, or 0·3671b. per square foot of total heating surface per hour. The total amount of feed-water pumped into the boilers was at the rate of 11·23lb. per lb. of coal. As the feed entered the boiler at an average temperature of 101° Fahr., and the temperature corresponding to the mean boiler pressure was 362° Fahr., each lb. of steam must have taken up 1,123 thermal units; and the equivalent evaporation from and at 212° Fahr., had the whole of the feed-water been turned into steam, would, therefore, have reached the very high figure of 13·06lb. of water per lb. of coal. The equivalent amount of heat utilised per lb. of coal would be 12,610 thermal units, or say 84·3 per cent. of the whole calorific value of the fuel. Such a figure, although unusually high, is of course not in the nature of things impossible; but if it really represented the evaporation in this case, it would follow that the unusual economy of the boilers was accompanied by an unusual want of economy in the engines. Fortunately the measurements made were sufficiently complete to enable it to be stated positively that (from whatever cause) the whole of the water pumped into the boiler was *not* turned into steam. The very complete and uniform series of samples of chimney gases, of which the analyses have been given in Table IV., enable the calculations connected with them to be made with considerable exactness and certainty. The weight of dry air per lb. of coal calculated from these analyses works out to 31·6lb., so that the total weight of furnace gases per lb. of coal would be about 32·6lb. The gases have been raised in temperature from the temperature of the outer air, say about 55° Fahr., to 477° Fahr., the chimney temperature. Taking the mean specific heat of the gases as 0·238, this corresponds to a loss of 3,307 thermal units per lb. of coal, or 22·1 per cent. of the whole calorific value of the fuel, including the raising through the same range of temperature of the steam formed by the combustion of the hydrogen in the fuel. The loss due to evaporation of the moisture in the fuel is so small as to be negligible, and in no one of the twenty analyses was any carbonic oxide found to be present in the chimney gases. The loss by radiation was no doubt considerably less than in the "Colchester" (the stoke-holds being very much cooler), but taking it as low as 8 per cent., and adding to it the 22 per cent. carried away by the chimney gases, it seems certain that the maximum boiler efficiency which can have been reached cannot have exceeded 70 per cent. This would correspond to an evaporation of 10·8lb. of water from and at 212° Fahr. per lb. of coal, which is about 83 per cent. of the apparent evaporation mentioned above. It is, moreover, to be noted that on the original log sheets the reporter finds in five different places memoranda made at different times by different assistants who were taking indicator diagrams, that they were unusually troubled by the amount of water which came through the indicator cocks.

Coal Consumption.—The total coal burnt, namely 1,920lb. per hour, corresponds to 1·77lb. per indicated horse-power per hour. This is equivalent to 1·82lb. of carbon-value per indicated horse-power per hour.

Engine Efficiencies.—Although the total quantity of water pumped into the boilers per indicated horse-power per hour amounted to $\frac{21,564}{1,087·4}$, or at the rate of 19·83lb. per i.h.p. per hour the quantity of *steam* consumed could not have exceeded, as the figures in the preceding paragraph show, 16·5lb. per i.h.p. per hour. The difference must be attributed to priming.

Total Efficiency.—The combined efficiency of the boiler and engines, or ratio of the heat turned into work to the total heat of combustion, was 9·7 per cent.

Steam from Indicator Diagrams.—The following are the results of measurements made upon all the indicator diagrams taken, to ascertain the proportion of steam accounted for by them. The actual weight of feed-water used per revolution was 51·3lb.

Proportion of Steam accounted for by Indicator Diagrams.	Lbs. per Revolution.	Percentage of Total Feed.	Percentage in Jackets or present in Cylinder as Water.
Steam present in high-pressure cylinder, after cut-off, when the pressure was 115·4lb. per square inch above the atmosphere	Lbs. 2·32	Per Cent. 45·2	Per Cent. 54·8
Steam present in intermediate cylinder when the pressure was 33·4lb. per square inch above the atmosphere	2·53	49·2	50·8
Steam present in intermediate cylinder when the pressure was 9·4lb. per square inch above the atmosphere	3·03	59·0	41·0
Steam present in low-pressure cylinder near end of expansion when the pressure was 7·1lb. per square inch below the atmosphere	3·12	60·7	39·3

Speed of Vessel.—The following notes from the log book of the ship may be of interest:—

	Time.
Left London Docks	5.0 a.m.
Gravesend	7.20
Nore.....	8.35
Girdler Light Ship	9.30
Dover	12·40 p.m.
Dungeness	2.20
Royal S. Light Vessel.....	4.20
Beachy Head.....	5.0
Owers	8.0
St. Catherine.....	11.30
Portland	5.0 a.m.

The Research Committee on Marine Engine Trials, in presenting to the members of the Institution their second report upon their work, desire it to be quite understood that they do not at all look upon their duties as yet ended. They are glad to be able to think, however, that they have already done enough to show that engine trials can be conducted on board ship on as complete a scale and in as scientific a method as on land (although, perhaps, with greater difficulty and discomfort to the observers), and that this can be done without any undue interference with the normal working of the ship or engines. The Committee wish also to say that they hope, when their work is completed, to present to the members a comparative summary of all their experiments, in the discussion on which many points as to the influence of design on economy may be better discussed than at present. Their future work may be much helped, however, by suggestions made at this stage as to improvements in the methods or in the instruments used, or as to the best means of ensuring the accuracy or measuring the errors of gauges, indicators, &c. They would also point out that there still does not exist any satisfactory means for measuring the *effective*

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horse-power of a marine engine in its actual work—*i.e.*, the power actually expended in pushing the ship forward (as measured by the thrust of the propeller and the speed of the ship), nor for measuring the quantity of the condensing water, a knowledge of which is necessary to enable a "heat balance" for the engines to be made.

The comparative results obtained in the four trials as yet made by the committee were given in a table on page 435 of our issue of the 9th ult.

THE EXPERIMENTAL VALUE OF THE STEAM JACKET.

The Research Committee appointed by the Institution of Mechanical Engineers to investigate the question of the value of the steam jacket recently issued their first report, and it contains an interesting collection of actual experiments, collated, as far as possible, from all the data published in England and elsewhere, with reference to this subject, up to the present time. Those experiments only are recorded which were made on the same engine with and without steam jackets.

The trials are divided into three groups, in which single cylinder non-condensing engines, single cylinder condensing engines, and compound condensing engines were tested. A great divergence is observable in the results obtained, but this is not to be wondered at if we consider the varying methods in which the steam jackets have been applied in the different cases and countries. In some of the experiments the steam jackets were such in name only; sometimes water and sometimes air were doubtless allowed to accumulate; the steam pipes supplying the jackets were often much too small, and very few cylinders had steam pressure gauges to their jackets. Occasionally the steam in the jackets was made to circulate, while in most cases it was stagnant. The steam pressures, the piston speeds, and the i.h.p. all greatly differed, and there were vertical and horizontal, small and large engines, with and without expansion. Notwithstanding these variations there is much worthy of study in the experiments, and, speaking generally, we may say at the outset that the results are decidedly favourable to the employment of steam jackets when *properly* applied. In nearly all cases the quantity of the jacket water is given. The results are expressed concisely in the tables, and the economy effected by the use of the jacket is shown in the smaller percentage of feed water required.

Having thus briefly indicated the scope and importance of the report, it may be interesting, before describing some of the experiments, to revert briefly to the first mention made of the steam jacket by the original inventor, James Watt. He does not appear to have left on record any experiments on steam-jacketed engines; at least none such have come to our knowledge, though we shall be glad to have particulars of them, if they exist. It is certain, however, that he laid down the principle of the steam jacket, and took out a patent for it, dated March 12th, 1782. In his specification he describes the jacket in the following words:—"The whole cylinder, or as much of it as possible, is enclosed in a case containing steam or otherwise is maintained of the same heat as boiling water or of the steam from the boiler." Thus his original idea was solely to keep the cylinder warm for very low-pressure steam.

Single Cylinder Non-Condensing Engines.—We now propose to make a few remarks on those experiments in the report which possess special interest, and will begin with the series of single cylinder non-condensing engines. The earliest experiments on steam jackets appear to have been made in France about the year 1846, when MM. Thomas and Laurens found that with 120 i.h.p. there was an economy of 8 to 10 per cent. in the feed water consequent upon the use of the steam jacket. Very few particulars, however, were published, or are now obtainable, with respect to this trial. The subject had already engaged the attention of M. Hirn, but he did not publish his results till some years later. The next set of experiments was made by Messrs. Farey & Bryan Donkin, Jun., in 1874, at Bermondsey, on a single cylinder beam engine, running slowly. The boiler pressure was about 45lb., and the economy effected varied from 11 to 21½ per cent., according to the number of expansions used, the number of revolutions being the same in each trial. Here the whole of the steam passed through the jacket, and this was perhaps among the first trials in which the jacket steam was made to circulate on its way to the cylinder. About the same period a series of experiments were made at Lille in France by M. Cornut. The expansions varied from 7½ to 20, the i.h.p. from 80 to 136, and the gain recorded by the use of the jacket was from 14 to 19½ per cent. This was confirmed by other experiments later in the same year and at the same place, with an expansion of 10, giving an economy of 19 per cent. Next in chronological sequence followed two experiments on marine engines, made in America, by Messrs. Loring & Emery. The jackets were supplied from the bottom of the steam chest. The steam pressure was 68½lb., the i.h.p. from 170 to 212, and the economy effected was a little over 10 per cent. A large number of experiments on a locomotive engine were made by M. Borodin at Kieff, in Russia, from 1881 to 1883. The jacket was supplied by a separate pipe. Six trials, with and without a steam jacket, were carried out with different pressures of steam, and the gain in economy was found to vary from 7 to 22½ per cent. Lastly, we have to mention an important series of experiments carried out in 1883 by M. Delafond, at the Creusot Works, in France. Twelve sets of trials were made, or twenty-four in all. The jacket was supplied with steam by a small pipe, and the pressures were varied, as also the number of expansions. The revolutions were about the same in all the trials, giving a mean of 61 per minute. Taking the results generally, they showed an economy varying from 22 per cent. with 6 expansions to as little as 1 per cent. with full steam.

MARINE ENGINE TRIALS.

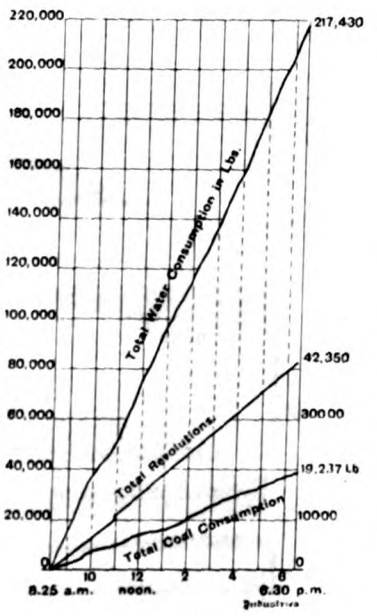


Fig. 11.

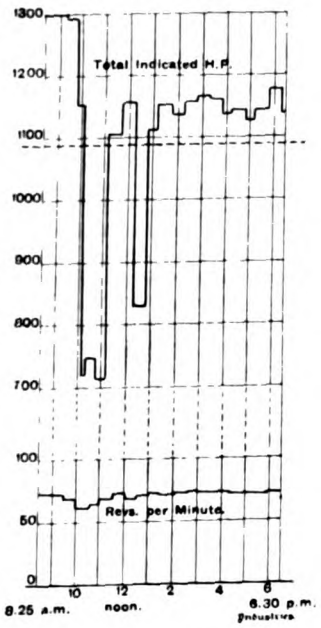


Fig. 12.

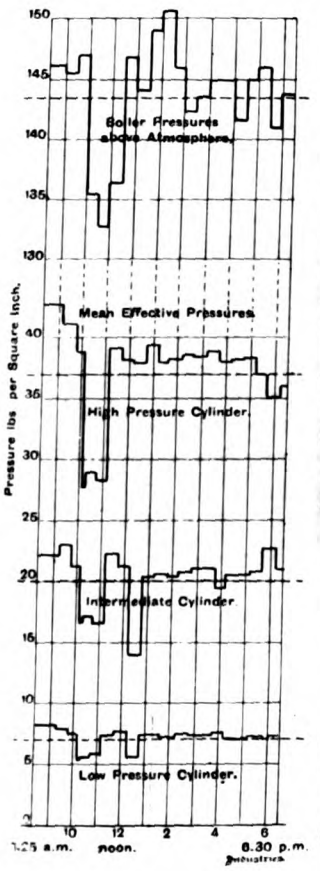


Fig. 13.

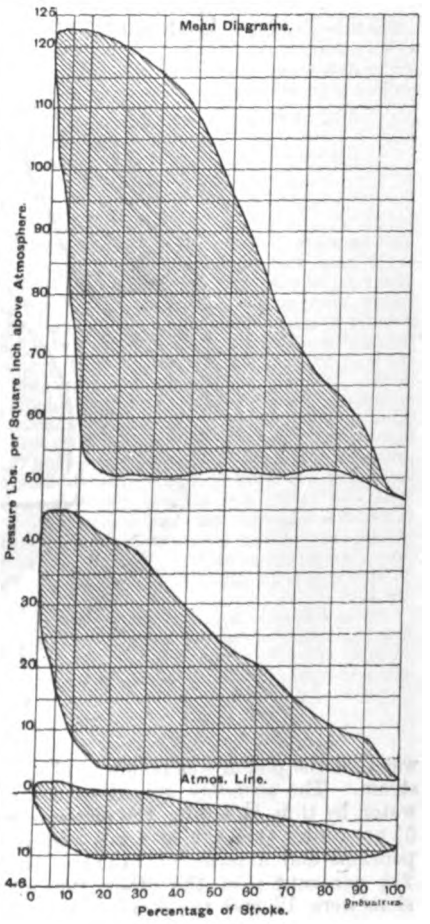


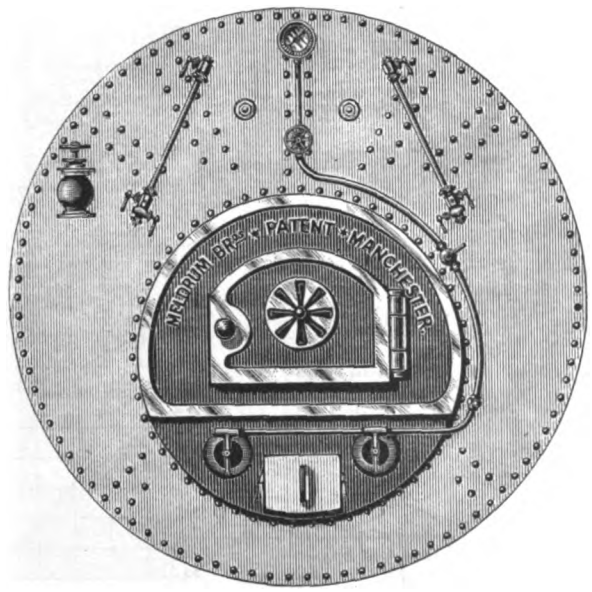
Fig 14.

Mention has already been made of M. Hirn's investigations of the laws governing the phenomena of the steam jacket. Among the many experiments he carried out, he reported upon two made with this type of engine, in conjunction with his colleague, M. Hallauer. The results may be briefly summed up. The economy in consumption of feed water was 23½ per cent., the number of expansions 10, and the i.h.p. was 56 without and 83 with a steam jacket. This was the mean of the economy usually obtained by M. Hirn. In four trials made by Mr. G. B. Rennie, in 1873, a saving of 32 per cent. was effected with an i.h.p. of about 40. A series of eight experiments were made by Messrs. Loring and Emery, of the United States Navy, in 1875, upon the engine of a steamer (stationary at the time). The number of expansions varied from 1½ to 7; the i.h.p. fluctuated with the boiler pressure, ranging from 87 with a pressure of 14½lb. to 348 with a pressure of 67lb. The mean of the economy obtained was 11 per cent. Another important series of trials were made in 1878 by MM. Meunier and Keller, on a Corliss engine, at a cotton mill, near Mulhouse. The peculiarity of these experiments elucidate the theory of the steam jacket than Hirn, and the exhaustive researches he undertook about 1855 threw more light on this subject at the time, than the labours of any other scientific worker. In Combe's experiments the number of expansions was 20. In one trial the jackets were supplied with the whole of the steam passing to the cylinder, in the other the steam was introduced through a small pipe only. In the first case the economy in feed water was 42, and in the last 27 per cent. Here the advantage of the circulation of the jacket steam is brought out. In 1860 four experiments on this type of engine were made by Mr. Isherwood at New York. The number of expansions in the first were about 5, and the gain in economy 31 per cent. The second set of trials were made with a very large beam engine, only the body being jacketed; the number of expansions was 1½, the i.h.p. 352 and 361 respectively, and the economy effected 2½ per cent. This very small gain is perhaps referable to the rather large size of the cylinder and the small boiler pressure. Two sets of experiments made in 1870 afford useful points of comparison. One was carried out upon a large Cornish Bull pumping engine by Mr. Bryan Donkin, Jun.; the number of expansions was 4, the i.h.p. showed a mean of 157, and the economy shown was 13 per cent. The other trial was made by Messrs. Farey & Bryan Donkin, Jun., upon a small beam engine; the i.h.p. was 7¾ and 9¼ respectively, 1¼ expansions were used, and the gain shown was 19 per cent.

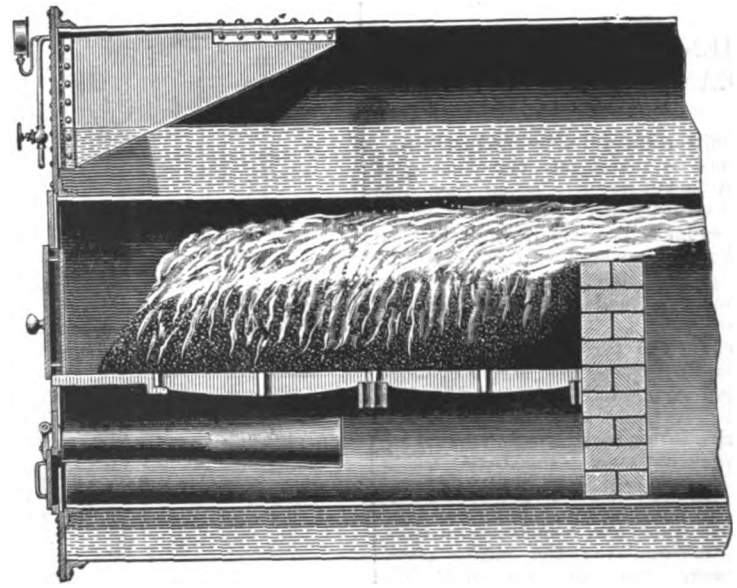
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BOILER FURNACE FOR BURNING BREEZE.

CONSTRUCTED BY MESSRS. MELDRUM BROTHERS, ENGINEERS, CATHEDRAL YARD, MANCHESTER.



FRONT VIEW OF BOILER.



LONGITUDINAL SECTION THROUGH BOILER AND FURNACE.

was that the piston was hollow, and could be filled with steam. The economy gained in consumption of feed water by thus jacketing the piston only was from 2 to 5½ per cent. One set of trials was made with 5½ expansions and a mean of 143 i.h.p., the economy being 21½ per cent.; in the other, the number of expansions were 12, and the economy was 30 per cent., with the jacket proper. Among the last on the list of trials we give of single cylinder condensing engines, are a large number of experiments, forty-six in all, made by M. Delafond, at the Creusot Works, in France, in 1883. They were carried out on the same engine as that used for the twenty-four non-condensing experiments already recorded, except that a condenser was added. None of the trials exceeded two hours in duration. The boiler pressure varied from 35lb. to 110lb., and the number of expansions ranged from 13½ to 1, being sometimes slightly higher without than with a steam jacket. The number of revolutions was about 59 or 60 per minute, the i.h.p. from 68 to 212. With such varying conditions, it will not appear surprising that there were great fluctuations in the percentage of gain of feed water. The highest economy was 26½ per cent. with 141 i.h.p., the lowest 0·47 per cent., while in one case the consumption of feed water was 0 61 per cent. less without than with steam in the jackets. Before passing on to the last series of trials, we must notice three carefully carried out experiments. The first was made at Dalkeith, in 1877, by Mr. Lavington E. Fletcher. The mean of the expansions used was nearly 4, of the i.h.p. 181, and the percentage of feed water 15½ less with the steam jacket. The second was undertaken at Chatham by Mr. J. G. Mair, under almost the same conditions; the economy obtained was 16½ per cent. The third was made by M. Farcot, in France, in 1879, and showed an economy of 17 per cent. with from 13 to 15 expansions.

Compound Condensing Engines.—In reviewing the third and last series of experiments, it will be at once apparent that the conditions of trial in this type of engine were more complex. Sometimes one, sometimes both cylinders were jacketed, while the jacket in either the high or the low pressure cylinder was suppressed, as occasion served. The earliest trials on compound condensing engines of which we have succeeded in obtaining particulars were undertaken by Hirn on his celebrated engine, at Logelbach, near Colmar, in 1854 and 1855. The number of expansions were 4, revolutions per minute 23½, and the same economy of feed water was recorded as in his previous trials, namely 23½ per cent. We pass next to two series of experiments made on the same engine, in 1859 and 1870, by Messrs. Farey & Bryan Donkin, Jun. The boiler pressure was in the first 41lb., in the second 45lb., and the number of revolutions about the same in both. Five and a half expansions were used, and the percentage of economy in feed water was 28½ per cent. In the second trials the expansions were 10, and the economy 38½ per cent., the highest figure attained in this record of experiments. A third series was undertaken by the same experimenters in 1868, and conducted under three different conditions, with and without steam in the jackets, and with steam admitted through a small pipe at a pressure of 4lb. When the steam was admitted freely, the economy was 31 per cent.; when the pressure was reduced to 4lb., the gain was only 13⅓ per cent. An important set of twenty-two experiments were carried out from 1875 to 1881, on a small engine at Bermondsey, by Messrs. Farey, Bryan Donkin, Jun., and Salter, to ascertain the effect of the steam jackets under various working conditions. The boiler pressure was uniformly 42lb. and the number of revolutions 98. Where the engine was running without steam in the jackets, the i.h.p. was 8¾. With steam admitted into the high-pressure jacket only, the h.p. was 7·8, and the economy in feed water 25½ per cent. Where it was allowed to enter the low-pressure jacket, the mean of seven experiments gave 10 i.h.p. and a saving of 29 per cent. In eight experiments the steam was admitted into both jackets; here the i.h.p. was 9½, and the gain in percentage of feed water 34.

Four trials on a pumping engine, and on a beam engine driving a flour mill, were made in August and December, 1881, by Mr. John G. Mair. The pumping engine showed the high percentage in economy of feed water of nearly 35, with 75 i.h.p., and a mean boiler pressure of 45lb.; the number of expansions varied from 9 to 15. In the other experiment from 7 to 9 expansions were used; the mean boiler pressure was 73lb., the i.h.p. 268, and the economy effected 8¾ per cent. Professor Kennedy and Mr. Bryan Donkin, Jun., made two trials in 1887, at the London Hydraulic Power Pumping Station, with a surface condensing vertical inverted engine. The number of expansions were 7, the i.h.p. varied from 157 to 168, and the gain shown in feed water was 15⅓ per cent.

In the last set of experiments in the series we are examining, the details were more complete than in others on the list. They were made by Professor Kennedy upon the same experimental engine, at University College, London, as was used in the twenty-two experiments described among these compound condensing trials, with which they tallied well. The experiments were conducted with extreme care, and a large number of data obtained bearing on the different phenomena exhibited in the working of a steam engine. Both cylinders were jacketed, and the steam circulated through the two jackets before entering the high-pressure valve chest. The steam and water in both cylinders, in the jackets and steam pipes, the trap water, radiation and condensation, were all carefully measured; the boiler pressure varied from 39lb. to 95lb. The smallest ratio of expansion was 3 to 1, the largest 5·92; the i.h.p. varied from 7¼ to 13¼. The least economy in feed water obtained with both jackets in use was 4⅓ per cent. with 13 h.p. and a ratio of expansion of 3·60; the highest gain by the jacket was 38 per cent. with the same horse-power, and the number of expansions used was 8·43.

We congratulate the Institution of Mechanical Engineers on this Report, and shall look for further experiments with much interest. We hope the Committee will give us more well-recorded facts relating to modern engines.

MACHINERY AND METALS IN HUNGARY.

HUNGARIAN statistics are in a backward condition, and the latest on the subject of machinery which have been available to the British Consul at Budapest are those for 1888. The imports of machinery for that year amounted to £561,725, of which the principal items were:—

Locomotives, &c.	£42,892
Sewing machines	116,845
Thrashing „	44,779
Mowing „	4,860
Sowing „	11,728
Ploughing „	47,969
Pumps, cranes, presses, &c.	50,571
Parts of machinery	212,119

Hungary is making great efforts to supply her own agricultural machinery, and it is stated that out of £660,000 worth of agricultural machinery required, £479,000 worth was furnished by Hungary herself. There are branches of several English agricultural machinery houses existing in Hungary, and it is possible that a considerable proportion of the native manufacture is effected by these establishments. The works of the Royal Hungarian State Railway is one of the chief manufactories in machinery, and have, it is said, been able to turn out, among other articles, about 100 steam thrashing machines of 6, 8, and 10 h.p. Measures will shortly be taken by the Government for extending the activity of the machinery department of this railway. In mowing and binding machines there was a small demand, and attention is drawn to the valuable new mowing and binding machine, the "Massey," from Canada, which is expected to have great success in Hungary. Steam ploughs are made by Messrs. Ganz & Co. As an extension of beetroot cultivation is expected, attention is being specially directed to implements connected with this industry. The larger and more elaborate machines have still to be imported from abroad, and there is a considerable import of complicated or delicate parts of machinery, which are put together in Hungary. Last year's iron trade was good, and the sudden increase in the demand on home producers for manufactured goods could scarcely be met owing to the want of sufficient raw material.

MELDRUM'S BREEZE FURNACE.

A FRONT view and longitudinal section is given herewith of a fuel-burning arrangement made by Messrs. Meldrum Brothers, Cathedral Yard, Manchester, as applied to a boiler furnace in which breeze or fine coal is used as a fuel. The system is one of forced draught with a closed ashpit, and a pressure equal to about ¾in. water gauge is obtained. The ashpit is closed by a frame in which there are two circular openings, to each

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of which is fitted a trumpet-shaped tube, as shown in the sectional view. In the frame, fitted to each of the openings, a cross-bar or tube is formed, by which the steam is admitted to a nozzle placed exactly in the centre. To the inner part of the opening the tube is fixed, so that when the steam is turned on a powerful induced air current is created. The steam connection is clearly shown in the front view. In the centre of the frame closing the ashpit an aperture is provided by which the ash can be withdrawn. There is a raised face surrounding this aperture, which is planed all over, and the door is very ingeniously arranged to be self-sealing. It has at each side a lug, which is tapered or wedge-shaped, and which fits into a similarly shaped staple cast with the frame. The weight of the door is thus sufficient to press its inner face—which is also planed—into close contact with that of the frame, thus establishing an air-tight joint without the employment of screws in any form.

The shape of the blower tube has been settled by the makers after a long series of experiments, and they claim to have obtained tubes of proportions which give the maximum of efficiency. The steam nozzles are only drilled with holes of a small size, so that the amount of steam used is comparatively small. We inspected a furnace in which breeze of a very inferior character was being used, and the combustion was very perfect—no difficulty being experienced in rapidly raising the required steam pressure. The fire was a thick one, but in spite of this it was burning well throughout its length. In order to facilitate the use of fine fuel the bars are closely set, and the resultant ash and clinker contain nothing of value as fuel.

The makers are applying blowers of this type to many purposes, such as agitating liquids, forming either an air pressure or vacuum as desired, and have a number of applications of interest in experimental work at the above address. With breeze and similar fuel they have been very successful, and they state that the steam consumption is very low having regard to the effectiveness of the apparatus.

MANWELL'S "READY LIFE SAVER."

In section 21 of the Merchant Shipping Act, 1876, it is stated that "every sea-going passenger steamer and every emigrant ship shall be provided, to the satisfaction of the Board of Trade, with a proper supply of lights inextinguishable in water and fitted for attachment to life buoys. . . . . If any such steamer or ship goes to sea from any port of the United Kingdom without being so provided as required by this section, for each default in any of the above requisites the owner shall, if he appears to be in fault, incur a penalty not exceeding one hundred pounds, and the master shall, if he appears to be in fault, incur a penalty not exceeding fifty pounds." The inextinguishable lights referred to usually consist of a chemical substance (phosphide of calcium), enclosed in a tin cannister, which must be of sufficient strength to remain perfectly air-tight and water-tight under all conditions of climate. The efficiency of the lights is absolutely dependent upon freedom from moisture—even of that contained in the atmosphere—until the time of use, when it is necessary to prick a hole in each end of the tin preparatory to its being thrown overboard. On water entering the tin, its action on the chemical substance causes ignition and a bright flaring light, visible for several miles at night, accompanied by dense smoke perceptible at a great distance in the daytime. The person to be saved having grasped the buoy, the rescuing vessel or boat is directed to the position with probably successful results.

The procedure hitherto followed may generally be gathered from the circumstances attending the lamentable death of General Sir Howard Elphinstone, a passenger on board the s.s. "Tongariro," as described by the chief officer, who said, "I was startled by the cry of 'man overboard!' I rushed to the telegraph and reversed the engines; then got ready, and threw a lifebuoy overboard. When I say 'got ready,' I had to punch two small holes in the tin case containing the light, as without a light we should not have been able to find it. Of course, for some time after the buoy was thrown, the ship continued to go ahead, so all we could do was to get the boat ready, and, after passing the buoy again going astern, we lowered it, and, with the second officer in charge, they pulled round and about the place, but no sign was ever seen of the unfortunate man." Assuming that two minutes elapsed between the cry of "man overboard" and the buoy being "got ready" and thrown overboard, and the ship's speed to have been 14 knots, there must have been an intervening space of about half a mile between the drowning man and the buoy.

It therefore goes without saying that any appliance that would materially reduce these intervals of time and distance must commend itself to the Board of Trade and shipowners as worthy of adoption, and one has recently been brought to our notice in the form of Manwell's "Ready Life Saver." This is shown in Figs. 1 and 2, and by a simple half turn of a handle—an action occupying only a fraction of a second—it punches the light canister at both ends and discharges the canister and the attached buoy. With one of these placed overhanging the water at each end of the vessel's bridge, and, therefore, in close proximity to the officer of the watch, an interval of, say, two seconds as a maximum would suffice to place the buoy and light in the water, with results much more favourable than those obtaining under the old plan of "getting ready."

A very small percentage of the deaths by drowning at sea is known to the public. It is only when consequential mishaps, such as rescuing boats capsizing on being lowered, some great casualty involving many lives, or when some deed of heroism has been performed, that publicity is given to the circumstances. With Manwell's apparatus on board the first duty of the officer of the watch would be to instantaneously discharge the buoy and light, which would fall within a short distance from the man overboard, whatever might be the speed of the vessel at the time. As will be seen from Figs. 1 and 2, the apparatus is very simple in design, and is, therefore, not likely to get out of order. It consists of a T-shaped board, on the top of which is fixed a box for holding the canister. At each end of the box are arranged needles or prickers E, which are actuated by a handle A through the levers B. The life buoy, when ready for action, is suspended from a rod F, one end of which is fastened to the hinged bottom G of the box, and the other end rests upon the toe D. The mode of using the apparatus is as follows:—The handle A is turned through 90°, which causes the prickers E to perforate the canister at each end. A further turn of the handle causes the prickers to recede, and just after the points are clear of the canister the toe D relieves the lever F, which then assumes a vertical position as shown by the dotted lines. The life buoy cord slips off F, and the canister falls with the buoy into the water, ignites, and gives out the necessary light. The turning of the handle A need only be the work of a second, or even less. Our illustration shows the body of the apparatus as made of wood, but in the Navy pattern we think metal would be a preferable material.

The apparatus has already been adopted by the Atlantic Transport Line of steamers, is under the consideration of the Elder Brethren of the Trinity House, and negotiations are pending for its application to some of the leading passenger lines. It can be seen at the offices of Messrs. Manwell & Glen, 8, Great Winchester Street, London, E.C.

MANWELL'S "READY LIFE SAVER."

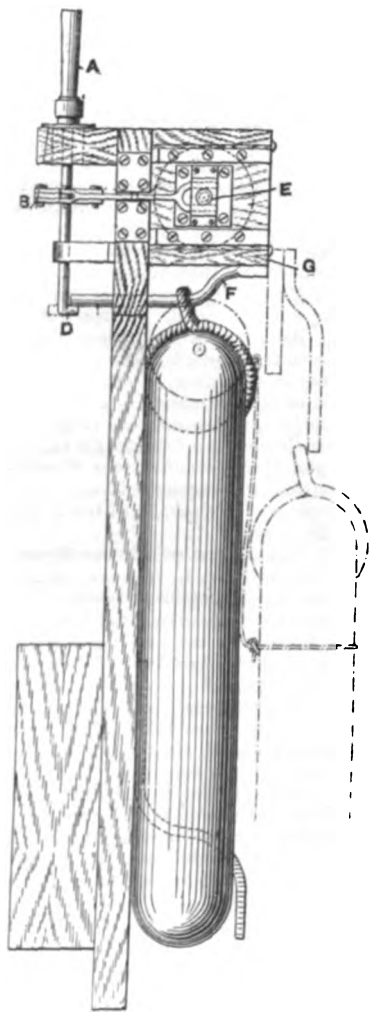


Fig. 1.—End Elevation.

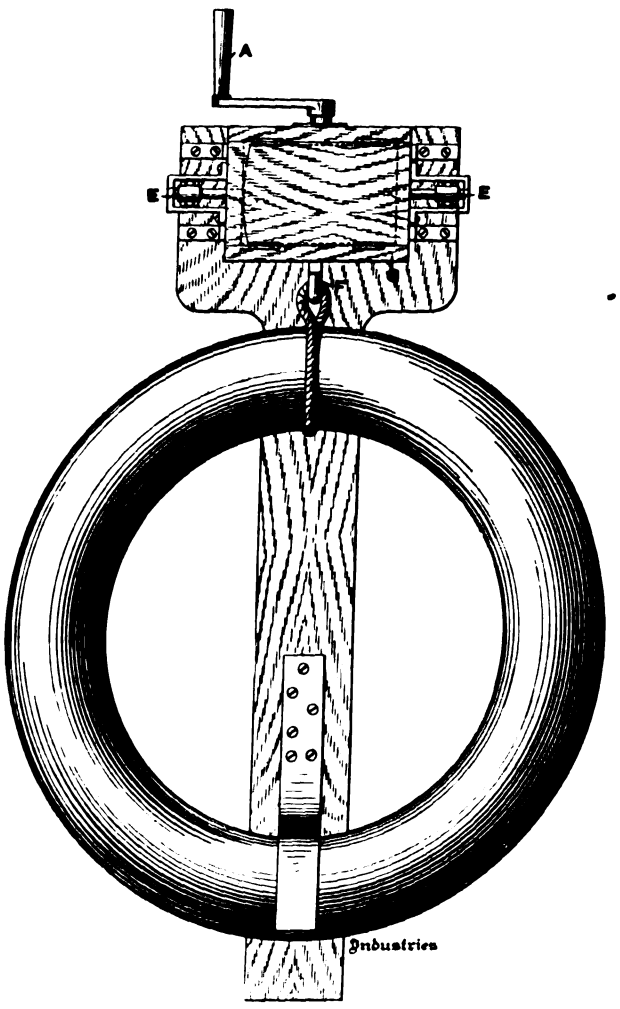
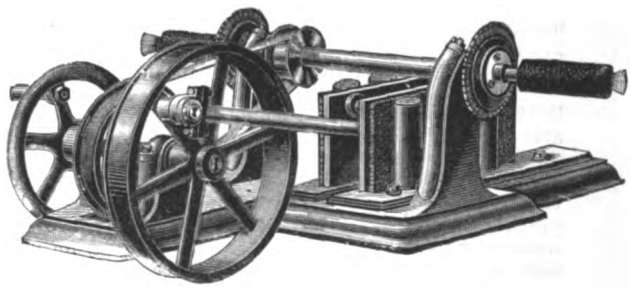


Fig. 2.—Front Elevation.

LAMP CLEANING MACHINE.

The "Presto Economic" lamp cleaning machine, as it is termed by the inventor, Mr. Bartholomew, of the Wombwell Main Colliery, near Barnsley, is a novel contrivance for cleaning the gauze and other parts of miners' safety lamps. Hitherto all machines have been constructed with circular rotating brushes, which require a considerable speed to render them effective. In this machine the inventor has given also a reciprocating motion to the brush.

The machine is driven by means of a belt pulley. On this pulley is secured a crank pin, which carries one end of a connecting rod; at the other end of the rod is



secured two reciprotating brushes for cleaning the gauze. On the same shaft is keyed another pulley which transmits the motion to another shaft carrying the revolving brushes for cleaning the ends of gauze and various other parts of the lamps. By means of this combination of reciprocating and rotary motions, the speed of the brushes is much reduced and the cleaning can be effected with much less trouble. We are informed that at the Wombwell Collieries the saving in the labour of cleaning has been very much reduced. The makers of this machine are Messrs. C. E. Hall, Robinson, & Co., Barnsley.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 17th June, 1890.

Iron.—The downward tendency of prices has become more distinctly marked. The demand, already slack, continues to fall off, and prices are steadily giving way. Here in Paris bars and joists are offered at 152s.; but 150s. is the highest price paid on orders of any importance. Old rails are neglected at 84s. The provincial markets are characterised by the same features, a slack demand and drooping prices. The reductions in the prices of Belgian iron announced the other day have influenced the French markets unfavourably. Consumers are encouraged to wait for the easier terms which they now regard as certain.

Coal.—The probable prices of coal in the second half of the current year continues to be a subject of absorbing interest in the industrial world. At a time when prices are falling in the foreign markets, and the consumption in France is being restricted by shrinkage in the iron trade, the colliery owners are seeking to force up their rates still higher. In the last week some advances have taken place in the North. To make matters worse, the colliers of the Saint Etienne district have interrupted the production in that locality by coming out on strike. The consequence must be to obstruct the current of trade very seriously, not only in iron, but in all the manufacturing industries.

Metals.—The copper speculation has succeeded beyond the expectations of the most sanguine. Prices continue to advance in spite of the fact that consumers limit their purchases to the bare needs of the moment, refusing to believe the statistics which are being published to show that stocks are constantly decreasing. Tin and lead are firm, in sympathy with copper, it must be said, for there is an abundance of both metals in the market. Spelter, though rising in most of the European markets, is weaker here, a point having been lost in the course of the last week.

BERLIN, 16th June, 1890.

Iron.—The iron market of the Upper Silesian district successfully resists the weakening influences arising from the depressed state of things in the West. Buyers operate somewhat less freely, and prices have been modified a little to satisfy their requirements, but, on the whole, there is not much diminution of activity. The current demand for pig iron is sufficient to absorb the whole of the production. Business in finished iron and steel is a little less active, joists being in slower demand. Wire and wire-nails, too, are less inquired after. A large export business in plates is being done with Roumania and Servia. Some important lots have been sold for Copenhagen. Founders and engineers have plenty to do. Here, in Berlin, the market is firmer, Silesian bars being again quoted as high as 200s. The general opinion, however, is that such prices cannot be long maintained. The machinery market is active. The exports of machinery, exclusive of locomotives, portable engines, boilers, and sewing machines, in the first four months of the year amounted to 21,658 tons, against 20,783 tons in the corresponding period of 1889.

Metals.—The metal market, though consumers buy only sufficient for present needs, continues to be characterised by an upward tendency in prices. As there is nothing in the relations of supply and demand to justify this state of things, the movement must be attributed to speculative operations. Mansfeld refined copper has risen to £64 to £66; English brands to £62 and £65 a ton. Tin is a little weaker, Banca being quoted £105. Lead is very firm. Spelter rises slowly, but continuously. Silesian W.H. brand is quoted £24 at Breslau and £26 in Berlin.

The Labour Movement.—The labour movement continues without much abatement all over the country, the consequence being a general increase in the cost of production. The latest development here is a strike of mechanics to obtain a nine hours day and a minimum of 21s. a week wages. Some sixty-two firms, employing about 900 hands, have conceded the men's demands.

Shipbuilding in 1889.—The statistics of shipbuilding in 1889, just published in a complete form, show remarkable activity in all the yards. In the previous year the total number of iron and steel ships built on German stocks, or abroad on German account, amounted to forty-three, of an aggregate tonnage registered as 56,541; last year the number was 101, registering 197,804 tons. Of this number fifty-six were built in Germany and forty-five abroad. Of those built in Germany three were for foreign owners. The estimates for steamers were 15 per cent. higher at the end of the year than at the beginning.

Smokeless Powder.—In some comparative experiments with the smokeless powder C/89, fired from cannon of various calibres, which took place on the shooting ground connected with the Grusonwerk, Buckau, near Magdeburg, it was proved that the new powder yielded an effect from three to four times greater per kilog. of the charge than the old sorts of powder. The powder C/89 threw off a thin brownish vapour, which was so thin that another shot could immediately be fired, the butt being distinctly visible. Even in rainy weather the vapour was completely dissipated within three seconds, whilst the smoke resulting from black powder hung about the gun for a long time, making a quick firing impossible. The powder C/89 leaves so little residuum after combustion that the bore remains almost clean, and the heating of the barrel and cartridge holder is much less than with black powder.

The Trade of Hamburg.—The improvement in the situation of the Hamburg shipowners may be seen from the newly issued report of the Hamburg Shipowners' Association. It appears that the shipping increased by 12,868 tons register in sailing vessels and 109,676 tons gross in steamers. According to the report the Hamburg mercantile marine numbers 290 sailing vessels and 316 steamers, 42 of the latter having been built in the course of the year; at least an equal number is at present on order or under construction. The shipping traffic of the port has also much increased. A total number of 8,059 vessels of 4,809,892 tons register entered, compared with 7,524 vessels with 4,345,000 tons register in the previous year. It is thought that 5,000,000 tons may be exceeded this year. The superiority of English shipowners is still maintained. They contributed 45·7 per cent. of the total shipping, whilst Hamburg itself could only show 36·6 per cent. With the increase in the traffic the extension of our docks has become the object of animated discussion. Recently, also, the question of the formation of a dock at Cuxhaven adapted for the large fast steamers has come to the front.

The Valves of Compound Locomotives.—In a recent article in the *Organ des Eisenbahnwesens*, Herr Von Borries says that the valves of compound locomotives should be composed of 82 parts of copper, 14 of tin, 2 of zinc, and 2 of antimony. He further states that a compound engine of the old Woolf tandem type, which was tested in France, gave a saving of 12 per cent. in fuel and an increased efficiency over similar simple types.

Novel Air Brakes.—Not the least interesting feature of the Jungfrau Railway is the plan for keeping the speed of the cars within prescribed limits during the descent. Folding doors will be placed along the tunnel at short intervals, and will be kept closed except during the passage of a car. The cars have movable wings which may be expanded by the guard until they nearly touch the tunnel lining. In this way the car becomes a kind of piston working in the tunnel as a cylinder, and the air acts as an automatic brake just as in the well-known dash-pots of Corliss engines. As the cars are also provided with several brakes of the usual types, it would seem as if the tourist need have little fear of such accidents as usually occur on inclined railways.

VIENNA, 16th June, 1890.

The Iron Market.—The situation of the iron market is very firm. Every attempt to cut down the prices is futile. Notwithstanding the lateness of the season there is a good demand for building materials. In Hungary the prospects of a good harvest have an excellent influence on the iron market, and the works are receiving important orders. There is a good sale for agricultural machines. No doubt the Agricultural Exhibition is to be thanked for this. The prices of iron may be quoted as follow:—Bar iron, 135fl. per ton; for girders, 130fl. per ton; boiler-plates, 200fl.; and tinned sheets, 275fl.

The Coal Market.—Animation continues throughout the coal market. The strike in the Pilsen district has terminated, but as many of the shafts are inundated it is not possible for labour to be completely resumed for some weeks.

A Vienna Central Railway.—A proposal is now afloat for constructing an underground railway in Vienna. The cost is estimated at 16 million gulden. The locomotives will be of the usual type, but will be adapted for burning coke instead of coal, so as to reduce the amount of smoke given off, and the carriages are to be built on the Pullman system. There seems to be every probability of the scheme being a success.

Beer.—In nineteen countries the sum of 173,662,717fl. was yielded last year by taxes on the production of beer. The total beer production was 236,319,397 hectolitres, of which 231,701,652 hectolitres were taxed. Comparing the latter quantity with the yield of the brewing tax, it is seen that each hectolitre of beer pays on an average 1·34fl. Whilst in the German Beer Excise District the tax per hectolitre is only 47 kreuzers, in Austria it is 2·18fl. With the exception of a few unimportant countries, Austria can boast of having the highest tax on beer. In Austria-Hungary, in 1889, there were 1,952 breweries at work, in which 13,728,431 hectolitres of beer were brewed (as compared with 13,184,026 hectolitres in the preceding year). The revenue accruing therefrom to the State was 25,325,252fl. (24,358,773fl. in 1888). The malt used amounted to 3,549,564 centners, and the hops to 102,800 centners only. In the German Empire in 1889 there were 25,434 breweries at work, and their total production was 47,602,939 hectolitres of beer (1888, 26,240 breweries, 47,243,706 hectolitres production).

BRUSSELS, 17th June, 1890.

Iron.—As the home demand for iron does not improve, and as moreover competition in foreign markets becomes every day more difficult, the syndicate of iron manufacturers has found itself compelled to make another reduction in prices. The rates now are—for merchant bars 116s., and for plates 140s. a ton, with 8s. a ton difference for each class. This makes 124s. for No. 2 bars. There are good grounds for believing that these reductions will bring a large accession of business, for buyers have been keeping back their orders in expectation of the event, and the changes have put our manufacturers in much more favourable circumstances relatively to the foreign markets. It is to be regretted that the new rates are not remunerative. The margin for profit will have to be obtained by reductions in the cost of coal. Founders generally are busy, and engineers report specifications coming to hand more freely. There is no change to note in the pig iron market. As prices are very irregular it is useless to give quotations.

Coal.—The situation is gradually changing in favour of buyers. As contracts run out they are not renewed, consumers contenting themselves with buying for present needs. This restriction of business is beginning to show itself in accumulations of stock about the pits. The weakening tendency of the market has been checked by the colliers' strikes in France, but it is generally believed that lower prices will soon be announced. The constantly drooping prices of iron show the impossibility of the manufacturers paying the present rates for coal. Though the demand is falling off there is still great activity in the trade. The number of coal waggons despatched over the State railways in the week ending with the 8th inst. amounted to 59,753 against 57,805 in the corresponding week of last year. The average for the twenty-three first weeks was 57,200 in 1890, against 54,929 in 1889 and 53,031 in 1888.

Glass.—The slight changes that have occurred in the last two or three weeks in the glass making industry have brought no relief to the manufacturers. The lower prices for coal are compensated by a rising tendency in wages. The demand continues slack, and there is no prospect of immediate improvement. The share market shows this in the weaker tone that prevails, the upward movement in glass securities having come to an end.

DÜSSELDORF, 17th June, 1890.

Iron.—The iron market continues lifeless. The anticipations of consumers have been in part realised, for at the general meeting of the blast furnace owners, held on the 10th inst. at Cologne, considerable reductions were made in the prices of pig iron. The minimum rates now are:—Ordinary spiegel, 93s.; best Rhenish-Westphalian forge, 72s.; foundry No. 1, 78s.; Bessemer, 78s.; and Thomas, 60s. a ton. These reductions will lead, probably, to some buying, because the consumers have been keeping back their orders for this opportunity. The market for finished iron and steel is very quiet, and the near prospect is discouraging. Were it not for the syndicate combination which exists, prices would fall heavily. Now that pig iron is cheaper some reduction may be expected at the next meeting of the manufacturers. In anticipation of this the merchants are offering iron 5s. a ton below the syndicate minimum. For joists there is still a fairly brisk demand, but all other classes of finished iron and steel are neglected. The calm is, however, in part—some believe for the most part—due to the withholding of orders in expectation of better terms.

Coal.—Business in the coal market continues slack. Buyers are playing a waiting game; but the situation is such that sellers can afford to look on with indifference. There can be hardly any accumulations of stocks to begin the winter with. The colliery owners have made large reductions in prices, and they have probably descended to the lowest level which this year is likely to bring. The Gas Coal Owners' Association have fixed their price at 12s. a ton. At the end of April the quotation was 13s. 6d. to 15s. The statistics of coal production in the month of May show, relatively to the same month of last year, the following changes:—In the Saar district, 405,190 tons, against 420,810 tons; in the Wurm district, in the neighbourhood of Aix-la-Chapelle, 110,840 tons, against 91,370 tons; in the Upper Silesian district, 864,710 tons, against 751,700 tons; and in the Ruhr district, 2,499,860 tons, against 1,288,580 tons. The great difference in the latter district is due to the general strike which took place in May of 1889.

The Art of Printing.—The four hundred and fiftieth anniversary of the invention of the art of printing is to be celebrated at Mayence, the cradle of the art, in a simple and worthy manner. An exhibition of old printing work will be opened in the Academical Hall of the Electoral Castle on the 22nd of June. A meeting will be held in connection in the town hall, when the municipal band and cathedral choir will render a musical selection, and Dr. Nelke, the curator of the museum, will deliver an address. A *fête* will take place in the Gutenbergsplatz on St. John's Day.

The Gunpowder Trade—A new share company has been registered, with a capital of 16½ million marks (£825,000), to absorb the United Rhenish-Westphalian Gunpowder Company and the Rottweil and Hamburg Gunpowder Company. The general management will be entrusted to Herr Heidemann. The new company is to be known as the Cologne and Rottweil Gunpowder Manufacturing Company. This fusion is a matter of considerable importance to the gunpowder trade, inasmuch as it is tantamount to the formation of a "ring."

The Frankfort Exhibition.—The Oerlikon Works, and Messrs. Escher, Wyss, & Co., of Zurich, propose to run electrical boats on the Maine. The Electro-Technical Society of Frankfort is organising a conference on technical subjects connected with their branch of science.

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LILLE, 17th June, 1890.

Iron.—Business is very slack in the iron market, and prices continue their downward course. Merchant bars are still quoted 144s., and common plates 176s. a ton, but large concessions are made on these prices. It would be difficult to say what the current prices of bars are. The Paris merchants are, it is said, offering 128s. for bars. This price is refused, it is true; but the fact of its being offered shows how the Paris merchants regard the future. In the face of all this the coal owners maintain their prices firmly. The situation is thus becoming greatly strained.

Textile Manufactures.—The linen goods trade has revived a little within the last few days, the volume of business transacted in the course of the week being considerably larger than that of the previous week. No change has taken place in prices. The continued rise in the prices of yarns is beginning to cause uneasiness on account of the difficulty of obtaining higher prices for woven goods. There are yet no signs of revival in the woollen goods trade of the Roubaix district. Manufacturers who, a few weeks ago, were very hopeful concerning the coming season, now regard the near future despondingly.

Flax and Yarns.—The market is very active for home-grown flax, and prices are steadily rising. A brisk business, too, is being done in Russian at firm prices. There is not much doing in tows; the better qualities are scarce. Yarns are in strong demand, and spinners have profited by it to further advance their prices. The higher rates are readily paid. The market is animated for jute yarns, the prices of which are decidedly in favour of sellers.

AMSTERDAM, 16th June, 1890.

Telegraphs in the Dutch West Indies.—The Dutch Government has impounded the guarantee, or caution money, deposited by the Pedro Segundo Telegraph Cable Company, of New York, which has failed to carry out its contract for the laying of a cable connecting Paramaribo, the capital of Surinam, with Cuba and Florida, *viâ* Curaçoa. The same contract, or a similar one, has now been undertaken by the Compagnie Française des Télégraphes Sous-marins, in Paris, against a Government subsidy of £2,000 per annum, which amount has, consequently, been made a budget proposal.

Ancient Dutch Compound Engines on Steamers.—Mr. N. Th. Michaelis, the President of the Royal Institute of Civil Engineers, has drawn public attention to the fact that the most ancient compound engines on steamers were probably constructed at Fyenoord, near Rotterdam. They were made there as early as 1829, when the steamer "Hercules" was launched from the establishment of Mr. C. Röntgen, having then a compound engine in her. Mr. Michaelis has received a letter from the French engineer, M. Mallet, who states therein, that to his knowledge eighteen ships had been fitted with compound engines at Fyenoord before the year 1843.

New Line of Steamers from Holland to South America.—The success of the Netherland-American Steamboat Company, in opening a new line of steamers to the Argentine Republic, has prompted the directors of the Royal Mail Steam Packet Company to start a line of ocean steamers from Rotterdam to Buenos Ayres and Montevideo. This new service will commence in September next. In the journey out, the vessels, after leaving Rotterdam every month, will call at London, Southampton, Corunna, Vigo, Cadiz, and Los Palmas, and will also call at some of these ports on the return journey, with the addition of Santos, Rio de Janeiro, and Lisbon.

COPENHAGEN, 14th June, 1890.

The Danish Engineering Society.—This society held its annual meeting the other day, Professor Holmberg in the chair. The President read the Society's report. The number of members had now reached 589. During the past year eight meetings had been held and eleven papers read. The members had visited several industrial establishments. The prize competition for 1889 was on "The use of animal offal, and industrial establishments for utilising it." Four answers were received, but not one was considered satisfactory, so the prize of 500kr. was not awarded. The following prize competition was decided upon for the present year:—"What should be the sanitary requirements for dwellings of the poor, especially where such dwellings have to be in large numbers in high buildings?"

Stockholm Gasworks.—The gasworks in Stockholm belonged, up to the year 1884, to a private company, but passed then into the possession of the corporation. Both the company and the town have made a very good thing out of the gasworks, and last year's profits compare favourably with those of previous years. The gross profits on the gasworks have, with the exception of one year, been steadily increasing since they have been in the hands of the corporation, as will be seen from the subjoined figures:—

1885	977,910kr.
1886	962,318kr.
1887	1,076,185kr.
1888	1,165,987kr.
1889	1,325,638kr.

The production of gas during last year amounted to 10,960,460 cubic metres, which is an increase of about 4¼ per cent. as compared with the previous year. The consumption of gas for public lighting has increased by 3 per cent., the private consumption for lighting about 2¼ per cent., and the consumption for cooking, heating, and motive power, 45·3 per cent.

Beet Sugar Manufacture in Sweden.—The manufacture of beet sugar in Sweden has become a very important one during the last few years, and the erection of one or two other works has been under contemplation. The Lund sugar manufactory has, from September 30th, 1889, to February 24th this year, handled 39,000,000 kilogrammes of beet root, and the cost of labour and raw material amounted to 1,357,000kr. The result was a very satisfactory one, the net profits amounting to between 300,000kr. and 400,000kr. A dividend of 15kr. per share was declared.

MADRID, 16th June, 1890.

Peral's Submarine Torpedo Boat.—There was a great deal of enthusiasm about the trials of the Peral submarine boat during the past week. The trials are considered to indicate the greatest possible success in submarine navigation. The boat travelled at a depth of 10 metres for one hour and five minutes following the course ordered by the admiral directing the trials. The boat was able to go down and to come up at any rate, and moved without any risk of overturning. Subsequently she discharged a torpedo without its being seen. All the naval authorities express great satisfaction.

Two Steamers Lost.—The merchant steamer "Cabo de Gata," belonging to a Seville company, and the "Manuela," owned by a Bilbao house, were wrecked on the same day. Both will be replaced at once by purchases to be made in England. It is likely that the ship that will replace the "Cabo de Gata" will be the last to be bought in England, as the building yard at Bilbao will in future attend to the wants of most of the Spanish companies. The building of the first merchant vessel at Bilbao is expected to begin next September.

Telephonic Concessions.—By a recent royal decree the Minister of the Colonies has been authorised to make concessions for telephonic services in the islands of Cuba and Porto Rico and the Philippine Isles.

NEW YORK, 7th June, 1890.

Shortening the Erie Railway.—Some time since extensive surveys were made between Forest City and Hovesdale for the purpose of shortening the route from Buffalo to New York. These surveys were for a route to connect the Carbondale and Hovesdale branches of the Erie railway, making them the main line and discarding the Deposit Hill branch, thus lessening the distance fifty miles. The surveys resulted in two schemes, one to tunnel the mountains for a distance of thirteen miles, which would involve an expense of $2,000,000, and another to adopt a less direct overland route through the valley at a cost of $1,500,000. The necessary capital has been secured, and at a meeting of the directors of the proposed short cut it was decided to adopt the tunnel route.

Government Vessels.—The gunboat "Bennington" was launched at Roach's shipyard, Chester, on the 3rd inst. She is a sister ship of the "Concord," launched a few months ago. Her dimensions are: Length, 230ft.; extreme breadth, 36ft.; displacement, 1,700 tons. Two triple-expansion engines, developing 2,200 h.p. with natural draught and 3,300 h.p. with forced draught, will supply the motive power. The cylinders are 29in., 31in., and 50in. diameter by 30in. stroke. Her armament will consist of six 6in. breechloading rifles and a secondary battery of eight rapid-firing guns and revolving cannon on rail and tripod mounts; also eight torpedo guns with complete outfit. The "Vesuvius" has been handed over to the Government, and has gone into commission. She is complete except as to electric light plant and rapid-firing guns.

Pan-American Plans.—On the 2nd inst. the President sent to Congress a letter from the Secretary of State, relative to the recommendations of the recent Pan-American Conference on the subject of Customs regulations. The President, in transmitting the letter, stated that the Conference recommended for adoption: uniform Customs regulations for the classification and valuation of imported merchandise; a uniform nomenclature for description of articles of merchandise imported and exported; and the establishment at Washington of an International Bureau of Information. The Conference also decided to establish at Washington, as a fitting memorial of its meeting, a Latin American Library, to be formed by contributions from the several nations, of historical, geographical, and literary works, maps, manuscripts, and official documents relating to the history and civilisation of America, and expressed a desire that the Government of the United States should provide a suitable building for the shelter of such a library, to be dedicated upon the four hundredth anniversary of the discovery of America. Secretary Blaine recommends that Congress appropriate $250,000 to provide a building to receive the proposed collection, which building may also be used for the offices of the proposed Bureau of Information.

The Justin Gun.—The attempt to fire dynamite from an ordinary gun, as tried by Dr. Justin near Perryville, New York, came to a sudden termination by the total collapse of the gun. Two previous trials had been made which were so satisfactory that there was little doubt as to the success of this trial. The gun was an ordinary 9in. Blakely rifle. The shell was 44in. long of half-inch steel, and weighed 289lb. It contained 16½lb. of dynamite. The powder charge was 30lb. of ¾ prismatic powder, which was fired by a slow burning fuse. The explosion scattered the pieces of the gun around the neighbourhood. It is believed that the walls of the shell were too thin, wedging it in the barrel, and causing the explosion to take place in the barrel itself. A flaw was found in the breech of the gun, but the result would probably have been the same if the gun had been perfect. It is probable that Dr. Justin will continue his experiments, as his financial backers have faith in his success.

The Chicago Exhibition.—The Chicago Fair site question seems to be practically settled in favour of the central lake front site, 253 acres of which has to be filled in. The most serious objection is that it will crowd the down-town streets excessively, the tide of travel corresponding with the regular business travel. About 8,500,000 cubic yards of filling will be required, which can most cheaply be obtained by dredging.

PHILADELPHIA, 6th June, 1890.

The Pennsylvania Railway Company.—The annual report of the Board of Directors of the Pennsylvania Company, presented at the meeting held on the 3rd inst., covers the operations of 2,870 miles of road. The total revenue derived from the net earnings of the Union line, rent of real estate and equipment, profit in operating leased roads, and dividends and interest on securities owned amounted to $2,610,577·82. Deducting expenses, interest on car trusts' bonds, and losses in operating certain leased roads, in all amounting to $1,882,775·60, there is a profit for the year 1889 of $727,802·22, against a loss of $74,890·63 for the year 1888. On the Pittsburgh, Fort Wayne, and Chicago Railway, there was a profit in operating of $756,811·75, against a loss for the same time in 1888 of $371,851·28. On the Erie and Pittsburgh road there was a loss of $290,734·42, an increased loss of $107,572·15 as compared with last year. On the Indianapolis and Vandalia road there was a loss of $155,436·42, a decreased loss of $18,353·69 as compared with last year. The tonnage on the North-Western system, exclusive of the Grand Rapids and Indiana Line, shows an increase of 2,944,034 tons, or over 17 per cent. The Pennsylvania Railroad has a force of 3,000 men at work on what is known as the Downingtown cut off, and it is intended to finish the line within six months. This road will run from Downington on the main line to Morrisville on the New York division, and when ready for use no through freight will come to Philadelphia, and fast passenger trains will also use it to make better time from New York to the West. Much of the work is very heavy, but it is being rapidly pushed on. A feature of the construction is that the curves on this new line are so arranged as to keep the entire range of sight open and clear to the driver.

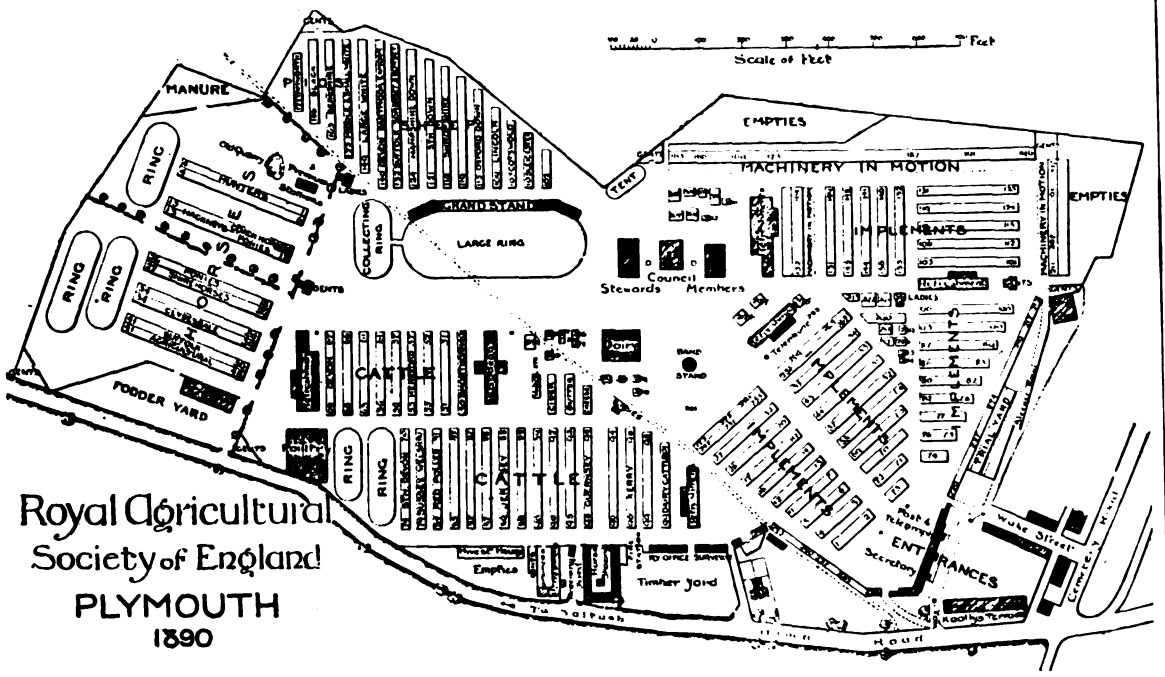
Railroad Consolidation.—Three important railroad meetings have been held in Philadelphia during the last few days—viz., the Chicago, St. Louis and Pittsburgh, the Pittsburgh, Cincinnati, and St. Louis, and the Pennsylvania Company. A plan for the consolidation of four Western lines, now controlled by the Pennsylvania Company, was submitted to the directors of the first two companies, and was agreed to by them. The plan is substantially as follows:—The first two companies, the Cincinnati and Richmond, and the Jeffersonville, Madison, and Indianapolis Company, are to be consolidated into one company. The capital stock of the new company will be $75,000,000, of which $45,000,000 will be common and the balance preferred stock. An equal amount of bonds will be issued. These issues will take the place of the stocks and bonds of the present companies. It is estimated that 40 million of stocks and bonds will be required for present use, the balance to be reserved for future improvements. After the plan has been presented to the directors of the last-named companies the stockholders of the four companies will meet and take action upon it.

Another Shipyard.—The rumour which has been current for the past two or three years, that a shipyard syndicate was to start a large shipbuilding establishment on the Delaware, has been revived, and it is said that sixty acres of land lying between the Pennsylvania Salt Works and Mifflin Street has been purchased for the purpose. The land is owned by Mr. Walton Ferguson, of New York, and no transfer has yet been recorded. A prominent shipbuilder says that there have been various syndicates formed within the past few years with a view of starting such a yard. These syndicates have all had considerable money at their back, but have never been able to accomplish anything.

A Large Testing Machine.—A testing machine, just completed by the Phœnix Iron Company, of Phœnixville, Pa., is said to be the largest ever built. It is designed to test full-size bridge members up to 55ft. in length, and with loads up to 2,000,000lb. either in tension or compression. Water pressure of 720lb. per square inch is applied to a cylinder 5ft. 6in. in diameter and 5ft. stroke. The general style of construction is similar to the machine at the Union Bridge Works at Athens, Pa. The cylinder is of cast steel, and without the heads weighs 28,000lb.; the other parts, cross-heads, &c., are correspondingly massive. All castings were made by the Chester Steel Co., of Chester, Pa., while the rest of the work was done in the shops of the Phœnix Co.

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THE ROYAL AGRICULTURAL SHOW.



PLAN OF SHOW YARD.

CLYDE SHIPBUILDING IN MAY.

SCARCELY any improvement has taken place in the demand for new tonnage, and the orders booked by Clyde shipbuilders during May were few in number, the aggregate tonnage being not more than 6,500 tons. The most important contract was arranged with Messrs. A. Stephen & Sons, Linthouse, by Mr. J. Bruce Murray, Glasgow, for a vessel of 2,700 tons, having a deadweight capability of 4,300 tons, and intended for general trading purposes. The other contracts include a screw steamer of 1,700 tons, to be built by the Campbeltown Shipbuilding Company; a sailing vessel to be built by a Port Glasgow firm; and a passenger steamer for service on the Nile, to be built by Messrs. J. McArthur & Co., Paisley. As in previous months during the year, the new work contracted for was largely exceeded in point of tonnage by the output, which reaches the respectable total of 25,974 tons. The work in hand is decreasing at a very rapid rate, and unless the flow of orders for new vessels becomes brisker than it has been for the past five months, quite a number of firms will shortly have little or nothing to do. The prices of material have a downward tendency, and although there is a disposition on the part of some builders to lower the standard of prices for work, labour still maintains itself at high rates. The trials of the two new paddle steamers, 'Marchioness of Breadalbane" and "Duchess of Hamilton," built for the passenger traffic of the Caledonian Steam Packet Company, took place during the month. The former vessel, which was constructed by Messrs. G. Reid & Co., Port Glasgow, is 200ft. long by 22ft. beam, by 7ft. 9in. depth, and on her trial attained a speed of 17 knots. The latter vessel, was built in Dumbarton by Messrs. William Denny & Brothers; she is 250ft. in length, 30ft. in breadth, and 10ft. 6in. in depth, and on trial proved herself to be the fastest paddle steamer on the Clyde, her average speed being 18·1 knots.

The following are the particulars of the vessels launched during the month:—

SINGLE SCREW STEAMERS.

"Alcestis," steel, 1,850 tons, built by Messrs. Mackie & Thomson, Govan, and fitted with triple-expansion engines by Messrs. Muir & Houston, Glasgow, for the general trade of Messrs. Aitken & Walker, Glasgow.

"Bosnian," steel, 348 tons, 450 i.h.p, built by Messrs. Mackie & Thomson, Govan, and fitted with triple-expansion engines by Messrs. Muir & Houston, to the order of Messrs. G. McFarlane & Co., Glasgow, for the Irish fish trade.

Dredger (hopper), steel, 400 tons, 300 i.h.p., built and engined by Messrs. W. Simons & Co., for dredging operations in Japan.

"Dunottar Castle," steel, 5,000 tons, built and supplied with triple-expansion engines by the Fairfield Shipbuilding and Engineering Company, Govan, for Messrs. Donald Currie & Co., for their service between Britain and South Africa.

"Finnieston," steel, elevating ferry, 250 tons, built and engined by Messrs. W. Simons & Co., Renfrew, for the cross river traffic of the Clyde Navigation Trust.

"Gannet," steel, 280 tons, built by Messrs. David Macgill & Co., Irvine, and engined by Messrs. Wm. Kemp, Govan, for the Glasgow and Greenock Shipping Company.

"Grimini," steel, 2,800 tons, built by Messrs. Charles Connell & Co., Scotstoun, and fitted with triple-expansion engines by Messrs. J. & G. Thomson, Glasgow, to the order of the Dampfschiff-Rhederei Hansa, Hamburg.

"Kallatina," steel, 500 tons, built and engined by Messrs. D. J. Dunlop & Co., Port Glasgow, for the Clarence, Richmond, and Macleay Rivers Steam Navigation Company, Sydney, N.S.W.

"Strathallan," steel, 2,340 tons, built by Messrs. Russell & Co., Greenock, and fitted with triple-expansion engines by Messrs. J. Howden & Co., Glasgow, for the general trade of Messrs. Birrell & Sons, Glasgow.

"Talbot," steel, 550 tons, built by Messrs. M'Knight & Co., Ayr, and fitted with triple-expansion engines by Messrs. Muir & Houston, Glasgow, and intended for the Liverpool, Swansea, and Port Talbot trade of Messrs. John Bacon & Co., Liverpool.

"Taviuni," steel, 1,500 tons, built by Messrs. William Denny & Bros., Dumbarton, and fitted with triple-expansion engines by Messrs. Denny & Co., for the Fiji trade of the Union Steamship Company, New Zealand.

"Teucer," steel, 2,800 tons, 1,500 i.h.p., built and fitted with compound tandem engines by Messrs. Scott & Co., Greenock, for the Ocean Steamship Company, Liverpool, for their China trade.

"Vitæ," steel, 900 tons, built by the Ailsa Shipbuilding Company, Troon, and fitted with triple-expansion engines by Messrs. Dunsmuir & Jackson, Govan, for the British India Steam Navigation Company, London.

TWIN SCREW STEAMER.

"Clutha" No. 7, steel, 30 tons, built by Messrs. Murray Brothers, Dumbarton, and engined by Messrs. Matthew Paul & Co., Dumbarton, for the passenger traffic of the Clyde Navigation Trust.

PADDLE STEAMERS.

"Hygeia," steel, 800 tons, built by Messrs. Napier, Shanks, & Bell, Yoker, to the order of Messrs. Huddart, Parker, & Co., for their passenger service in Australian waters.

"Mana," tug, 240 tons, built and engined by Messrs. Fleming & Ferguson, Paisley, for the Timaru Harbour Board, New Zealand.

"Marchioness of Bute," steel, 250 tons, built by Messrs. J. Reid & Co., Port Glasgow, and fitted with compound engines by Messrs. Rankin & Blackmore, Greenock, for the passenger traffic of the Caledonian Steam Packet Company.

SAILING VESSELS.

"Airdnamurchan," steel, 1,700 tons, built by Messrs. Russell & Co., Port Glasgow, to the order of Mr. H. Hogarth, Glasgow.

"Barcraig," steel, 2,100 tons, built by Messrs. W. Hamilton, Port Glasgow, for the general trade of Messrs. Hamilton & Harvey, Glasgow.

"Mirfield," steel, 1,320 tons, built by Messrs. Russell & Co., Port Glasgow, to the order of Messrs. Alexander Rae & Co.

YACHTS.

"Encore," 10 tons, built by Messrs. W. Fife & Sons, Fairlie, for Mr. K. H. Clark, Paisley.

"Nan," 6 tons, built by Messrs. Fife & Sons, for Mr. T. Burrows, Lismore, Ireland.

"Phantom," 10 tons, built by Mr. James Adam, Gourock, for Mr. A. Arthur.

"Woodcock," 10 tons, built by Messrs. W. Fife & Sons, Fairlie.

In addition to the above four electric launches were completed by Messrs. T. B. Seath & Co., Rutherglen, for the Electric Traction Company, and intended for use at the Edinburgh Exhibition.

ANALYSIS OF LAUNCHES.

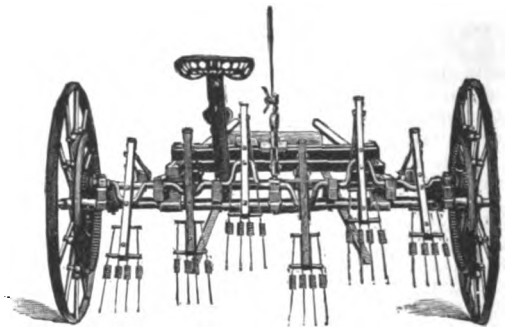
	Steamers. No.	Steamers. Tonnage.	Sailing Vessels. No.	Sailing Vessels. Tonnage.	Yachts. No.	Yachts. Tons.
Great Britain	11	14,598	3	5,120	4	36
New Zealand	2	1,740	—	—	—	—
Australia	2	1,300	—	—	—	—
Germany	1	2,800	—	—	—	—
Japan	1	400	—	—	—	—
	17	20,838	3	5,120	4	36

THE ROYAL AGRICULTURAL SHOW.

THE annual Show of the Royal Agricultural Society will be held at Plymouth from Saturday, the 21st inst., to Friday, the 27th inst., inclusive. On the first day only the implement department will be on exhibition, and the show of live stock will be open on Monday, the 23rd. On Tuesday, at 12.30, a general meeting of the members will be held. Various competitions will be held during the week, such as horse shoeing, butter making, &c., and lectures and demonstrations in bee keeping, dairy work, jam making, &c., will take place at intervals. The yard is being protected from fire by one of Messrs. Shand, Mason, & Co.'s steam fire engines. The accompanying plan of the yard may be of use to our readers; we are indebted to the Society for permission to reproduce it from their official catalogue.

THE "HASELEY TEDDER."

WE illustrate below a tedder which is made by Mr. J. V. Gibbons, Haseley Ironworks, near Tetsworth, Oxon. In it a row of hay-forks is actuated by cranks, so as to give a motion similar to manual hay tedding.



Each fork is fitted with four of Gibbons' coiled spring teeth, which have great flexibility. All the working parts can be thrown out of gear when travelling.

THE TOWER BRIDGE.

THE erection of the steel superstructure of the Tower Bridge may now be said to have been commenced in earnest. For the last six months preparations have been made at the site, that all might be ready to build the bridge by the time the lower portion of the work has been constructed at Messrs. William Arrol & Co.'s Works at Glasgow, where there is now a large quantity of the steelwork finished.

As many of our readers are aware, the bridge will consist of one central opening of 200ft. clear, and two side openings each of 270ft. clear. Upon each of the two massive masonry piers—which are already built in the river—and also on each of the abutments, will be placed four steel octagonal columns, those on the piers reaching to a height of 135ft., and those on the abutments 66ft., above high water. These columns will carry steel chains, from which the roadway of the side spans is suspended. For the purposes of the river traffic the central span is capable of being opened, the steelwork being so designed as to admit of each half rotating in a vertical plane through an angle of 90 deg. In order not to prevent pedestrian traffic while the bridge is thus open, an overhead footway is provided at a level of 135ft. above high water, at each end of which hydraulic lifts will be provided.

Two temporary timber piers have been driven in the side opening next to the Middlesex shore, and upon these girders have been placed, to form a stage some 70ft. wide, upon which the steelwork of this span will be built. This stage appears now to be practically complete. The side opening on the Surrey shore of the

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river will be similarly staged over, one of the temporary timber piers being finished and the other in the course of construction. Considerable care and labour has evidently been expended in forming these timber piers. The traffic at this part of the river is so great that the driving of the piles alone must have given a good deal of trouble; and when it is considered how liable they are to collision from the many large steamboats that unload near the site, to say nothing of the numberless barges that crowd the river, and how serious a collision might prove when the steelwork is in the course of erection, it is evidently of primary importance to have such piers as we now see constructed.

Many hundreds of tons of the steelwork have been delivered, and some erected, at the site, and large quantities are being sent on weekly from Glasgow. It is expected that the building of the main columns on the Middlesex pier will be commenced next week.

ROYAL STATISTICAL SOCIETY.

"An Examination of the Coal and Iron Production of the Principal Coal and Iron-Producing Countries of the World, with reference to the English Coal Question," was the title of the paper read by Mr. G. G. Chisholm, M.A., B.Sc., &c., on Tuesday, the 17th inst.

With a view to this examination a comparison is first made of the rates of increase in the amount of coal production in different countries. A table drawn up for this purpose shows that since 1860 the rate of expansion under this head has been less rapid in the United Kingdom than in several other countries, notably the United States and Germany. If the same average rates of expansion were continued indefinitely in the future for the United Kingdom, the United States, and Germany respectively, as are found by calculation to have been maintained for these countries between the mean of the three years 1879–81 and the mean of the three years 1886–88, then the coal production of the United Kingdom would be overtaken by that of the United States in 1894, by that of Germany in 1928, by the aggregate coal and lignite production of Germany in 1919. A similar examination of the rate of growth of the production of iron shows that in this industry these two countries appear to be gaining still more rapidly upon the United Kingdom. This is important as tending to bring about a diminution in the rate of increase in the demand for British coal. Hitherto the iron industry of the chief industrial countries has been greatly stimulated by the rapid extension of railways. An examination of railway statistics since 1840 shows that the new mileage required year by year all over the world has increased on the average at a pretty high geometrical rate. The examination shows also, however, that this is brought about by the construction of railways on a great scale in different parts of the world successively. Regions in which railways have long been laid show no such rapid increase in the amount of the new mileage. This leads to the conclusion that sooner or later a time will come when the rate of increase of the railway mileage of the world will be greatly reduced. That would probably involve a pretty severe check to the growth of the demand for iron, and indirectly that of the demand for coal.

With regard to the consumption of British coal, any conclusions that may be drawn from such data as are dealt with in this paper should be stated with great diffidence: but, so far as yet appears, we have no reason to anticipate at any time anything of the nature of a disaster or sudden catastrophe from our continued consumption of coal. The change of conditions will probably be a gradual one throughout. First we may expect only the continuation of a process already begun, a gradual contraction in the rate of expansion of the coal production. That may pass insensibly into a stationary state of coal production, to be followed by a gradual decline. Such, remarks Professor Marshall, is the actually observed history of the working of individual coal mines. It may be that the modification of the rate of increase or decrease of the amount of coal production will not always be so gradual as it is now: still we may hope that it may be gradual enough to allow of the habits of the people being adapted to the changing conditions. Nevertheless, the fact of the steady rate of increase in the aggregate number of the population of Great Britain, taken along with apparent signs of a declining rate of expansion in some of the chief industries of the country, is one that cannot be regarded with equanimity, and makes it urgently to be desired that the true state of the case should be carefully inquired into, and made as widely known as possible. With reference to the possibility of the influences adverse to the production of British coal being somewhat suddenly and strongly reinforced in the future, an account is given from Richthofen's "China," of certain great Chinese coalfields, the connection of which by rail with the great plain of China and the great seaports could not fail, according to Richthofen, "to bring about a revolution in the commerce and intercourse of the world."

PRICES CURRENT, 18th June, 1890.

Quotations at per ton, unless otherwise specified.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	5 10 0	.....	6 0 0	f.o.t. wks.
" Angles	5 5 0	.....	5 15 0	"
" Plates	5 7 6	.....	5 17 6	"
Staffordshire Bars (cheaper makes)	7 10 0	.....	8 0 0	London.
" Angles	7 10 0	.....	8 0 0	"
Crown Sheets	7 2 6	.....	7 12 6	"
" Hoops	7 0 0	.....	7 10 0	"
"Siemens-Martin" Steel Boiler Plates			7 17 6	"
" Ship and Girder			6 17 6	"

Market quiet.

PIG IRON.

Middlesbro' Warrants, No. 3	41/10½	Cash
Scotch Warrants, m n	45/-	"
Hematite Warrants, m n	51/-	"

Stocks in Stores	Scotch	726,395—Dec.	for week 6,091	Tons.
	Middlesbro'	97,983—Dec.	" 2,240	"
	Hematite	297,348—Dec.	" 4,732	"

Exclusive of stocks in makers' yards.

	No. 1.		No. 3.	
Coltness	61/6	.....	56/6	f.o.b. Glasgow.
Gartsherrie	59/6	.....	55/6	" "
Langloan	61/6	.....	56/-	" "
Summerlee	60/6	.....	56/-	" "
Glengarnock	60 6	.....	53 6	" "
G.M.B. ex Store	45/6	.....	45,3	" "

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	67/-	..... 57/-

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

METALS.

Spelter:	Ordinary	£24	10	0	to	24	15	0
Copper:	British Cakes and Ingots	64	0	0	"	65	0	0
"	Chili Bars, G.O.B.'s	59	0	0	"	59	10	0
"	Other sorts, G.M.B.'s (equal to Chili Bars)	59	0	0	"	59	10	0
"	Manufactured (strong)	70	0	0	"	72	0	0
Lead:	Common Pig	14	0	0	"	14	2	6
"	English Sheet	14	15	0	"	14	17	6
Tin:	Straits	96	5	0	"	96	10	0
"	Australian	96	10	0	"	97	0	0
"	English Ingots	100	10	0	"	.....		

Messrs. Carrick & Brockbank, Manchester, report as follows:—

Copper continues firm and strong, with a tendency to still higher values. Prices of raw are steadily advancing, large buying taking place both for consumption and for speculative account, the statistical position inducing speculators to take a keen interest in copper. It is a noticeable feature that a large proportion of the buying is for three months' account, which indicates confidence in the market. Stocks are being very considerably reduced, the visible supply showing a reduction of slightly over 6,000 tons from the 1st to the 15th inst. Chili bar quotations to-day are £59 to £59 10s. cash, with large business. Manufactured is quoted £70 to £72 sheets, £73 to £75 bottoms.

Tin has fluctuated somewhat during the week, and values are lower, the variations in silver having affected prices. A firmer tone, however, is to day observable at improving rates.

Lead: As noted in our last, the market is firmer, and prices have advanced slightly. A fair business has been done during the week, and there is a better demand all round.

Spelter continues very firm, as the metal is scarce, and buyers have to pay full prices. It is likely to advance, as business is improving, and there are no stocks in makers' hands or at the outports.

CHEMICALS.

		£ s. d.		£ s. d.
Acid: Carbolic Crystals	lb.	0 0 8	to	0 0 9½
" " Liquid	gal.	0 1 2	—	.....
" Citric	lb.	0 1 4	—	.....
" Oxalic	"	0 0 4	—	.....
" Sulphuric	ton	1 12 0	—	.....
" Tartaric	lb.	0 1 4	—	.....
Alum: Lump (powder 10/- ex.)	ton	4 17 6	—	.....
Ammonia: Carbonate	lb.	0 0 3½	—	.....
" Muriate (Grey)	ton	22 15 0	—	.....
" " (White)	"	26 10 0	—	.....
" Sulphate	"	11 5 0	—	.....
" Liquor	lb.	0 0 3⅜	—	.....
Antimony	ton	.....	—	.....
Bleaching Powder	"	4 15 0	—	4 17 6
Bisulphide of Carbon	"	13 10 0	—	.....
Borax	"	30 0 0	—	.....
Benzole (90%)	gal.	0 3 10	—	.....
" (50/90%)	"	0 2 10	—	.....
Copper Sulphate	ton	24 0 0	—	.....
Copperas	"	2 0 0	—	.....
Kieserit	"	.....	—	.....
Lead: Nitrate	"	22 10 0	—	.....
" White Sugar	"	24 0 0	—	.....
" Brown	"	19 0 0	—	.....
Potash: Bichromate	lb.	0 0 4	—	.....
" Caustic	ton	22 0 0	—	.....
" Carbonate	"	19 10 0	—	.....
" Chlorate	lb.	0 0 4½	—	0 0 4¾
" Prussiate (Yellow)	"	0 0 9½	—	.....
" Sulphate (Basis 90%)	ton	9 10 0	—	.....
Precipitate: Red	lb.	0 3 1	—	.....
" White	"	0 3 2	—	.....
Salts: Epsom Bags	ton	3 0 0	—	.....
Salts: Epsom Casks	"	3 15 0	—	.....
" Glauber	"	1 10 0	—	.....
Sulphur: Sublimed Flowers	"	9 0 0	—	.....
" Recovered	"	4 10 0	—	.....
Soda: Ash	deg.	0 0 1¾	—	.....
" Caustic (White 70%)	ton	8 10 0	—	.....
" " " 60%)	"	7 10 0	—	.....
" " (Cream 60%)	"	7 5 0	—	.....
" Crystals	"	3 2 6	—	3 5 0
" Bicarbonate	"	6 5 0	—	.....
" Hyposulphite	"	6 5 0	—	.....
Solvent Naphtha	gal.	0 4 0	—	.....
Tartar, Cream of	cwt.	5 12 6	—	.....
Zinc Sulphate	ton	7 10 0	—	.....

Messrs. S. W. Royse & Co., Manchester, report as follows:—

Chemicals: Caustic soda has considerably improved during the last week, and prices are tending further upwards. Soda crystals are also firm, and bicarbonate of soda is in short supply for present delivery. Bleaching powder is very dull at lower figures, and soda ash is quiet at rather easier prices. Sulphate of copper is more freely offered for present and July delivery. There is considerable variation in quotations for later delivery, and the steady advance in copper has checked business in that direction. Carbolic acids are again very quiet; there is more crude offering, and makers show more disposition to meet buyers' terms. Tartaric and citric acids are easier, and oxalic acid is more freely offered.

OILS.

		£ s. d.
Cocoanut: Cochin	per tun	30 0 0
" Ceylon	"	25 10 0
Cottonseed	"	22 10 0
Cod	"	20 0 0
Lard	"	35 10 0
Linseed	"	24 10 0
Palm, Lagos	"	25 10 0
Rapeseed: English	"	32 0 0
Seal: Pale	"	27 0 0
" Brown	"	22 0 0
Sperm	"	45 0 0
Whale	"	24 0 0
Turpentine	per cwt.	1 9 3
Coal	per gal.	
Petroleum (Refined)	"	0 0 5 7/8
" Spirit	"	0 0 7

SHIPBUILDING NOTES.

On the 30th ult. Messrs. R. & H. Green launched the second of two composite lightships they have on order for the Trinity House Corporation. The vessel was built from the designs of Mr. F. C. Goodall, the naval architect to the Corporation. The fittings are generally of teak, of which a liberal use is made; the decks, however, are of elm planking. Special provision is made for ship's stores and the carrying of explosives, an allowance of which becomes necessary in the vessel. It is proposed to use a flashing-power of 20,000 candles in the lamps to be employed. These will be of 60 candle-power each, and placed in an 8ft cylindrical lantern, the reflector being 21in. diameter. The fog signal siren will be worked by a steam motor to compress air in a reservoir from which to draw its supply. Provision is thus made for starting the signal at any moment. The machinery for this purpose is fitted in duplicate in case of breakdown.

On the 17th inst. the "Gertrude," a steel screw yacht of 137 tons gross, was launched by Messrs. A. & J. Inglis, Pointhouse, for Mr. Heys, Belfast. The dimensions are:—Length, 126ft.; breadth, 18ft. 1in.; depth, 11ft. 5in.

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HOME INDUSTRIES.

LONDON, 19th June, 1890.

THE MONEY MARKET.—Money was plentiful in Lombard Street in the earlier part of the week, while borrowers were scarce. Later on, however, when advances obtained from the Bank last week fell due, money became harder, but rates have been comparatively light. The discount market maintains its steadiness, Continental exchanges still being against London, and a steady demand for gold for Germany, Holland, and Austria being maintained. The stock markets are depressed and lacking in vitality, and the only securities which have kept up an appearance of vigour are copper shares. Home railways have reacted after the briskness of a week or two, and there is no stimulus to wake them into activity. American railroad stocks are in much the same position, as the fact of the market being heavily committed to a speculation for the rise stands in the way of a recovery. Foreign stocks have had a distinct set-back this week, the cholera scare causing a break in Spanish bonds, which has sympathetically depressed the whole list. Argentines and Brazilians have recovered from the depression which overtook them last week on the publication of disquieting news. The other departments are quiet and featureless.

COMPANIES.—The following companies have been registered since our last report:—Stipendum Stopper Co., Ld., with a capital of £5,000, to carry on business as manufacturers; United States Exploration, Mineral, Coal, and Land Syndicate, Ld., with a capital of £10,100; Dunkley's Patent Wheel and Tyre Co., Ld., with a capital of £10,000; Bowden & Coote, Ld, with a capital of £20,000, to carry on the business of brewers, &c.; Purlis Syndicate Co., with a capital of £5,000, to carry on mining operations in Siam and the Malay Peninsula; Turner, Symons, & Co., Ld., with a capital of £50,000, to carry on the business of paper manufacturers; Dick, Kerr, & Co., Ld., with a capital of £160,000, to carry on the business of engineers; James Lang & Co., Ld., with a capital of £6,300, to carry on the business of manufacturers of firearms, &c.; City of Chicago Brewing & Malting Co., Ld., with a capital of £1,250,000; La Plata and Ensenada Tramways Co., Ld., with a capital of £525,000; New Morgan Gold Mining Co., Ld., with a capital of £40,000; The Wheal Sisters Mining Co., Ld., with a capital of £25,000, to carry on operations in Cornwall; Spanish Prospecting Syndicate, Ld., with a capital of £12,000; Illinois United Breweries, Ld., with a capital of £200,000; The Model Fibre Factory Co., Ld., with a capital of £20,000; South Pacific Mother-of-Pearl Syndicate, Ld., with a capital of £2,500; The Guadalcanal Mining Syndicate, Ld., with a capital of £30,000; Palermo Waterworks Co., Ld., with a capital of £550,000; Stever Lubricator Syndicate, Ld., with a capital of £6,000; The Patent Adamant Stone Co., Ld., with a capital of £65,000; E. & J. Buckley, Ld., with a capital of £15,000, to carry on the business of calico printing and dyeing; Minneapolis and La Crosse Breweries, Ld., with a capital of £200,000; The Column Printing Telegraph Co., Ld., with a capital of £100,000; Orinoco Exploration and Trading Co., Ld., with a capital of £260,000; Jones, Venn, & Co., Ld., with a capital of £5,000, to carry on the business of bicycle manufacturers, &c.; Allen, Everitt, & Sons, Ld., with a capital of £300,000, to carry on the business of manufacturers of brass and copper tube, sheeting, &c.; Tubular Frame Wagon Co., Ld., with a capital of £200,000.

THE INSTITUTION OF ELECTRICAL ENGINEERS.—We understand that the President, being desirous of rendering the annual conversazione especially attractive, hoped to have been able to hold it in a new locale. Every preparation had been made in anticipation of that arrangement, which has, however, unfortunately fallen through, and it being now too late in the season to make any other, the soirée will be postponed until the autumn.

MORGAN'S ELECTRIC SIGNAL SYSTEM.—We referred to this system of police alarm in a recent issue, and now learn that a network will shortly be installed in the Brixton district, with a view to demonstrating its utility on a practical basis.

RUBBER TRADE BENEVOLENT ASSOCIATON.—Mr. Herbert Standring, 131, Finsbury Pavement, E.C., proposes to form a benevolent association for persons engaged in the rubber trades. A meeting will be held in July to discuss details.

CHEMICAL APPARATUS.—We have received an illustrated catalogue and price list of a very great variety of chemical and analytical balances, scales, and weights, made by Messrs. F. E. Becker & Co., 33-35-37, Hatton Wall, Hatton Garden.

THE SOCIETY OF CHEMICAL INDUSTRY.—The annual general meeting of this society will be held at Nottingham, on the 9th, 10th, and 11th of July. The President (Sir Lowthian Bell) will deliver his address at University College, at 11 a.m., on Wednesday, the 9th; in the afternoon a visit will be paid to the Midland Railway Works at Derby; and in the evening the Mayor will hold a reception at the Castle. Thursday morning will be occupied by a visit to the Burton breweries, and the evening by the annual dinner. An excursion to Sherwood Forest on Friday will conclude the business of the meeting. In addition to the above arrangements there are a large number of alternative visits to works, &c, of minor importance.

THE SANITARY INSTITUTE.—The following appointments have been made for the Congress and Exhibition at Brighton, which commences on the 25th of August:—President, Sir Thomas Crawford, K.C.B., M.D.; Hon. Treasurer, the Mayor of Brighton; Hon. Secretary, Arthur Newsholme, M.D.; President, Section I. (Sanitary Science and Preventive Medicine), George Vivian Poore, M.D., F.R.C.P.; President, Section II. (Engineering and Architecture), Professor Roger Smith, F.R.I.B.A.; President, Section III. (Chemistry, Meteorology, and Geology), William Topley, F.R.S., F.G.S.; President of the Conference of Medical Officers of Health, Arthur Newsholme, M.D.; President of the Conference of Inspectors of Nuisances, Alfred Carpenter, M.D., M.R.C.P. On Tuesday there will be a conversazione in the Pavilion Building; on Wednesday, a lecture to Congress, by W. H. Preece, F.R.S.; and on Saturday there will be excursions, and an address to the working classes by Benjamin Ward Richardson, M.D., LL.D., F.R.S. The meetings of the Congress and Exhibition will be held in the Pavilion Buildings.

DANGERS OF THE STREETS OF LONDON.—At the Lord Mayor's Court last week, a Mr. Harris obtained £25 damages from the Corporation of London for injuries resulting from his slipping down on a worn hydrant cover. A worn iron hydrant coverlid is very likely to cause such an accident. Mr. J. C. Merryweather, of Long Acre, has recently introduced a new cover to obviate such mishaps. It consists of an iron tray filled with cement or asphalte, in which lead plugs or strips are inserted. Several have been put down in the Strand, and have been found to answer well.

ADMIRALTY SURVEYS.—The Hydrographer's report of Admiralty Surveys for the year 1889 has just been published. Three vessels were engaged on various parts of the home coast and seven abroad, with 66 officers and 345 men. In each case details are given of the operations of the surveying parties. One matter of interest reported in the book is the subject of a question of which notice was given by Mr. Webb in the House of Commons on Thursday. It had been reported that a danger existed about 20 miles from Cape St. Mary, Newfoundland. On examination and inquiry no rock was found, but fresh evidence was brought as to the existence of the rock, and the "Gulnare" proceeded in the middle of August to make a thorough examination. A fisherman named Patrick Lamb was found in a boat, and he consented to point out the rock, though he knew he was thereby giving up exclusive knowledge of a rich fishing-ground. The rock, now called Lamb Rock, proved to be a small pinnacle with 33ft. of water over it. Lamb's anticipations of personal loss were at once justified by the other fishing-boats crowding to the place in search of cod. The importance of the knowledge of its existence will be seen from the fact that many mail steamers pass this way on their course to the St. Lawrence. Observations place it in lat. 46° 28′ 5″ N., long. 54° 1′ 30″ W.

MANCHESTER, 19th June, 1890.

THE ENGINEERING TRADES.—In spite of the drooping condition of the markets for raw materials, there is no lack of employment among the engineers of this district. Engine builders are fully occupied, and a fair amount of work is coming to hand. Shippers, however, report a little less pressure than existed a few months back, but there is not yet any real ground for complaint. Boiler makers are especially busy, and in some cases are unable to take orders except for very extended delivery. In bridge building there is great activity, and in railway work generally there is plenty of work. The special department of tool making continues to be fully occupied, and few makers have any reason to complain. In textile machinery the tone is good, and all the well-known firms are working at their highest capacity. Many of them have some difficulty in satisfying their customers, and there are no signs of any falling off in the volume of trade in this department. Loom makers are steadily engaged, especially those who make the better class of machines for weaving the higher kinds of fabrics.

FUSTIAN CUTTING MACHINERY.—A scheme is on foot to form a company to cut fustians and velveteens by means of a machine which was patented several years ago. At present all this work is done by hand. The saving in time is said to be 75 per cent., and in addition the cutting is better performed.

TECHNICAL INSTRUCTION.—The special committee of the Manchester City Council have been inquiring into the claims of various educational bodies for participation in the aid to be given by the city authorities. After consideration the committee will make a report upon which action will be taken. The first part of the scheme of the Whitworth Trustees was carried into effect on the 14th inst., when an extensive plot of ground was opened as a public park. In one portion of this an art gallery and school is to be erected. The Whitworth Institute, near the works of Sir Joseph Whitworth & Co., Limited, is rapidly approaching completion.

IMPROVED DUST TRUNKS.—Messrs. Platt Brothers & Co., Limited, have recently introduced an improvement in the dust trunks used between the breaker and opener in cotton factories. In most cases the trunks are provided with small chambers, into which the dirt can fall as the cotton travels along them, and can be afterwards periodically removed. The improvement consists in the introduction of an endless lattice fitted with scrapers or blades between which the dirt falls, and is carried to the end of the frame, where it drops on to a balanced plate. The latter closes an aperture below which a bag is hung, and when the weight of dirt is sufficient it opens the plate and falls into the bag. This is a simple but important provision, and ensures the absolute removal of the dirt at all times without the risks arising when it is allowed to collect. For Indian cotton it is especially useful.

THE LINEN AND JUTE TRADES.—We are unable to report any active movement in the home trade, but in the shipping section there is a brisker demand, and the United States market absorbs very large quantities. The fancy handkerchief trade is in a satisfactory condition. Coarse makes are quiet, and some uncertainty is felt with regard to future prices, which, it is feared, may prove unremunerative to manufacturers, who are already on the losing side. Damasks are slow, the season for these goods not having yet really commenced. Several extensive sales of late have interfered somewhat with the regular course of business, but the effect is not felt greatly, as this period is generally a poor one for linens. Roughs are not inquired for to any extent, and towellings are also dull. Linen threads are moving off freely. The proposed increase in the United States duties does not disturb the trade much, as the largest producers have mills across the Atlantic in addition to those in operation in the United Kingdom. Jute goods are only bought for special orders. The raw material keeps firmer on account of the Silver Bill proposals. Fancy jute carpet squares, with fringed borders, are now a standard feature in this department, and the attention given to designing has increased their popularity.

GLASGOW, 19th June, 1890.

PIG IRON.—A considerable amount of buying has been taking place, and considerable quantities of iron are passing into consumption in spite of the quietness of the shipping trade. The price seems firm, although general trade has fallen off, it being understood that stocks are now very strongly held. The stock in Connal's stores has fallen to three-quarters of a million tons, and is decreasing at the rate of 5,000 tons per week. One furnace was put out of blast this week. There is a strong prospect of labour trouble in England, if not also in Scotland. Altogether the indications seem to point at least to firmness in prices in the meantime, although "bear" speculators are operating to a considerable extent, relying upon the reaction in trade, which certainty affects the shipping and shipbuilding and engineering industries at the moment. Restriction of output, the greatly reduced stocks, and the strong holding of these must, however, have an important influence in the steadying of prices, thus partly neutralising the effect of the falling off in demand.

SHIPBUILDING.—Nearly all the shipbuilding yards in the Clyde district are now suffering from want of work. The ships which were on the stocks in the autumn when trade began to fall off are now leaving them, and orders are very few. A few specifications have been quoted for during the past week or two, but we understand that the prices ruling afford scarcely any margin at current rates for labour and raw materials. With the latter considerably above the rates ruling about three years ago, before the revival of trade had made much progress, the prices for the finished product are now little, if anything, in advance of the low prices of the dull period. The "Princess Victoria," which was built by Messrs. Wm. Denny & Brothers, Dumbarton, has been placed on the Stranraer and Larne route. The "Princess Victoria" has beaten the record, having made the passage, pier to pier, in one hour and fifty minutes. The normal passage by the steamers formerly on the route was two and a half hours.

EDINBURGH EXHIBITION.—The *Chemin de Fer Glissant* has now been in working order for some days, and the telpher line is approaching completion. The Phonograph Exhibition, which was opened by Mr. Stanley, is one of the sights of the show. An interesting experiment will be tried in a few days. A type composing machine will be brought from the printing office of Messrs. T. & A. Constable, printers to the Exhibition, and a compositor will, by means of it, set up in type the utterances of the phonograph. The next step, which, it is understood, Mr. Edison fully expects to make, is to eliminate the compositor. The whole of the five large Galloway boilers supplied by Galloways Limited, Manchester, which provide all the steam required in the Edinburgh Exhibition, have been purchased by the North British Rubber Company for their Castle Mills, Edinburgh.

SCOTCH RAILWAYS, &C.—The operations connected with the Glasgow Central Railway have been begun.—The works at the subway at Finnieston are proceeding rapidly.—The opening of the North British Forth Bridge route has had an influence upon traffic returns, which are up £4,500 on the week in consequence.

FIRE AT THE CALEDONIAN RAILWAY STATION, EDINBURGH.—On Monday last the Princes Street Station of the Caledonian Railway, at Edinburgh, was burnt down to the extent of over one-half of its area. The fire is supposed to have originated in the oil store of the station shortly before two o'clock, and, in spite of all efforts to cope with it, spread so rapidly that in two hours one-half of the roof, with the platforms below it, was a wreck. The platforms were cut, and the fire in the roof subdued, however, before the front of the station was attacked. The passenger traffic was much disorganised, the incoming trains being stopped at Merchiston for some hours, and the outgoing trains being despatched from the goods station in Lothian Road. By five o'clock in the afternoon, however, the trains were being despatched from the unburned ends of the platform of the passenger station. The new station, which is to be erected on the site of that now burned, and which is to extend along Lothian Road, will now be pushed forward with all possible rapidity.

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(From our own Correspondents.)

LIVERPOOL, 18th June, 1890.

THE SALT TRADE.—The shipments of salt from the River Mersey during the month of May were very satisfactory, and were greatly in excess of those for many months past. Compared with the exports of a corresponding period last year, the excess of white salt is nearly 10,000 tons, whilst the export of rock salt has nearly doubled. The amount of salt manufactured in Cheshire during the past month is 1,154,649 tons; the white salt shipped from Liverpool was 62,093 tons; from Runcorn, 7,834 tons; and from Weston Point, 6,634 tons; the total amount of rock salt shipped being 8,555 tons.

WORKMEN'S INDUSTRIAL EXHIBITION.—It is proposed to hold a Workmen's Industrial Exhibition in the buildings and grounds of the Walker Engineering Laboratory, and workmen are invited to send models, inventions, ferneries, drawings, &c.; diplomas of merit being offered to such exhibits as the jurors may consider of sufficient merit to receive them. Many of the local firms are also sending exhibits, and other attractions will be offered in the shape of a fairy fountain, electric light, microscopes, art exhibition, &c. The Exhibition is to be opened by the Mayor on the 5th July.

LEEDS, 18th June, 1890.

THE IRON AND STEEL TRADES.—The manufactured iron and steel trades are somewhat improved, though there is still a disinclination on the part of buyers to go beyond present needs. However, the feeling appears to be one of confidence in regard to the future. Some of the forges in this district are by no means fully employed, so that the placing of new work would be greatly appreciated both by masters and men. The Leeds Steel Works have nearly completed the alterations which they have been making, and operations will shortly be resumed there. Extensive building in Leeds and the surrounding district helps to keep ironfounders fairly busy. The briskness observable in the engineering departments is, generally speaking, owing to old contracts. The threatened strike of engineers has been averted. As stated in *Industries* a fortnight ago, the local branch of the Amalgamated Society of Engineers issued circulars to employers asking for an all round advance of 2s. per week. The replies at first were not encouraging, but towards the day that the notices of the men expired several important firms conceded the demand. At the time of writing the addition to wages has been granted at every establishment with two exceptions, the firms who refuse the request employing altogether 80 hands. The apprentices at one or two shops have now struck for an advance of 1s. per week. An important matter for Leeds, having regard to late and present trade disputes, is the formation of a provisional Board of Conciliation for the town, consisting of twelve employers and twelve representatives of labour, the former to be selected by the Leeds Chamber of Commerce, and the latter by the Leeds Trade Council.

THE COAL TRADE.—There is less inquiry for steel for domestic and manufacturing purposes, with a consequent tendency to a reduction of prices. The shipping and locomotive coal trade, however, remains active, and it is expected that fresh contracts for this class of fuel will not be completed without an advance on the rates in operation six months ago.

SHEFFIELD, 18th June, 1890.

IRON AND STEEL TRADES.—Two of the largest concerns in this district have testified by the dividends just announced to the improvement in trade during the past year. Messrs. John Brown & Co., Limited, of the Atlas Works, show a net profit for the year of £115,971 17s. 2d., which, with the balance forward of last year of £9,356 14s. 11d., gives an undivided profit of £125,328 12s. 1d. Out of this the directors recommend a dividend at the rate of 7½ per cent. on the ordinary shares, in addition to the usual 5 per cent. on preference shares. They also write off £50,000 for goodwill, and carry forward £10,547.148. The Staveley Coal and Iron Company, Limited, have a report equally good in every way. The firm have done well, and never were so full of orders as at the present time.

NORTH STAFFORDSHIRE, 18th June, 1890.

THE IRON TRADE.—The downward course of prices continues, and competition is becoming so keen that little hopes of an improvement are entertained just now. Something will have to be done to reduce the cost of production of the raw material, and a reduction in wages all round must shortly occur. It is a fact that current prices are absolutely below the cost of production. It is likely that more blast furnaces will shortly be blown out.

NORTH STAFFORDSHIRE MINING INSTITUTE.—There was a large attendance of members at a meeting of this Institute on Monday last, when Mr. Shepherd, from the offices of the engineers of the proposed ship canal from Birmingham to Liverpool, by way of the Potteries, attended and explained the contemplated scheme. The estimated cost of the canal, irrespective of the necessary outlay for land, is £3,000,000 sterling. The navigation is intended to accommodate vessels to the extent of 400 tons. The scheme is being actively supported by many local gentlemen, and it is likely that Parliamentary powers will shortly be sought.

CARDIFF, 18th June, 1890.

IRON AND STEEL.—Pig iron prices are a little firmer, and in some instances sales have been effected at 6d. per ton above the prices current at the commencement of the month. Hematite is quoted at 54s. 6d. to 55s. for makers' iron. Steel bars for tinplates are quoted at £5 10s. Iron ore is without appreciable change. Rubio is quoted at 14s. 6d. c.i.f. Cardiff and Newport, 15s. 3d. Tees, 15s. 6d. Glasgow, for 50 per cent. iron guaranteed.

COAL AND COKE.—The steam coal market is firm. The shipments during the past week amounted to 250,000 tons. Prices have advanced a little, and for ordinary first-class quality 15s. 3d. has been obtained; seconds, 14s. 3d. to 14s. 9d.; thirds, 13s. 3d. to 14s. Small steam shows an advance of 3d., being now 9s. 9d., and No. 3 Rhondda, small, 11s. 9d. to 12s. 3d. The weakness in the coke trade seems to become more pronounced, consumers having overbought themselves at the commencement of the year. Household sorts are quiet. Freights continue low, and already several steamers have been laid up in the northern ports; and one or two leading shipowners in this district have expressed their intention to follow this course rather than encroach on their reserve funds by running their boats at a loss.

BARROW-IN-FURNESS, 18th June, 1890.

HEMATITE PIG IRON.—There is a quiet market this week for hematite pig iron. Business is slow alike on home and foreign account. The Bessemer trade is quiet because of the limited requirements of steel makers, and there is not much doing in the ordinary hematite trade. Warrants are quoted at 50s. 6d. per ton, but makers are still asking 54s. to 57s. per ton.

STEEL.—Steel makers are busily employed five days a week. Orders are offering to a fair extent for rails at prices varying from £4 10s. to £5 per ton for heavy sections, light sections being at £6, and colliery rails at £7 per ton. The trade in steel shipbuilding material is quiet, and there is no life in the trade in blooms, tinplate bars, hoops, steel wire, billets, &c.

SHIPPING.—There is still a depression in shipping compared with last year. The exports of pig iron and steel during the week have represented 18,019 tons, compared with 18,539 tons in the corresponding week of last year. The aggregate shipments since January have been 492,584 tons, compared with 502,243 tons in the corresponding period of last year.

MIDDLESBROUGH, 18th June, 1890.

PIG IRON.—There was no great muster on 'Change yesterday, but there was some good business done. The improved price was maintained, and it is likely to become better still, seeing that the shipments are good and stocks are falling. No. 3 G.M.B. Cleveland cannot now be got under 41s. 6d. from makers; some, indeed, will not sell under 42s., special brands being from 1s. to 2s. more. In warrants, Cleveland No. 3 G.M.B. cannot be had under 41s. 5d. to 41s. 6d. cash. Foundry iron is becoming scarce. In hematite iron, East Coast brands can be had for 54s. per ton f.o.b. makers' iron, and West Coast hematites at 50s. 7d. to 50s. 8d. per ton cash. The stock in Connal's stores has decreased during the week by 1,114 tons, standing at 99,123 tons on Monday.

SHIPMENTS OF PIG IRON.—Considering that we are approaching the dead season of the year the shipments are exceedingly good. Up till Monday the shipments for June amounted to 38,785 tons, against 35,878 tons to the 16th of May, and 33,560 tons to the 16th of June last year. The shipments to Scotland are improving, now that Cleveland is approaching its normal price compared with Scotch. Germany and Holland are also taking more, as well as other foreign countries.

MANUFACTURED IRON AND STEEL.—There is a better feeling in the finished iron trade and more inquiry. Prices are much the same however. Iron ship plates are at £5 7s. 6d.; angles, £5 5s.; bars, £5 12s. 6d.; steel ship plates, £6 10s., and £6 7s. 6d. would be taken; angles, £6 5s. to £6 7s. 6d. Steel rails are rather better, and £5 would now have to be given for them. Some steel works are still running short time.

SHIPBUILDING.—This industry, which has been very active for some time past, shows signs of falling off. A few orders came lately, but now they seem to have ceased, and the future has so far not much to make builders hopeful.

SUNDERLAND, 18th June, 1890.

SHIPBUILDING.—No new contracts are being booked. Considerable interest has been occasioned in the launching of a large steamer by Mr. James Laing from his higher yard at Deptford. Fourteen days ago the steamer's launch began, but, unfortunately, the vessel stopped in its course. A number of tug steamers were employed to endeavour to complete the launch, but in the attempt they slued the vessel, and caused her to drop on her bilge. The ways have since been relaid, and a further distance traversed. The completion of the launch, however, is still delayed. The river is very narrow at Deptford, and the declivity of the launching ways, especially for large vessels, is usually minimised.—A specialty that is growing in favour with shipbuilders is Mason's skylight, in which the flap is pivoted at mid-length. The s.s. "Taff," recently launched by Messrs. Osbourne, Graham, & Co., North Hylton, has the engine-room fitted with several of these skylights, and the same firm is similarly fitting another steamer.

SHIPPING.—The probability of tonnage being laid up on account of the unremunerative freights has been realised, and upwards of thirty steamers are now idle on this and the adjoining river. As yet there has been no recovery of moment, although Black Sea rates are not quite so low as they were a few days ago. It looks as though the bad times had again set in for shipping investors.—Despite the stoppage of Monkwearmouth Colliery, the coal shipments of the last week were satisfactory. They amounted to 77,866 tons, an increase of 14,222 tons over the previous week. Of the total shipments, 38,010 tons went coastwise, and 39,858 to foreign ports. The other shipments included 1,192 tons of coke, 50 tons of crystals, 400 tons of firebricks, and 15,000 dozen glass bottles.

NEWCASTLE, 18th June, 1890.

THE COAL TRADE.—The shipments of coal and coke at Tyne Dock during the week ending June 14th amounted to 126,763 tons, being an increase, as compared with the corresponding week in 1889, of 37,505 tons.

ENGINEERING.—Messrs. R. & W. Hawthorn, Leslie, & Co., who for some years past have had their marine engineering department largely occupied with Admiralty contracts, are now understood to be the recipients of further important orders from the same source. These include the engines and boilers for two cruisers now building at two of Her Majesty's dockyards, and, with the Government work already in hand, will keep the place busy well into next year. Messrs. Clark, Chapman, & Co., of the Victoria Works, Gateshead, have some good orders for their patent windlass (the only one manufactured having riding spring brakes), and are also busy in the production of steam winches, donkey boilers, &c. Though few new orders have been booked lately, it is not anticipated that any serious lack of work will be felt in the establishment during the present year. Messrs. Geo. Angus & Co., manufacturers of Amianthus cloth packing and other engineering specialties, continue to be well supplied with orders, and are resorting to overtime in some departments with a view to meet customers' requirements.

SEAMEN AND FIREMEN'S WAGES.—A conference between members of the newly-formed Shipowners' Association and representatives of the Sailors and Firemen's Union has been held in Newcastle to discuss a proposal put forward by the former for a reduction of wages. A long discussion took place, but nothing definite was arrived at, the sailors' representatives declining to submit to any reduction of the present rates. The consideration of the subject will, it is thought, be resumed at a future conference, the date of which, however, is not yet fixed.

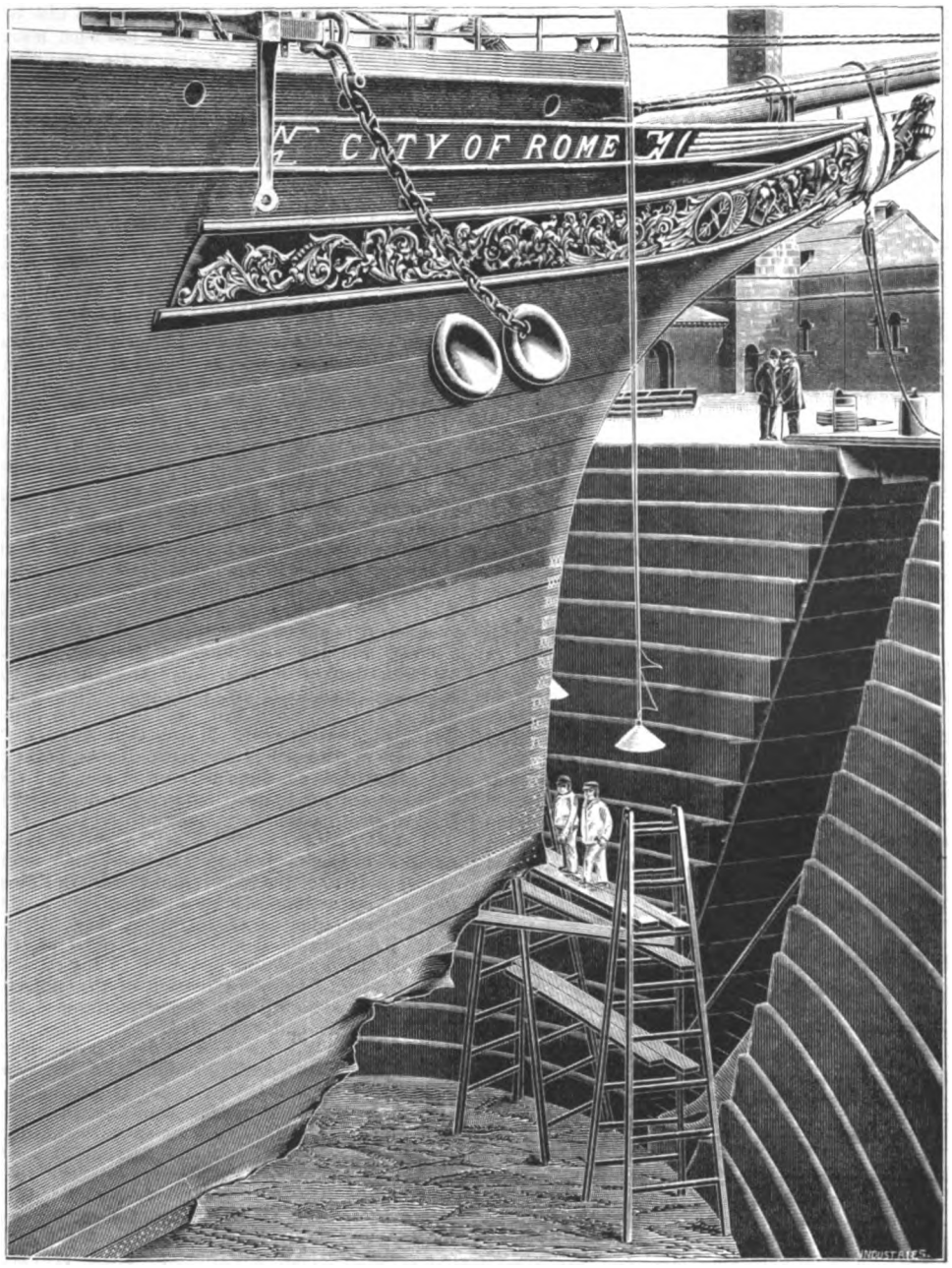
SHIPBUILDING.—No new orders have recently been booked by Tyneside shipbuilders, and the symptoms of incipient slackness in the industry are becoming more marked. Two of the leading establishments on the river have quite half their building space unoccupied, and in several other cases the vacant berths outnumber those that are in use. Shipbuilders, indeed, are loth to take contracts at the prices now obtainable, for while the latter are almost as low as at the worst of the last depressed period, the prices of everything entering into the cost of production—excepting only iron and steel—still stand at the abnormally high rates attained last year, and new contracts negotiated under these conditions must consequently involve loss rather than profit. The lessening of work in the yards has necessarily caused the discharge or suspension of a large number of operatives, and as under existing circumstances this thinning of the ranks of the employed is bound to continue, the outlook for the coming winter is the reverse of cheerful.

DUNDEE, 18th June, 1890.

JUTE AND FLAX TRADES.—The jute market is again a little easier here, but prices have undergone little change. Burlaps, 40in. 10½oz., are quoted at 5¾c. per yard in the New York market. The prospects of the new jute crop are beginning to attract attention. Reports are favourable, and it is expected the crop will be early. The market for loose jute in Calcutta is quiet. First marks of the new crop are quoted on this side at £16 to £16 5s., but there are no transactions reported. The arrivals of jute at this port last week were large. Seven vessels, with a united tonnage of 13,430 tons, came to the port and brought 107,253 bales of jute. Goods are not moving off rapidly, but prices are maintained. Jute yarns are in rather less request, and prices tend to be easier. Prices of Hessians are also rather in favour of buyers. Re-sellers are reported to be obtaining orders by underselling manufacturers. There is a steady business passing in sacking, bagging, and tarpaulin. A strike among the calender workers has been impeding business to a considerable extent during the past fortnight, and it is reported that some buyers have cancelled orders, owing to their being unable to obtain delivery of goods. In flax business is confined pretty much to the satisfaction of immediate wants. The demand for flax yarns is quiet. Orders for linen goods are not coming in freely, and manufacturers are not so well booked forward as they would like. Makers of the finer class of linen goods are, however, well employed, and reports from the Fifeshire district state that a satisfactory feeling is prevalent, the demand being active and prices firm.

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ACCIDENT TO THE "CITY OF ROME."



View of the Damaged Stem.

THE SUEZ CANAL.

The report presented by M. De Lesseps to the shareholders of the Suez Canal at their recent annual meeting was of the most favourable kind. It stated that the gross receipts were 69,000,000fr., and the expenditure, with interest at 5 per cent., 32,000,000fr., leaving 37,000,000fr. available for distribution as dividends among the shareholders, being at the rate of 18 per cent., and a slight advance on the previous year. The reserve fund has stood for several years at the highest point required by the statutes, and consequently no deduction had to be made on that account. The works had been extended and materials renewed at a cost of 9,600,000fr., and a further sum of 13,000,000fr. is still available for the same purposes, so that the agreement made in 1886 for the widening and deepening of the canal is being faithfully carried out. Ships drawing as much as 26ft. of water can now pass through it, and the speed is being gradually accelerated. The management appears to be very economical, for the working expenses, apart from the repayment of capital, amount only to 11½ per cent. of the revenue. During last year 3,425 vessels passed through the canal, representing a tonnage of 6,783,187, and yielding an income of 64,412,000fr. The electric lighting arrangements enable a much larger proportion of the ships to pass through during the night, the percentage last year being no less than 71 per cent. of the total traffic as compared with 46 per cent. in 1888. Altogether the position of the canal is most favourable; the only regretable feature about it is that the Egyptian people derive such a small proportion of the direct gain, its Government having bartered it away years ago for what now appears a ridiculously small sum. It was entitled by the constitution of the company to 15 per cent. of the profits after the first charges were met and after 5 per cent. was paid to the shareholders, but it sold its right to this during the whole period of the company's concession to the Crédit Foncier of France for what is little more than four years' purchase of the dividend paid last year. The shares held by the British Government have hitherto only been paid 5 per cent., although they have quadrupled in capital value, owing to the fact that they will be entitled to the full dividend in 1894.

THE SOCIETY OF ENGINEERS.

By the courtesy of the management of the Thames Ironworks and Shipbuilding Company a party of the Society of Engineers, numbering over 100, were conducted over the works on Tuesday last. No less an area than thirty acres of ground is included in the company's operations. There are two large dry docks facing the river, also an extensive forge, rolling mills, foundries, and engine shops. The work done embraces the highest types of warship construction, some of the most important armourclads of our own and foreign Governments having been built there. The company are also able to compete successfully for fast passenger steamers, or where any peculiarity of design is necessary. Any urgent repairs to the fleets which frequent the Thames are very likely to fall into the firm's hands by reason of the accommodation their docks and wharves afford. In addition, a considerable amount of bridge and girder work is done by the firm.

The "Warrior," the first British ironclad, was laid down at this yard, and two fast cruisers are now on the stocks, the "Blenheim" and "Grafton," and when the former is launched, on the 5th of July, a sister ship to the latter will be at once commenced. These are all for our own Government. The "Grafton" has only been in progress eight months. She, therefore, afforded a considerable opportunity to visitors for inspecting the system on which modern men-of-war are designed. She will have twin screws and engines of 12,000 i.h.p., and it is anticipated that she will attain a speed of over 19 knots. The great attraction was undoubtedly the "Blenheim," this vessel being very far advanced towards completion. Indeed, the "ways" appeared to be almost ready for launching. The "Blenheim" is of 9,000 tons displacement, and has been one year and nine months on the stocks. Her engines will be 20,000 i.h.p., and will be connected to twin screws. These are expected to propel the ship at 22 knots with forced draught. The main dimensions of the vessel are:—Length, 375ft.; breadth, 65ft.; and depth, 38ft. The armament will be two 22-ton and ten 6in. breechloading guns, sixteen three-pounder quick-firing guns, together with Nordenfelts and four tubes for torpedo warfare. It will thus be seen that the ship will be one of the fastest and most powerful cruisers in the Navy.

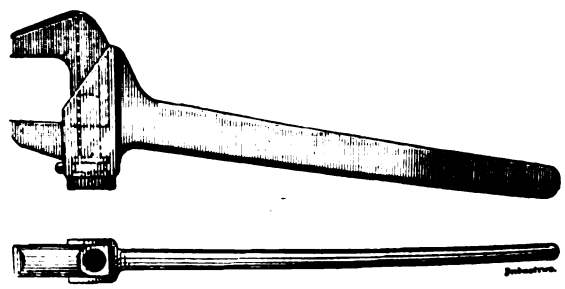
At the termination of the tour, after a vote of thanks had been accorded the company by Mr. Henry Adams, the President of the Society, it was stated that trade on the London river was more promising now than it had been for the past five years. Some four thousand men were now employed at the company's works, and if labour troubles could be avoided there was a likelihood of prosperity for some time to come. Members were specially asked to note the quality of the work they had seen, and the "Warrior" was quoted as an example of excellent past workmanship.

THE ACCIDENT TO THE "CITY OF ROME."

In our last week's issue we gave a short account of the accident which happened to the "City of Rome" upon her last homeward passage; and we are now enabled, by the reproduction of a photograph taken the morning after she was docked in the Birkenhead Graving Dock, to illustrate the extent and nature of the damage done to the vessel's stem. It will be seen that the damage is far more serious than was first anticipated, and if it had not been for the efficiency of the bulkheads the vessel would no doubt have been completely wrecked, with a fearful loss of life. Twenty plates were completely torn off the stem and five ribs were broken, and many others displaced and injured. Immediately after the water was pumped from the graving dock, a gang of men from Messrs. Clover, Clayton, & Co.'s yard, Birkenhead, commenced the repairs; by working double shifts these have progressed rapidly, and it is expected that the vessel will be ready to proceed to New York on the 28th inst.

IMPROVED CLYBURN SPANNER.

We illustrate an improved Clyburn spanner which is being put upon the market by Mr. John Woodward, St. Ann's Square, Manchester. The chief feature in the spanner is the formation of the sliding jaw, and the method of moving it. As will be noticed, the controlling screw is revolved from one side of the spanner head instead of the bottom of the jaw as usual, and the movable



jaw is so made that even when fully open it has a good bearing to resist the thrust put on it when in use. The spanner is made in malleable iron at a low cost, and is thoroughly strong and serviceable, without being heavy. The adjustment is made with more ease and exactness than with the older type.

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Advertisements intended for insertion in the current week's issue should reach our London Offices not later than first mail delivery on Thursday morning. Scale of charges for displayed advertisements on cover and inside pages will be forwarded on application. Orders for single advertisements must be accompanied by payment in order to insure insertion, the charge for which is 2s. 6d. for the first four lines or under, and 8d. for each additional line. Situation advertisements (Vacant or Wanted) 1s. for two lines or under, and 6d. for each additional line—which averages eight words. While all practical regularity in the insertion of serial advertisements will be observed, it can only be absolutely guaranteed in the case of those ordered to appear weekly.

As we go to press early with certain of our advertisement pages, all Alterations to Standing Advertisements should reach the Publisher not later than 2 o'clock on Wednesday afternoon in each week.

All accounts are payable to GEO. CAWLEY, *358, Strand, London, W.C. Cheques should be crossed Manchester and Liverpool District Banking Co., Limited, 75, Cornhill, London, E.C. Post Office Orders should be made payable at the Post Office, 369, Strand, London, W.C.*

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

Contents.

	PAGE
Japanese Exhibition at Tokio (*Illus.*)	577
Research Committee on Marine Engine Trials (*Illus.*)	577
The Experimental Value of the Steam Jacket	579
Machinery and Metals in Hungary	580
Meldrum's Breeze Furnace (*Illus.*)	580
Manwell's "Ready Life Saver" (*Illus.*)	581
Lamp Cleaning Machine (*Illus.*)	581
Foreign Industries (Corres.)	582-583
Clyde Shipbuilding in May	584
The Royal Agricultural Show (*Illus.*)	584
The "Haseley Tedder" (*Illus.*)	584
The Tower Bridge	584
Royal Statistical Society	585
Prices Current	585
Shipbuilding Notes	585
Home Industries (Corres.)	586-587
The Suez Canal	588
The Society of Engineers	588
The Accident to the "City of Rome" (*Illus.*)	588
Improved Clyburn Spanner (*Illus.*)	588
British Shipping and Shipping Facilities	589
The Foreign Trade of Japan in 1889	590
The Royal Society Conversazione	590
Legal Proceedings	591
Letters to the Editor:—	
Communication Between France and England	591
British Manufactures on the Continent	591
Description of a Commercial Trial of a ½-Kilowatt Electric Lighting Plant (*Illus.*)	591
Protection in Italy	592
The Wolseley Sheep Shearing Machines	592
Books Received	592
Reviews	592
The Great Tower for London (*Illus.*)	593
The Board of Trade and Electric Lighting	594
The American Institute of Electrical Engineers (Corres.)	594
The Physical Society	595
Notes	596
"Industries" Patent Record:—	
Applications and Acceptances	597-598
Illustrated Abridgments	598-600

To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

We cannot undertake to return manuscripts or drawings, and must request correspondents to keep copies.

BOUND VOLUMES OF **Industries**,

In half calf, gilt lettered, may be obtained at our London, Manchester, and Glasgow Offices, Price 20s. each.

Industries:

FRIDAY, 20TH JUNE, 1890.

BRITISH SHIPPING AND SHIPPING FACILITIES.

WITHIN the last few days a very remarkable Blue Book has been published, showing the astonishing progress that has been made in the shipping trade of the United Kingdom during the last two years. It shows the recent progress of the shipping trade of the United Kingdom with foreign countries and British possessions, and gives full details of the entrances and clearances into and from every port in the United Kingdom. It is very gratifying to find from this bulky statement that the shipping trade was larger in 1889 than in any former year in the history of the country, and that the extent of progress made during the last three years has been something truly portentous. This remark applies equally to the home and to the foreign trade, but more especially to the latter. The total entrances and clearances in 1889 reached the enormous figure of 161 millions of tons, employing 730,000 vessels. This compares very favourably with the returns for 1887, when the entrances and clearances amounted to only 149 millions of tons, an increase of some 12 millions of tons, and when 676,000 vessels, or 54,000 less, were engaged in the business of our ocean transport.

The following statement shows how the entrances in the foreign trade of our principal ports compare in 1887 and 1889:—

	1887.		1889.	
	Ships.	Tonnage.	Ships.	Tonnage.
London	10,457	6,880,000	10,730	7,550,000
Liverpool	4,477	5,186,000	4,689	5,789,000
Tyne Ports	4,653	2,368,000	5,474	2,953,000
Cardiff	3,620	2,536,000	3,872	2,913,000
Hull	3,106	1,816,000	3,266	2,008,000
Glasgow	939	972,000	957	1,058,000

The enormous preponderance of London over all other ports is the point in these figures that will most arrest attention. The Thames, indeed, has long maintained the lead as an import centre, and is likely to continue to do so, owing to its great distributing facilities and the enormous population whose food supplies depend on the sea. The exports, however, are tending rather to go to the other ports, as will be seen from the next table of clearances from the same ports in the same years:—

	1887.		1889.	
	Ships.	Tonnage.	Ships.	Tonnage.
London	8,094	5,284,000	8,029	5,566,000
Liverpool	4,005	4,758,000	4,064	5,147,000
Tyne Ports	6,608	3,665,000	7,970	4,786,000
Cardiff	5,925	4,714,000	6,281	5,401,000
Hull	2,769	1,535,000	1,827	1,582,000
Glasgow	1,385	1,464,000	1,439	1,621,000

One of the features of this table is the rivalry between London and Liverpool. Some years ago London was behind Liverpool as a port for exports, whereas now it appears that London has got a considerable lead, and that, too, in spite of the fact that the number and tonnage of the vessels on the Liverpool register—at any rate, in sailing ships—is higher than that of London. No doubt the difference in favour of London is largely due to the better facilities afforded to vessels, but that is not the only reason. It is not a secret that the Liverpool dock dues are exceptionally high, and they are not likely to command the lion's share of the shipping trade if they keep up such relatively high dues. Then, again, vessels can now enter the Thames at almost all hours of the day and night, whereas in the case of Liverpool they are bound to wait for tides and for the convenience of the port authorities. Liverpool, however, has the advantage of being much nearer than London to most of the principal foreign ports, and more especially to the chief ports of the United States, with which our largest business is done.

One of the most remarkable of the recent developments of our local taxation is that incurred by port and harbour authorities. This is, of course, the price that we have to pay for the possession of the most remarkable and efficient shipping facilities in the world. The growth of this system is comparatively modern. Even Liverpool, which has a stream so strong, and a situation so exposed, as to threaten serious danger to shipping, did not begin to provide dock accommodation until 1709, and this dock supplied all the requirements of the port for half a century, when a second one was commenced. But Liverpool has now a series of some thirty or more great docks, with a total water area of over 600 acres, approached by some fifty locks with gates varying from 40ft. to nearly 100ft. in width. Besides these, there are many graving docks for the repair of ships, and it has been well remarked that these, with the warehouses, sheds, and machinery, "make up an aggregate of works which, though not perhaps so showy as some of the architectural productions of the Romans, or of some modern nations, are, when compared with those of Birkenhead, unrivalled as specimens of solid utilitarian grandeur."

There are, however, cases where the results do not appear to have quite justified the high expectations formed as to the results of the works projected or carried out for the improvement of the trade of a port. Barrow-in-Furness may be quoted as an example. Up to a certain point the growth of this port was remarkable. The town and trade increased with phenomenal rapidity. The obscure fishing village became a considerable town, with mushroom-like advances. The pilgrim fathers of the place looked forward to its becoming a second Liverpool, and, perhaps, even putting that notable mart of shipping in the shade. They, therefore, undertook an expenditure of about two millions on the docks and quays, but against this their total income from 1868 to 1883 was only £116,838, a sum which is only equal to the payment of 5·8 per cent. on the expenditure for a single year! During the same period the tonnage of the vessels using the docks increased from 255,000 to 539,000 tons. The total tonnage that had entered and cleared from these magnificent docks to the end of 1882 was about 5½ millions, and the average receipts or tolls received per ton was about fivepence. In 1889 the Barrow entrances and clearances only amounted, for the foreign trade, to 196,000 tons.

The tendency of the shipping trade to undergo rapid expansion within recent years may be illustrated by a very large number of examples. That of the Cardiff Docks is perhaps one of the most striking, as it illustrates the recent development of the trade in respect alike of the greater tonnage and the larger size of vessels dealt with. In 1863 the total number of vessels entering these docks was 9,299, and they registered a total of 1,616,000 tons. Twenty years later the number of vessels was 9,489, and the tonnage 3,482,000. In 1889 19,256 vessels entered and cleared, with 9,487,000 tonnage. In the first interval there was an increase of 1,866,000

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tons, or about 109 per cent., in the tonnage, but of only 190 in the number of vessels. Put in another way, the average size of the vessels that frequented the Cardiff Docks had increased from 174 to 370 tons during these twenty years, but, of course, both averages include a number of very much larger vessels, for which extra accommodation had to be provided, alike in the way of deeper docks, greater quay space, wider dock gates, and otherwise. These docks, like all docks that are to be equal to the requirements of the present day, must be capable of accommodating the largest vessels afloat.

It is interesting to compare the British shipping returns with those of France, our nearest neighbour. The commerce of France by sea is carried on at fifty principal ports, and a few smaller ports, the principal being the ports of Marseilles, Havre, Bordeaux, and Cette. At these ports in 1888 the number of ships that entered and cleared, with their tonnage capacity, and the actual tonnage of merchandise transported, were as under:—

	No. of Vessels.	Tonnage Capacity.	Tons Carried.
Marseilles	13,111	8,610,000	4,235,000
Havre	9,921	4,387,000	2,535,000
Bordeaux	20,622	3,067,000	2,457,000
Cette	4,980	2,175,000	1,014,000
Dunkirk	4,038	1,645,000	1,806,000
Total of fifty chief ports	125,124	30,218,000	20,010,000
Total for all French ports	156,282	32,236,000	21,263,000

The *rapport* between the tonnage capacity of the vessels employed in 1887 and the tonnage of merchandise actually carried varied considerably as between one port and another, being as low as 0·231 in the case of Calais, and as high as 1·120 in the case of Bayonne. There are no similar returns of tonnage capacity issued officially for England, which is a matter for regret, as a very useful comparison might thereby have been instituted.

The French Government, during the last ten or twelve years, have expended large sums of money over the principal ports of their country, in order to adapt them better for the purposes of commerce. This expenditure has been, to a certain extent, justified by the results, but not to the extent that might have been expected. The exports and imports of general commerce at each of the principal French ports, in each of the years 1878 and 1887, have been as under (1 = 1,000 tons):—

	Year 1878.		Year 1888.	
	Imports.	Exports.	Imports.	Exports.
Marseilles	2,145	884	2,219	1,218
Havre	1,526	366	1,410	549
Bordeaux	823	442	1,281	718
Dunkirk	878	106	1,299	183
Rouen	577	145	935	161
St. Nazaire	439	74	658	99
Cette	413	158	719	190
Dieppe	509	80	500	81
Boulogne	316	61	261	104
Calais	317	25	199	41

The above figures do not include the returns of what are called *commerce spécial*. Such as they are, however, they comprise all but a fraction of the trade, and they show how infinitely superior is the commerce of the United Kingdom, and how much more rapidly our own trade is being developed.

THE FOREIGN TRADE OF JAPAN IN 1889.

The returns of the Japanese Customs for the year 1889 of the foreign trade of the country show an increase of a little over $5,000,000 as compared with 1888, the figures being $136,164,472, against $131,160,444, and the increase was due almost entirely to exports, which amounted last year to $70,069,705, while the imports remained almost stationary. The total trade was distributed as follows:—Great Britain and her possessions, $55,498,530; United States, $31,426,044; France, $17,592,893; China, $14,642,205; Germany, $6,526,282. Although these figures show that British trade with Japan is equal to that of the United States, France, and Germany together, still it ought to be noted that British trade, excluding Hong Kong, has fallen by about $3,000,000 during last year, while that for the United States shows an increase of almost the same amount. That of France and Germany shows a considerable decrease. In the British imports the chief decrease is in British and Indian yarns—over a million dollars—caused, no doubt, by the growing manufacture of yarn in Japan, and the consequent increase in the import of raw cotton from China. In 1887 this latter item was under a million dollars; in 1889 it was nearly five millions and a-half. The other departments of British trade which have fallen off are gunpowder, bar and rod iron, rail iron, pig iron, iron nails, machinery, Portland cement, grey shirtings and woollen cloths. On the other hand, there was an increase in blankets, Turkey reds, cotton drills, cotton velvets, hats and caps, plate and sheet iron, railway carriages, steam boilers, and steel.

We have heard a good deal about the increase of German trade in Japan, but, with the exception of flannels, the increase appears to have been in the less important departments. The German trade in flannels continues to increase with great rapidity, a fact which we believe to be largely due to the bad material which the British merchants supplied some years ago. In 1887 the trade amounted to $222,267, in 1888 to $406,601, and in 1889 to $886,288, while last year the British trade in flannels was only $129,686. The chief increases in German trade took place in the following articles: analyne dyes, gunpowder, iron nails, lamps, iodide of potash, salicylic acid, sheet zinc, and satins—that is to say, in articles the manufacture of which require special technical skill, many of which the Germans have monopolised in this country as well as in Japan. Taken, however, from 1887, the British trade, which is eight times the bulk of that of Germany, has increased 37 per cent., while that of Germany increased only 22 per cent., so that the fears regarding Germany ousting Britain are not well founded. The great staple of American trade in Japan is kerosine, which was imported last year to the value of $3,783,193, while a considerable trade was done in leather, clocks, and flour. One-half of the French trade with Japan is in *mousseline de laine*, while the remainder is taken up with fancy goods of all kinds.

America is the best customer of Japan for the export of her products, of which the chief are silk and silk goods, sulphur, tea, and rice. Great Britain takes rice, camphor, silk goods, tobacco, and copper. Of late years France and the United States have become the chief markets for Japanese silk, and the export is steadily increasing, while that of tea is diminishing.

THE ROYAL SOCIETY CONVERSAZIONE.

The second conversazione of the session was held on the 18th inst., in the Society's rooms, at Burlington House.

Great interest was shown in Professor Fleming's demonstration of some of Professor Elihu Thomson's recent experiments on electromagnetic repulsion. The apparatus employed for the demonstrations was the same as exhibited by Professor Thomson at the Paris Exhibition last year, and was lent by him for exhibition to the Society. A striking experiment consisted in placing rings of good conducting material, such as copper or zinc, over the upper end of the vertically placed core of a powerful electromagnet excited by an alternating current supplied by a 10 h.p. transformer, lent by, and fed from the circuits of, the London Electric Supply Corporation. When the electromagnet was excited by this alternating current the rings were projected upwards to a considerable height. By placing a paper cylinder over the end of the core and slipping the rings on to it, they were shown suspended in the air, and two rings placed over the paper cylinder at the same time were seen to attract each other owing to the currents induced in them being in the same direction and phase. A copper disc placed over the end of the electromagnet core was shown to be powerfully repelled. In addition to these experiments, various others made by Professor Thomson, and described in Professor Fleming's lecture before the Society of Arts last month, were repeated and explained.

Mr. Shelford Bidwell exhibited his interesting experiments of the electrification of a steam jet, which the author considers may throw some light on the intense blackness, often tempered by a lurid yellow glow, of thunderclouds. The experiment was originally shown at a meeting of the Physical Society. Among other experiments which have been exhibited at the Physical Society, and described elsewhere in our columns, we may mention Dr. Kœnig's experiments on the production of beats and beat-tones, exhibited by Professor S. P. Thompson, with the aid of some of Dr. Kœnig's magnificent apparatus, which he brought over for exhibition at a recent meeting of the Physical Society. Mr. C. V. Boys also repeated his oscillating spark experiment, and exhibited his series of photographs illustrating the formation of drops, and the thaumatrope constructed from the photographs.

Professor Roberts-Austen gave an experimental demonstration of the determination of the melting point of gold by means of Le Chatelier's pyrometer, consisting of a thermo-couple, composed of platinum and platinum alloyed with 10 per cent. of rhodium, connected with a dead-beat d'Arsonval galvanometer. The pyrometer scale had been calibrated by heating the thermo-couple to certain known temperatures determined by means of the air thermometer.

Professor Worthington exhibited his ingenious apparatus for stretching a liquid and measuring simultaneously the stress and strain. The liquid (alcohol was the one shown) is deprived of air by prolonged boiling, and sealed in a strong glass vessel, which it almost fills at a particular temperature. On raising the temperature the liquid expands and fills the whole. On now lowering the temperature the liquid is prevented from contracting by its adhesion to the walls of the vessel, and remains distended, filling the whole and tugging at the walls. The tension exerted is measured by means of the change in capacity of the ellipsoidal bulb of a thermometer sealed into the vessel, and called the "tonometer." This bulb becomes slightly more spherical, and therefore more capacious, under the pull of the liquid, and the mercury in the tonometer stem falls. The tension corresponding to the fall is previously determined from observation of the rise produced by an equal pressure. The liquid is caused, at any desired instant, to let go its hold and spring back to its original volume by heating for a moment, by means of an electric current, a fine platinum wire passing transversely through the capillary stem that forms part of the vessel. The space left vacant in the tube represents the amount by which the volume of the liquid was extended. A correction has still to be applied for the alteration of the volume of the glass vessel. By means of this instrument measures have been obtained up to a tension exceeding seventeen atmospheres, or 250lb. per square inch.

The Postmaster-General exhibited, under the superintendence of Mr. W. H. Preece, three of Hughes' type-printing telegraphs, which were connected with Paris, Berlin, and Rome respectively, and during the evening the President held communication with Professors Helmholtz and Dubois Reymond in Berlin, Professor Mascart in Paris, and Professor Cannizaro in Rome.

Mr. W. B. Croft exhibited a series of breath-figures, showing that polished surfaces placed near to bodies in low relief often take an impression of the detail, which is made visible by breathing upon the surface. When these figures are examined with a microscope, water particles are found to cover the entire surface, the effect being black or white according as the particles are larger or smaller.

Mr. G. F. Symons exhibited a "brontometer," or thunderstorm-measurer, devised by himself and MM. Richard Frères, the makers of the instrument, in order to investigate the causes of the rapid barometric variations frequently observed during heavy rains and thunderstorms. The endless paper is carried under the recording pens at a speed of six feet an hour, so that the time of any phenomenon can be easily read to half a second, each 60th second being automatically recorded. The velocity of the wind is continuously recorded by one of Richard's anemo-cinemographs, and the atmospheric pressure by a modified form of their statoscope, which is so delicate as to give 30in. for each inch of the mercurial barometer, or about three times the scale of a glycerine barometer. There are mechanical arrangements whereby the observer records:—(1) The commencement, variation in intensity, and termination of rain; (2) the instant of each flash of lightning; (3) the commencement and duration of each clap of thunder; (4) the commencement, variation in intensity, and termination of hail. As all these phenomena are recorded on one paper, with a single time scale of 0·02in. per second, it is evident that their precise sequence and correlation will be recorded.

Dr. Pole showed a series of diagrams illustrative of colour blindness, and Dr. Grossmann exhibited his apparatus for testing for colour blindness, consisting of a series of test plates, each built up of small squares of glass of various tints in pairs, the squares being arranged so as to show a letter or figure in one tint upon a ground of the other.

The Director-General of Ordnance Factories exhibited the new magazine rifle now being made for the British Army. It has a calibre of 0·303in., is on the bolt principle, and is provided with a detachable magazine underneath to hold eight cartridges; a cut-off on the right side enables it to be used as a single loader. It has two sets of sights; the ordinary ones are graduated up to 1,900 yards, the long range sights on the left side up to 3,500 yards. The sword-bayonet, which is attached

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underneath the barrel, has a double-edged blade 12in. long.

The Director-General of the Geological Survey exhibited a series of specimens illustrating deep borings in the South of England, and also a series of specimens illustrative of dynamical metamorphism in rocks. The effects of mechanical movements, even among the comparatively young and soft rocks of the South of England, were illustrated by two specimens from the under surface of a "thrust-plane" in the vertical chalk of the Dorsetshire coast. They show how the chalk has been indurated, smoothed, and polished by the movement of the overlying mass.

Mr. Norman Lockyer and Mr. Isaac Roberts exhibited some interesting astronomical photographs, and the Royal Meteorological Society showed a series of photographs of lightning flashes and of electric sparks, illustrating the formation of dark images of lightning flashes. They also exhibited a series of photographs, showing the devastation caused by the tornado at Rochester, Minnesota, in August, 1883. The great force of the wind is illustrated in a striking manner by two of the photographs, one showing a horse impaled on a large branch of a tree, and the other, pieces of straw driven end-on into the bark of trees.

There was also a large number of interesting natural history and miscellaneous exhibits. Of the botanical exhibits, the most important from an industrial point of view was a series, shown by Mr. D. Morris, of seed and seedlings of the sugar cane.

Legal Proceedings.

OAKEY *v.* FLATAU.

This was an action tried before Mr. Justice Kay on the 9th inst., for an injunction to restrain the infringement of a registered trade mark, and damages for the wrongful passing off of defendant's goods as being of plaintiffs' manufacture. The plaintiffs are Messrs. John Oakey & Sons, the manufacturers of the well-known "Wellington" knife polish, and the defendant is Mr. Wm. Flatau, trading and sued as W. Flatau & Sons. The defendant is, like the plaintiffs, a dealer in knife polishing powder, but he does not manufacture what he sells, and the act complained of was his use of a label so closely resembling the plaintiffs' trade mark as to be calculated to deceive the public. It was a point made against the infringing mark that the resemblance to the original was rendered closer by the employment of the same colours.

In the result, the learned Judge held that the plaintiffs' case had been made out, and gave judgment accordingly, remarking that the defendant had gone as near as he dared go to the exact imitation of the plaintiffs' label. It had been proved in the course of the case that knife polish was a commodity which was purchased in large quantities by servant girls and persons in very humble circumstances. This, therefore, was the class of persons whom the Court was called upon to protect, and he entertained no doubt that the defendant's label was calculated to deceive them. Referring to the circumstances in which the design of the label was produced, the learned Judge observed that the defendant's account of what passed between himself and the printer when the latter received the order to design the label did not advance the defendant's cause. He had sworn that it had been arranged that the general idea of the label should be something in entire contrast to the label used for the "Wellington" polish, with which the "Nelson" would naturally be regarded as an indirect competition. The result of those instructions was that the designer slavishly copied Oakey's mark. There was in the one an oval enclosing a head of Wellington, and in the other an oval enclosing a head of Nelson. The defendant explained his adoption of the head of Nelson as a trade mark by the circumstance that he had purchased the Nelson mark from somebody else. Then, again, the defendant's mark stated that the powder was manufactured by W. Flatau & Sons, a statement which was untrue. In both these respects the defendant's label was assimilated to the plaintiffs' label, on which appeared the words "Manufactured by Oakey & Sons." The learned Judge also referred to the colours of the two labels, which, as already explained, are strikingly similar.

He next proceeded to consider the alternative design of label which the defendant proposed to use in future. He remarked that the only alteration consisted in the substitution of a lozenge for the oval frame, and that he had no doubt, especially having regard to the class of persons who chiefly buy this powder, that the altered design was calculated to deceive and would have that effect. He, therefore, granted an injunction restraining the defendant from using any canister got up like the plaintiffs' proved in the action, and directed an inquiry as to the profits derived by the defendant from his wrongful sale of goods under the infringing mark; awarding to the plaintiffs also the costs of the action.

Letters to the Editor.

COMMUNICATION BETWEEN FRANCE AND ENGLAND.

To the Editor of "Industries."

Sir,—With reference to your article on this subject, I am pretty certain that none of the three schemes of crossing will be carried out. Sir Edward Watkin is a persevering man, but he would do well to devote himself to the Underground Railway and his new Tower, and let the tunnel sink into oblivion. The prejudices, both of a large section of our military advisers, and also of the general public, are so strong against it, that there is no chance of the scheme being allowed to come to maturity.

To the combination of piers and tunnel there is less objection from a military point of view; but if carried out it would have to depend almost solely on goods traffic, for passengers would be chary of experimenting with what may be described as a kind of maritime switch-back.

As regards the third project, its financial results would be of such an exceedingly problematic nature that I am dubious whether even an English public, ready though it is to throw money into bad companies, would care to trust its coin in such a venture. There is no doubt that the idea is a magnificent one from an engineering point of view, and I believe it to be practicable, but there is no use doing the work merely for glory. If the French are willing to go to the expense of putting it up, good and well, but it would be a pity to see English money going astray upon it.

Yours, &c.,
Thomas Davis.

London, 16th June, 1890.

BRITISH MANUFACTURES ON THE CONTINENT.

To the Editor of "Industries."

Sir,—I am not sorry to find the cudgels taken up against the views I ventured to put forward on the above subject in a recent issue. The points of my argument do not, however, appear to have been fully grasped. Surely we are in the same position with regard to protective duties, say, in Russia, as our competitor Sweden. Yet it is nevertheless the fact that considerable orders for one of our leading lines—viz., steamers—are continually passing from the former to the latter. I am unable to follow, therefore, your correspondent's reasoning that these duties account for the loss to us, for it is to be presumed that the same tax is levied in the one instance as in the other.

It is so very easy in this as in other matters to wave the hand and dismiss the question with the magic word "protection." I say that in Continental countries we are in precisely the same condition as regards the sale of goods as any of our neighbours. There is the obtaining of the order, the suitability of the article for the particular market, the freight and terms of payment. Assuming there is no difference in the tariff at the Customs in the two cases, I still hold that any other difficulties, as above enumerated, become practically absorbed in the one of representation. If this be efficient, provision is at the same time assured for the character of the goods. As to freight, we ought generally to be as well off as our competitors. Even when we turn to the mode of payment, this is also but allied to the question of a thorough knowledge of the people with whom business is to be transacted, and this cannot be attained without the power of conversation. Englishmen, on an average, under our present system, are not linguists; the consequence is they are handicapped in communicating with customers. To employ foreigners on the behalf of our manufacturers would not be a good policy for obvious reasons. The field, therefore, remains in a great measure quite untouched. I will only add that if your correspondent "T. R." will take any one country as an example, he will see that, as exporters, we are no worse off than another in passing the protective barrier raised up equally against both. What is wanted is a system whereby our young business men would be placed on an even footing with those of other European nations, and, as we are not alone in the race for supremacy now, the matter is one requiring urgent attention.

Yours, &c.,
Trader.

Manchester, 18th June, 1890.

DESCRIPTION OF A COMMERCIAL TRIAL OF A ½-KILOWATT ELECTRIC LIGHTING PLANT.

To the Editor of "Industries."

Sir,—In February last year I put up a complete plant for lighting my house by electricity. The house is a small one, and thirty 8 candle-power lamps suffice for all my purposes. A half-horse nominal "Otto" gas engine drives a 1-kilowatt shunt-wound Statter dynamo, which charges an accumulator consisting of sixteen 11-L. E.P.S. storage cells (1888 pattern). On the switchboard the usual provision is made for switching end cells in or out of the charging or discharging circuit Means are also provided for measuring the current and the electromotive force.

As trials of so small an installation are not numerous, it occurred to me that an account of a trial I made a few days ago, which was carried out on purely commercial lines, might not be altogether without interest. The fact should be borne in mind that the conditions of the trial were not those obtaining in a laboratory. The gas engine had not been cleaned or overhauled for the occasion, the slide had been running for about 25 hours since last being cleaned, the cylinder had not been touched for over a year, nor were any extraordinary precautions of any kind taken to ensure good running or high efficiency—in fact, the condition of things may be perhaps best summed up in stating that the cells required recharging in the ordinary course, and that I took this opportunity of finding out what my electric light was really costing.

As I pay for my gas through the company's meter, I measured the gas consumption by this meter, and did not use any special type.

The quantities measured were:—

(1) Gas.
(2) Potential difference at the terminal of the dynamo.
(3) Current flowing in the external circuit.
(4) Speed of engine.
(5) Speed of dynamo armature.

The instruments used were an Evershed gravity voltmeter and gravity ammeter. I checked both instruments before using them as well as I could, and found that the voltmeter read too low. I could not determine the coefficient of error with great accuracy, but as well as I could ascertain it I found that about two volts should be added to the mean reading. The ammeter was very fairly correct.

The engine was started at 5 20 p.m., but regular readings were not taken until 6.7½ p.m. The voltmeter and ammeter were read every ten minutes, the engine and armature speeds being taken at the same time intervals, until 6.59½, when I was obliged to leave home. I got another set of readings at 8.25, and another at 10.1 p.m. As under ordinary circumstances the engine runs without skilled attendance, I did not touch the brushes during the whole run. This, of course, accounts for the speed of the engine increasing as the cells become charged.

The measurement of the gas consumed is important, and I may just point out how the meter readings were obtained. The meter registers 100,000, 10,000, 1,000, and single cubic feet. I therefore timed the speed of revolution of the small hand marking cubic feet, and found that a little less than two complete revolutions were made in five minutes. Thus I was able to read it every ten minutes by noting the lag behind a complete revolution. To prevent magnetisation of my watch, I took the revolutions of the armature per 180 revolutions of the engine, and, immediately after, timed the speed of the engine per minute. The slip of the belt may, I think, be reasonably taken as constant over the period of regular readings, so that the armature speeds were indirectly obtained quite accurately. The observations are given below. Everything happens as one would expect. The e.m.f. rises gradually, the specific gravity of the solution also rises, and, after a while, there is an appreciable diminution in the amperes. The speed of the engine rises, as the brushes are not shifted to suit the decrease in the effect of cross magnetisation owing to the strengthening of the fields and to the decrease of current flowing in the armature.

Electrical Readings.

Time.	Volts.	Amperes.	Sp. Grav. of Solution in Cell No. 6.
6·7½	34·6	18·95	1,190
6·17½	34·9	18·50	—
6·27½	34·9	18·70	1,191
6·37½	34·9	18·60	—
6·47½	35·0	18·50	—
6·57½	35·0	18·00	—
8·25	35·0	18·00	1,193
10·1	36·0	12·80	1,195
Mean values from 6·7½ to 6·57½.	34·9	18·54	
+ correction	2·0		
	36·9		

This value of the e.m.f. (36·9) is probably very near the correct one. I took the e.m.f. of the cells with a voltmeter specially arranged for this purpose, and found an average e.m.f. of 2·3 volts per cell.

Speeds of Engine and Dynamo.

Time.	Revolutions of Armature per 180 Revolutions of Engine.	Revolutions of Engine per Minute.	Revolutions of Armature per Minute.
6·11½	1,383	—	—
6·13	—	183	1,406
6·21½	1,385	—	—
6·23	—	185	1,423
6·31½	1,385	—	—
6·33	—	185	1,423
6·41½	1,383	—	—
6·43	—	185	1,420
6·51½	1,385	—	—
6·53	—	188	1,408
8·27	1,401	—	—
8·28	—	189	1,471
10·1	1,476	—	—
10·2	—	192	1,574

The ignitions of the gas engine were quite regular throughout.

Gas Meter Readings.

Time.	Revolutions of the Small Hand indicating 2 Cub. Ft. per Revolution.	Differences.
6·9½	0·00	3·97
6·19½	3·97	3·91
6·29½	7·88	3·92
6·39½	11·80	3·92
6·49½	15·72	3·77
6·59½	19·49	

Means revs. of small hand per ten minutes = 3·9 nearly.
From these results the following is deduced:—
Gas consumed per hour, 46·8 cubic feet,
Costing at 2s. 6d. per 1,000 cubic feet, 1·41d.
Volts at dynamo terminals = 36·9 volts.
Current in charging circuit = 13·54 amperes.
Watts through cells = 499·6 watts
(or, say, half a kilowatt).

Hence:
Cost of gas per kilowatt, 2·82d.

The allowable discharge rate of my cells is 22 amperes. I rarely discharge higher than 5 amperes; hence it may reasonably be assumed that the cells are about 90 per cent. efficient. This is further borne out by observation and experience of

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their working over a long period. Supposing them to be 90 per cent. efficient, the cost at the lamp terminals would be $2{\cdot}82 \times \frac{10}{9} = 3{\cdot}13$d.

To this must be added a proportionate amount for oil and waste. This item amounted in the last year to 41s., owing to the high class oil necessary for the engine.

Now, at a very liberal allowance, the lamp hours for the past twelve months have been 9,000. Assuming the lamps to be 35-watt lamps, this is equivalent to 250,000 watts produced by the machine—allowing for counter-efficiency of the cells.

There is very little doubt that the oil has been far too plentifully used by my servant, whom I have always warned against letting the engine slide run dry. However, taking the figures as they stand, we must add

$$\frac{41 \times 12}{250} = 1{\cdot}96\text{d.}$$

to the cost of production per kilowatt. This is a large item, being 41 per cent. of the total cost of production, which now becomes 4·78d., or, say, 4¾d. per kilowatt.

No allowance has been made for attendance, depreciation, &c. It would be difficult to estimate this in my case, but it should be borne in mind that some further amount should really be added to cover this.

It may be of interest to compare the working of the gas engine. The engine is five-and-a-half years old, and was second-hand when I bought it. I indicated it some months ago, and also measured the brake h.p. by a rope brake, similar to that used by Professor Kennedy at the Society of Arts trials last year. Inasmuch as there has been no indication of any alteration in the performance of the engine since then, it may, I think, be fairly assumed that these measurements represent very nearly the

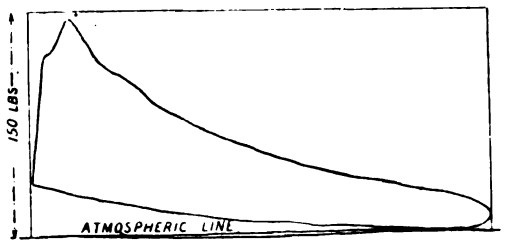


Fig. 1.—Rev. 171 per Min.; I.H.P. 1·8.

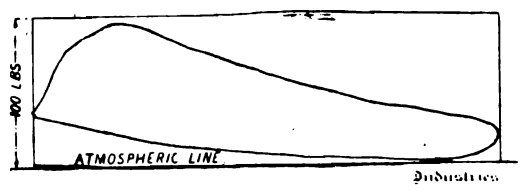


Fig. 2.—Rev. 190 per Min.; I.H.P. ·51.

actual state of things. I took a good many cards. One is shown in Fig. 1, taken at full load. Fig. 2 shows a card taken when the engine was simply driving itself.

The i.h.p. was:—

Full load	1·8
Running light	0·51

The brake trial gave the following results:—

Weight on brake	15lb. 14oz.
Mean reading of spring balance	2lb. 2oz.
Mean revolutions per minute	184.
Periphery of fly-wheel	131·88in.

Ignitions quite regular.

$$\text{b.h.p.} = \frac{13{\cdot}75 \times 131{\cdot}88 \times 184}{12 \times 33000} = 0{\cdot}84$$

Thus it seems to make some difference—at least to a gas engine—at what rate work is absorbed in internal friction when running light and when running with a load on.

We can also from these results get a rough idea of the efficiency of the dynamo:—

0·84 b.h.p. = 627 watts;

therefore commercial efficiency of dynamo

$$= \frac{500}{627} = 79 \text{ per cent.}$$

$$\text{electrical efficiency} = \frac{500 + \left(36{\cdot}9 \times \frac{36{\cdot}9}{53}\right)}{627}$$

= nearly 84 per cent.

(the resistance of the shunt hot being 53 ohms. The armature resistance is so small that the energy lost in it may reasonably be neglected in so rough a calculation).

These efficiencies are certainly good for so small a machine, and the performance of the gas engine is also very creditable—viz., 26·1 cubic feet of gas per i.h.p. per hour. But, of course, I cannot claim scientific accuracy for these figures, as the company's meter may be wrong.

Yours, &c.,
Ed. C. de Segundo,
Assoc.M.Inst.C.E.

7, Victoria Street, Westminster, S.W.,
16th June, 1890.

PROTECTION IN ITALY.

To the Editor of "Industries."

Sir,—I have been greatly struck with the remarkable facts contained in your recent article on engineering in Italy. It is not long ago that Italy was virtually wholly dependent upon other other countries for its machinery. Yet by the very simple expedient of putting on protective duties the Government have succeeded in fostering a new industry, which appears to be meeting with the utmost success, notwithstanding the difficulty which had to be met in connection with the scarcity of raw materials. That this state of matters is bad for engineers and machinists in this country goes without saying. There are some who would be prepared to go further and assert that it is bad for the Italians, but though I am aware that a large proportion of the British public professes to believe in this as a general principle, I fail to see how it can be applied to the particular case in point. The Italians have got new works, fresh employment for their population, and money is now being spent at home which would otherwise have gone to us, to the Germans, Austrians, French, and Belgians. With such a result they have every reason to be satisfied.

Yours, &c.,
Tariff.

London, 15th June, 1890.

THE WOLSELEY SHEEP SHEARING MACHINES.

To the Editor of "Industries."

Sir,—With regard to the paragraph in your issue of yesterday, reflecting upon an experiment made at Stargard, Pomerania, with this company's machine shears, permit to say that the facts, as stated, are incorrect in some particulars, and greatly exaggerated in other respects, and to add that the succeeding exhibition given at the Strasburg Alsace Show was a perfect success, as the accompanying copy of our agent's letter, dated the 5th inst., will prove.

Yours faithfully,
H. E. McLeod,
Secretary,
Wolseley Sheep Shearing Machine Company, Limited.

Crown Court, Old Broad Street,
London, E.C., 14th June, 1890.

"Strasburg, Alsace,
"To the Secretary, "5th June, 1890.
"Wolseley S. S. M. Co., Ld.,
"Crown Court,
"Old Broad Street.

"Dear Sir,

"I beg to inform you that I am at present at this place with Langford, who occupies about 6 to 6½ or 7 minutes in shearing each sheep. The people are *very much* satisfied. I have excluded all Rambouillet sheep hitherto, but shall perhaps begin shearing a few to-morrow. There have been present a number of large sheep farmers at our shed, and all of them have a very good opinion of your machines.

"Yours very truly,
"(Signed) F. C. Jenkins."

Books Received.

A Treatise on the Law and Practice of Patents for Inventions. By James Johnson & J. Henry Johnson. London: Longmans, Green, & Co.

The Oil Fields of India. Notes on the Petroleum Deposits of Burma, Assam, the Punjab, and Beluchistan. By Boverton Redwood, F.R.S.E., F.I.C., F.C.S.

Gems and Precious Stones of North America. By George Frederick Kunz. New York: The Scientific Publishing Company.

Report of the Royal Commission on the Mineral Resources of Canada and Measures for their Development. Printed by order of the Legislative Assembly.

Traité de Physique Industrielle. Production et Utilisation de la Chaleur. Par L. Seu, avec la Collaboration de MM. L. Carette et E. Herscher. Tome II., 1st Part. Paris: G. Masson.

The Wealth of India and the Hindrances to its Increase. By William Birkmyre. Glasgow: McNaughton & Sinclair.

Scheme for New Scottish Main Railway System. By "Eon Strathaar." Glasgow: R. L. Holmes.

The Gold Fields of Victoria. Reports of the Mining Registrars for the Quarter ending 31st December, 1889.

Transactions of the American Society of Civil Engineers, April, 1890.

Reviews.

American Railroad Bridges. By Theodore Cooper. New York: Engineering News Publishing Company.

This is a reprint, from the *Transactions of the American Society of Civil Engineers*, of a paper recently contributed by the author. The work commences with a brief historical review of American bridge building, beginning with "The Great Bridge," constructed in 1660 across the Charles River between Old Cambridge and Brighton, and ending with the Poughkeepsie Bridge, recently completed. The author then proceeds to consider the designing and proportioning of American bridges, the strength of materials and parts of skeleton structures, the manufacture of bridges and their erection, typical American railroad bridges and their relative merits, the number and kinds of bridges in the United States, and, finally, bridge failures. The author gives particulars of the train loads now assumed in America in designing bridges, and demonstrates the fallacy of the old method of employing equivalent uniform loads in proportioning structures. In view of the adverse criticism to which American bridges have been subjected in this country, part of Mr. Cooper's work is naturally a defence of the methods of construction adopted in the United States, and, on the whole, we think he makes out a very fair case as far as the engineers and contractors are concerned. Much has been made in some of our technical journals of the numerous failures of bridges which have occurred on American railways, but the author alleges that the data in regard to these failures have been magnified and distorted, and that the fact that the majority occurred with old and defective wooden bridges is ignored. There is not much consolation in this for the travelling public, who run the risk of mangling, drowning, or burning, or an unhappy combination of all three, whenever they cross such erections, but the fault lies with the railway companies and not with the present system of bridge design. Of 265 failures recorded as occurring during the ten years ending January 1st, 1889, only 38 bridges are known to have been of iron. It is well known that the loads per axle carried on American lines have been continually on the increase, while the bridges over which they run have not been proportionately strengthened or renewed; under such circumstances accidents were inevitable, but it is unfair to lay the blame for them on the system of pin connections. Mr. Cooper states that, with a few exceptions, "the iron railroad bridges of the United States for spans over 100ft., amounting to about 7,000 spans, aggregating 210 miles in length, are of the pin-connecting type." "The American people," he continues, "are of too practical a character to have built this quantity of bridges of a peculiar type, with the knowledge of other forms in use, both here and in European countries, and, after thirty years' experience in their use, to still adhere to them, if their merits were not strong and positive ones." At the same time the author admits the evils of the competitive system, which, to give the best results, should be "supplemented by the independent judgment of the practical bridge engineer."

In an appendix an interesting abstract of recent tests on full-size bridge members is given, while various types of bridges, some of them very curious, are illustrated in a series of folding plates, well executed. Altogether Mr. Cooper's book is a welcome addition to the literature of its subject, in which the author appears to be thoroughly at home.

Losses in Gold Amalgamation, with Notes on the Concentration of Gold and Silver Ores. By W. M'Dermott and P. W. Duffield. London: E. & F. N. Spon. 1890.

The recent gold discoveries in South Africa, and the revival in the gold-mining industry, have given rise to a number of treatises dealing with the extraction of gold from its ores. The latest addition to the list is an unpretentious work of 98 pages, in which Messrs. M'Dermott and Duffield record the results of a wide experience. Unlike recent works on gold, it is not made up of mere extracts from books, but bears internal evidence of being the work of two shrewd practitioners thoroughly at home with the minutest details of their profession. The aim of the book is not to give detailed descriptions of processes and machinery, but to present to directors of mining companies useful knowledge on the principles that are too often ignored by untrained mine managers. The authors warn directors not to listen to the specious promises of inventors of new processes, nor to plunge their shareholders into experiments which, in most cases, result in nothing but needless expense. The proper place for experiments is not in a new enterprise, but at a mine already as successful as known processes can render it, and too often what appear to be new processes and machinery are nothing but old contrivances and plausible theories long since exploded among practical men. Consequently, the authors confine their attention to modifications of approved processes. Most of their examples are drawn from the United States, for although the credit of scientific concentration of ores is due to the Germans, the working of gold ores is practised in Germany in a very limited degree. In the United States, the chief improvements on German methods are direct coarse stamping and classifying over jigs and slime machinery, and direct fine stamping over improved slime working machinery without sizing. The Cornish methods are not considered, for, being ill-adapted for good work on tin and copper ores, they are out of the question for gold ores.

The loss of gold in copper-plate amalgamation is shown to be much less than many inventors of new processes believe. In modern mills the tailings assay not more than ¼dwt. to 1½dwt. per ton. The concentration of gold and silver ores by a direct process, without sizing, after fine crushing by stamps, has become the established process for American ores, and, when properly conducted, leaves nothing to be desired. The authors

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prefer steam stamps and hydraulic sizing to rolls and screens. They advocate the use of stamps for hard rock, and that of the Huntington mill for softer ores and for regrinding tailings. For combined gold and silver ores concentration is effected either by dry stamping, roasting, and pan amalgamation, or by coarser crushing, roasting in Stetefeldt furnaces, and double-leaching by the Russell process. When the ores contain much gold and but little base metals, roasting is avoided, and copper plates and concentration, or concentration and pan amalgamation, is used. The authors note a curious instance of successful roasting of a gold and silver ore, which is very free from base metals, at the Dickens-Custer mine in Idaho. The ore, consisting of quartz and calcite carrying free gold, native silver, brittle silver ore, and a minute quantity of base metal, yields 90 per cent. of the silver and 85 per cent. of the gold. The unusual freedom from base mineral probably accounts for the high proportion of gold extracted after roasting. For the treatment of ores in which the sulphides are extremely rich, double concentration should be employed. As a rule, it is assumed that if two Frue vanners are placed to five stamps, the mineral then escaping is too fine for concentration. Such is not the case. The loss is not a necessary but an accidental one, and can be reduced by a second treatment.

We can cordially recommend this book. To engineers engaged in the concentration of ores it will be of the greatest value. It is written in faultless literary style, and, were it not for the somewhat unsystematic arrangement of the material, and for the absence of an index, would deserve unqualified praise.

LOCKWOOD'S BUILDERS AND CONTRACTORS' PRICE BOOK, 1890.

This price book appears in a remodelled and enlarged form in the edition for the present year, and has much to commend it. As stated in the preface, recent improved methods of construction and every special feature of modern building, such as ventilation, sanitary appliances, and electric lighting, have been fully dealt with, and the book generally has been brought up to date. Under the different headings the "Memoranda" will be found interesting and of practical utility. They are a decided step in advance, and some of them are more to the purpose than in any previous edition, or, indeed, as far as we are aware, than in any other published builders' price book. The memoranda on roadmaking, concrete, Portland cement, bricklayer, and terra cotta are all good. A very full list of British building stones will be found, together with some of the principal French stones. Notice is taken of the beautiful Devonshire marbles, which have an increasing reputation. The appendix contains, besides Acts of Parliament, &c., the regulations issued by the London County Council and other public bodies, and also the rules adopted by the Phœnix Fire Office with regard to electric lighting. Ample information is given as to the "measurement" of work, and the prices should prove, with good judgment, a satisfactory guide. Exception may be taken, here and there, to a few of the prices: for instance, those for well sinking below 30ft. are low. However, as before stated, this book is a very useful one, and should find a place in every English office connected with the building and engineering professions.

AID BOOK TO ENGINEERING ENTERPRISE. By Ewing Matheson. Second Edition. London: E. & F. N. SPON. 1889.

When a book attains to the honour of a second edition, the work of the critic becomes almost superfluous in so far as practical results are concerned. Mr. Matheson's work, now before us, is in this happy position. The first edition was published in two separate parts, which have now been combined in one volume. To the first part a chapter on mining enterprises has been added, while the chapter on the manufacture and uses of steel has been re-written and extended; besides this some of the modern applications of electricity are referred to. The character of the information contained in these additions is, of course, much the same as in other parts of the work, of a distinctly practical nature. Engineers and contractors of experience might be inclined to complain that much of the information given is too general and commonplace, and that they knew it all before. For such, however, Mr. Matheson does not profess to cater.

We notice that, in connection with the use of steel, Mr. Matheson writes, p. 508, "For railway axles, ... steel of about 28 tons is required." As a matter of fact, a very much higher tensile strength than this is often specified; for instance, the proposed railway Clearing House standard specification for the construction of 8 or 10 tons private owners' waggons, to work upon the lines of the railway companies, states that "each axle must be guaranteed to stand a tensile strain of not less than 35 tons per square inch, with 20 per cent. elongation in ten inches." Among the modern applications of electricity to which Mr. Matheson refers, electric welding finds a place, as well as the transmission of power.

The work is now so well known that it is unnecessary to enter into further details.

THE GREAT TOWER FOR LONDON.

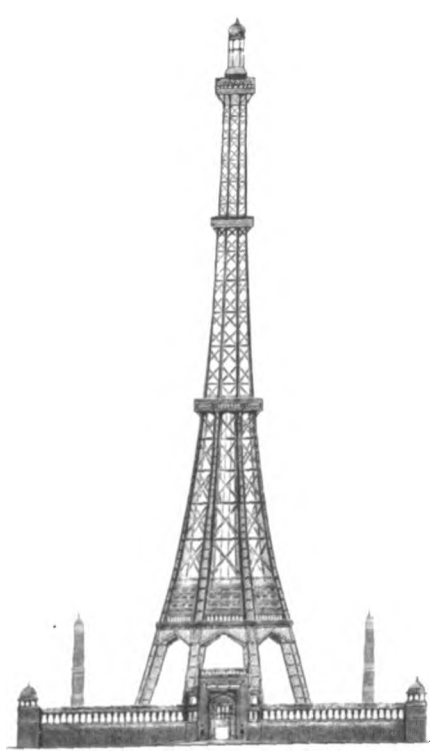


FIG. 1.—FIRST PRIZE.

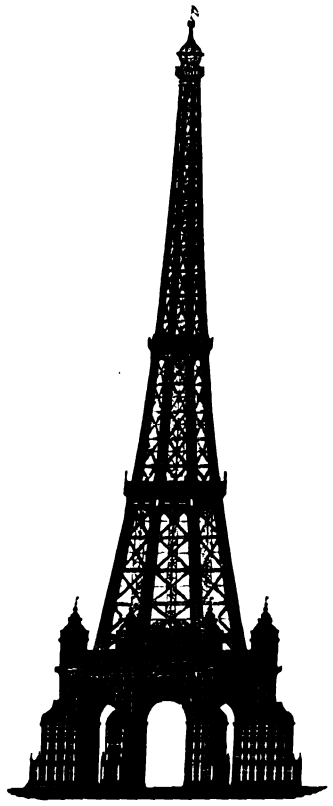


FIG. 2.—SECOND PRIZE.

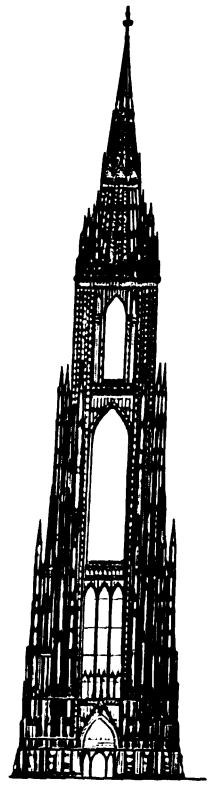


FIG. 3.—HONOURABLE MENTION.

THE GREAT TOWER FOR LONDON.

OUR readers will recollect that in our issue of the 9th ult. we published, in a two-page supplement, twenty of the sixty-eight designs for the Great Tower for London, sent in to the Tower Company, Limited, in response to their invitation. We remarked at the time that it would be invidious to make any comment until the jurors had given their decision. This decision has now being given, and we publish the Jurors' Report herewith. It may be seen that the three designs mentioned in the Report are Figs. 8, 13, and 12, on our two-page supplement, which we republish above as Figs. 1, 2, and 3. The first prize of 500 guineas has been awarded to the design shown in Fig. 1, and sent in by Mr. A. D. Stewart, M.Inst.C.E., 2, Queen's Square Place, London, W.; Mr. J. M. Maclaren, and Mr. W. Dunn, A.R.I.B.A., both of 21, King William Street, Strand, London, W.C. The design is for a tower 1,200ft. in height, having an octagonal skeleton 300ft. in diameter at base. The tower is constructed of steel throughout, and fitted with steam lifts to the top. The second prize of 250 guineas has been given to the design shown in Fig 2, and forwarded by Mr. John J. Webster, M.Inst.C.E., and Mr. J. W. Haigh, both of 67, Lord Street, Liverpool. This design represents an octagonal steel tower 1,300ft. high, standing on a base 470ft. in diameter. Hydraulic lifts are used, and the lower part of the tower and upper platforms are provided with buildings for residential and other purposes. The design shown in Fig. 3 has received honourable mention from the Jurors, and was sent in by Mr. Max am Ende, 5, Victoria Street, London, S.W. The design is for a tower 1,550ft. in height, of Gothic design, and constructed entirely of steel. The platform at 1,000ft. level is treated as the principal one. The lifts involve a train of carriages moving upwards between vertical guides, while a driving carriage below the train runs upon a spiral railway having a developed gradient of 1 in 5½. These spiral railway lifts may be placed in each of the four main columns. The competition was open to all competitors, and as stated in the Jurors' Report, the designs sent "were of very varying merit," and were disappointing as a whole, "there being no single design which they could recommend as it stands for execution."

REPORT OF THE JURORS.

GENTLEMEN,—Having completed our investigation of the competitive designs for the proposed Tower, we now submit our report. Invitations to compete were advertised on the 23rd October, 1889, and 68 designs were sent in. We met to consider these designs for the first time on the 15th March last. Every drawing has been carefully examined by the majority of the committee repeatedly, and whilst on exhibition at the Drapers' Hall (where the fullest opportunity was afforded of comparing the respective designs), we devoted an entire day there to the work, and throughout have given the most detailed consideration to the question before coming to a final decision as to the award of prizes. The designs were of very varying merit, and, although there were good points about many of them, we must confess to a feeling of disappointment on the whole as to the result of the competition, there being no single design which we could recommend as it stands for execution. In justice to the competitors it must be remembered, however, that the existence of the Eiffel Tower, and the desire to avoid imitations, necessarily considerably enhanced the difficulties of the problem, because in the Eiffel Tower the most natural and obvious way of combining economical construction and suitable architectural effect had already been appropriated. As a result some of the designs submitted were wildly eccentric or extravagant, whilst others were marked by an entire absence of architectural merit. We found little difficulty in eliminating the larger proportion of the designs, but the final award was not arrived at without repeated and prolonged consideration. Confining ourselves to the designs properly worked out by competent men, we found that in some cases the chief consideration had been given to economical construction and in others to architectural effect. In other words, some designers approached the problem from the point of view that the main thing was to get 1,200ft. above the ground with a form of tower which, having a fairly good outline, was specially adapted to resist wind pressure and other stresses with the minimum weight of steel, while others adopted the opposite view—namely, that the primary object was to get the best architectural effect without special regard to economy in construction or general practicability. In comparing the designs, we endeavoured to do the competitors the justice of judging of the merit of their work from the point of view adopted by themselves, and we also gave weight to the amount of time and care which had been devoted to the elaboration of the designs and calculation of stresses and estimates.

After very careful consideration we have decided to award the prizes as follow:—First prize (500 guineas), to Messrs. A. D. Stewart, J. M. Maclaren, & W. Dunn, of 21, King William Street, Strand, W.C., joint authors of design No. 37; second prize (250 guineas), to Messrs. J. J. Webster & J. W. Haigh, of 67, Lord Street, Liverpool, joint authors of design No. 51.

It is unnecessary for us to set forth the reasons of our decision in detail or to classify in the order of merit designs for which no prizes are available, but the Committee desire to state that they consider the design No. 50, by Mr. Max am Ende, deserves honourable mention.

We are, Gentlemen,
Your obedient servants,
E. H. CARBUTT (Chairman).
FREDERICK BRAMWELL.
B. BAKER.
E. J. HARLAND.
ALEX. B. W. KENNEDY.
C. LIDDELL.
J. F. MOULTON.
THOMAS VERITY.

17th June, 1890.

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THE BOARD OF TRADE AND ELECTRIC LIGHTING.*

(*Continued from page 547.*)

NATURE AND MODE OF SUPPLY.—In the old Orders two systems were mentioned, viz., the "parallel system," and the "*series system*," meaning constant-pressure and constant-current systems respectively. Now no system is specified, except that it must be one approved by the Board of Trade. A new sub-section was added to this last year at the instance of the telephone companies, by agreement with the promoters, for the protection of the telephone circuits against interference by induction or otherwise, they being naturally rather alarmed at the proposed general use of alternating currents. In the "Works" clauses, I need only mention that in the new model it is proposed to give powers for the construction of "street" boxes in place of "distributing" boxes. The special power taken is necessary, I believe, because these boxes come up to, and may come above, the surface of the ground. Also, that the prohibition of overhead wires, introduced last year, is inserted in the new model for companies, with the alteration that the time allowed for removal of existing overhead wires is reduced to one year. But they may be erected or continued in use with the consent of the local authority. This prohibitory section is based upon, and really does not go beyond, section 14 of the Act of 1882. The "*Compulsory Works*" clauses provide generally that the undertakers shall do something substantial towards carrying out their undertaking within a specified time, under penalties of fine or revocation of the Orders. The Board of Trade, however, must, in the case of a company, be moved to exercise its power of revocation by the local authority, except in the last model, where this has been altered; while in the case of a local authority being the undertakers, the Board of Trade has not hitherto, so far as I am aware, thought fit to exercise its power of revocation for non-performance of works within the required time, probably considering the plea that the practical knowledge and experience of electrical distribution was not sufficient to justify any expenditure of public funds, a valid one. This plea, however, is obviously daily diminishing in force. In nearly all Orders the specified time within which mains have to be laid in certain streets is two years. It is three years in the Birmingham Order of last year, but all streets within the area are included. The Liverpool Order is also an exception. In the old Orders two years was also the period that had to elapse before any supply could be requisitioned in other streets, and six months more is allowed to comply with the requisition. In last year's London Orders and the new forms, however, supply can be requisitioned after eighteen months, with six months for compliance; so that persons in streets not scheduled can get a supply at the same time as those in scheduled streets. Also, in the recent Orders, as already mentioned, supply can be requisitioned for any part of the area included in the Order; whereas in the old Orders it could only be requisitioned for the A district. There is a slight variation, too, in wording, which may be important, viz.: whereas in the old Orders mains were to be laid *in* every street, now it is *throughout* every street. The requisition to lay distributing mains in any street has to be signed by a number of persons, which number is a very variable quantity in different Orders. Thus in the old Orders of 1883 it was two or more owners or occupiers in the case of an Order given to a company or person, and the owners or occupiers of not less than one-fourth of the premises in the street in the case of a local authority. In the Chelsea Order of 1886 it was six or more owners or occupiers. Last year the Board of Trade reverted to the former practice both in the case of companies and local authorities, except in the Birmingham and Liverpool Orders, where no power of requisitioning is given to owners. These two Orders are very exceptional in respect of these clauses. This year, in the model forms, which are not intended to apply to London, it is proposed to follow the precedent of the Chelsea Order, and to require six signatures to a requisition, the number being the same both for local authority and company Orders. After the requisition clause follows a long clause intended to provide that the undertakers shall, if they so require, be guaranteed by the persons making the requisition a return for their outlay in laying the requisite mains of 20 per cent. per annum for three years in the old Orders, two years in the London Orders, and again three years in the new model Orders.

After these "Compulsory Works" clauses come a few clauses headed "Maps," and then, in the old Orders, "Regulations as to Supply on the Parallel System." These regulations are not inserted in any of the recent Orders, but are issued separately with the Safety Regulations. Then we come to some clauses headed "Testing" in all Orders up to this year; but in the new models an improved arrangement has been followed, and "Supply" comes next to "Works," which certainly seems a more logical sequence; also, the clauses applying to the appointment and duties of electric inspectors are now put under a separate heading. Taking these clauses first, the appointment of electric inspectors is vested, in the case of all Orders to companies, except the London Orders, in the local authority; in the London Orders it is vested in the County Council; and in all existing local authority Orders in a court of summary jurisdiction, moved either by a consumer or by the undertakers themselves. In the new model this appointment is vested in the Board of Trade. In case of the local authority not appointing an inspector, or imperfectly attending to inspectional duties, there is a provision in all company Orders for appointment, in some cases by a magistrate, in others by the Board of Trade. In the new model Orders a clause has been added specifically stating that the Board of Trade may appoint an inspector for the purposes of any inquiry on an accident or as to safety. I think it is obvious that the Board of Trade has in any case, whether expressed in the Order or not, the right to make inquiry as regards safety. All local inspectors are to be paid by the local authority, or County Council for London; but fees may be charged by means of which part, at any rate, of the cost of inspection will be recouped. Inspectors may be appointed from time to time for particular services, or the appointment may be continuous. It is rather difficult to see how this matter will work in small towns where there may be no resident electrician unconnected with the undertakers, or, at any rate, none who would care to undertake the job for such remuneration as could be offered without unduly increasing the cost of the supply, since the expenses of inspection must in one way or another be borne by the consumers. Probably one electrician will secure the appointment for several towns not very far apart, and reside in a convenient locality for his district. It will be something like the birth of a new species; and some follower of Darwin will in the next century write an exhaustive monograph on the genesis of the electric inspector, showing how he came to differentiate from ordinary mortals, how he gradually acquired an extra sense warning him against high pressure, &c. The duties of electric inspectors are clearly defined in the new model Orders, as follows:—

"The duties of an electric inspector under this Order shall be as follows: (*a*) The inspection and testing, periodically and in special cases, of the undertakers' electric lines and works and the supply of energy given by them; (*b*) The certifying and examination of meters; and, (*c*) Such other duties in relation to the undertaking as may be required of him under the provisions of this Order or of any regulations under this Order."

The next clauses in the new models are headed "Testing and Inspection;" and this is an improvement on the old heading of "Testing" alone, since it is obvious that in the case of a network of mains a good deal may be found out by inspection that could hardly be arrived at by testing. These clauses have been greatly altered, and I would especially draw attention to a new clause—"40. An electric inspector, if and when required to do so by any consumer, shall from time to time, on payment by the consumer of the prescribed fee, test the variation of electric pressure at the consumer's terminals, or make such other inspection and testing of the service lines, apparatus, and works of the undertakers upon the consumer's premises as may be necessary for the purpose of determining whether the undertakers have complied with the provisions of this Order, and the regulations and conditions subject to which they are for the time being authorised to supply energy;" which is, I think, very practical and may have important results. This clause takes the place of the following in the existing Orders:—"35. Every electric inspector, if and when required to do so by any person supplied with energy by the undertakers, shall from time to time test for insulation and conductivity any service lines by which such energy is supplied and the efficiency of any joints in such service lines, and make such other tests in relation to such service lines as may from time to time be approved of by the Board of Trade." In all Orders there is a clause providing for the establishment of testing stations at various points in the area, either by the undertakers or by the local authority. I am not aware that any such testing stations have yet been established; but I believe that in several districts in London they are to be established for one position at any rate—at the office of the local authority. The practical use of these testing stations is obviously to obtain a record of the variations of pressure at different points in the system, and of the duration of any abnormal pressure or stoppage of supply. The best solution appears to be to have a recording voltmeter at each station, which might be made in the shape of a pillar box; and possibly an indicating voltmeter exhibiting the pressure at any time would be a welcome addition. I consider that the production of a thoroughly trustworthy recording voltmeter is distinctly a desideratum for the improvement of electric supply. There appear to be very few such instruments in use at the present time. In all Orders I think there is reserved an appeal to the Board of Trade against any report of any electric inspector. It is to be hoped that this power will be used with discretion, as the electrical staff of the Board of Trade is strictly limited at present.

Now, taking the "Supply" clauses, we have, first, that any owner or occupier of premises situated within a certain distance of any district main can demand a supply. This distance is in the 1883 Orders 25 yards; in the London Orders and the new forms 50 yards. He may be required, however, to pay the cost of service lines beyond a distance of 30ft. in the old, 60ft. in the London and new model Orders. He must name a maximum current in the old Orders, or a maximum power in the new, so that the proper size of service lines may be laid, and this maximum must not be larger than what may reasonably be expected to be the consumption on the premises; and if afterwards he wishes to go beyond the declared maximum, he must be prepared to pay for any alteration of service lines or apparatus thereby rendered necessary. The person requiring a supply must also be prepared to make a contract to take and pay for a supply for at least two years of sufficient amount to pay 20 per cent. on the outlay incurred by the undertakers. Then follow provisoes as regards security for payment, prohibition of improper use of the supply, and a very important one added last year. The "Price" clauses have been considerably affected by the supply being now considered a supply of energy, and not, as formerly, of electricity. I will give the first clause as it stood in the old Orders and in the London Orders:—"31. The undertakers may charge for electricity supplied by them to any consumer (otherwise than by agreement)—(1) By the quantity of energy contained in such supply; or (2) by the actual quantity of electricity so supplied; or, unless the Board of Trade from time to time otherwise direct, (3) by the number of hours during which the supply of electricity is actually used by such consumer, and the maximum current with which he is for the time being entitled to be supplied." "50. The undertakers may charge for energy supplied by them to any ordinary consumer (otherwise than by agreement)—(1) By the actual quantity of energy so supplied; or (2) by the electrical quantity contained in such supply; or, unless the Board of Trade from time to time otherwise direct, (3) by the number of hours during which the supply of energy is actually used by such consumer, and the maximum power with which he is for the time being entitled to be supplied." In the new models method (3) has been altered as follows:—"32. The undertakers may charge for energy supplied by them to any ordinary consumer (otherwise than by agreement)—(1) By the actual amount of energy so supplied; or, (2) by the electrical quantity contained in such supply; or (3) by such other method as may for the time being be approved by the Board of Trade." The reason for this is that the old method (3) is decidedly wasteful, and, if generally adopted, would lead to far more energy than was necessary being supplied from central stations. Except in special cases, such as lighting of shops and business premises, it should be noted that the consumers are free to make any agreement they prefer as to the price to be charged and the method, but they have a right to be charged in accordance with methods (1) or (2), and the undertakers are always bound by the undue preference clause.

The meter clauses have hardly been altered at all, and it is, in my opinion, proof of the very great care and acumen with which these clauses were originally drawn—so far back as the year 1883—that no really satisfactory improvement has yet been proposed. These clauses will repay very attentive study. They are sometimes looked upon as stumbling-blocks, and it is said that they are unintelligible, and that they won't work; but I am afraid that these difficulties are rather due to want of study and defects of meters than to the clauses themselves. Any number and description of meters may be used both by consumer and undertakers, but only one meter is to be used for ascertaining the value of the supply. This is to be a meter certified by an electric inspector appointed under the Order. Note that it cannot be certified by anyone else. The inspector must certify three things: (1st) That the meter is of some construction and pattern approved by the Board of Trade; (2nd) that it has been fixed and connected to the service lines in some manner approved by the Board of Trade, which must, therefore, in approving any pattern of meter, prescribe in what way it is to be fixed and connected to the service lines; (3rd) that it is a correct meter; and in making this last declaration the inspector, in my opinion, may reasonably take account of and be guided by any mark or certificate attached to the meter showing that it has been thoroughly tested and found sufficiently accurate to be pronounced a correct meter in some standardising laboratory, or he may himself carry out the necessary tests in a laboratory. It is obvious that he cannot thoroughly test it in the consumer's cellar, and also that the words "a correct meter" cannot be held to be only applicable to a meter that was absolutely perfect throughout its range. The undertakers are to supply the consumer, either by purchase or hire, with a meter on demand, and procure its certification. No consumer is allowed to connect or disconnect the meter used for ascertaining the value of the supply without giving 48 hours' notice to the undertakers, under penalty. If this meter belongs to the consumer, he is to keep it in proper order, but if it is hired from the undertakers they must maintain it, and in either case they may remove it for testing, all expenses connected with the removal being paid by the consumer if the meter turns out to be faulty, and by the undertakers if it is in proper order; and any other meter or apparatus placed by the undertakers upon the consumer's premises for the purpose of ascertaining or regulating the supply of energy must be of some construction and pattern and connected in a manner approved by the Board of Trade.

The only other point in the Orders of much electrical interest is the Price Schedule. In this the definition of the Board of Trade unit has remained unaltered, except the simplification of the wording. Last year there was, as you may remember, some agitation to have the amount of the unit increased tenfold. The point was referred to your Council, who did not recommend the alteration, and the Board of Trade very willingly left it as it was. Of course undertakers are at liberty to make agreements for a price per 10 units, provided that the charges do not exceed the rates laid down in this schedule. In the London Orders of last year there was added to the second section a proviso to enable the standard pressure on the mains to be taken into account in assessing the value of the supply where this pressure is a high pressure, and the energy is transformed; but in the new model this section has been much simplified by the introduction of a new term, viz., the declared pressure at the consumer's terminals, which it is proposed to deal with in the new regulations.

(*To be continued.*)

* Paper read by Major Cardew before the Institution of Electrical Engineers on the 17th ult.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

(*From our New York Correspondent.*)

(*Continued from page 572.*)

THE first paper read on the 21st of May was by Mr. Wilfrid H. Fleming, on "Electric Lighting in the Tropics." The chief difficulties experienced, said the writer, were due to the lack of skilled labour and the distance from the factory which was the base of operations. Electric lighting had met with much favour in the tropics, and the use of motors was likely to be equally popular. One of the attractions of electric lighting was the fact that the lamps could be started up at once, which was desirable on account of the brief twilight. It was necessary to import suitable poles, and in India it was important that the basis should be thoroughly creosoted as a protection against white ants. On account of the moist atmosphere, dust, and insects, it was found that a native could not properly care for more than twenty-five lamps per day. In station construction the rain gutters should be double the size allowed for in temperate climates. The building material most suitable depends upon the particular locality in question. The heat of the sun is so powerful that insulation of a proper character is essential, and unusual precautions should be observed against damage by lightning. In 1877 what was probably the first commercial arc lamp shown in India was used in the offices of the Bombay *Times*, since which date the demand for electric lighting in that country had steadily increased. The high price of coal, ranging from $8 to $50 per ton delivered, makes it important that the most economical engine should be used. On many West Indian sugar plantations, however, economy in this respect is not so essential, as owing to the large boiler capacity of the

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mills the small proportion of steam is not missed. The machines used in the East Indies are of European manufacture, the Siemens, Gramme, Silvertown, and other well-known types. In the West Indies, South and Central America, they are generally of American make, and the market is quite important. In shipping machinery to the tropics it is imperative that every essential tool for construction should be included, also spare armatures, complete sets of arc lamp apparatus, duplicate parts of dynamos, brasses for the engine, tubes for the boiler, &c.

"Life and Efficiency of Arc Light Carbons" was the subject of a paper by Mr. Louis B. Marks. This investigation of carbon pencils was taken up at Cornell University for the reason that little or no increase in the efficiency of carbons had been witnessed since the inception of the business, and that with the practical perfection of lamps and dynamos the improvement in carbons was pre-eminently important. The carbons experimented upon were from five different American manufacturers. The subject was treated under the heads of structure, life, efficiency, candle-power, and observations of the arc and carbon points. The requirement of the low-tension system is a carbon that is hard, well plated, and a good conductor, the latter being most important. In the high-tension system, hardness and conductivity are of secondary importance. There is a tendency to flame and burn unsteadily when a hard carbon is used in this system, and a softer one becomes necessary. One company makes "forced" carbons in which the material is forced through a die, while another makes only moulded pencils. Twelve photographs were shown, in which the appearance of the carbons was manifest. They were obtained by mounting thin transverse sections, and subjecting them to a magnifying power of from 40 to 80 diameters. They showed a marked difference in structure between the forced and moulded carbons. In the high-tension pencil of one brand the structure was a loose one, while in the low-tension carbon of the same group the structure was dense and homogeneous, the grains being much smaller, and under the microscope having a more metallic lustre. In one brand, the moulded carbons are made under a greater pressure, for use in low-tension systems.

The life tests showed that if a carbon is burned with a small current, its life will be long at a sacrifice of light-giving properties. On the other hand, if a large current is used, there may be a gain in efficiency at a sacrifice of life. The question, then, arises, What is the proper current to use? The high-tension carbons were designed for a current of 10, and the low-tension for 20 amperes. In the life tests, a Thomson lamp was used for high-tension runs, the current constant at 10 amperes and 50 volts. For low tension a Weston lamp was used. It has been stated that "with carbons of the same *hardness* and length, but having different diameters, the larger will undoubtedly outlive the smaller. Of carbons of the same *diameter* and length, but differing in hardness, the harder will outlive the softer." (G. W. Parker.) This statement presupposes that the conductivity of the carbon is directly dependent on the hardness or softness of the pencil. In order to examine the relation between diameter, resistance, and mortality of a pencil, six sets varying in diameter from $\frac{1}{8}$in. to $1\frac{1}{8}$in. were carefully weighed, their resistances measured, and the pencils burned with a constant current of 10 amperes and 50 volts from a Gramme dynamo. The diameters and resistances of the upper and lower carbons were practically equal. The results of an hour's run showed that the life of a carbon varies *directly* with its *diameter*, and *inversely* with its *resistance*. This law holds only for homogeneous carbons of the same manufacture, type, and structure, and for constant current and voltage. Taking the $\frac{1}{8}$in. and 1in. pencils as standards, and calculating the mortality of the other carbons, it appears that the calculated life throughout the series is larger than the actual when the $\frac{1}{8}$in. carbon is taken as a standard, and smaller when the 1in. pencil is made the basis of calculation. While every precaution was taken to avoid discrepancies, it is clear that from the nature of the substance, and the difficulty of maintaining constant conditions, errors are apt to creep into the work. The results obtained, as well as later determinations, undoubtedly point to the existence of such a law as has been quoted. Experiments were also made to determine the curve for current and mortality of the pencil with constant voltage, also with constant current and varying voltage. No experiments were made upon arc-light carbons fed by alternating currents, but an investigation of the relative loss of the positive and negative pencils showed that the positive may burn away as fast as the negative, or may waste more than three and a half times as quickly. The causes that influence the relative life of pencils of the same diameter lie chiefly in the difference in the resistance of the carbons and the variations of potential difference.

In the efficiency tests, the horizontal efficiency was very small compared with the maximum; and it was shown that the relatively high efficiency in a *forced high tension* carbon is obtained only at the expense of life; that a moulded carbon is, generally speaking, superior to a *forced* for high tension, and *vice versâ* for low tension. While the life of a copper-plated carbon is greater than that of an unplated carbon of the same diameter and type, the mean spherical efficiency appears to be the same for both. No positive explanation of this phenomenon has yet been given, but it appears that the actual amount of *combustion* in both cases is the same, while the *disintegration* caused by the passage of the current is greater in the case of the unplated carbon. In the candle-power measurements it appeared that the efficiency of low-tension carbons and specially *moulded* low-pressure pencils is comparatively small. While the efficiencies of moulded high-tension carbons were as high as ·953 and ·888 watts per spherical candle, or 783 and 840 candles per electrical horse-power expended in the lamp, the efficiencies of low-tension pencils of nearly the same diameter as the high are as small as 1·255 and 1·612 watts per candle, or 594 and 502 candles per electrical horse-power. Gerard's law will not hold for calculating the mean spherical efficiency from the horizontal and the maximum. But for approximations a similar law holds—*i.e.*,

$$\textit{Spherical efficiency} = \tfrac{1}{4}\ \textit{horizontal} + \tfrac{3}{4}\ \textit{maximum}.$$

Observations of the arc and carbon points showed that with a given potential difference between the terminals of the lamp the length of the arc depended on the current flowing, and increased as the current became greater. If the current be kept constant, the length of the arc increases with the P.D. No direct relation seems to exist between the length of the arc, and the current, and P.D. In this case the length of the arc with constant potential increased very rapidly as the current was changed from 6 to 9 amperes, and then gained slowly from 9 to 13 amperes. The nature of the change was somewhat different in the constant current runs, the arc increasing more nearly as the square of the voltage. It was found that the carbon points assumed particular shapes, depending upon the current and P.D. used. With 5 amperes there was a tendency to form a "mushroom" on the lower carbon; with 10 amperes, this tendency is not at all marked, and at 15, almost inappreciable. Most of the irregularities in the action of arc lamps probably result more from unsuitable carbons, than from defects in lamp mechanism or changes in the strength of current, or P.D. in the line. The remedy lies with the carbon manufacturer, who should be able to produce a carbon especially adapted for the needs of any particular system.

(To be continued.)

THE PHYSICAL SOCIETY.

At the meeting of this Society on the 6th inst., Professor W. E. Ayrton, F.R.S., President, in the chair, Mr. H. Tomlinson, F.R.S., read a paper on "The Effect of Change of Temperature on the Villari Critical Points of Iron." This, he said, was a continuation of the paper he read before the Society on the 21st March, and the method employed was the same as then described (see *Phil. Mag.*, Vol. XXVIII., page 394). Since then, however, he has made experiments at various temperatures up to 285° C., the temperature being measured by the resistance of a platinum wire, whose temperature coefficient was carefully determined. The following table shows some of the results obtained with a well-annealed iron wire, 1mm. in diameter, which had been repeatedly heated up to 300° C., and cooled to the temperature of the room until the temporary permeability with various loads attained constant values at both temperatures:—

Magnetising Force in C.G.S. Units.	Load in Kilogrammes for which Permeability is the same as for Unloaded Wire at Temperature				
	12° C.	76° C.	167° C.	244° C.	285° C.
2·84	4·7	5·0	5·3 and 12	5·7 and 10	None
3·70	2·5	3·2	3·6	4·2 and 11·5	4·7 and 9·9
4·8	1·8	2·5	2·7	—	3·1 and 12·3
7·69	None	None	None	None	None
10·40	,,	,,	,,	,,	,,
15·32	,,	,,	,,	,,	,,

Curves from which these numbers were obtained are given in the paper, and in these load in kilogrammes and percentage change of temporary permeability are plotted. From the curves and table it will be seen that if the first points in which the curves cut the load line be considered, then, at all temperatures, the Villari values increase as the load decreases. If, however, the second points be taken, the critical values increase both with load and temperature. In both cases the Villari value is increased by rise of temperature. From the curves it follows that rise of temperature reduces the total variation of permeability that can be produced by loading. A table showing the temporary permeability of the unloaded wire at the various temperatures accompanied the paper.

A paper on "The Diurnal Variations of the Magnet at Kew," by Messrs. W. G. Robson and S. W. J. Smith, was communicated by Professor Rücker. In some preliminary remarks, the Professor pointed out the great advisability of having the results of magnetic observations at various observatories reduced and published in the same manner, and for the same periods. In order that this may be effected, the methods of reduction must be reliable, but not very elaborate. The Greenwich plan is too laborious to be generally adopted, but the method suggested by Dr. Wild (Rep. Brit. Assoc. 1885, page 78), in which the mean diurnal variation is obtained from measurements on five quiet days in each month, is feasible. With a view to further testing the reliability of this method the work described in the paper was undertaken. Mr. Whipple had made a comparison of the two methods for the years 1870-71-72, with the result shown in the following table:—

$K_s - K_w = 0{\cdot}7'$ (minutes of arc)
$G - K_s = 1{\cdot}2'$,, ,,
$G - K_w = 1{\cdot}6'$,, ,,

where K_s is the mean diurnal range at Kew as obtained by Sabine's method; K_w the mean diurnal range at Kew as obtained by Wild's method; and G the mean diurnal range at Greenwich by the Greenwich method. He also found that the mean hourly differences followed some definite law. The authors undertook the reduction of the Kew observations according to Wild's method for the years 1883 and 1886-87; the first was chosen as being a year of maximum sun spots. The results give:—

1883 ... $G - K_w$ = 1·5′
1886 ... ditto = 1·2′
1887 ... ditto = 1·9′

There is thus a difference of nearly two minutes in the variations at the two places, and this cannot all be accounted for by the method of reduction. Another peculiarity is that the range, as calculated by Wild's method, is greater by about 0·5′ than that obtained by Greenwich method, although the latter includes days of moderate disturbance. The total range at both places has diminished by about 1·6′ between 1883 and 1887. The paper was accompanied by tables and curves plotted from the differences in the mean hourly readings at Greenwich and Kew for each of the above six years, and a marked similarity exists between all of them. The mean of the six curves differs in no case by more than 0·4′ from the curve of any year. It is thus possible to calculate the Greenwich values from the Kew numbers, and as these latter are published about two years sooner than the former this fact may be very important. Referring to the reduction of results, Professor Rücker said that the Stonyhurst observers and Professor Mascart were willing to adopt Wild's method; Falmouth, he hoped, would follow suit; and Greenwich had been asked to publish their results in both ways.

Mr. Whipple said that before recording instruments were available, and the numbers were obtained from separate experiments, the labour involved was considerable, and a single large disturbance or magnetic storm might vitiate the result of a whole year's work. Methods were therefore adopted to eliminate these disturbances. Of these, that used by Sabine may be particularly mentioned. Although declination records have now been obtained for a considerable number of years, the cause of the variations still remains unknown. They do not seem to be dependent on temperature or on astronomical facts. He considered it valuable to obtain magnetic data from different parts of the earth, but comparisons were only possible when all are published on the same plan. This, he hoped, would result from the efforts of Professors Rücker and Adams. When this is accomplished, the observations on magnetic force will need treatment; this work will be laborious, and the aid of volunteers like Messrs. Robson and Smith would be of great service.

Professor W. G. Adams said he was glad to see the satisfactory nature of the work which had just been brought before the Society. Usually the mass of figures to be dealt with was so large that the mere reduction was a great undertaking. If, however, the difference between results obtained by the Greenwich and Wild's method was not more than 0·4′, it may be possible to make out the causes of the variations from observations reduced on Wild's plan. He himself would put more faith in horizontal force observations, and wished they could be worked out by some ready method. He hoped the one adopted in America, of obtaining mean curves by photography, may prove satisfactory.

Professor Perry asked if a machine could not be made to do the work.

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Mr. Whipple said such machines had been used by the Meteorological Office, but they were so elaborate and expensive that clerical work was just as cheap. The method of photographing mean curves had been tried at Kew, but it was open to the objection that accidental disturbances such as those produced by the movement of iron in the vicinity, and the approach of cabs, &c., were not eliminated.

Mr. Boys, referring to the use of integrators, said that for a harmonic analyser his disc-cylinder pattern was preferable to the ball-disc-cylinder integrators of J. Thompson, for it is much cheaper and has less inertia.

The President said the movement initiated by Professor Rücker would be of great service if it resulted in the numbers obtained at the various magnetic observatories being published in the same way. It was a great advantage to have such men, who were not attached to an observatory, to take up the subjects and suggest improvements. The heads of such Institutions were usually too much employed in making the necessary reductions to have time for devising improved methods. In his opinion greater freedom should be allowed to the chiefs of observatories, for it should be borne in mind that the object of observations is not to produce volumes of figures, but to increase our knowledge. Referring to the reduction of observations, he thought the voluntary services of senior physical students should be more generally accepted, and to this end he suggested that properly recommended persons should be allowed to spend some time in observatories as honorary assistants. This would be of great use to the students themselves and an advantage to the observatories, for the reduction of observations could then be expedited. As regards the accidental disturbances referred to by Mr. Whipple, he contended that regulations should be adopted to render them impossible.

Notes.

THE "HENRY."

It is to be hoped engineers will adopt the American suggestion, and call the practical unit of self-induction the "Henry. The name "Quad" is unsystematic, because all the other units are formed from men's names. It also has the still more important objection of implying some physical identity between self-induction and length. The only drawback to the name "Henry" is that it may be shortened into "Hen."

PUBLIC WORKS IN GREECE.

Fifty years back the Piræus was a small hamlet with 4,000 inhabitants, but it has developed rapidly, and is now prosperous, with a population of about 36,000. Flour and cotton mills, paper works, iron foundries, saw mills, and nail works have been established. It is proposed to dredge the bay, and, a larger supply of water being needed, artesian wells have been sunk at Phaleron. The water will be conveyed in iron pipes to reservoirs now being built for the purpose. Consul Dupuis states that the works of the cutting of the Corinth Canal, which were suspended for want of funds, will probably be shortly resumed by a new company.

AMERICAN COTTON.

Mr. Vice-Consul Robertson reports to the Foreign Office that the town of Savannah is making very rapid progress. It is not yet entitled to be classed among the manufacturing cities of the United States, but industries are springing up. Last year nearly all the exports increased. The value of the cotton was £4,923,312, as compared with £3,117,426 in 1888. This was due, first, to the exceptionally fine weather throughout the whole cotton belt for the growing and making of the staple; secondly, the increased acreage planted in cotton; and thirdly, the additional territory available to the Savannah market by the increased railway extension. The exportation of cotton seed continues to increase.

GRANTS FOR TECHNICAL EDUCATION.

The Committee of Council on Education have allocated for the financial year 1891-92 the sum of £5,000 for grants in aid of technical instruction given under the Technical Instruction Act. In a discussion on the subject in the House of Commons, Mr. Mundella remarked that there was not a canton in Switzerland that would not be ashamed of such a paltry provision for technical education. Mr. Goschen, however, explained that the smallness of the amount was the result of the comparatively small demand made by the local authorities, and that there was every disposition on the part of the Government to meet the full requirements of the Act. The grants in aid will not necessarily be equal to, and in no case will exceed, the amount contributed by the local authority out of the rates, and each grant will be computed, as far as possible, on the basis of the amount spent on subjects of technical instruction other than those for which the Science and Art Department gives aid. This arrangement we consider very good, as it will prevent waste of money and lavish expenditure, when at least one-half of the total amount is to be paid for by the localities. Grants from the Imperial Treasury are too often looked upon as gifts direct from heaven, and are spent in a most reckless manner, whereas when they are paid for directly by the localities the ratepayers generally look sharply after them.

POSTAL ARRANGEMENTS IN CHINA.

In Japan for some years past there has been a very perfect system of postal and telegraph service, which has done much to develop that country, but in China there is, as yet, no national postal service, and special arrangements have to be made by the foreign residents at each of the treaty ports. At Shanghai the chief foreign Powers have maintained post offices of their own, and in the other open ports were branches which were under the charge of the consular officers. This arrangement has not been found satisfactory, for the work of each office was not sufficient to justify a sufficient staff being kept, and complaints have been very numerous. Sir Robert Hart has for some years maintained a small postal service of his own in connection with the Customs, and he now suggests that he should take over all the foreign postal agencies at the various open ports and run them as branches of the Customs. Considering the trouble the present arrangements give to all concerned, and the very unsatisfactory results, we should think that the various parties interested will be only too glad to hand them over to Sir Robert Hart, who is certain to take care that his proposals will be efficiently carried out.

ANTI-FOREIGN FEELING IN BRAZIL.

It is somewhat curious to observe how often Republican forms of Government are more selfish and narrow than those of an autocratic or aristocratic form, and this has been strikingly shown under the new *régime* in Brazil. The Minister of Finance recently issued a decree relative to the more complete and reliable collection of statistics referring to finances, navigation, and commerce of Brazil, and in it he makes a bitter attack on the foreign merchants of the country. He states that credit establishments must be formed to make advances to producers and merchants, and that Brazilian houses must be established in the foreign markets, so that in this manner the monopoly of the exportation, which is exercised exclusively by foreign houses in Brazil, would cease to be affiliated to head offices situated in European and American markets, which indulge in speculation that has an arbitrary effect on prices. He states that while the formation of these houses in foreign markets must be due to private initiative, still the Government of the Republic may, through certain incentives, foster this initiative. There is also talk of creating a great national steamship line for transatlantic and coasting trade. Hitherto the province of Rio Grande do Sul has had an advantage over the others in respect to customs duties, but the Republican Government has determined to place all the States on the same footing from the 1st of July.

AUTOMATIC GAS RETORT.

The Brentford Gasworks at Southall have recently been utilised for a series of trials of the coking retorts devised by M. Coze, in which the coal is made to self-feed the retort, which is arranged in such a way that the angle of slope is always maintained. The coal remains still when put into the retort, but at the carbonised end the coke slides out upon being subjected to the slightest disturbance. The plant erected at Southall has been somewhat modified during the progress of the investigation by Messrs. Morris and Van Vestraut, and in its final form possesses several important advantages over the French process. The retorts are inclined at an angle of 30 deg. and charged by means of a telescopic shoot, which is thus enabled to reach each tier. A guide is attached to the lower end of the shoot, to control the velocity of the falling coal, and thus maintains an even distribution of the material over the bottom of the retort, while the coke slips uniformly out of the lower end at the slightest touch. A recent report speaks very favourably upon this modified form of automatic gas retort, and, from its obvious advantages of economy in working and construction, it seems likely that the new system will give gas companies great command over the carbonising department of their works in the event of future labour difficulties.

ROUMANIAN INDUSTRIES.

Three years ago a law came into force in Roumania, the object of which was to foster home industries; but though a good many undertakings have availed themselves of it, there has not been much progress, owing to smallness of capital and want of skilled labour. Among those which have got on are several tanneries, factories for making coarse cloth, two glass works, three paper mills, and a boot and shoe factory. Steam flour mills are flourishing and distilleries are in the same position. A new company has been formed for the manufacture of Portland cement at Ibraila, and another for working petroleum. Rope works have been successful.

PUBLIC WORKS AT KUSTENDJIE.

Mr. Vice-Consul Churchward, of Kustendjie, which is officially known as Constanza, states that now that the Roumanian Government has accepted a tender of the French Fives-Lille Company, for the construction of a commercial bridge across the Danube at Tchernavoda, it will probably bring further enterprises in its train in which British capital could be employed. When the bridge is finished harbour works will be required, as well as an extension of railways. Town improvements will follow, including water works, gas or electric light supply, and public granaries.

THE PHYSICAL FOUNDATION OF MUSIC.

At the Royal Institution, on Friday evening last, Professor Silvanus P. Thompson delivered a discourse on the above subject. The lecturer began by observing that experimenters had endeavoured to give physical expression to psychical sensation. The precise cause of the gratification the ear experienced by hearing a succession of notes whose vibrations had such relations to each other as to cause them to constitute a "scale," and form the basis of "melody," or by hearing the sound produced by some combinations and not by others, the examination of which is the object of "harmony," or by a note from one instrument rather than from another differing in "timbre," was difficult to locate. Sounding the middle C of the ordinary pianoforte scale with D produced dissonance, the reason being, according to Helmholtz, the formation of "beats." The unpleasant effect of the beats was at its maximum when they numbered 33 per second, diminishing when both more and fewer were produced. In this connection it must be remembered that Helmholtz considered the number of beats produced by any given pair of dissonant notes was equal to the difference of their respective numbers of vibrations per second. Thus, between the lowest C and D there was a difference of 4 vibrations per second, giving 4 beats, while the middle C and D gave 32 beats, and the top C and D 256 beats But this theory failed in some respects, and had to be supported by several sub-hypotheses, and was not borne out by the researches of König, who had made a special study of the matter. By using tuning forks for the production of the notes needed, König had at once procured pure tones (unattainable by the use of stretched strings), thus obtaining ing reliable data; and his conclusion was that the number of beats was equal to the remainder got by dividing the number of vibrations of one of the dissonant notes into that of the other, and, further, that the remainder need not be "positive." Besides the question of beats, there were other points in which König's experiments traversed commonly accepted ideas. Helmholtz ascribes difference of "timbre" to the difference in the number of harmonics accompanying a given note sounded on different instruments. According to this, it should be possible to produce the "timbre" of any instrument by sounding the note together with the requisite number of harmonics; but such was not the case. He also denies that it can be influenced by "phase;" whereas a mere inspection of the wave diagrams yielded by the same two notes differing variously in phase proved the impossibility of such an assumption. In the light of König's theory it was possible to imitate synthetically the "timbre" of some of the coarser musical instruments, a practical proof of its correctness.

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Patent Record.

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

2nd June, 1890.

8487. Townsend, Andrews, & Townsend ..... Signals for railways.
8490. Sutcliffe, W. ..... Looms.
8491. Charlton & Pepper..... Reducing valves.
8494. Fenby & Pollock ..... Hydraulic valves.
8496. Smith, J. ..... Spinning machines.
8499. Schulze-Berge & Schulze-Berge..... Air pumps.
8504. Butterfield & Renton Apparatus for finishing paper.
8505. Phenix, J. ..... Fuel economisers.
8510. Broadhead, Beesley, & Evans ..... Boiler furnaces.
8511. Burlinson, J..... Boiler gauges.
8517. Dilitz & Kretschmann Railway couplings.
8520. Favier, P. A. ..... Machines for decorticating.
8523. Paddon, E. F. ..... Furnaces.
8525. Allen, S. L. . ..... Cultivators. (7th November, 1889.)
8527. Lake, H. H..... Air compressors (*Muller*).
8528. Mills, B. J. B. ..... Transmitting power (*Johnson*).
8529. Simons, P. ..... Rack railways.
8531-2. Neate, P. J..... Edge runner grinding mills.
8538. Mick, Kursteiner, & Janenz..... ..... Embroidering machines.

3rd June, 1890.

8539. Allison, H. J..... Skelp welding machine (*Spiral Weld Tube Company*).
8544. Johnson & Hutchinson Filter presses.
8548. Kent, E. A..... Machine for making paper tubes.
8550. Dorman, W. H. ..... Boot machinery.
8552. Low, J. B. ..... Railway cars.
8554. Eitle, C. ..... Apparatus for charging retorts.
8556. Paul, R. W. ..... Tool-holder.
8561. Foote, C. H. ..... Hot-blast stoves.
8563. White & Boyd ..... Brick-making machines.
8564. Taft, J. C. ..... Twist drills.
8569. Harmon, C. S. ..... Lathes.
8570. O'Brien & Carew..... Anvils.
8579. Johnson, J. Y. ..... Paper-winding apparatus (*Bingham*).
8580. Molison, T..... Potato-dressing machine.
8581. Wise, J. N. ..... Expansion gear for rolls.
8583. Day, W. H. ..... Candle-moulding machines.
8591. Clark, J. A. ..... High-pressure valves.
8593. Holmstrom, C. ..... Breechloading guns.
8594. Haubert, S. C. ..... Toothed wheels.
8597. Stuart, S. ..... Construction of ships.
8598. Wenger, A. ..... Railway brakes.
8602. Carl, R. A. ..... Riveting machines.
8607. Sherman & Bates..... Car axles.
8608. Jenson, C. A. ..... Corrugating tubes (*Kossuth*).
8610. Farebrother, Papineau, & Pether ..... Mechanical fire cleanser.

4th June, 1890.

8613. Porges, P. ..... Hydraulic power transmitter.
8614. Wise, W. L. ..... Manufacture of filtering plates (*Eyen & Bassenge*).
8615. Perkins, J. E. S. ..... Rollers.
8616. Moyé, H. ..... Railway couplings.
8622. Goodwin, Barsby, & Pochin..... Stone-breaking machines.
8627. Cooper & Ormerod ..... Looms.
8628. Holmes, J. ..... An improved machine.
8632. Commons, S. ..... Packing for steam engines.
8636. Rylands & Emmet ..... Air-pressure pistons.
8639. Blackmore, Clark, & Standfield ..... Floating docks, &c.
8640. Sperryn, J. N. ..... Tube couplings.
8643. Hern, S. ..... Obtaining motive power.
8644. Dewar, R. M. ..... Circulation of water in boilers.
8645. Lea & Brett ..... Gas engines.
8649. Paxman, J. N..... Multitubular steam generators. (13th November, 1889.)
8660. Boult, A. J. ..... Steam generators and cannon (*Reynolds*).
8669. Weiss, R..... ..... Embroidery machines.
8670. Branch, E. L..... Shifting eccentrics.
8672. Daudeteau, L. M. R. ... Firearms.

5th June, 1890.

8676. Barford & Perkins..... Crushing mills.
8679. Grahame, J. ..... Removing smoke from tunnels.
8680. Parini, G. C. ..... Blast fans.
8684. Cutting, H. ..... Compound engines.
8686. Caddick, D..... Heating furnaces.
8687. Crawshaw & Battye ... Signalling on railways.
8688. Keith, J. ..... Furnace grates (*Bartlett Hayward & Co.*).
8690. Nelson & Shaw..... Mule.
8691. Harris, H. B..... Percussion fuse.
8692. Thompson, W. ..... Tentering machines.
8693. Whitlaw, Jun., & Kincaid ..... Looms.
8696. Bickle, T. E ..... Pulverisers and amalgamators.
8697. Annett, J. P. ..... Compensator for signal wires.
8701. Agudio, T. ..... Boiler tubes.
8706. Beesley, F..... Drop-down small arms.
8707. Von Langer & Cooper... Gas furnaces.
8713. Wetherell, A. ..... Car couplings.
8714. Haddon, H. J. ..... Journal bearings (*Andrews & Andrews*).
8715. Attenborough & Mottershaw ..... Knitting machines.
8721. Chesebrough, R. A..... Protection of ships against fouling, &c.
8727. Justice, P. M..... Poppets for boring bars (*Taylor*).

6th June, 1890.

8744. Richardson, E. ..... Screw-cutting.
8748. Jorling, E. ..... Manhole doors.
8755. Craig, J. ..... Motive power from tides.
8759. Von Langer, J. ..... Iron and steel.
8762. Boult, A. J. ..... Computing machines (*Sharpe*).
8772. Northrop, W. B. ..... Typewriting machines.
8781. Bousfield, E. T. ..... Typewriters.
8783. Gardner, C. F. ..... Sewing machines (*Stanley Manufacturing Company*).
8784. Müller, J. A..... Liquid meters.
8785 Liardet, L. E. ..... Chain shackles.
8788. Johnson, J. Y. ..... Purifying feed water (*Chapsal*).

7th June, 1890.

8790. Watson & Robertson ... Evaporating and distilling.
8793. Chidlaw, R. ..... Wheel cutting machines.
8794. Blackadder, A. C. ..... Steering gear.
8795. Norman, G..... Pulleys and drums.
8797. Maleham, C. H..... Drop-down guns.
8807. Harris, P. T.... . ..... Metallic packing.
8808. Leslie, R. ..... Furnaces.
8810. Reffitt, J. ..... Machinery for pressing woollen fabrics.
8813. Turney, F N. ..... Machine for splitting skins.
8815. Carroll, J. ..... Combing machines.
8816. Harris, H. M. ..... Aërial navigation.
8824. Richardson, R. ..... Steam engines.
8831. Gardner, J. ..... Typewriting machines.
8835. Marshall, J. G. ..... Bearings.
8841. Mennons, F. L. F. H. ... Tubular boilers.
8842. Kleczénski, W..... Lever pump.
8844. Huelser, C. ..... Sewing machines (*Kuhut & Deissler*).
8846-7. Archambault, A. ..... Looms.
8848. Pocock & Pocock ..... Brakes for vehicles.
8851. Poupard, W. J, Jun. ... Weighing machines.
8859. Bayly, J. P. ..... Water wheel (*Le Duc & Bertrand*).
8860. Bayly, J. P. ..... Steam actuated valve (*Patten, Robertson, & Fraser*).

ELECTRICITY.

2nd June, 1890.

8495. Williams, P. H..... Magneto-electric brakes.
8534. De Benardos & Lloyd & Lloyd ..... Accumulators.

3rd June, 1890.

8559. Rixom, W. ..... Connecting electric wires.
8567. Cobb, H. B. ..... Conductors and conduits.
8578. Johnson, J. Y. ..... Accumulators (*Hering*).
8595. Granville, W. P..... Electric logs.
8599. Anderson, F. ..... Generation of currents.

4th June, 1890.

8651. Smith, T..... Casing for conductors.
8652. Greene, E. M. ..... Magneto-telephone systems.

5th June, 1890.

8703. Thompson, W. P. ..... Electric welding (*Coffin*).
8720. Walter, H. E. ..... Electromagnetic brake.
8730. Miner, W. M..... Electric soldering irons.

6th June, 1890.

8749. Héndlé & Poole ..... Arc lamps.
8754. Garrett & Lucas..... Protecting conductors from lightning.
8758. Colacchi & Rolland ... Electric generators.
8777. Lake, H. H..... Electric call-bells (*Hathaway*).
8778. Groswith, H..... Electric motors.
8787. Schanschieff, A. ..... Motors and dynamos.

7th June, 1890.

8800. Thompson, W. P. ..... Accumulators (*Pearl*).
8819. Selwyn, J. H..... Compasses.
8853. Piat, A. ..... Electric motors.
8854. Desruelles & Chauvin Measuring electrical energy.

CHEMISTRY.

2nd June, 1890.

8498. Macfarlane & Macfarlane ..... Treatment of sewage.
8506. Imray, O..... Colouring matter (*Farbwerke vormals Meister, Lucius & Brüning*).
8530. Willcox, B. ..... Azo colours (*Farbenfabriken vormals Friedrich Bayer & Co.*).
8535. Pitt, S. ..... Illuminating gas (*Jerzmanowski*).

3rd June, 1890.

8541. Hart, J. J. ..... Colouring matters.
8572. Thomas & Hillman ..... Galvanising ironwork.
8609. Fyfe, W. W. ..... Amalgamating ores.

4th June, 1890.

8655. Miller, E. C..... Anti-friction alloys (*Magnolia Anti-Friction Metal Company*).

5th June, 1890.

8716. Edwards, E. ..... Zinc (*Lange*).
8717. Blinkhorn, E. ..... Explosives.
8725. Willcox, B. ..... Alizarine (*Farbenfabriken vormals Friedrich Bayer & Co.*).
8726. Johnson, J. Y. ..... Artificial indigo (*Badische Anilin & Soda Fabrik*).
8728. Fenner & Colls ..... Naphthalene.

6th June, 1890.

8733. Bruce, W. ..... Carbonic acid gas.
8752. Cryer, W. ..... Oxygen.
8786. Léon, G. ..... Sulphuric acid.

7th June, 1890.

8799. North, A. ..... Dyeing cotton.
8811. Kolf, H. ..... Gunpowder.
8820. Clark & Clark..... Alloys of allumiuium.
8826. Coombs, J. ..... Gold extraction.
8836. Blinkhorn, E. ..... Nitrate of ammonia.
8843. Müller, E. ..... Nitrifying cotton.

MISCELLANEOUS.

2nd June, 1890.

8488. Andrews, J. ..... Screws and screw nails.
8519. Prinz, O. ..... Cement.

3rd June, 1890.

8543. Pearson & Jones ..... Fog signalling.
8545. Lindley, R. H. N..... Cocks.
8565. Boult, A. J. ..... Incandescent gas burners (*Chemin*).
8568. Thompson, W. P. ..... Filters (*Bowden*).
8574. Freeborn, W..... Applying oil to the bottoms of vessels.
8575. Chabrand, L. V. ..... Life buoys.
8606. Bryan, S. G. T. C..... Treatment of slag.

4th June, 1890.

8618. Johnston, J. ..... Self-generating gas burners.
8638. Farr & Hancock ..... Tool for use in mines.
8666. Pratt, E. ..... Fire escape and extinguishing fires.
8668. Piffard, B..... ..... Varnishes.

5th June, 1890.

8685. Chaffer & Simms (both of the British Sewage and Refuse Company) Purifying sewage.
8712. Postolka & Eliasch ... Miners' safety lamps.
8723. Ollier, G. ..... Fire-resisting cements.

6th June, 1890.

8751. Whiteley, J. ..... Winding bobbins.

7th June, 1890.

8805. Murrie, J. ..... Indicating temperatures and pressures.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form of such opposition.

Year 1889.

9062. Smallman.
9185. Haas.
9253. Sanderson.
9388. King (*Kennedy & Aiken*).
9439. Adams & Hallam.
9481. Blackstone & Branson.
9598. Cockburn.
9720. Carrara.
9791. Thwaite.
10429. Thomson.
10558. Fletcher.
10710. Shepherd.
10815. Taylor.
10878. Morison.
10940. Hollins.
10996. Wayte, Sayer, & Sayer.
11078. Donnan.
11232. Phillips.
11352. Garton, Garton, & Lawrence.
11514. Thorne.
11535. Davidson.
11597. Llewellin.
11671. Arnold.
11822. Taylor.
12000. Garroway.
12091. Clamond.
12187. Lederer.
12224. Harrison.
12246. Revret & Honore-Colson.
12272. Smith.
12321. Kipling & Walker.
12335. Oliver.
12346. Chavasse.
12444. Smith.
12466. Wright.
12502. Lanchester.
12512. Kirkcaldy.
9145. Craig.
9216. Barker.
9321. Maynard.
9397. Cox.
9441. Boileau.
9486. Wilson.
9701. Kahnes & Schumann.
9729. Barker & Sproule.
10058. Dixon.
10469. Johnson (*Serve*).
10590. Gisborne.
10808. Stopes.
10847. Fogerty.
10891. Sleeman.
10960. Coldicott.
11016. Weekes.
11061. Sandon & Watson.
11216. Ball & Blyde.
11345. Sheardown & Barker.
11371. Hodder.
11506. Richmond.
11518. Clarkson & Spurge.
11543. Cockroft & Farmer.
11652. Boyle.
11779. Durand.
11982. Whiting.
12036. Kent.
12148. Simpson & Simpson.
12212. Farmer.
12244. De Normanville.
12265. Thompson.
12268. Buckton.
12282. Ayres & Stranders.
12330. Ley.
12344. Paget.
12351. Leonhardt.
12459. Mulligan & Swindell.
12500. Twynam.
12510. Schoth.
12534. Hollingworth.

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12546. HADDAN (*Mavet-Metcalf*).
12648. CLARK.
12692. HIGGINBOTTOM.
13290. HOUGHTON.
13962. GORTON. (5th February, 1889.)
14656. BERNSTEIN.
15459. HALL, SMITH, & BENNETT.
16162. HAMILTON (*Thorne Machine Company*).
17713. SLATTER & WATKINS.
17801. JOHNSON.
18250. WHITE & BROOKES.
19329. LAING.
12617. JOHNSON (*Thorne Machine Company*).
12964. CLEATHERO & NICHOLS.
13609. SHEPHERD.
14179. CARTWRIGHT.
14386. BROWN.
14939. LAING.
15597. JONES.
15941. VALLOT.
17368. WILLBRINGHAUS.
17654. FRODSHAM, JUN. (*Frodsham, Sen.*).
18153. FOSTER.
19017. BARKER (*Foster*).
19759. PENNY & RICHARDSON.
19895. KOTTLORS.

1890.

237. BROWN & IRVINE.
806. MUNSLOW & MUNSLOW.
1520. SCHNEIDER & THORNE.
1870. REINECKER.
2816. GLOVER.
3202. HUGHES.
3324. HOEY.
3456. BILLINGS.
4083. LAWRANCE & RANYARD.
4158. BRIGHAM.
4327. TONNAR.
4552. FRIEDEBERG.
4697. BERG (*Coyle*).
4781. SCHMITZ.
5099. WEISS.
5222. BOULT (*Justin*).
5335. LAKE (*Stetson*).
5345. LAKE (*Russell & Erwin Manufacturing Company*).
5676. VAN FLEET & GRAFF.
5909. NIEHUS & NIEHUS.
6052. PRICE.
6115. BROWN.
6260. LEWIS.
6280. PEYTON.
6471. HIRSCH.
6760. CHEALS.
6806. HARLAND.
6814. LAKE (*Poggenburg*).
6854. BROPHY.
6870. KEEFER.
6893. VON DER POPPENBURG.
6955. DRAPER, HOLMGREN, MOUNT, & BARNES.
7024. BOULT (*Macdonald & Tussie*).
7027. THOMPSON (*Reeves Pulley Company*).
7035. HAYTON.
7047. SPEICHER.
7103. YORKE.
697. LAKE (*Stafford*).
1168. JOHNSON (*Rogers*).
1679. TWEEDY.
1925. JORDAN.
2878. DE BOER.
3239. ENGLISH.
3452. LAKE (*Wheeler*).
3943. WALDRON.
4087. CHESWRIGHT.
4273. DUCKETT & DUCKETT.
4451. BOULT (*Kutschbach*).
4661. COYLE. (31st August, 1889.)
5063. SMITH & KNAPP.
5166. KOLLÉN.
5264. BUTCHER (*Hargreaves*).
5343. LAKE (*Maynadier*).
5353. FOX.
5375. NOPPEL, GROSCHE, & BIGLER.
5729. WEISS.
6018. BRECKNELL.
6110. DE PASS (*Imbs*).
6170. BOULT (*Hutchinson & Moore*).
6383. MARX.
6480. SCHNEIDER.
6799. HUMAN.
6811. VOGEL & CALKINS.
6823. NOWILL (*Nowill*).
6855. HIGHAM.
6877. HIERTZ & GARNET.
6896. AMBLER.
6977. BRITAIN.
7000. SCHMIDT.
7025. JONES.
7026. THOMPSON (*Reeves Pulley Company*).
7029. THOMPSON (*Jones*).
7039. LAKE (*Quevedo*).
7098. HILL.
7131. IMRAY (*Kommandilgesellschaft "Merkur" Rothgieser & Company*).

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

CORK MAKING MACHINE.—*G. Duncan & J. Latta, Liverpool.*—The process consists essentially in cutting the rough pieces of cork into strips, in shaping the strips into cylindrical rods, in smoothing or polishing the cylindrical rods, and finally in cutting the smoothed or polished rods into lengths so that each length forms a cork. The cork is cut into strips preferably square in cross-section by means of knives in any usual or suitable manner, or a circular saw may be used. The strips are made cylindrical by being passed endwise between cutters rotating round a centre.

FIG. 1

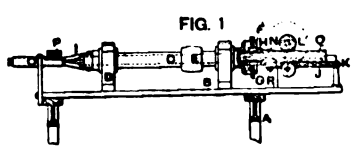


FIG. 3

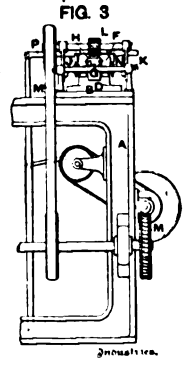
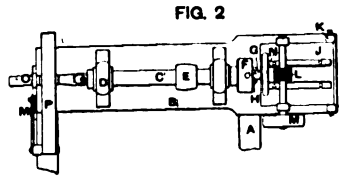


FIG. 2



The strips are then smoothed or polished by contact with a rotating drum, moving band, or reciprocating bar coated with glass or some other abrading substance, the smooth cylindrical strips being finally cut into corks of the required length by means of knives or blades in any convenient way. In the accompanying illustrations a machine is shown for performing these operations, excepting the first and last, which is preferably done in the usual manner. On the front end of a hollow mandrel C are fixed a cylindrical cutter G and radial cutter H. To the opposite end of the mandrel are secured clamps I. The corks are formed as follows:—The mandrel C is revolved at a very high speed by a belt passing round the pulley E, and revolves the cutters G and H with it. Strips of cork are then passed to the knives between eed rollers L in a direction corresponding to the axis of the mandrel. The cutters, revolving at a high speed, cut the corners off the strips and form them into cylinders. These cylindrical pieces then pass through the tubular mandrel and out at the opposite end, where they are gripped by the clamps I and revolved. Above the cork, as it leaves the mandrel, is placed a flat bar P with its under side covered with an abrading material such as glass. This bar receives a reciprocating motion from an upright bar oscillated by a pin in a revolving wheel, shown in Fig. 3. The bar P rests upon the cylindrical cork as it leaves the mandrel, and by its reciprocating motion and the rotation of the cork smoothes the latter down as it is gradually passed from the machine through the steadying tube O. Claims: (1) Cutting cork into strips shaping the strips so as to form cylindrical rods, smoothing or polishing the rods, and cutting the said rods into lengths as described; (2) in apparatus for making corks the combination of rotating cutters with an adjustable feed table; (3) in apparatus for making corks the combination of rotating cutters with feed rollers and a steadying strap N; (4) in apparatus for making corks the combination of cutting and smoothing or polishing apparatus for the purpose set forth.—No. 10651. July 2nd, 1889. 6*d*.

CAPSTANS.—*J. Cowley, Great Yarmouth, & F. & J. Lelen, London.*—Hitherto great difficulty has been experienced in the use of wire ropes on capstans, but by the improved construction of capstan here described the inventors claim to overcome these difficulties, and, besides, to enable it to be worked single handed. Fig. 1 is a sectional elevation and Fig. 2 a front elevation of this improved capstan. It is revolved by a vertical shaft S, whose upper part is secured to the barrel, and its lower supported in a step bearing A. The shaft is also supported in a bearing T fixed to the deck, and it is prevented from rising out

FIG. 1.

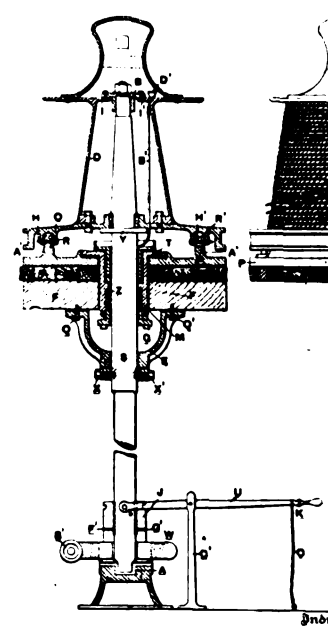
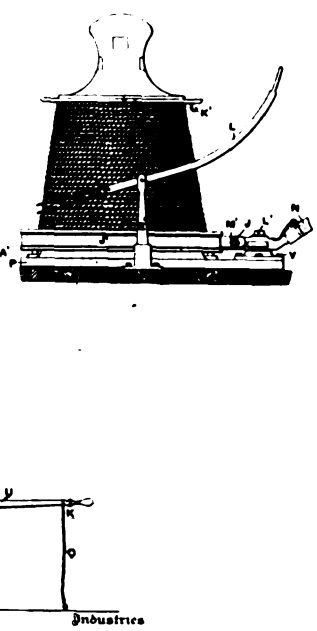


FIG. 2.



of its step by the collar E fixed to the under part of the deck. On the base plate P is a circular bearing path A^1 for the rollers R, mounted in the lower flange of the capstan barrel. A friction band J^1 passes around the channelled part of the lower flange, and constitutes, with the swivel lever N, a brake for retarding the motion of the capstan when paying out. When winding in, the capstan is revolved by steam or other power transmitted through the worm S^1 and worm-wheel W to the shaft S. The worm-wheel W is loose upon the shaft S, but may be secured to it by the clutch J, operated by the lever O. Claims: (1) The improved capstan, arranged, constructed, and operating as and for the purpose described; (2) in steam and other capstans the use of wire ropes for operating the same as set forth.—No. 8749. May 27th, 1889. 8*d*.

FINISHING TEXTILE FABRICS.—*R. Clegg, Manchester.*—A continuous or endless running of textile fabrics through calenders, during the finishing processes, is attained with this machine, by causing an accumulation of cloth to be held in suspension, and in advance, so to speak, of the calender. Such accumulation affords the attendants sufficient time to attach the last end of the cloth, so held in reserve, to the first end of another piece of cloth to be operated upon. By this arrangement there is no empty running of the calender. In the accompanying illustrations B B^1 are the draw rollers. Below these in the brackets C is the box C^1 with the cloth upon it. The cloth, as it is drawn off the box C^1 by the rollers B B^1, fall from the latter over rods N which are moved forward at regular intervals, and so take up only a certain quantity of cloth. These rods are stored up in a hopper P, and are taken from there singly and moved forward to the point M^1 by levers L, G, and K, worked by the cams E. The cams are suitably formed to give the levers L, G, and K the motion necessary to perform this action. As the succeeding rod is moved to the point M^1, the proceeding one is dislodged and rolls down the incline brackets, with its lap of cloth, to the point Y. When the cloth has been taken off a rod by the calender, the pull of the cloth forces the rod over the point Y, so that it drops into the collecting box Y^1. A further part of the invention is an arrangement for releasing the shaft or rod carrying the batch or box of cloth from the brackets which support it. It consists of two brackets C C, one at each side of the frame, each having bearings somewhat like three sides of a square, one of the three sides of each forming part of the lever T, and can be lifted up so as to leave one side of each bearing clear or open. These levers T have at each end an incline U. When it is desired to remove the empty box and replace it by a full one, the full one is pushed forward from the point U^1 and the pivots of the shaft carrying the full box coming against the two inclines U on the levers T, lift the ends forming one of the three sides of each bearing, which hitherto secured the pivots of the box when being operated upon. The full box is thus forced forward against the empty one and throws it out of the bearing now open. Under each bracket C C are curved arms W in position to receive the dropping box and deposit it in a position for the attendant to pick up conveniently. Claims: (1) A machine or apparatus by means of which continuous or endless running of textile fabrics through calenders during finishing processes, &c., is attained, having folds L^1 of cloth or fabric hanging on rods arranged substantially in the

FIG. 1.

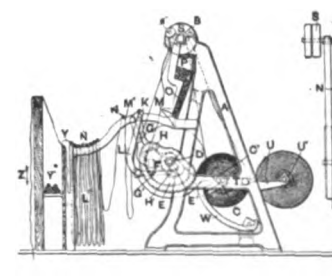
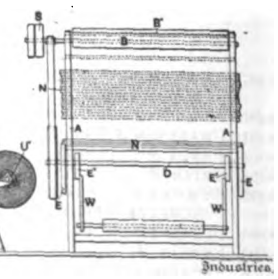


FIG. 2.



same manner described; (2) the arrangement for carrying the rods from one point to another, which arrangement consists in the cams E E^1, levers G G^1, swivel levers K, rods L, passage O, chamber P, all arranged and employed in conjunction with each other for the purpose and substantially in the manner described; (3) the arrangement for releasing the shaft or rod carrying the exhausted box or batch from the bearings, which arrangement consists of the brackets C, levers T, inclines U, curved arms W, all arranged and employed in conjunction with each other for the purpose described.—No. 7386. May 3rd, 1889. 8*d*.

SMOKE CONSUMER.—*R. & D. Walker, Middleton, Lancashire.*—The escaping smoke products of combustion and vapours are treated with steam so as to saturate the carbon and other suspended matters, and by so increasing their specific gravities cause them to become precipitated in a suitable chamber. The accompanying illustrations show a sectional elevation and plan of the apparatus used in this process, adapted to an ordinary horizontal boiler. The boiler A^1 is set in the ordinary brickwork B^1, and has an under return flue C and side flues D as is usual. The side flues meet at the back of the boiler at the dampers E P, the smoke passing through the damper E to the exhaust fan F or other suitable exhausting or forcing apparatus. The other damper P closes the entrance to the flue G which leads to the chimney H. Thus by closing one damper or the other the whole of the smoke could be directed either to the condensing apparatus or to the chimney. In the illustrations the whole of the smoke is passed on to the condensing apparatus as indicated by the arrows. The fan F, which may be driven by any suitable means, draws the smoke from the boiler flues and forces it into the pipe I, which extends from the fan into the condensing chamber J. This chamber may be built of brick as shown. The smoke pipe I, which extends the length of the bottom of the chamber, is turned upwards and backwards as shown in Fig. 1 so as to project the smoke into the chamber. At the other end of the chamber, and about opposite to the emission mouth of the smoke pipe, is placed a steam pipe K, through which is blown steam from the boiler or from the engine exhaust or other source into the chamber. This inflowing supply of steam meets the smoke as it issues from the smoke pipe I, and the two currents become thoroughly commingled. The condenser is thus filled with moist vapour and smoke, the result being that the particles of carbon in the smoke or heated products of combustion become saturated with moisture and fall to the bottom of the chamber, from whence the accumulated deposit may from time to time be

FIG. 1

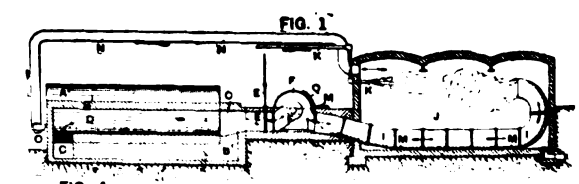


FIG. 4

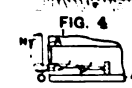


FIG. 3

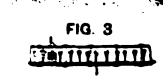
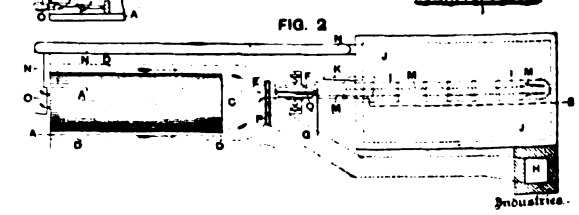


FIG. 2

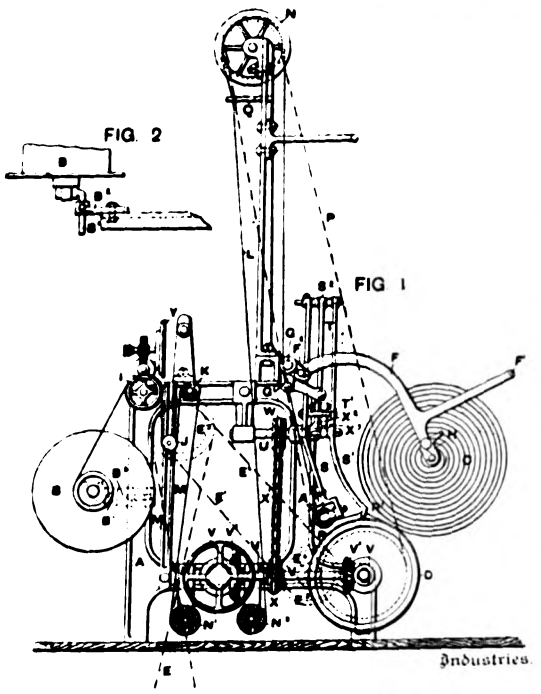


removed. The bottom of the condensing chamber is made of perforated metal or tiles, or it may be formed with intersecting runlets leading to the sides or ends, so as to allow the moisture to drain away from the precipitated matters, as, for example, through the drain pipe shown in Fig. 1. To assist in saturating the smoke with moisture, spray pipes M may be placed in the smoke pipe I as shown in Fig. 3. Water under pressure is led into these pipes, and the pipes are perforated at intervals so as to throw finely-divided sprays of water into the interior of the pipes. A similar spray might be directed into the fan and assist in keeping it cool. Claims: (1) The general arrangement and combination of apparatus for condensing and consuming smoke and vapours as described and shown; (2) in apparatus for condensing smoke and vapours, a closed condensing chamber into which the smoke is led or forced and there saturated or humidified by means of steam so as to cause precipitation of the particles of carbon as described and shown; (3) in apparatus for condensing

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smoke and vapours, the condensing chamber J in combination with the fan F, smoke pipe I, and steam jet K, for the purposes described; (4) in apparatus of the indicated type, returning the uncondensed smoke from the condensing chamber to the furnace and forcing it thereinto as described; (5) in apparatus of the indicated nature, humidifying the smoke or heated products of combustion on their way to the condensing chamber by the introducing of sprays of water or steam into the fan and smoke pipe as described.—No. 8478. May 22nd, 1889. 8*d*.

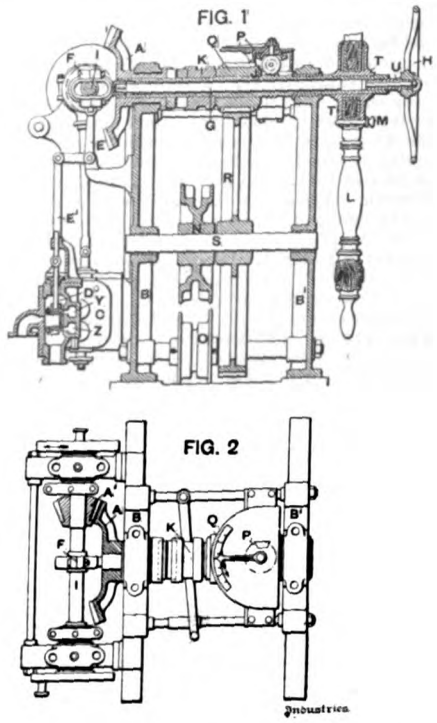
WARP BALLING MACHINES.—*J., J. P., & J. Sunderland, Nelson, Lancashire.*—Improvements are here introduced into the above machine for making long chains, in ball form, in a more expeditious and efficient manner than is effected by balling machines of the present kinds. Fig. 1 is a sectional elevation of a balling machine constructed in accordance with our invention; Fig. 2 is a view of detached parts of the mechanism. The warp threads are unrolled from the back beam B and wound up in ball form C by the revolving movement of the drum D, which is driven by the straps E E^1 and suitable toothed gear wheels. A steady action and even pressure is ensured whilst balling by two angular side pieces F pressing on the ball spindle. The side pieces F are bolted together, and are connected to the ball spindle by hooks H, which are so arranged as to facilitate the removal of the ball from the pieces F. The back beam B is placed as shown, with its arbours resting in notches formed in slide pieces B^1, capable of moving horizontally in slots formed in fixtures B^2, for lateral adjustment to the various widths of back beams that may be used. The warp to be balled from the back beam B is conveyed in a sheet-like manner over the roller I and K, and supports the falling roller J, which performs the same functions as the falling roller of a beaming frame, moving up and down in slots in the vertical standards M. When leaving the roller K the warp is conveyed downwards, and made to partially lap the drum V through the medium of guide rollers N^1 and N^2. The warp L is from thence conveyed



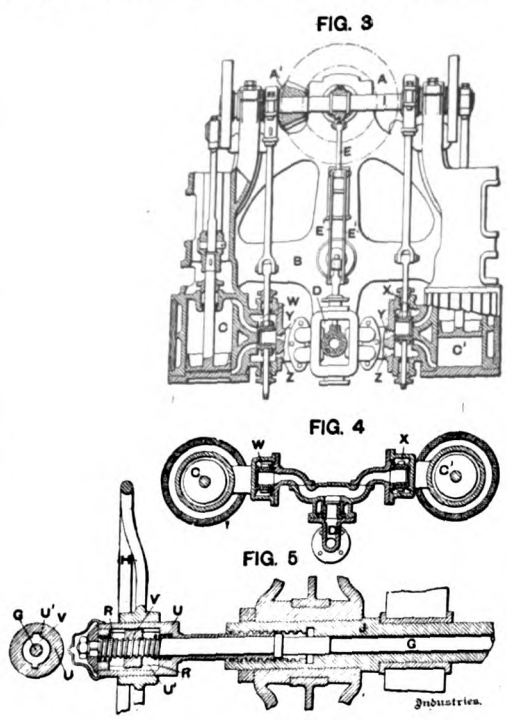
upwards from the roller N^2 over elevated roller N, the distance between the two being sufficient to allow the warp to gradually contract from its sheet-like form in passing to and through the eye of the bracket Q to the elevated roller N. From this roller the warp, now in chain form, is conveyed under pulley R and through the eye R^1, of the lap-traversing device, which guides the chain from one side to the other, forming a lap backwards and forwards over the surface of the revolving ball of warp. The lap-traversing device is composed of two arms S and S^1 on the upright T; both arms are fixed together rigidly by the bolt T^1, and are made to swing backwards and forwards similarly to the pendulum of a clock. The elevated roller N and drum V are driven from the drum D, the former by the counter-strap P, the latter by the bevel gear wheels and shaft V^1. A revolving crank X^2 imparts motion to the traversing device, the crank X^2 being revolved by the shaft V^1 through the sprocket wheels W and chain X^1. Claim: In a warp balling machine the arrangement and combination of the parts described and illustrated.—No. 9889. June 17th, 1889. 8*d*.

LUBRICATORS.—*J. Rebmann, Horgen, Switzerland.*—This new lubricator is for working with grease. The grease is subjected to the combined pressure of a spring and screw. The reservoir is of cylindrical form placed vertically, and is fitted with a piston that is pressed downwards by a coiled spring surrounding its rod. The piston rod passes up through the top cover, and has attached to its end a small button for moving the piston. The top cover is made in one with the reservoir, but the lower cover is made to screw into the cylinder, and it is formed with the necessary stem for fixing the lubricator. To fill the reservoir it is removed from its bottom cover and the spring-loaded piston drawn back to the end of the cylinder. Grease is now placed into the reservoir, and the reservoir rescrewed upon its bottom cover until the pressure exerted by the spring upon the piston is sufficient to keep the supply of grease well down to the outlet in the stem. When a part of the grease has been used the reservoir is screwed still farther down on to its lower cover, so bringing the pressure of the spring up to its original force. Claim: A self-acting lubricator for greases regulated by the combination of a screw and spiral spring in such a way that the spring acting upon a piston is reinforced by screwing the box over the bottom as and for the purpose described.—No. 16929. October 26th, 1889. 6*d*.

STEERING GEAR.—*W. P. Thompson, Liverpool. (P. & V. Callard, Harre, France.)*—This system of steering is based upon the following: (1) The use of bevel gearing as transmitter between the motor shaft and the intermediate shaft which gears with the shaft carrying the steering chain drum; (2) the arrangement of the motive cylinders vertically at the back of the machine; (3) the method of fixing the intermediate shaft permiting its use as gearing when the steering is done by steam, as the working shaft when the steering is done by hand, and forming a guide for the spindle that works the admission valves of



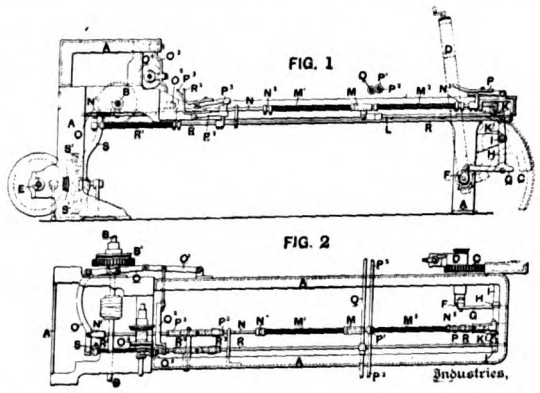
the engines. In the illustrations, Fig. 1 is a vertical longitudinal section, Fig. 2 a plan, Fig. 3 a transverse section, and Figs. 4 and 5 sectional details of the machine. The cylinders of the engines C are fixed at the back of the machine, and their pistons are connected as usual to the motor shaft I. The slide valves of these engines are of the type described by the inventors in a previous patent, No. 1831 of 1889. Steam is admitted to the engines through the reversing valve D, which is coupled to an elbow lever E pivoted to the framing. The upper arm of this lever is connected to the rod G, so that by a longitudinal sliding motion of the latter the valve D is shifted. The rod G passes through the hollow intermediate shaft J. This intermediate shaft is geared by the beveled wheels A A^1 to the motor shaft, and by the pinion Q and large wheel R to the shaft carrying the usual steering chain wheel N. When the steering is to be performed by steam the hand-wheel L is disconnected from the intermediate shaft J by withdrawing the pin M. The valve D is then worked by the small hand-wheel H in the following manner. The wheel H is mounted upon a metal sleeve U, threaded upon its outer surface to screw into the hollow intermediate shaft J. Through the sleeve U is passed and secured the reduced end of the



sliding rod G, which by reason of its connection to the motor shaft is prevented from turning upon its axis. Thus by turning the wheel H the shaft G is forced forwards or backwards, and the motion being transmitted through the lever E the valve D is opened in one or other direction and the engine worked accordingly. By the motion, however, of the intermediate shaft, the rod G is screwed back to its normal position and the valve D closed. To prevent the excessive displacement of the rudder by turning the wheel H too much, an arrangement is made as illustrated in Fig. 5. The sleeve U is made of a box form, and the end of the rod G is threaded. Upon the threaded part of G is a nut V, which partakes of the rotary motion of the wheel H, and has besides freedom longitudinally. As the rod G cannot revolve, it will be seen that the motion of the sleeve U in the intermediate shaft J is limited both ways. When hand steering the motor is disconnected from the intermediate shaft J by a clutch K. Five claims are made.—No. 9730. June 13th, 1889. 8*d*.

LOOMS.—*J. Greenwood & J. Ashworth, Bury, Lancashire.*—The treading apparatus for operating the healds in looms is here referred to. In plain looms the healds are attached by cords to horizontal levers working upon a stud, such levers being actuated by eccentrics or tappets for the purpose of opening and closing the shed. The present method and form of the tappets has been found to be unsatisfactory, because at certain parts of each revolution of the tappet it temporarily left the horizontal levers, leaving them free and under no control, so causing damage to the healds. To prevent this the tappets are made, according to the invention, of such a size and shape that they never leave the bowls of the levers. The tappets are approximately circular pieces placed eccentrically upon their shafts, but having the part furthest from the centre or true arc struck from the centre of the shaft. Thus when the levers are right up or down they remain in that position for a short dwell to give the shuttle sufficient time to cross the loom. Claim: The formation of tappets so shaped and adjusted with regard to each other that their surfaces at no time leave the treading bowls.—No. 11,380. July 16th, 1889. 6*d*.

SPINNING AND DOUBLING COTTON.—*R. Curtis & J. Wain, Manchester.*—An improved method is described in this specification for putting into and out of gear the drawing-out catch-box, the front roller catch-box, and the drawing-up friction gear in mules and twiners, the cam shaft and its appurtenances being dispensed with. Fig. 1 is an elevation partly in section, and Fig. 2 a plan view of so much of the headstock of a self-acting mule as is necessary to illustrate the invention. A is part of the headstock framing, B the back-shaft, C the quadrant, D the quadrant arm, and E the scroll shaft. For the purposes of the invention there is mounted on the quadrant axle, at its inner end, a short arm F which is connected by a link G to a hanging lever H fixed to or cast on a transverse rocking shaft I carried in suitable bearings at the front of the headstock. On this transverse shaft is also fixed or cast an upright lever K, and the upper end of this is connected by a link L to a sliding boss M working between two coiled springs M^1 and M^2. The boss M is on a sliding rod N, whose back end is connected at N^1 with the cranked change lever O, which



actuates the back-shaft catch-box B^1 for putting in gear the drawing out motion of the carriage. This lever O also acts upon another lever O^1 which is connected to the front roller catch-box O^4, thus throwing the drawing-out motion and the front roller catch-box into and out of gear simultaneously at the proper moment. As the spindle carriage is going out and the quadrant C and the quadrant arm D move in the same direction, the short arm F acting on the sliding boss M compresses the spring M^1, the rod N being prevented from sliding with the boss M by means of a catch lever P at the front end, and the other spring M^2 remaining perfectly free and idle. As the carriage completes its stretch, a boss P^1 on the counter faller shaft P^2 raises the catch lever P by coming into contact with its inclined part, and allows the spring M^1 to expand. The rod N is thus moved in the direction of the arrow, and puts the drawing-out and front roller catch-boxes out of gear, and at the same time lets down the catch lever P^3, at the back end of the headstock. As the carriage runs in towards the rollers the reverse movement of the quadrant draws the sliding boss M in the opposite direction, thus compressing the spring M^2, which is held and released in a similar manner to the spring M^1 by the catch lever P^3, and so throws the drawing-out and front-roller catch-boxes into gear again. A similar contrivance, but acting in one direction only, is used for actuating the scroll friction gear for drawing in the carriage. In this case the rod N is provided with one spring, which is compressed by a second lever K^1 upon the lever I. Claim: The arrangement of apparatus substantially as described and illustrated for putting into and out of gear the drawing-out and front roller catch-boxes, and the drawing-up friction gear, whether employed separately or in combination with each other.—No. 10781. July 4th, 1889.

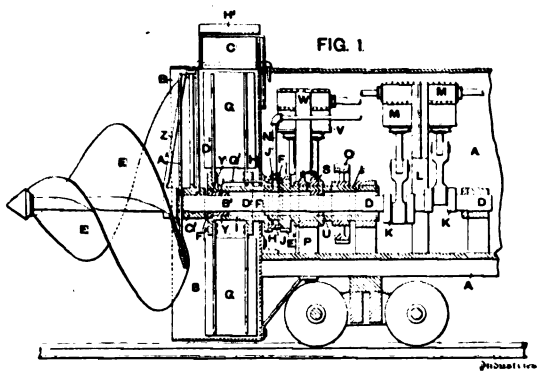
RAILWAY WHEELS.—*J. Clemenson, London.*—This invention relates to an improved method of constructing railway, tramway, or other wheels, whereby great lateral stability, combined with elasticity and direct resistance to torsional strains, are obtained. According to one method of constructing these wheels, the nave is made of any suitable material and formed with spokes or radial arms, and also with a groove on each of its sides or faces. The tire is rolled with a ridge upon its inside, and has a groove cut in each side of the ridge; recesses are also formed in the ridge for the reception of the spokes. When the wheel is built up, the nave is within the tire, the ends of the spokes or arms fitting into the recesses formed in the ridge of the tire. Segmental plates are then placed upon each side of the wheel and bolted together with the spokes of the wheel between them. The edges of these plates are formed to fit the grooves cut in the faces of the nave and in the ridge of the tire. They are also made with depressions to stiffen the wheel when the plates are bolted in place.

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Claims: (1) In a wheel the combination of the nave and spokes with the discs and tire as described; (2) the general arrangement of parts and method of construction as described.—No. 9936. June 18th, 1889. 6*d*.

ROTARY SNOW PLOUGHS.—*W. P. Thompson, Liverpool. (E. P. Caldwell, Minneapolis, U.S.A.)*—This machine is intended for clearing snow from railway tracks. It consists essentially of a revolving spiral cutter head which feeds the snow to a shallow cylindrical chamber. The cylindrical chamber is fitted with vanes which revolve and throw the snow outside the track. In the illustrations of this snow plough, Fig. 1 is a longitudinal

FIG. 1.



vertical section, Fig. 2 a front elevation, and Fig. 3 a rear elevation. The whole of the machinery is mounted upon a suitable car truck and it is worked by its own special engines. E is the spiral-bladed cutter mounted upon the front end of a stiff horizontal shaft D, and revolved by an engine M. This spiral-bladed cutter is mounted immediately in front of the cylindrical fan casing B in which are revolved the vanes or blades G. The blades G are secured to a second hollow shaft I which surrounds that of the spiral cutter. In the top of the chamber B are openings C for the discharge of the snow by the revolving fan. One of these outlets is opened at a time according to the side upon which the snow is to be discharged. The fan is driven by two engines V placed upon each side of the shaft I and having their separate crank-shafts R geared to the hollow shaft I by toothed wheels O. The two shafts are thus driven independently of each other, and therefore the motion of the fan may be reversed without effecting the motion of the spiral cutter. In the hollow shaft I is cut a groove F which is closed by a sliding ring J, so forming a small annular chamber. The ring J is held stationary

FIG. 2

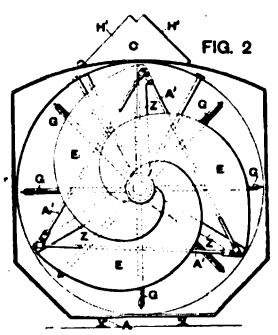
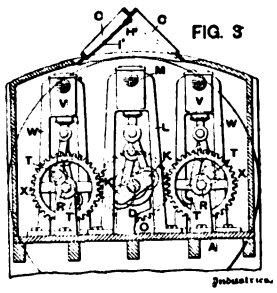


FIG. 3



whilst the shaft I revolves, and thus forms the means of communicating the annular chamber with the steam supply through the pipe N. The annular chamber communicates further with small grooves surrounding the bearing Y, and so these grooves are kept supplied with steam, which prevents the lubricating matters from becoming frozen. The other bearings of the machine may be treated in like manner. Nine claims are made.—No. 8670. May 24th, 1889. 8*d*.

EVAPORATING LIQUIDS.—*R. C. & C. H. Garton & W. Lawrence, London.*—The improved apparatus comprises a tube or series of vertical tubes heated from the inside by the passage of steam, and having the liquid to be evaporated passed over their outer surfaces, the chief point of the invention being the shape of the tubes. These are fluted, grooved, or channelled, either spirally, longitudinally, or laterally, to cause the liquid to spread more uniformly over the evaporating surfaces. Claims: (1) In apparatus for evaporating, heating or cooling, liquids, and not working under pressure or *in vacuo*, an arrangement comprising one or more, or a set of vertical or nearly vertical tubes, which are fluted, grooved, or channelled, either spirally, longitudinally, or laterally, or are spirally twisted, and means whereby the liquid to be treated is caused to flow in a film down the exterior of such tube or tubes, while the steam or other acting medium is brought into contact with the interior of the tube or tubes; (2) in apparatus for evaporating, heating, or cooling liquids, and not working under pressure or *in vacuo*, an arrangement comprising one or more or a set of vertical or nearly vertical tubes which are fluted, grooved, or channelled, either spirally, longitudinally, or laterally, or are spirally twisted, and means whereby the liquid to be treated is caused to flow in a film down the inside of such tubes, while the steam or other acting medium is brought into contact with the interior of the tube or tubes. No. 11350. July 15th, 1890. 8*d*.

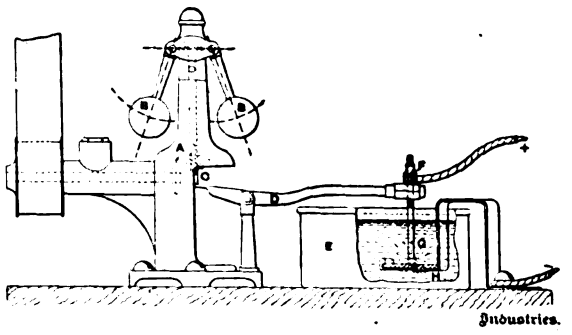
ELECTRICITY.

CONTROLLING THEATRE DOORS, &C.—*H. J. Harris, London.*—The doors employed in connection with the invention are sliding doors, sliding back into the thickness of the wall or into a suitable casing. Rollers are fixed to the top and bottom of the doors to ensure the door sliding freely. A vertical sliding bolt with a bevelled upper end is fitted in the floor and pressed upwards by a spring, so that when the doors are pulled out and closed the bolt is pressed upwards, and, engaging with the door, locks it. A rubber spring is attached to the inner edge of each door and to the back part of its case to pull the doors open when the bolt is withdrawn. Attached to the lower end of each bolt is a soft iron armature, and an electromagnet is placed in such a position as to act upon the armature and withdraw the bolt when the magnet is vitalised. In a theatre or other public place the electromagnets of the various doors fitted with this appliance are all placed in circuit and switches provided in different parts of the building for closing the circuit and withdrawing the bolts in cases of fire or panic. The doors can be opened independently by a lever or other device attached to the sliding bolt and operated by hand. Claims: (1) The combination of a sliding bolt operated by an electromagnet to lock and release the doors as described; (2) the combination with an ordinary hinged door of a bolt operated by electromagnet; (3) the combination of a series of doors constructed as set forth in claims 1 and 2 arranged to be opened simultaneously by an electric current as set forth; (4) the combination with a vertical bolt of a rod or other suitable device for opening the door without employing the electric current; (5) an arrangement for opening a door by means of an electric current constructed as described.—No. 10285. June 24th, 1889. 8*d*.

CONDUIT FITTINGS FOR ELECTRIC CONDUCTORS.—*R. E. B. Crompton, Chelmsford.*—To facilitate the introduction and withdrawal of the copper strips from the conduits, the inventor makes use of movable insulator carriages. These consist of a frame made of suitable material supported on three or more rollers or wheels. On these frames are mounted any required number of pairs of vertical insulators, which carry grooved wheels or small pulleys with flanges to support the conductors. These insulator carriages are made so that they can be readily drawn into and along the conduit. It will be seen that by the employment of these carriages the openings in the conduits may be made a great distance apart, and after the copper conductors have been drawn in, a number of these carriages can be drawn in afterwards at certain intervals apart to support the conductors at a proper height and position. For the purpose of making the conductors taut, there is built into the wall of the conduit, at a position near the surface box, one or more pairs of bars crossing the conduit. These cross-bars are built in pairs one above the other at a sufficient distance apart to admit the conductors to pass between them. Resting with one leg on each of these bars, but insulated from them, is a bridge of similar shape to those employed on the manholes of boilers. The conductors pass through a hole in the centre of this bridge, and may be tightened up by any of the means described in a previous specification, No. 7655 of 1888. Claims: (1) Insulator carriages running on rolling supports in underground conduits, having insulator supports for frames which carry rotatory insulators as supports for the copper tape conductors; (2) in carriages to run in underground culverts or tubes as supporters of conductors of electrical energy, the employment of fixed insulators connected together by frames serving as supports for rotatory circular insulators having side flanges and centre roller, forming grooves to receive the conductors; (3) in means for conducting electrical energy the combination of an underground culvert or tube, with carriages provided with fixed insulators, connecting frames, and rotatory insulators with means for clamping and straining the conductors; (4) the combination of parts of conduits, guide, and carriage for copper tape conductors so as to adapt them for preserving their hold of such tapes in straining and transforming the line of strain of such conductors; (5) the general arrangement and combination of the various parts of apparatus for conveying electrical energy.—No. 11589. July 20th, 1889. 8*d*.

CORES FOR ELECTRICAL APPARATUS.—*W. P. Thompson, Liverpool. (The Westinghouse Electric Company, Pittsburg, U.S.A.)*—The object of the invention is to reduce to a minimum the spaces occupied by the insulation in cores, and at the same time to provide a method of manufacturing the core which will secure the required insulation between the lamenæ and also cheapen and improve the construction. Plates of the required size for building up the core are first stamped from sheets of suitable magnetisable soft iron. These plates are then subjected to an annealing process, which is carried to such an extent that a thin film of oxide is formed over their entire surfaces, and over also the rough edges produced by the stamping process. The core is then built up by placing these plates side by side. The film formed on the plates is chiefly magnetic oxide, and this is found to be such a poor conductor as to practically effect the insulation of one metal plate from the other. It is, however, more or less magnetised, so that it serves, when the plates are placed together, not only to insulate them, but as a magnetisable material for the core, thus combining two desirable qualities. At the same time the insulation is exceedingly thin. The annealing process is carried out as follows:—The plates are arranged in small piles in a suitable annealing box. The box is then placed in an oven and gradually heated. This step in practice usually occupies from six to twelve hours. When the proper temperature has been reached it is kept approximately constant for a sufficient time to produce the required effects. This may be varied in different instances, but it is usual to so heat the plates for twelve hours. They are then allowed to cool gradually, the heat being gradually decreased. This may occupy a somewhat greater length of time, say from twelve to twenty-fours. The gradual cooling secures thoroughly annealed soft plates. The oxide is very firmly attached to the surface of the plates, and can only be removed by attrition, so that the plates may be handled without special care and without endangering the insulation. Four claims are made.—No. 11046. July 9th, 1889. 8*d*.

ELECTRIC CUT-OUTS.—*W. E. Heys, Manchester. (N. & J. Chaize, Paris.)*—The apparatus is constructed to open the circuit below the surface of a liquid such as water which possesses a comparatively high resistance. The presence of the liquid, whilst it may not prevent the formation of an arc or spark, effectually prevents the localisation of any heating and the burning of the contact pieces. The accompanying illustration shows a practical application of this invention to the regulation of an electromotor by means of a pendulum governor. A is the governor which is driven by the motor. When the current attains a pressure sufficient to drive the motor at a speed greater than is desired, the balls B of the governor rise by centrifugal force and depress the spindle C in the same manner as when a similar governor is used with a steam engine. The lower end of the spindle C rests upon the end of a lever D, which carries at its opposite end the vertical rod or circuit interrupter G adjustably secured by the nut F. In a vessel E filled with water or other suitable fluid there is immersed the contact mass H, which forms the terminal of one conductor, whilst the rod G forms the terminal of the



Industries.

other conductor, so that when G is in contact with the mass H the circuit in which the motor is included is closed, but when G is lifted out of contact with H the circuit is opened. Thus when the spindle C is depressed the circuit is interrupted. Claims: (1) In an apparatus for opening and interrupting an electric circuit, the combination and arrangement of a fixed conductive mass immersed in water or other suitable fluid, and connected to one terminal of an electric circuit, with a conductor connected to the other terminal of the circuit and to a lever or device for lifting it out of contact with the fixed mass below the surface of the fluid, substantially as and for the purpose described; (2) in an apparatus for opening and interrupting an electromotor circuit, the combination and arrangement with a governor driven by the motor of a lever operated by the governor, a contact carried by the lever, which contact dips below the surface of a fluid such as water, and is connected to one terminal of the motor circuit, and a fixed contact immersed in the water or similar suitable fluid, and connected to the other terminal of the motor circuit, substantially as and for the purpose described and as illustrated.—No. 12135. July 31st, 1889. 6*d*.

MISCELLANEOUS.

MAKING HOLLOW WARE.—*J. R. Thame, Boxmoor, Hertfordshire, & H. Sanguinetti, London.*—The ware is formed of paper or like pulp. The appliance employed has an inner perforated shell, or former, covered with wire or other gauze, and an outer solid shell arranged to be drawn away from the inner and perforated one. Both shells have flanges at one end, by which they are held in place. The space between the shells forms the mould for the hollow ware or bucket. Between these shells the pulp is introduced by a force pump, a vacuum at the same time being produced in the inner shell. By this means the pulp is to some extent cleared of its water. When the space between the two shells is filled, the pulp supply is discontinued and air pressure applied to either side of the partially formed pulp article. The pulp is thus pressed into a seamless and homogeneous body, and can be removed from the mould. The machine may be continuously shaken whilst the pulp is being forced in, to cause the fibres to more effectually mat together. Claims: (1) Forming hollow ware articles from paper or like pulp contained in a suitable mould by the use of compressed air to compress the pulp and force out the water aided by compressing surfaces and the use of vacuum; (2) the combination or arrangement and use of parts of apparatus for extracting the moisture from paper pulp in order to form hollow ware articles with the aid of compressed air or compressed air and vacuum as described.—No. 10911. July 6th, 1889. 8*d*.

FIXING POSTS.—*W. H. Thomson, New York, U.S.A.*—This describes a base or support for telegraph, gate, and other posts, which base is stiffened and held in place by detachable cross stakes or pins passed obliquely through the base and driven into the ground. The base may be of any suitable form or material in a single piece, and preferably formed with a pointed or tapering lower end to enable it to be driven into the ground. At its upper end the base is formed with a socket to receive the lower end of the post, and in its sides are oblique passages through which the pins are inserted. The pins are flat with tapered ends. To fix the post the base is driven into the ground until the upper openings for the pins are just above the surface of the ground. The pins are then inserted and driven into the earth until their heads are flush with the post. Greater rigidity and security is obtained by driving one pin in with its flat side uppermost and a second with its thin edge uppermost. These two pins are threaded through the post from opposite sides, and the second pin passed through a slot in the first after the first has been driven home. The pins are thus driven in in pairs, and each pair is made to cross the one above and below it. Seven claims are made.—No. 9992. June 18th, 1889. 8*d*.

Copies of the British specifications may be obtained on application to H. READER LACK, Esq., Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every 10d. or fraction of 10d. Remittances exceeding one shilling must be made by Post Office Order.

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BURNHAM'S "STEAM LOOP."

We recently had an opportunity of inspecting working models of a new invention for economising the fuel used in steam boilers and steam heating apparatus, by what the inventor (Mr. Burnham) calls the "steam loop," or "steam sweep." By means of this appliance condensed water can be raised from a low level back to the boiler, which is situated at a higher level, without using either a pump or injector, and, paradoxical as it may appear, the water flows back as if it were under the influence of gravity. Hitherto it has been customary to fix the engine at a higher level than the boiler in order that the condensed water might flow back into the boiler by gravity, but by means of this appliance the difference of level is found to be quite unnecessary.

The apparatus has been widely used in the United States for the last eighteen months. Amongst the users are the Worthington Pumping Engine Company, New York; the Pullman Car Company, Chicago; the Westinghouse Machine Company, Pittsburg, Pa. The patent rights for the United States and Canada have been acquired by Messrs. Westinghouse, Church, Kerr, & Co. The apparatus is now being tried by Messrs. Armstrong, Mitchell, & Co., Newcastle-on-Tyne, and other firms in this country. The consulting engineer is Mr. Charles Blagburn, 150, Leadenhall Street, and the sole licensee, Mr. John Gillespie, Leadenhall Buildings, Leadenhall Street. The action of the steam loop will be understood from the diagram Fig. 1, which shows its application to a steam coil as used for heating purposes. The loop consists invariably of three parts—the vertical pipe from the coil, called a "riser"; the horizontal portion, called the "horizontal"; and the vertical pipe entering the boiler, called the "drop-leg." To work the steam loop, the valve A on the boiler (Fig. 1), the valve B on the coil, and the blow-off valve C are all opened, the valve D being closed. As soon as all air and water are discharged and live steam blows out, the valve C is closed; then the steam gauge E shows pressure in the drop-leg. The latter is allowed to fill with water, and as soon as the steam gauge E shows a slight excess of pressure over steam gauge F on boiler the valve D is opened and the water is forced out of the drop-leg into the boiler until the pressure gauges E and F show the same pressure. The difference between the gauges G and F shows the loss of pressure by condensation, which must

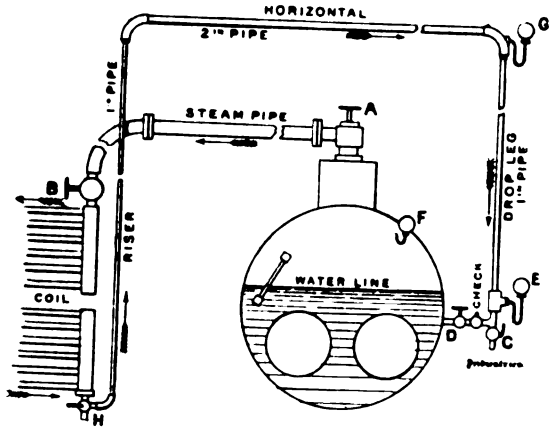


Fig. 1.—Application to Steam Heating Coil.

be made up by the rising of the water in the drop-leg. This difference multiplied by 2·3 will give the height of a column of water in the drop-leg above the boiler water-level, and provision must be made to have the length of drop-leg enough to allow for this column. Fresh water coming over cannot stay in the drop-leg, but flows continuously into the boiler. The valve H is a three-way drainage cock. The flow of the steam is indicated by arrows. Steam, as is well known, always flows to the point of lowest pressure, and the pressure begins to fall directly it leaves the boiler, partly by condensation, and partly by friction. The point of lowest pressure will be at the boiler water-level in the drop-leg, and, as a consequence, there is a constant flow of steam towards this point, which flow continues as long as condensation goes on. This sweep of steam carries along with it all the water formed by condensation or contained in the steam, at first in the form of a thin film swept along the inner surface of the loop, and afterwards, when the accumulation of water is sufficient, in the form of small slugs or pistons of water, which completely fill the pipe at intervals, travelling rapidly towards the point of lowest pressure and forming a column of water above the boiler level. This accumulates until it reaches a height which would balance the difference of pressure. As the loop still continues to bring over water, it follows that as fast as a slug or piston of water is deposited by the steam sweep on the top of the column, it overbalances

BURNHAM'S "STEAM LOOP."

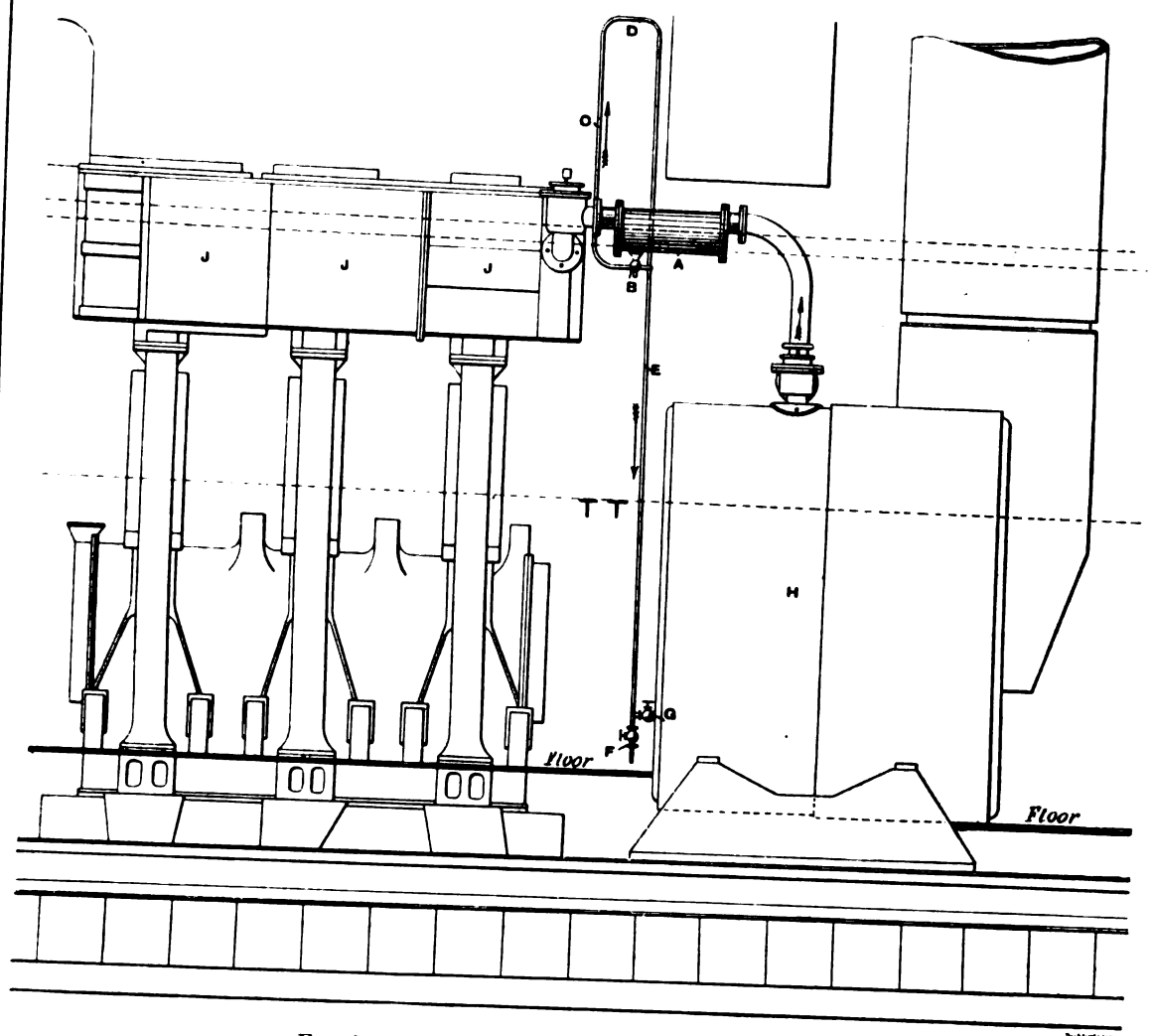


Fig. 2.—Application to Triple-Expansion Engine.

the equilibrium, and an equal amount of water is discharged from the bottom of the column through the check valve into the boiler. The water is thus returned to the water with the minimum loss of heat.

When the steam loop is used in connection with a steam engine, a separator is employed immediately in front of the engine, which catches the water of condensation, as well as that carried over by the steam. The "riser" of the loop is connected to the separator, and the water carried back to the boiler in the manner described above. Fig. 2 shows the application of the steam loop to triple-expansion engines, where A is the separator on main steam pipe, B three-way drainage cock, C riser of steam loop, D horizontal steam loop, E drop-leg steam loop, F blow-off cock, G boiler check valve, H main boiler, J J J steam cylinders. The economy of quickly returning to the boiler the water of condensation hot and under pressure in all uses of steam is generally admitted by all steam users. The appliance appears to fulfil this end in a satisfactory manner. It is remarkable in its simplicity, and there should be a wide field for its use in this country.

THE ROYAL AGRICULTURAL SOCIETY'S SHOW AT PLYMOUTH.

The Royal Agricultural Show was opened to the public on Saturday last. The weather was everything which could be desired, and the ground, rising from near the North Road Station, presented a most interesting sight. The town was gaily decorated with innumerable flags, triumphal arches, and decorations. Last year the Society celebrated its Jubilee, and the number of exhibits and the ground covered exceeded the average. This year the average is maintained, but it would be unfair to compare the present show with that of last year at Windsor. The exhibits are numerous and interesting; all the chief makers of implements are represented; but they are content to repeat their stock types, which have now become settled. Novelties are the exception rather than the rule, and this is not to be wondered at when it is considered how rapidly one show succeeds another. Implement makers hold high carnival twice a year, once in mid-winter at the Smithfield Show, and once every mid-summer at the Royal Agricultural Show. Probably at the summer meeting dairy machinery figures more largely than at the winter show.

Messrs. Clayton & Shuttleworth's exhibits are up to their usual excellence, and comprise portable and traction engines, thrashing and chaff-cutting machines, sack lifting and running barrows, besides lifting chocks and screw-jacks. Messrs. John Fowler & Co. show their 10 h.p. compound ploughing engine, fitted with two speeds, steel gearing and drums, and self-acting coiling gear; an 8 h.p. agricultural engine, and a 12 h.p. horizontal engine; also an assortment of portable railway appliances. Messrs. J. & F. Howard, Bedford, have a large number of ploughs, harrows, hoes, haymakers, and other implements; they also show again their specimens of portable railways and appliances, and a double-side tip-waggon. Messrs. Ransomes, Sims, & Jefferies, Limited, Ipswich, exhibit a large collection of their manufactures, including a 10 h.p. compound small type engine and boiler fitted with an automatic governor expansion gear; the steam chest of the high-pressure cylinder is fitted with a sight feed lubricator, and the jacket is drained by a steam trap. The cylinder and working parts are mounted on a strong wrought-iron frame, and are thus specially adapted for export. The ease with which they are fixed is a marked feature; the boiler can be detached readily from the engine, and the girder frame taken to pieces, thereby rendering the weight of the packages for transport exceedingly convenient. Messrs. R. Hornsby & Sons, Limited, Grantham, have a good show of ploughs, pulpers, reapers, and mowers. They also show an 8 h.p. traction engine constructed to work at 120lb. pressure per square inch, the gearing throughout being of crucible cast steel; also an 8 h.p. and a 6 h.p. portable engine, each with a second lock-up safety valve in addition to the usual fittings. A 4 h.p. vertical engine and boiler on wheels is also shown, arranged so that the fly-wheel can run clear of floor: Messrs. Charles Burrell & Sons, Limited, Thetford, Norfolk, in addition to their other exhibits, show their single-crank system of compound road locomotives. The high-pressure cylinder is placed directly over the low-pressure cylinder, and the piston rods of both are connected to one long crosshead, which is equal in length to the distance between the centres of the two cylinders. The steam, after leaving the smaller cylinder

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THE ROYAL AGRICULTURAL SHOW AT PLYMOUTH.

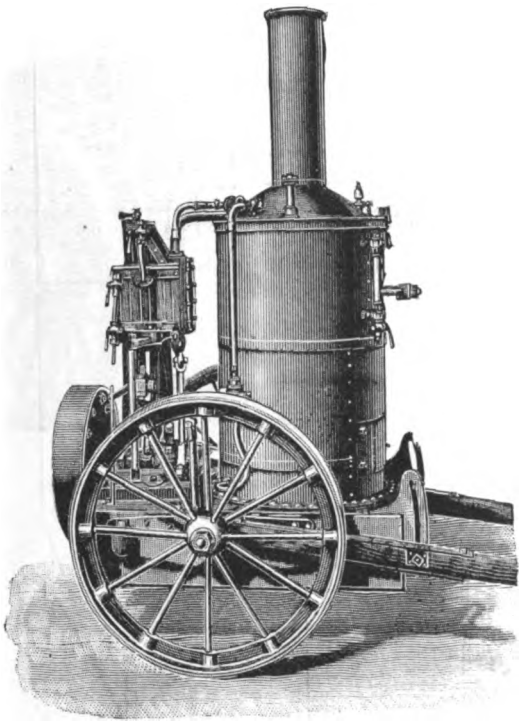


FIG. 1.—MESSRS. SIMPSON, STRICKLAND, & CO.'S SMALL PORTABLE ENGINE.

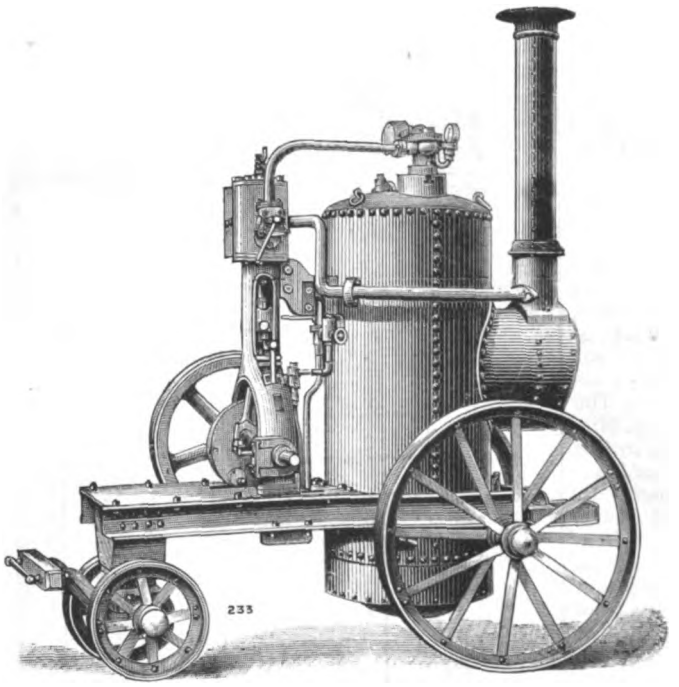


FIG. 2.—MESSRS. E. R. & F. TURNER'S SMALL PORTABLE ENGINE.

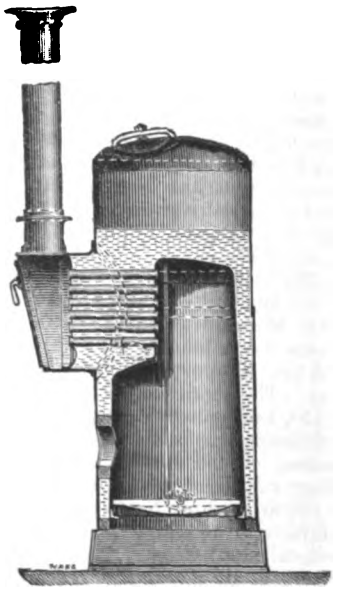


FIG. 3.—SECTION OF BOILER OF MESSRS. TURNERS' ENGINE.

passes directly into the low-pressure cylinder, all clearances being filled up as closely as possible. The slide valves of both high and low pressure cylinders are coupled together and driven by one link motion, so that, beyond having two extra glands to pack, there are no more parts requiring attention than in the ordinary engine with one cylinder.

Messrs. Davey, Paxman, & Co., of Colchester, exhibit two steam engines of the portable type, both of which have been selected by the Jurors for driving the various machines sent for competition. They also show a 16 h.p. undertype engine, a horizontal girder engine, and their "Essex" vertical boiler.

Messrs. Priestman Brothers, Hull and London, exhibit a 2 h.p. horizontal petroleum engine, with oil cistern, vaporiser, air pump, igniting apparatus, and all details for preparation of oil vapour, including separate water vessel, with circulating pump. An 11 h.p. portable oil engine, mounted on wheels, is shown, driving one of Wallis & Steven's thrashing machines, for which purpose it appears to be very suitable. This engine is similar in construction to the 7 h.p. engine shown and illustrated by us last year, as is also a 5 h.p. engine, which has been awarded the first prize by the Royal Agricultural Society for light portable motors up to 5 brake h.p. Messrs. Priestman also show models of their patent dredging and excavating machinery.

The first prize for steam engines up to 5 h.p. using solid fuel has been awarded to Messrs. Simpson, Strickland, & Co., Dartmouth, for a vertical engine and boiler illustrated in Fig. 1, above. This engine has been designed for the light work of a farm, such as cutting chaff, pulping roots, and elevating hay. It is mounted upon a pair of wrought-iron wheels, and is so light that a small-sized horse can readily draw it about, its draught not exceeding that of an ordinary farm cart. This firm also exhibits a very neat steam launch with quadruple-expansion surface condensing engines.

The second prize for steam engines using solid fuel has been taken by Messrs. E. R. & F. Turner, Ipswich. This is illustrated in Figs. 2 and 3, and is a $2\frac{1}{2}$ h.p. vertical portable called "The Gippeswyk." As will be seen, it is carried on a light wrought-iron frame mounted upon wrought-iron wheels, and fitted with a pair of shafts, so that it can be readily transported.

Messrs. Avery, Birmingham, show two novel weighing machines. The first (Fig. 4) is a weighing crane, which enables the weight of a body suspended from the crane to be ascertained while it is being lifted. The crane can be used for ordinary purposes without reference to its weighing properties, the latter only being used when the levers are put in gear, which is effected by a very simple arrangement. The recording lever or steelyard is contained in a box with a falling lid, which can be locked when the weighing mechanism is not in use. An arrangement of chains preserves the balance of the beam, the amount of chain being equally distributed on each side of the crane at all times. There are two pendant chains with weights at their extremities; one of these chains is intended to carry the body to be weighed, while the other acts as a counterweight, rising as the freight chain falls and falling as the freight chain rises, thereby keeping the apparatus in constant equilibrium. The other novelty is a weighing machine and tip-cart combined (Fig. 5), which is made as if the body of a cart were fixed to an ordinary platform weighing machine, and the wheels to the frame. The cart can be used for all ordinary purposes, and it is balanced so that when empty the steelyard registers zero, the recording steelyard only weighing the load in the cart. This is in front of the cart. To effect a weighing the sliding poises are moved along the steelyard. If a printed record is required it can be obtained by inserting a ticket in a slit in the larger poise and depressing a handle. On withdrawing the ticket it will be found to be embossed in bold figures with the weight of the load.

Prizes for disintegrators were taken by the Hardy Patent Pick Company, Limited, Sheffield, and by Messrs. W. N. Nicholson & Sons, Newark. The machine, for which the first prize was awarded, is known as "The Devil" disintegrator. The conditions of award for this are that it must be capable of being worked with a portable or traction engine not exceeding 20 brake horse-power. The machine combines the percussive action of ordinary high-speed disintegrators with a grinding action, which progresses step by step, and gradually reduces the material dealt with to the degree of fineness required. It consists of two grinding rings, one fixed, and the other revolving. Each grinding ring has teeth upon its face, arranged in concentric circles with spaces between them, the teeth and spaces decreasing in size towards the outside edges of the grinding rings, the teeth of one ring passing between the circles of teeth on the other. The patterns of grinding rings generally used are capable of dealing with a wide range of materials, such as grain, bones, rags, clay, pepper, &c. Where one class of material only is required to be ground the grinding rings are specialised to suit the work. For granulating a brittle material grinding rings with moderately coarse teeth are used, but for reducing the material to a fine powder rings with a large number of fine teeth are preferred. The revolving disc is driven at a speed of 800 to 1,000 revolutions per minute. The materials are introduced through a hopper into the centre of the machine, and all material must pass between the grinding rings before reaching the outlet, an opening at the bottom of the casing.

The second prize disintegrator, by Messrs. W. N. Nicholson & Sons, is shown by Fig. 6. It is on a different principle from "The Devil," the material to be acted upon being crushed between two pairs of rollers, composed of hardened discs of tough annealed crucible cast steel, firmly bolted together. An effective way has been adopted of securely interlocking the discs of which the rollers are formed, so that in case of breakage the pieces are held by the discs on either side of the broken one and are prevented from falling out and causing serious damage to the rollers or gearing. The discs when bolted together are as substantial as if made in one solid mass. The rollers are run at different velocities; they are thus rendered self-cleaning. The upper pair of rollers have chisel-pointed teeth, the lower pair have more pointed teeth. These deliver and work against corresponding toothed "concaves," which embrace the lower half of the periphery of one or both rollers. To prevent breakage the rollers are provided with strong boxed springs at each bearing, whilst the concaves are safe-guarded by a weighted lever, the pressure on which can be regulated, and a finer or coarser sample produced at pleasure. By the removal of the weight the concaves can be thrown out of use. Messrs. Nicholson have also an excellent collection of small implements, of which their "Snapdragon" self-acting horse rake is new this year. The principles attempted in this implement are the abolition of springs, the prevention of re-locking before delivery of load, a novel snap arrangement by which it is prevented from again coming into gear after delivery of the load, the trussing of the part of the rake frame which is liable to be strained by careless working, and an improved form of stripper for clearing the teeth. The action of the rake is as follows:—A slight and short pressure of the driver's foot on the pedal when riding, or an easy lift of the back lever if walking, allows the pawls to engage with the ratchet wheels. At the same time the re-locking of the rake by the horse stopping or backing before the load is delivered is prevented by wings or stops formed on the rake frame, against which the pawls abut. The rake having delivered its load, the teeth fall by their own weight with a steady descent to get well through and under the hay, and so ensure a good load and clean raking.

Mr. J. Harrison Carter, of Mark Lane, London, has a fine exhibit of his disintegrators in six sizes. We give an illustration in Fig. 7 of one of these machines. This will pulverise three tons of bones per hour. The variety of substances for which disintegrators are used constitutes a striking feature, and accounts in some measure for the variety of these machines now in the market. Mr. Carter informs us that his disintegrator will pulverise every possible substance that can be got into the machine. The list is too long for us to give it in full, no less than seventy materials being enumerated. The samples shown us clearly prove that the machine does its work effectively. To mention vegetable products, metals, bones, and clay gives an idea of the range of substances which are dealt with by disintegrators. In Carter's machine the material is fed in at the periphery of the grinding chamber, and, falling on the extremity of the beaters, which travel at the rate of three miles per minute, is pulverised by them by being beaten against the serrated chilled iron linings of the upper half of the chamber or the steel bars of the screens which form the lower half. The beaters are made of Lowmoor iron and faced with steel. They are

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THE ROYAL AGRICULTURAL SHOW AT PLYMOUTH.

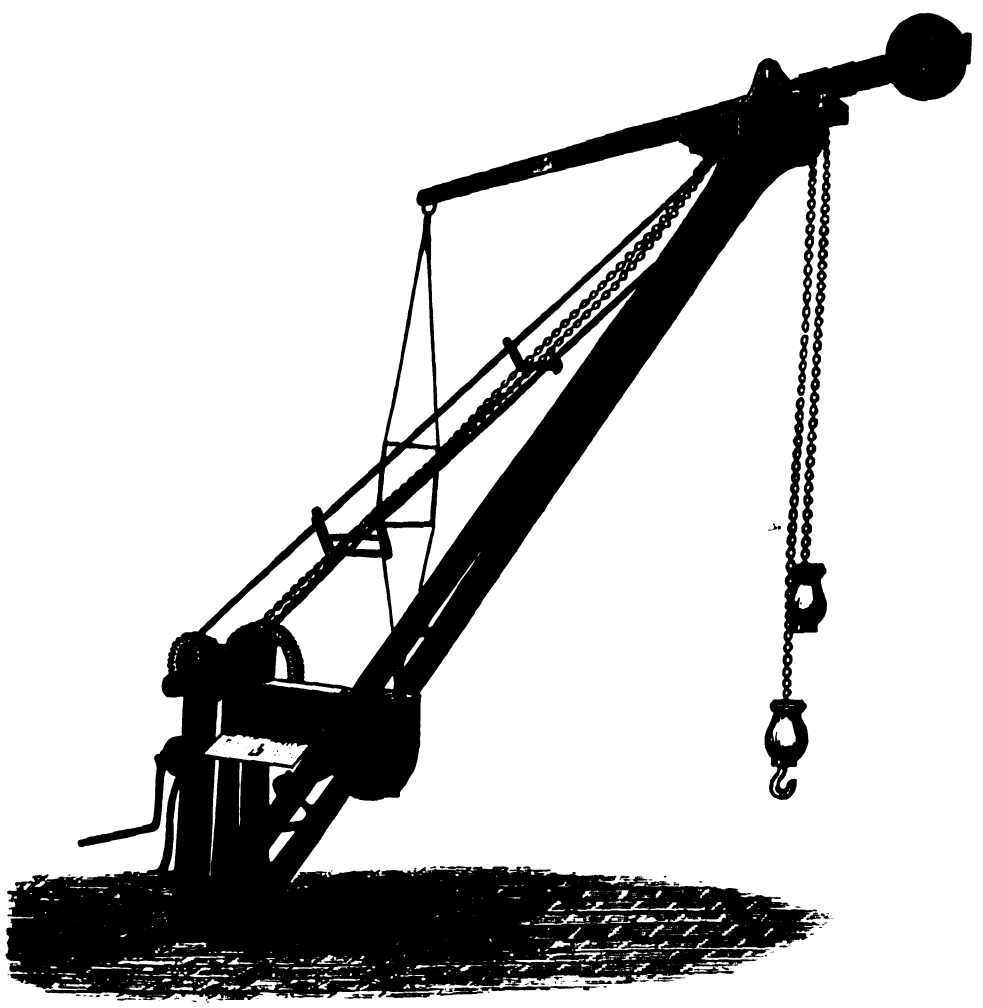


Fig. 4.—Messrs. Avery's Weighing Crane.

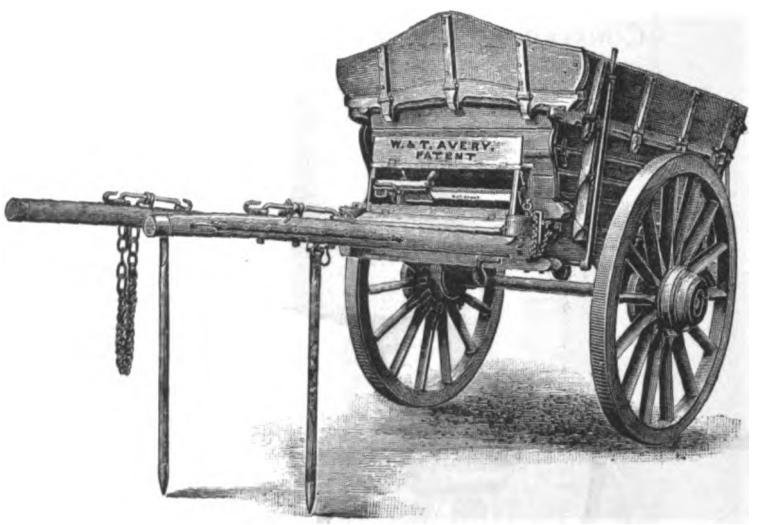


Fig. 5.—Messrs. Avery's Weighing Cart.

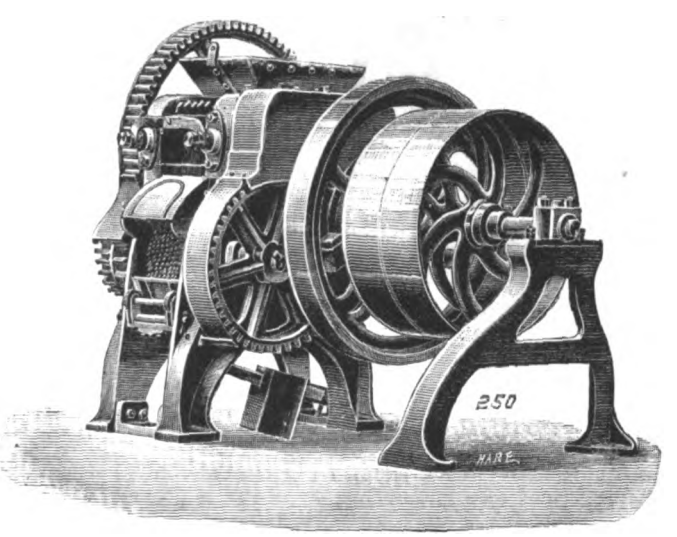


Fig. 6.—Messrs. Nicholsons' Disintegrator.

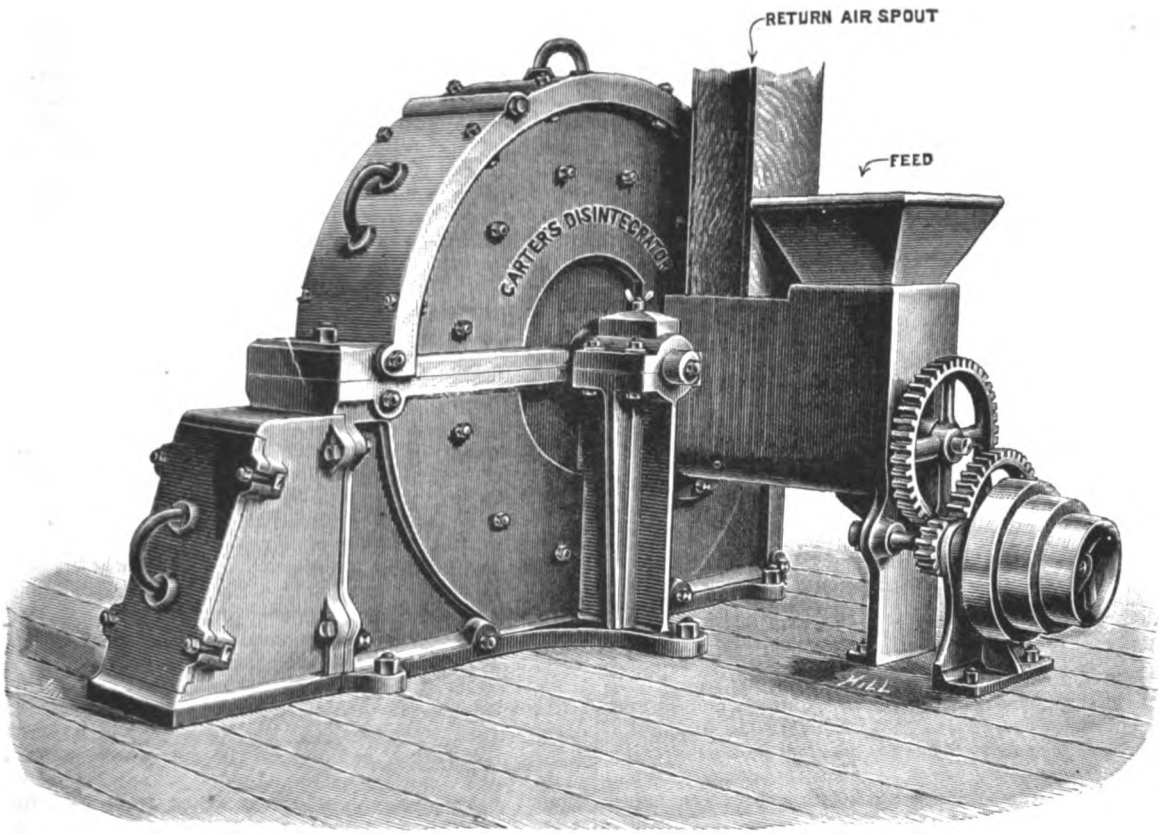


Fig. 7.—Mr. Harrison Carter's Disintegrator.

set so that in running they travel in three parallel paths, thus covering the whole available space of the beater chamber. A novelty at Mr. Carter's stand is a magnetic separator and dynamo. This machine is employed to separate pieces of iron, which frequently are found amongst bones when they are bought in bulk, marine store dealers not being careful enough to prevent the mixing, which invariably takes place between the producers and the grinders. The bones are fed upon an inclined plane, which receives a rapid series of impulses, causing the bones to travel downwards. At the bottom they pass over an irregular roller, which has a large number of electromagnets distributed throughout its length and circumference; these magnets seize hold of any iron which passes over the roller, and leave the bones to fall into the feeder of the disintegrator. The pieces of iron are carried round by the roller past a partition, when the magnets are demagnetised and the iron falls off into another receptacle. This is done continuously, the magnets being alternately magnetised and demagnetised during the revolution of the roller.

Mr. W. H. Coward, Bath, exhibits two of his new slow-motion rapid pulverising mills. This pulveriser consists of a revolving drum, containing an edge runner running at the bottom of the drum. The runner is thus caused to roll in contact with the periphery of the drum, and to crush or pulverise the material brought under its action. The edge runner is carried by a shaft at a lower level than the shaft driving the drum. After the material has passed under the runner, it is carried up by two circles of wedge-shaped cups, fixed on each side of the drum; the edge runner being of less width than the drum allows room for these cups. The cups, as they pass the centre, reverse their position, and the material falls again and again until it is fine enough to pass a screen, through which the finished material is drawn by an exhaust fan. Allied to disintegrators are stone breakers: these are represented by Baxter's knapping-motion stone breaker and by the Blake-Marsden machine. The latter is of the lever hand-hammer motion type; it is fitted with automatic screening apparatus, and mounted on travelling wheels. The machine is driven by an 8 h.p. steam engine, and is capable of breaking 10 to 15 tons of road metalling per hour.

Amongst the exhibitors of the smaller class of machines, Messrs. R. Hunt & Co., Colne, Essex, have a good show, their various grinding mills being simple and compact. This little mill is driven by a two or three-horse gear or by a small engine. It is fitted with safety lever and weight, which instantly releases any hard substance without injuring the plates, and has an adjustable slip for regulating the feed. It is fitted with a hook and chain for raising the lever and weight and releasing the grinding surfaces when the machine is running empty. The bevel gear being arranged for gaining speed, 150 to 200 revolutions per minute is ample for its maximum speed. The grinding surfaces

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THE "VICTORIA" CREAM SEPARATOR.

CONSTRUCTED BY MESSRS. WATSON, LAIDLAW, & CO., GLASGOW.

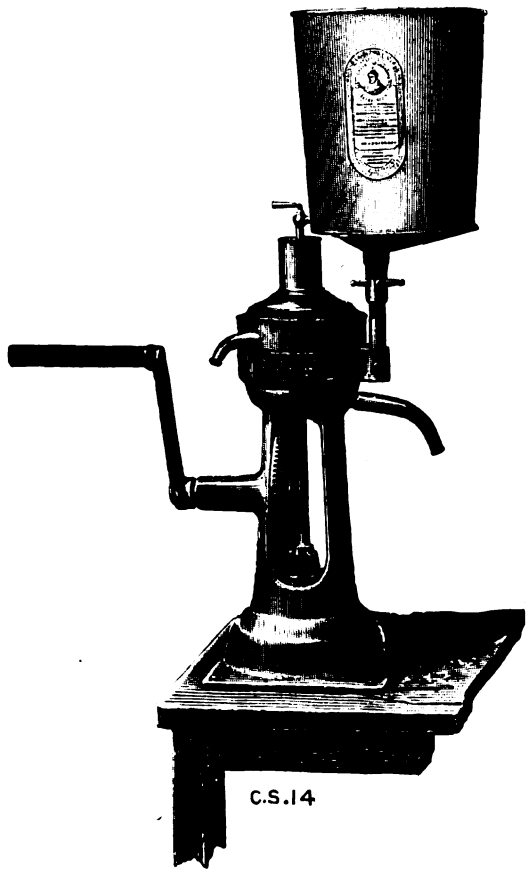


FIG. 1.—GENERAL VIEW.

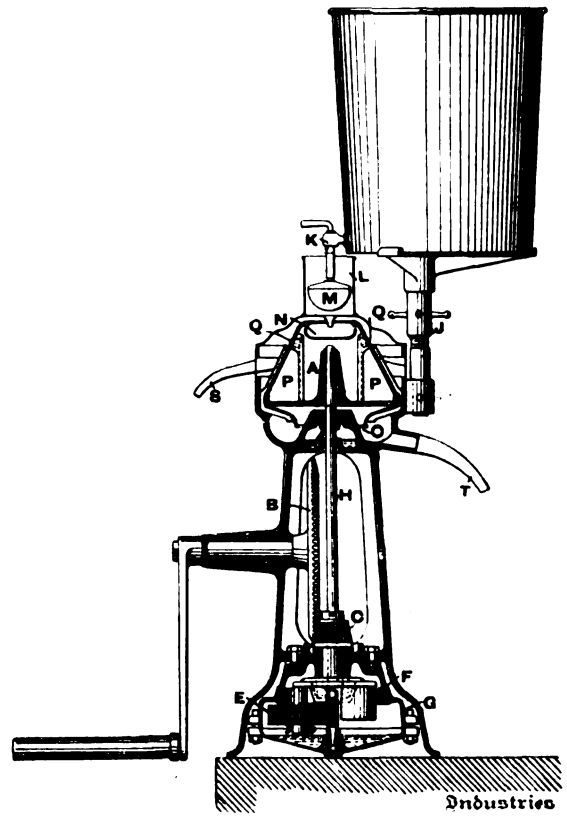


FIG. 2.—VERTICAL SECTION.

consist of two flat circular plates, so grooved and fluted that the corn or seed entering at the centre is ground before passing out at the edges. The pitch can readily be adjusted to grind into fine or coarse meal.

Mr. Davies, of Gwellath, Cury, Cornwall, exhibits his new patent revolving divider, which was first shown at Smithfield last year. It consists of a long fluted conical roller, driven by a chain from the self-raker or binder platform wheel, and as it revolves the grain, which under adverse circumstances clings to the ordinary stationary divider, is lifted up, and is thus cut as easily as unlaid grain. This appliance can be fitted to any harvester. The Agricultural Mill Company, Lawrence Pountney Hill, London, show Andrew's new corn grinding mill in three sizes. At the same stand we notice that Mr. Joseph Westwood, Millwall, exhibits the well-known Hawksley treads so much used at railway stations.

Mr. J. Best, Plymouth, shows a novel automatic stop and starting valve, "The Estover," for starting and stopping small water wheels and hydraulic rams, where there is a continuous stream, but which is insufficient to drive a machine continuously. Mr. Best allows the water from the stream to flow into a tank, where it is stored until there is water enough to work the wheel or ram for a few hours. The valve then acts by opening a connection between the tank and the machine, which works until the supply is exhausted, when the valve shuts and the storage begins again. The principle is shown by Fig. 8. The rivulet water runs into the tank at M; as the water rises it lifts the guided float D, which has a square prong E attached to one side and sliding in a loop F during the time of filling; the loop F has adjustable screws; it is attached at the bottom to a gun-metal valve A, with inlet at the bottom, and sliding plug B, with stop bars C C. This valve A opens communication with the machine to be worked by admitting water to the drive pipe L. At the top the link F is attached to a beam lever I I with a counter-balance ball J; as the link rises or falls, so it turns the beam lever to one side or the other; the action is accelerated by a store of mercury contained in a steel cylinder G, the mercury flowing from one side to the other as the beam is lifted or lowered. The sensitiveness of the beam can be regulated to any degree by the position of the cylinder containing the mercury, as the hands H H enable the cylinder to be fixed anywhere on the beam.

Dairy machinery is well represented at the show by a number of stands, the Aylesbury Dairy Company having one of the finest exhibits. The Redcliffe Galvanised Iron Company show a small but useful improvement to milk cans. Three small wheels fitted with indiarubber tires enable the cans to be run along easily instead of twisting them along their edge in the usual manner. They also exhibit a new departure in the shape of the cans, making them flat on one side, to enable them to be more easily carried on a man's back. Mr. H. G. Vacher, Winchester, exhibits a collection of lift pumps, hydraulic rams, and turbines. This type of turbine is for use in places where it is preferred to drive by belt or rope. It

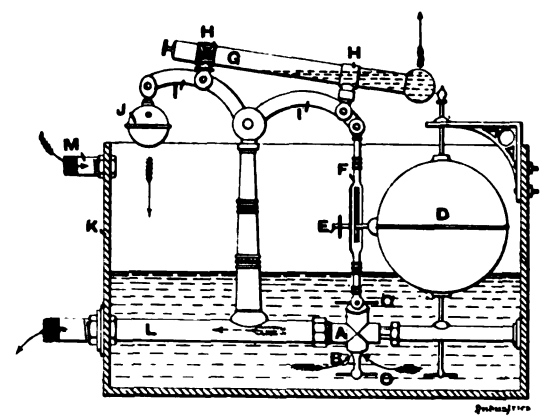


FIG. 8.

consists of a revolving wheel with curved buckets, which is divided in the centre by a disc, and has a right and left outlet for the water. It is fitted inside an annular guide case provided with stationary guide blades which direct the inflowing water against the buckets of the wheel. The guide blades are fitted with wedge-shaped tongues, which when open lie in recesses in the guide blades. The tongues have a small shaft passing through the top of the guide case above mentioned. The shafts are fitted with arms, which are connected together by a ring, so that, in the event of one tongue moving, all of them move in the same direction. The ring is controlled by a counterbalancing weight or spring, which always tends to keep the tongues closed. When part of the load is taken off the turbine, the wheel commences to rotate at a higher speed, and the centrifugal action of the water in the wheel, reacting on the inflowing water, reduces the pressure on the face of the tongues, so that they will be at once partially closed by the counterbalancing weight acting through the ring and arms before mentioned, but as soon as the speed of the wheel is reduced the centrifugal action ceases, and, the pressure of the incoming water being restored, the tongues return to their seats.

Messrs. Powell Brothers & Whittaker, Wrexham, show, in addition to their agricultural implements, a specimen of their "Minerva" rock drill. In this drill a piston rod is provided with two pistons, each of which works in connection with an independent set of parts formed in the cylinder of the drill. The piston rod with the tool receives a rotating motion by means of a twist bar which passes through the other piston. At the outer end the twist bar carries a ratchet wheel in connection with which are double-ended pawls, which, whilst permitting the rotation of the ratchet wheel in one direction, prevent any movement in the direction opposite. Messrs. Barnard & Lake show their thatch-making machines, which have been out a few years; they also show a lighter and modified pattern, with several minor improvements, including the introduction of steel tubes for main frame in lieu of the present heavy cast-iron one. Messrs. Tasker & Sons, Andover, show a double-action well machine combined with a force pump. By the use of this machine one man is able to raise water from a well 150ft. deep and force it to a tank 50ft. above the level of the machine. It is constructed wholly of iron, and stands on an iron curb. A pulley is placed over the upper part of the machine, over which a rope or chain passes with a bucket at both ends, so that when one bucket is delivered at the top full the other is being filled at bottom of the well. A tank provided with two catches is placed on the curb plate, so arranged that the buckets are automatically tilted over and the contents emptied into the tank. A force pump worked from the same handle as the well machinery forces the water from the receiving tank to where it is desired for use. Mr. H. Sykes, London, shows his "Bankside" portable pumping-engine, consisting of vertical boiler, high-speed engine, and centrifugal pump, mounted on wrought-iron frame, with wheels and shafts. Messrs. John Cowley & Son, Hyde, show a collection of screwing machines, including a handy little tool recently designed for screwing pipe bends, which cannot be done with the ordinary stocks and dies. By the introduction of bevel wheels the handle working the machine turns in a plane parallel to the longitudinal axis of the pipe, which it is thus enabled to clear. The makers state that a full thread can be cut at one screwing. A pair of extra wheels is provided for attaining additional speed when screwing the smaller sizes; pieces of pipe as short as 3in. can be screwed along 1in. at both ends without spoiling the thread or damaging the tube. For street or other outdoor work the tool should prove very useful. Mr. W. A. Stone, of Prague, Austria, again exhibits Dolberg's patent flexible narrow gauge railway, together with specimens of the rolling stock suitable for it. Messrs. Entwisle & Kenyon, Accrington, show a collection of vices, including a new one with a swivel jaw, by means of which a taper cotter can be held with the same facility that a parallel piece of iron can be held.

(To be continued.)

THE "VICTORIA" PATENT CREAM SEPARATOR.

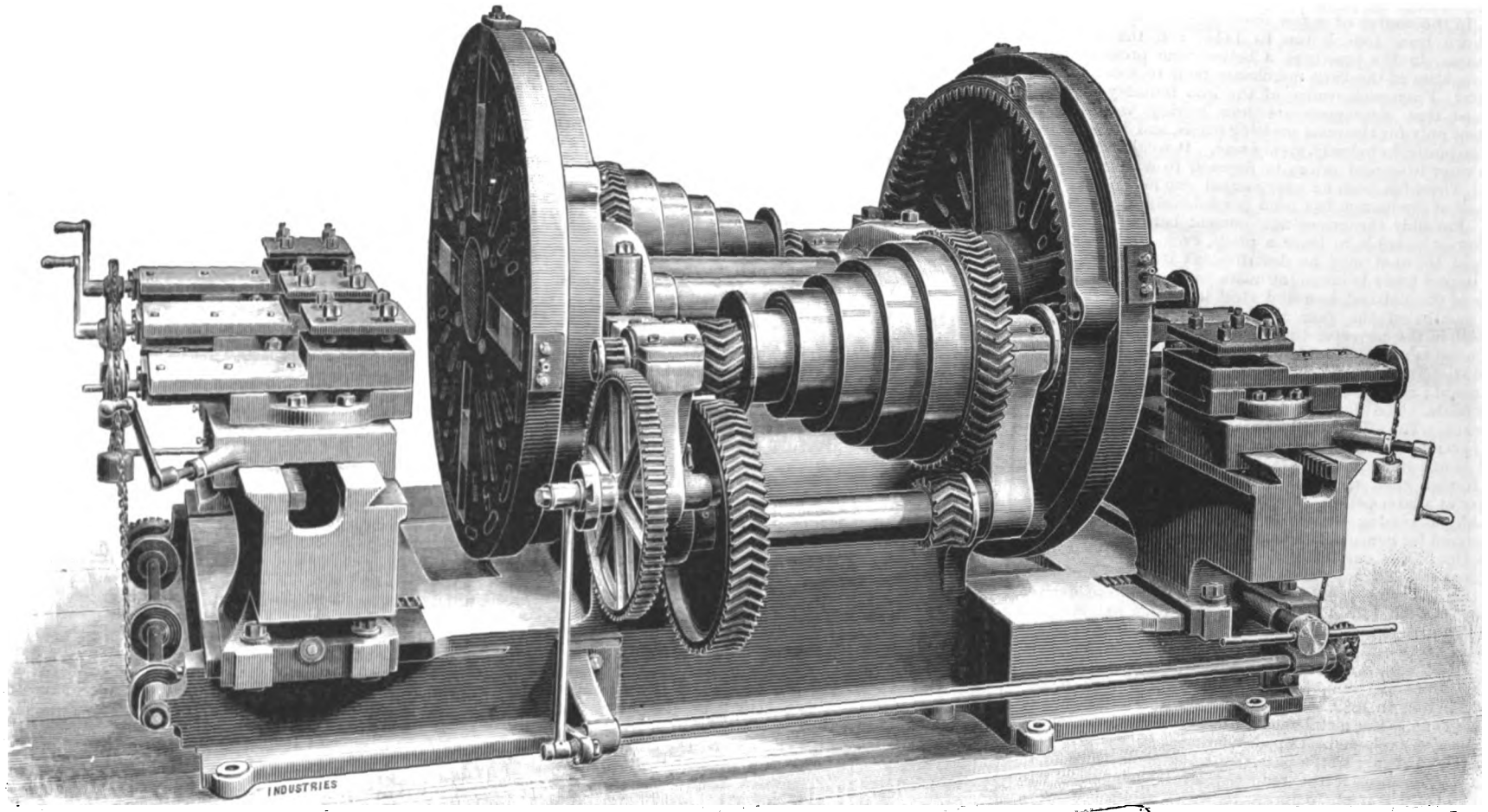
OF late years the importance of the dairying industries has become more generally recognised, and as a consequence new dairies have been started, some as private enterprises and some as public companies. This industry has proved, when conducted on modern scientific methods, to be very remunerative. In some cases a number of farmers in a pasture district join together, and start a central "creamery" or "butter factory," where the produce of all is dealt with and converted into butter, or the cream is mechanically separated from the milk while quite new for immediate sale. Important among the inventions required is the centrifugal cream separator, by the use of which every particle, or rather globule, of the fat which goes to make butter can be extracted and quickly separated from the milk immediately it is taken from the cow. The old process causes from 2 per cent. to 5 per cent. of the cream to be left in the skim milk.

The illustrations (Figs. 1 and 2 above) show the "Victoria" hand-power cream separator, which has been invented and is manufactured solely by Messrs. Watson, Laidlaw, & Co., engineers, Glasgow. The "Victoria" separators are made in various sizes, the smallest size, which we illustrate, being capable of separating 20 gallons of milk per hour, and it can be driven with ease by a lad or girl. The largest size made at present separates 150 gallons of milk per hour, and is

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DUPLEX TYRE TURNING LATHE.

CONSTRUCTED BY MESSRS. SHEPHERD, HILL, & CO., TOOL MAKERS, HUNSLET ROAD, LEEDS.



driven by a steam engine or other convenient motor. Fig. 1, on the opposite page, shows the small machine complete, fixed upon a table ready for action, and Fig. 2 shows the machine in section. The separation of the milk from the cream is effected in the "drum" A of the machine while running at a speed of about 7,000 revolutions per minute. The speed is attained by a gear which has a velocity ratio of 1 to 174 —*i.e.*, for one revolution of the handle the drum A makes 174 revolutions. The bevel wheel B gears with the bevel pinion C, which is fixed to the hollow shaft of the crank D. This crank is fitted with a pin which carries a double spur wheel E. The smaller of these gears with the teeth of the internal wheel F, which is fixed to the gear box G, while the larger wheel gears with the teeth which are cut in the end of the spindle H. It will, therefore, be seen that when the crank-shaft D is set in motion, the wheels E are caused to revolve rapidly about the pin which carries them, and that this motion is again multiplied when transmitted to the spindle H. In addition to this direct increase of speed have to be added the revolutions which the crank-shaft D makes about the spindle H.

We will now proceed to explain how the rich milk is fed into the machine, and how the separation is effected. The milk can or reservoir, which may be raised or lowered at will by means of the regulator nut J, is first filled, and the regulator tripod raised as high as it will go, so that the tap K projects only a short way into the float cup L. The tap is then opened, and the milk flows into the float cup quicker than it can escape from the small hole at the foot. This causes the float M to rise and press against the tap, and thus maintain a uniform head of milk in the float cup. This is necessary to ensure that the flow of milk into the machine is uniform and not intermittent. The distributor cup D receives the milk, and gives it the velocity of the drum A, into which it passes through a number of small holes in the sides under centrifugal pressure due to the velocity of the drum and distributor cup. The milk, of course, assumes a vertical position round the sides of the drum, and remains in the drum until the surface of the wall of milk reaches the bottom edge of drum O. It will be observed that there is a series of holes round the edge of the diaphragm or centre part of the drum, which makes a free passage between the upper and lower compartment of the drum. The drum is also provided with two vanes P. On the inner face of each a channel is cut; the top of this channel communicates with the outer collecting tray by means of the two small holes Q, Q.

These, briefly, are the mechanical details necessary to effect the separation of the milk from the cream, but to fully understand their application it is necessary to consider the action of centrifugal force. When a body, whether solid or liquid, revolves, it tends to move away from the centre round which it revolves. In the case of the cream separator the speed of rotation is so high, and the pressure inside the drum so great, that it necessitates this part of the machine being made of the strongest possible form and material, and it is, therefore, made of steel forgings. As the amount of centrifugal force which bodies exert depends partly upon their weight, it follows that the skim milk, being heavier than the fatty particles of the new milk, acquires a greater force outwards. This being so, the result is that the skim milk takes up the space next to the sides of the drum, and the cream forms an annular wall on the inner surface of the milk. No cream gains access into the bottom chamber of the drum, as the only channels are the small holes through the diaphragm as already mentioned, and these, it has been shown, are in a part of the drum occupied by the skim milk only. It will be seen, therefore, that the only outlets for liquid poured into the drum are either by the channels in the front of the vanes P P and the hole Q Q, or at the lower edge of the drum marked O. These points of escape are so arranged that the proper quantities of cream can escape out of the former and skim milk from the latter. A glance at Fig. 2 will show that the cream and milk are collected in channels as they overflow, and are led off by two different spouts. The cream spout is indicated by S, and the milk spout is shown at T.

An important feature of the "Victoria" cream separator is that the separation does not depend upon the accurate setting of adjustable tubes or valves, as is the case with some other types of machines. It further possesses the great advantage that by the raising or lowering of the feed-can by the regulator nut J, the cream may be discharged either thick or thin, at will, while still extracting the whole of the cream from the milk.

When the machine comes to rest the skim milk remaining in the drum flows into the bottom collecting chamber and out at the skim milk spout. This latter quality is peculiar to the "Victoria" separator.

Practical tests recently made with great care has shown that over 30 per cent. more butter can be obtained from a given quantity of milk when passed through this separator than with the old process of setting up and skimming by hand.

This separator is in use at the Edinburgh Exhibition at the working dairy of Mr. G. H. Pierce. It is also being exhibited at the Royal Military Exhibition, Chelsea.

DUPLEX TYRE TURNING LATHE.

THE tyre turning lathe shown above is adapted to turn and bore tyres 5ft. 6in. diameter. A strong headstock and foundation bed are cast in one piece. The headstock is fitted with two spindles, which run in gunmetal bearings, 9in. diameter. Each spindle carries a face-plate 5ft. 6in. diameter, which is fitted with four movable chuck jaws. The spindles are driven separately by five speeded cones, 5in. wide. In front of each face-plate a strong bed, 7ft. long, is fitted to the foundation, and can be moved to or from the face-plate by means of a rack and pinions. Three compound slide rests are fitted to each of these beds, and are made self-acting in both directions by ratchet wheels and levers, and each is worked independently. The two outside rests can be used for turning the tyres, and at the same time the centre one can be used for boring the boss. This lathe is made by Messrs. Shepherd, Hill, & Co., Hunslet Road, Leeds.

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FOREIGN INDUSTRIES.

(From our own Correspondents.)

PARIS, 24th June, 1890.

IRON.—Prices are again tobogganing in the Paris markets. In the course of a few days bars and joists have slid down from 156s. a ton to 144s., and the descent continues. In the provinces a better tone prevails, but these vagaries of the Paris merchants tend to weaken the markets. From each centre of the iron industry we are informed that consumers are now buying very little, sufficient only for the most pressing needs, and that prices are constantly, but slowly, giving way. It would, however, be an error to expect prices to descend to a much lower level. There has been no exaggerated rise in France, and the cost of production has been permanently increased of late. Probably the prices now current here in Paris are the lowest possible to leave a profit, even after coal has dropped to what may be described as its natural level. The import trade is becoming more active. The declared value of the finished iron and steel imported in the first five months of the year amounted to £95,280, against £81,440 in the corresponding period of 1889; that of iron of all sorts exported to £646,280, against £229,840.

COAL.—The strike of colliers in the St. Etienne district is at an end; but the effects will be felt for some time in the coal trade. The downward tendency of prices has been checked. The effects of the continued high prices of coal are severely felt in all the great manufacturing industries; and as one consequence is a large increase in the imports of foreign coal, the coal mining industry itself must suffer at a later period. English coal is being received in rapidly increasing quantities. The total import of coal delivered for consumption in the country in the first five months of the current year amounted to 3,490,695 tons, against 3,076,965 tons in the corresponding period of 1889. Of this quantity, 1,688,610 (1,425,926) tons were derived from England, 1,524,123 (1,339,222) tons from Belgium, and 275,464 (311,193) tons from Germany, the figures in parentheses representing the quantities received in the same period of last year. The coke imports, the bulk of which came from Belgium, amounted to 515,136 tons against 452,910 tons in 1889.

METALS.—The metal market has become an enigma not easy to be explained. Copper continues its upward movement at a steady trot, a pace that would be justified by the state of business if the reduction of the stocks in hand was what it is made to appear to be. It requires, however, a lively faith to accept the figures which are month by month put before us. Tin has gained a little in the course of the week, thanks to speculative buying. Lead and spelter are firm, with a distinctly marked tendency to rise. Amid such artificial conditions it is vain to attempt to forecast the course of business.

BERLIN, 23rd June, 1890.

IRON.—The business of the iron market is steadily declining. The trade of Upper Silesia is now giving way, buyers holding back for easier terms. The home demand for plates has greatly fallen off; but a brisk export business in this class of goods is kept up with Russia. Joists, too, are in good demand on export account. Manufacturers will be busy on old contracts for some months to come; but fresh orders are likely to become scarce. Founders, though they have plenty of work in hand, are already complaining of the scarcity of orders. During the last week the price of Silesian bars has oscillated between 195s. and 200s. a ton at the works, leaving off at the lower figure. Here in Berlin nothing has been done under 200s.; but the market is weak and evidently tending in favour of buyers. The latest report from Breslau describes the market as still very active for pig iron. This state of things may continue a few weeks longer. But evidently a quieter time is approaching. The export trade continues to shrink.

COAL.—The reaction in the coal market becomes more distinctly marked as the summer advances. Consumers are as reluctant to buy coal now as they were eager only a short time ago. This fact may in part be taken to indicate diminished activity in the manufacturing industries, but it must be borne in mind that the extraordinary brisk business of the coal market in the first four months of the year was largely due to the stocking of coal by consumers to protect themselves against threatened strikes. The Upper Silesian market is very dull, but prices are maintained at from 8s. to 8s. 6d. for large coal; from 7s. 3d. to 8s. for "nuts"; and from 4s. 6d. to 4s. 9d. for small, at the pits. To avoid accumulating stocks the colliery owners are working their pits only five days a week. The coke industry continues active.

METALS.—The changes which have taken place in the metal market in the course of the last week are all in favour of sellers. The latter manifest no disposition to press sales, so that buyers have in many instances found themselves compelled to offer higher prices. The situation is, however, largely artificial, being in the main the outcome of speculative operations. Copper has further advanced. Tin has followed the upward movement. Lead is quiet at last week's prices. Spelter, though not in strong demand, remains very firm, with a tendency to rise.

TEXTILE MANUFACTURES.—The situation of the textile goods trade is on the whole unsatisfactory, and without prospect of speedy improvement. The spinning industry is beginning to feel severely the effects of the depression. The shoddy spinners have reduced production to one-half by working half-time. The "vigogne" spinners of Saxony have under consideration a proposal to greatly restrict production. The worsted spinners, who have already considerably reduced their output, are about to make a further restriction. They only wait a similar movement on the part of their French rivals.

THE FLOATING EXHIBITION.—The German Industrial Floating Exhibition—that is, the scheme for sending a vessel laden with samples of German manufactures round the world—seems to be regarded with growing favour. The number of exhibitors already reaches 500. Some of the principal firms of South Germany and Silesia have within the last few days applied for space.

NEW GLOW LAMP FILAMENT.—The Allgemeine Elektricitäts-Gesellschaft has just introduced a new glow lamp filament, made from cellulose, which is said to give excellent results economically.

VIENNA, 23rd June, 1890.

THE IRON MARKET.—The Austro-Hungarian iron syndicate will come to an end with the present year, but most of the firms connected with it are agreeable to its continuance for another three years. Although the official resolution to this end cannot be passed until the autumn, the prolongation of the syndicate can already be considered secured. Manufacturers say that the continuance of the agreement will contribute to the maintenance of the excellent condition of the market, and that there is no cause to decrease the prices. The present situation is very firm, and there is a good prospect for the future. Last week the Nadrager Eisen-Industrie-Gesellschaft held its general meeting. The total business last year of this company amounted to 524,000fl., and increased 24 per cent. on that of the previous year. The company made a profit of 103,000fl., and a dividend of 5 per cent. will be paid. The Vienna tool manufactory, Reinhard Fernau & Co., has bought the works of the bankrupt waggon manufactory of C. von Milde & Co., for the price of 210,000fl.

THE COAL MARKET.—In the coal market there is still great animation. Prices continue very firm, and colliery owners decline to make contracts for the winter season at the current rates. In the Bohemian market a want has been felt for high-class coals since the inundation of the pits at Osseg. The Brüxer-Kohlenbergbau-Gesellschaft are making efforts to strike new seams, and last week one was obtained at a depth of 332 metres. According to a circular issued by the directors of the Salgo-Tarjan collieries, this company is paying back 20fl. of the capital to each share. The company did an extremely good business last year.

BRUSSELS, 24th June, 1890.

IRON.—The market for iron is still greatly depressed, and the depression affects equally all branches of the trade. Generally speaking, the rolling mills work only four days a week. The recent reduction in prices has had but little effect in stimulating the market, buyers being encouraged to persist in their policy of abstention by the declining tendency of the German and French markets. The general aspect of the industry is gloomy. There has been some inquiry for joists on English account, but the prices offered were too low to be accepted except in the case of a few small lots. The production of pig iron is being more and more restricted, yet stocks continue to accumulate. Prices are merely nominal, there being practically no business doing. The English plate-makers are now underselling the Belgian manufacturers in the foreign markets.

COAL.—The persistence with which the colliery owners maintain their prices is due largely to the fact that the French demand is exceptionally heavy. Coal is still scarce in France, and a great rise of prices, joined to a notable reduction of the output from the mines of the Saar district, has opened up a new market for Belgian coal in the direction of the Vosges. The near prospects of the great coal-consuming industries of this country, particularly the iron industry, are therefore discouraging from this point of view. But pressure is being brought to bear from the German side. German coke is now being offered to French consumers at 14s. a ton at the pits. In consequence of this the Belgian Coke Syndicate has reduced its prices from 20s. to 16s. a ton. Coal prices remain unaltered. The production of coke has been reduced fully 20 per cent. in the last few weeks. The statistics of coal mining in the Mons district, in which 28,160 hands are employed in nineteen mines, show the average wages for all hands, above and below ground, in the year 1889, to have been 2·87fr. a day, against 2·64fr. in 1888. The present rate is considerably above the average for last year.

GLASS.—The market for glass continues lifeless. Recent reductions in prices seem to have checked the already slack current of business by inducing buyers to wait for further reductions. Of course, in these circumstances the state of the industry grows worse every day, for while the selling prices decline the cost of production rises in consequence of the smaller output. Several of the larger works are now on half-time. The export trade to the United States has been moderately active in the last two or three weeks.

DÜSSELDORF, 24th June, 1890.

IRON.—The iron market becomes week by week more and more depressed. The recent reductions in the prices of pig have so far had no appreciable effect in stimulating business. The fact of large quantities of foreign pig being thrown on the market has neutralised the effect of these reductions. Consumers perceive that they have nothing to lose by waiting, and continue to buy only for present needs. Spiegel pig of the 10 to 12 per cent. quality may now be bought for 90s. Business is very languid in the market for finished iron and steel. Buyers hold aloof, waiting for the reduction in prices which must necessarily follow that lately made in crude iron. The declining prices of coal favour the expectation of a large drop in finished iron. The only class of iron now being dealt in is joists, for which the builders have to press for prompt delivery. The tone of affairs generally is gloomy. Reports from Upper Silesia are less favourable.

COAL.—Interest continues to be centred in the coal market. For the moment prices are maintained with some firmness; but the fact that the daily output of the pits in this district is still kept up to some 95,000 tons, in spite of the slack demand, points to a further decline. The coke syndicate has announced a reduction of 10 per cent. in prices. Sales of coke to French consumers have been made at 14s. a ton at the ovens. The merchants are offering both coal and coke at prices that are considerably below those fixed by the syndicate. Hence consumers are encouraged to hope for easier terms later in the season.

THE CLOTH TRADE.—The Cloth Manufacturers' Association of Aix-la-Chapelle and Burtscheid have decided to hold annually two cloth auction sales at the former town, the first to take place in November next.

THE GLASS TRADE.—The Association of German Plate Glass Makers, with a view to check to constantly increasing imports of window glass, have decided to adopt measures for controlling the whole of the production of the German works, and thereby render competition less difficult.

THE GUNPOWDER TRADE.—The balance-sheet of the United Rhenish-Westphalia Gunpowder Company for the second half of the year 1889 has just been issued to the shareholders. We learn from it that the net profits for the half-year amounted to 430,598 marks (£21,529), a clear 6 per cent. on the share capital. This makes 12 per cent. for the year. It appears that the export trade of the company is steadily increasing.

LILLE, 24th June, 1890.

IRON.—Our manufacturers seem unable to hold their ground any longer, for not only have the official prices—that is, the syndicate minimum—been reduced, but, under the name of discounts, commissions, &c., the minimum is being undersold. So irregular has the market become that it is impossible to say what the current prices are. These concessions have, as usual, driven buyers out of the market, for their effect is to weaken confidence in the situation. There is never much buying in a falling market. The fresh orders now coming to hand are scarcely sufficient to absorb one-half of the production.

TEXTILE MANUFACTURES.—The last week has been a quiet period for the linen goods trade. The amount of business transacted fell below the average, and compares unfavourably with that of the corresponding week of last year. In the matter of prices the market is steady. The latest report of the woollen goods trade at Roubaix, just to hand, is written in a despondent tone. Business is greatly depressed, and the prospect has no encouraging feature. There is very little doing in the market for raw wool. A correspondent, writing from Calais, says that the prospects of the tulle industry are improving. At least the manufacturers appear to have some grounds for expecting a fairly active autumn business.

FLAX AND YARNS.—The demand for home-grown flax continues active and prices are constantly rising. A fairly brisk business is being done in Russians; the demand is, however, scarcely so strong as it was a week ago. Tows of good quality are inquired for, prices being in favour of buyers. There is an active market for yarns, the prices for which still tend in favour of the spinners, who manifest no eagerness to sell. Jute yarns are in strong demand at full prices.

AMSTERDAM, 23rd June, 1890.

RAILWAYS.—The Second Chamber of the States-General has approved, by only a small majority, the Government measure for the acquisition of the Dutch-Rhenish Railway and the division of the working of the State Railways between the Holland Railway Company and the State Railways Company. The Bill now goes to the First Chamber, and, as the majority there is not in favour of the present Ministry, fears are expressed that the Government proposals may not be sanctioned after all, the voting upon them having been of such a narrow character in the Lower Chamber. Hence, the shares of the Dutch-Rhenish Railway Company have not risen to the value which they would represent if paid off in accordance with the pending Bill.

THE AMSTERDAM EXHIBITION.—The International Exhibition in Amsterdam of appliances for minimising danger to life and limbs of workmen in factories and workshops has been opened with much ceremony, and proves a great success, the daily average attendance of

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visitors being over 1,000. In connection with this interesting Exhibition a special journal is issued, which will continue to be published whilst the show lasts.

THE ELECTRIC LIGHT IN AMSTERDAM.—The Communal Council in Amsterdam is now discussing the proposal for granting an exclusive concession for the electric lighting of the city during a term of years. The city will share in the profits made, but the proportion is not yet fixed. The town authorities of Rotterdam have also introduced a similar Bill into their own Council for the lighting of Rotterdam.

THE NEW LINE OF STEAMERS TO MEXICO.—The Dutch Consul-General in Mexico has reported to the Government that the improvements of Tampico Harbour have been commenced by the removal of the sandbank barring the mouth of the Panuco river. It is expected that this important work will be completed early next year, when there will be 24ft. of water in Tampico Harbour. In connection herewith, and with the recent opening of the railway from Tampico to San Louis Potosi, the Dutch Consul-General again urges the prompt necessity of establishing a new and direct line of steamers from a Dutch harbour to Tampico. A Dutch syndicate has now been formed in Amsterdam for the promotion of this scheme, and the Mexican Government has been requested to grant a preliminary concession.

COPENHAGEN, 21st June, 1890.

THE TIMBER INDUSTRY IN SWEDEN.—Of late a good many new saw mills have been erected in Sweden, and several of the older establishments have been extended and had new machinery installed. Jonsson & Co. have built a saw mill at Ockelbo, with planing machinery, &c. The engine is from Bolinder's, Stockholm; the saw mill from Sjoström, Gefle; and the planing machine from Beronins's firm, Eskilstuna. Electric lighting has been installed. At Iarfed a new extensive saw mill is in course of construction, as is also one at Okue. The latter is being built by the Okue Augsagsbolag. The new saw mill at Munksund commenced work about a month ago, and the new saw mill at Boxholm, which was built in lieu of the one destroyed by fire, has also been going for some time. The latter is rather a large establishment, and the machinery has been supplied by Bolinder's Engineering Works, Stockholm. Altogether these many new saw mills have furnished a lot of work for the manufacturing engineers in Sweden, especially in connection with the numerous wood pulp manufactories which have been erected. The floating down of timber proceeds satisfactorily. At Tägtens bar, Dalälfven, 625,000 timbers had been taken out up to the middle of June, and about 750,000 timbers were then remaining. At Nye Kelby, 572,500, and at Tovstong, 510,500 timbers had been taken out. In several districts of the Vösterdal river the floating is still in full progress.

GAS WORKS IN SWEDEN.—According to the latest official statistics, there are in Sweden twenty-six gas works, with an annual production of 694,357,425 cubic feet of gas. The largest gas works are those in Stockholm, Gothenburg, and Malmö, and the smallest the one at Södertelze, with an annual production of only 784,000 cubic feet. There are twenty-two coke manufactories, with a production of 3,216,511 cubic feet of coke.

RAILWAYS IN NORWAY.—The Norwegian Government proposed some time ago to build several new railway lines. This measure has now been considered in a special committee, who have altogether reported favourably on the matter. The question has not yet been before the Storthing, but there is every probability of the various proposals being passed. The question about the important Bergen line will, to all appearances, be allowed to remain in abeyance for some time yet, much to the disappointment of the large districts interested in the construction of such a railway.

THE SWEDISH-NORWEGIAN RAILWAY COMPANY.—There do not appear to be any immediate prospects of the transfer to the Swedish State of this company's Lulea-Gellivara section. There have lately been several representatives for the Dutch debenture-holders in Stockholm, in order to confer with the Swedish Government about an agreement, but no result was arrived at. The parties were agreed about the cash payment offered by Sweden, but the debenture-holders seemed loth to part with their entire rights. Besides, they have not yet the full legal power to dispose of the railway, which is, of course, a *sine qui non* condition for an eventual transfer. The matter was left open at present, so that the debenture-holders might try and get this point arranged. As far as the Norwegian section of the railway goes complete uncertainty still seems to prevail. The Norwegians are not satisfied with the present state of affairs, and think the Swedish Government has favoured the company at the expense of the Norwegian interests. The original terms of the concession stipulated for the same length of railway being built every year on the Norwegian and on the Swedish sections. This was afterwards altered, so that the same sum should be expended on each section every year, the building in Norway being more expensive than in Sweden. This was afterwards again altered in this manner—that there should be half the money expended in Norway of what they were building for in Sweden. It almost looks as if there was, at least at present, little or no chance of the Norwegian section being taken in hand again.

MADRID, 23rd June, 1890.

CUBA RAILWAYS.—After many weeks of keeping this question open, the Government has at last decided not to give the concession to either of the two tendering parties. The outside view of the question is that the English proposals required some changes, though very likely the tendering parties would have agreed to accept the concession on the precise terms of the Government. But some very influential politicians were in favour of the rival tender, and rather than see the concession given to the English company, made a point of its not being given to either.

GOLD MINING IN SPAIN.—Every now and then the question of gold mining is revived. There are at present three interesting workings. In the first place there is the Guadalajara mines, which are now in the hands of an English firm. Next to this a Mr. Brown is doing some work at the old mine of the Oriental Company in the province of Toledo. This mine has always been one likely to succeed if plenty of capital were employed. Lastly, a wonderful gold mine is reported to have been discovered in the North. The work will be commenced early next month, when some report of the actual results may be obtained.

THE SPANISH PATENTS LAW.—By the Spanish patent law a patent is void if not practised within two years of its being granted. In ordinary cases some means are found to prove that an invention relative to a machine has been applied; for instance, the parts of a machine can easily be made and applied even in one case only, and then a certificate may be obtained. There are some patents, however, in which that way of proving the practice is impossible. It is noteworthy that a number of very valuable patents are now void in this country on account of their not having been applied within two years. Any one could now obtain five years' patents for these processes, and would be entitled to their exclusive use. Then even the inventor himself could not apply his process in Spain.

NEW YORK, 14th June, 1890.

THE IRON AND STEEL MARKET.—The demand in all lines is fair and prices are firmly held, and indications point to better business in the near future. Prices for pig iron are firmer, and full-quoted rates are being insisted upon. This, to large consumers, means an advance of from 25c. to 50c. a ton, and orders are coming in only as the material is needed. Any quantity of iron, at full rates, can be bought for June and July delivery, but beyond that makers are taking few orders, as it looks as though prices would advance after that time. For manufactured iron prices are unchanged, but the market is firm and confident. The demand for all sorts of finished iron and steel is improving, and prospects indicate a large business during the next three or four months. The mills are already beginning to feel the effects of the improvement. Best refined bars are quoted at 1·80c. to 1·85c. per lb., plates at 2·10c. to 2·20c., and angles at 2·20c. to 2·25c. Large sales of skelp iron were recently effected at 1·75c. per lb. delivered, but sellers now take 1·75c. to 1·80c. on all new business. The demand for steel rails is improving, and prices are firm at an advance of half a dollar per ton, so that $32 is the inside price for large lots. Billets are showing great strength, and prices have risen a dollar per ton in the past week. The demand has largely increased, so that prices are likely to go higher. Mills are all running to their full capacity.

SHORTENING TRANSATLANTIC TRIPS.—At a meeting of the Land Board of New York State on the 10th, an application was received from the New York and Long Island Railroad Company for a grant of the right of way, 99ft. in width, and 50ft. in height, under the bed of the East River, within which to construct a tunnel for the use and operation of its railroad. The tunnel will begin at Tenth Avenue and Forty-second Street, in New York City, and run easterly under Forty-second Street and the East River, coming to the surface at Hunter's Point, Long Island City. If no remonstrances are filed the Commissioners will grant the application at their next meeting. It was current during the last session of the Legislature, that the Ramey Bill to bridge the East River to Long Island City was backed by Mr. Austin Corbin, the President of the Reading Railroad. He said that as soon as he got the bridge over the East River he would double-track the Long Island Railroad, which begins at Long Island City and runs to the eastern, or Montauk, end of the island. The object of the scheme was to establish a line of steamers between Montauk Point and Liverpool, and give the best of rapid transit from the Point to New York City, thus shortening the ocean trips over a day. Some time ago when Montauk Point was sold by auction, it was bought for Mr. Corbin for $275,000. The Bridge Bill failed because of the refusal of the Governor to approve it, and it is now the intention to accomplish by means of a tunnel what they wished to accomplish by the bridge.

THE NEW NAVY.—Bids for over five million dollars' worth of new naval vessels were opened at the Navy Department on the 10th inst. The largest of the three vessels, which is the largest ever designed for the United States Navy, is known as "Armoured Cruiser No. 2," and is of 8,100 tons. She will carry light armour and a 6in. protective deck. She will be armed with six 8in. and twelve 4in. breechloading rifles. The engines are to develop 16,000 h.p., and to drive the ship at 20 knots. Her principal dimensions are—Length, 380ft.; extreme breadth, 64ft. 2½in.; and depth of hold, 41ft. 3in. The other large vessel is designated as "Cruiser No. 6," and is to have a displacement of 5,500 tons. She has no armour, but is provided with a protective deck 4½in. thick. Her main batteries consist of two 8in. and ten 4in. breechloading rifles. The vessel is of the same type as, but of heavier tonnage than, the "Baltimore," "Philadelphia," "Newark," and "San Francisco." Her dimensions are—Length, 330ft.; extreme breadth, 53ft.; and depth, 33ft. The third vessel is the practice cruiser of 800 tons, a miniature man-of-war for the training of the cadets at the Naval Academy. The appropriation limits for the three vessels are as follow:—Armoured cruiser, $3,500,000; protected cruiser, $1,800,000; and $260,000 for the practice ship. For the armoured cruiser on the plans and specifications of the Navy Department the Union Iron Works, of San Francisco, bid $3,100,000; William Cramp & Sons, of Philadelphia, $3,150,000; and the Risdon Iron and Locomotive Works, of San Francisco, $3,450,000. The Union Iron Works and the Cramps also submitted bids for this vessel on their own plans and specifications, the former for $3,000,000, and the latter for $2,985,000. The only bids for the protective cruiser were from the Union Iron Works, of San Francisco. They propose to construct the vessel on the Department's plans and specifications for $1,796,000, and on their own plans for $1,760,000. Two bids were received for the practice vessel, both on the Department's plans—F. W. Wheeler, of West Bay City, Michigan, at $245,000, and Samuel L. Moore & Co., of Elizabethport, N.J., at $250,000. No award will be made until the Department officers have had an opportunity to examine the bidders' proposals.

BRICK PAVEMENTS.—Brick paving has been thoroughly tested in Galesburg, Illinois, and is pronounced a success after six years' trial with about five miles laid. Three manufactories there now make paving brick, turning out about 160,000 daily and employing 400 men. The clay is exceptionally good, and is ground up and sifted as fine as flour, and then moistened, moulded, and burned in a close kiln with a downward draught. From one-fourth to one-third more time is consumed in burning than with the ordinary brick. In burning the brick shrinks from 9in. in length to 8in., and proportionately in other directions. It is thoroughly vitrified throughout and weighs about 5lb. This brick will resist the best steel drill and a chip will scratch glass. In laying, the street is properly graded and covered with 4in. to 5in. of macadam, then 4in. of sand is put down and levelled. Then one course of brick is laid down flat and lengthwise with the street and rolled with a light roller; on this course is placed 1in. of sand, and then a final course of brick is laid on edge and across the street; a ¼in. of sand on top fills the crevices, and the whole is well rolled. The street is graded with a fall of 6in. in 19ft. from the centre. The fall is carried to within 3ft. of the curb, where it is level to within 1ft. of the curb, and then rises 1in. This pavement has stood the test of the severest traffic of the town, in some cases for six years; it shows no wear, and has cost literally nothing for repairs. As to price, the contractors were required to do the grading, furnish sand and all other materials, except only the guttering, and make the pavement complete, and all this they did for $1·40 per yard. The paving bricks sell at Galesburg for $8·50 per 1,000 on cars, and the price is shaded to $8·25 per 1,000 on large contracts.

PHILADELPHIA, 13th June, 1890.

NEW RAILROAD CARS.—The rivalry between the Pennsylvania Railroad and the Baltimore and Ohio-Reading-New Jersey Central combination in the lines between New York and Washington has led the latter to determine to do away with all the old cars on the New York line, and replace them with new ones. The line will be known as the Royal Blue Line, from the colour of the cars. The three companies have ordered the cars from the Pullman Company, of Chicago. There will be sixteen passenger coaches, eight combination cars for baggage and passengers, and ten parlour cars. Each train will consist of four or five cars. Each car will be vestibuled, and will have a smoking apartment for twelve persons. The cars will be lighted with gas and heated with steam, and will have automatic brakes. There will be no extra charge for travel in these trains, except for seats in parlour cars and berths in Pullman sleepers. The expense of equipment is to be borne equally by the three companies.

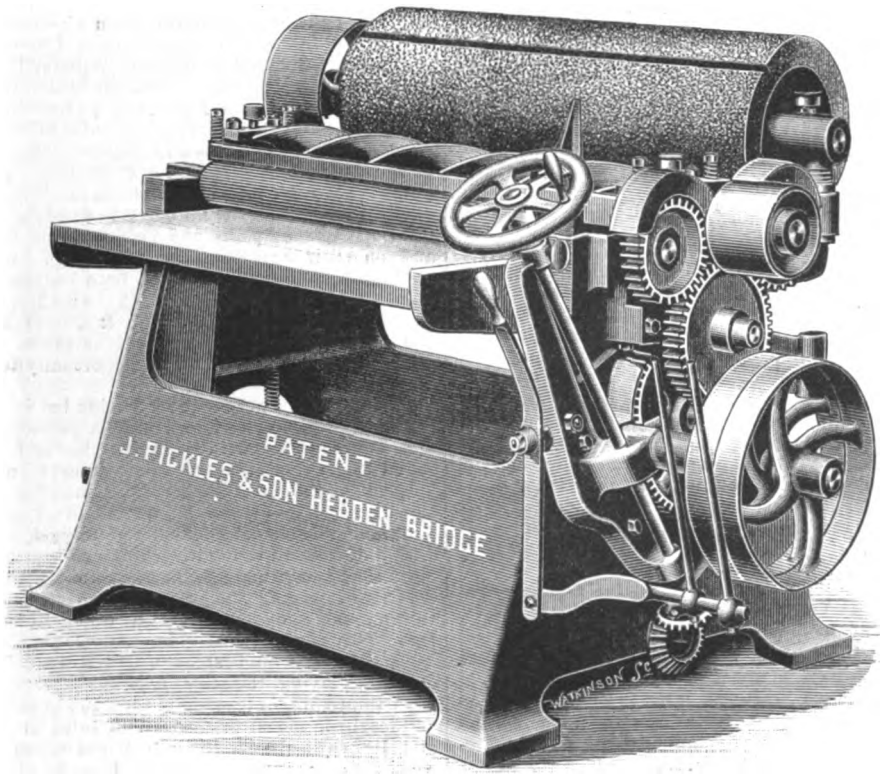
THE NICARAGUA CANAL.—The first dredger for the Nicaragua Canal sailed from Charleston, South Carolina, on the 28th ult. Three others will follow within forty days. These are all for the harbour dredging work, and not for the main channel of the canal, the dredging for which cannot be economically pushed till work on the great divide cut is well advanced. The railway to reach the latter, for which Mr. Chas. P. Treat has the contract, is being pushed as fast as possible, and is likely to be finished early in the autumn.

THE MARYLAND AND DELAWARE CANAL.—The Maryland and Delaware ship canal project is again revived, and there is talk of an early commencement of work. The enterprise is said to be in the hands of a French company, with $8,000,000 capital. The route selected is the Sassafras route, surveyed in 1874. It will begin at Sassafras, on Chesapeake Bay, 39½ miles from Baltimore; then up that stream 16½ miles; then through a country with 80ft. maximum cutting above low water, and down the valley of the Black Bird Creek. It finally passes through a ridge of high ground, and enters Delaware Bay near Liston's Point. The solid cutting is only 7½ miles, and the whole distance between navigable water on both sides is but 14½ miles.

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PLANING, THICKNESSING, AND GLASS PAPERING MACHINE.

CONSTRUCTED BY MESSRS. JOHN PICKLES & SON, HEBDEN BRIDGE, YORKSHIRE.



DUTTON'S SIGNAL LAMPS.

WE illustrate herewith in Figs. 1, 2, 3, 4, 5, and 6, Dutton's improved signal lamps. The particular features of novelty in these lamps are the form of the lens used and the method of cutting a part away so as to show a difference between the lamps used for distant, shunt, and home signals. The lamps can be used either with gas or oil, and are so made as to allow the gas fitting to be turned down on an elbow joint out of the way when the oil lamp is in use. In Figs. 1, 2, and 3 the lens A is circular with a segment cut off the top and bottom. The inner face is flat, and the central part of the outer face is convex and surrounded by raised zones in which the radii of convexity increase as they are more remote from the centre of the lens. This is shown clearly in Fig. 2, where the effect of the shape of the lens and of the parabolic reflector is to cause the rays to diverge laterally more than usual, but to show a well-defined disc of light in the centre. Fig. 1 shows the oil lamp in use with the gas tube B turned down out of the way; the air enters as shown by the arrows. Fig. 3 shows the oil lamp removed and the fitting for the gas jet placed inside the case. Fig. 2 is a sectional plan of the lamp. The lens is often made circular, and exhibits a brilliant light visible from any point of observation within a lateral range of 60°, which is a considerable improvement upon the narrow field of effective light given by the ordinary lamps in use. In order to clearly distinguish the home, starting, and distant signals at night the lens is cut away in the centre and a black plate is inserted, as shown in Figs. 5 and 6, the distant signal lamp having a taper horizontal bar, and the shunt-signal lamp a vertical parallel bar across it. As the lens is made of colourless glass, when the signal arm hangs at "all right" a white light is seen with a dark bar across it, and when the signal arm stands at "danger" the red spectacle glass comes down in front of the lamp and so causes a red light to be shown crossed with a dark bar. These lamps are now in use upon several of the main lines in England, Scotland, and Ireland, and are manufactured by Messrs. Dutton & Co., Limited, of Worcester.

FIG. 1.

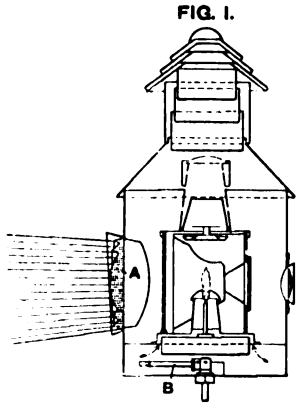


FIG. 3.

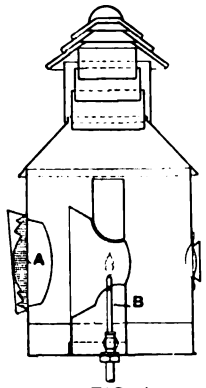


FIG. 2.

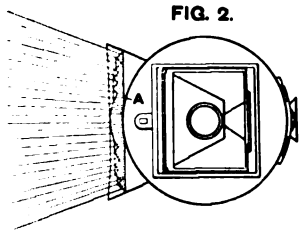
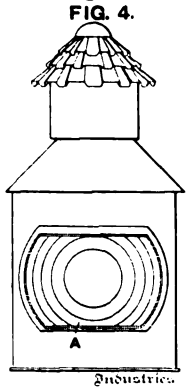


FIG. 4.



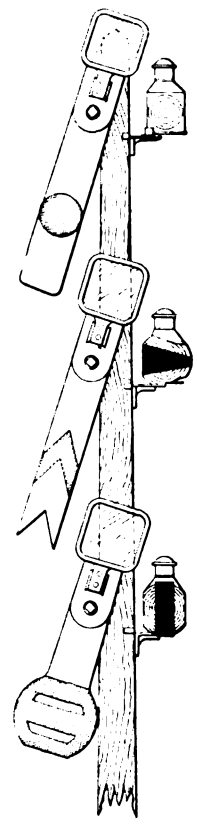


FIG. 5.

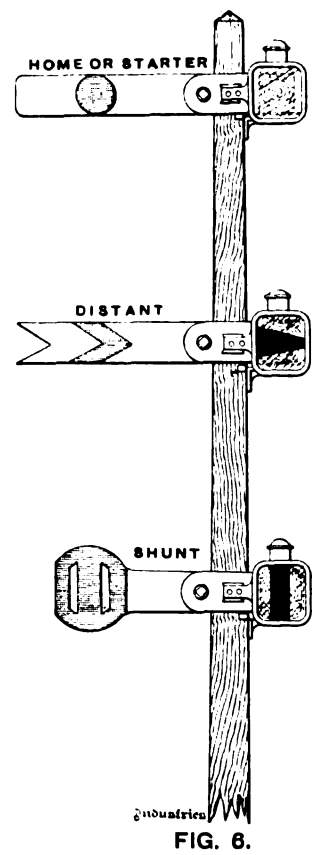


FIG. 6.

PLANING, THICKNESSING, AND GLASS PAPERING MACHINE.

THE accompanying illustration represents an improved machine for planing and glass papering timber, made by Messrs. John Pickles & Son, saw mill engineers, Hebden Bridge. It is fitted with spiral cutters, for it is a well-known fact that, while planing and thicknessing machines with straight cutters are found very useful for working soft and common woods, they are found deficient when used for hard and gnarly, or cross-grained timber, and require an extra amount of hand labour being expended upon the object to get up the necessary face and finish. To obviate and remedy the above defects various means have been adopted. The spiral cutter meets the difficulty, and renders the planing of most curly timber, parquetry, or other difficult work quite an easy and inexpensive process. The cutter gently enters the timber under operation, and takes off a very fine shaving, and when the blade has worked for about 7½in. in width, another blade commences cutting, so that with a 30in. cutter, all the blades are working at the same time. For grinding the cutters from time to time, a special grinding apparatus has been devised which can be readily fixed by two bolts upon the table of the machine. This grinding arrangement consists of a fine emery wheel fixed upon a sliding arm. This enables the cutter to be presented in its entire length to the emery wheel. The feeding of the timber through the machine is affected by means of four rollers, two on each side of the cutters, the top rollers being driven, the front one being grooved. These rollers are fitted with an efficient variable spring pressure arrangement. Between the feeding rollers and the cutter spindle are provided pressure bars, with spring arrangement, to keep the timber under operation firmly down upon the bed of the machine. The bed or table is provided with lips which obviate the indenting of the timber a short distance from the end. The table is raised or lowered by means of a hand wheel, and bevel and screw motion on each side of the machine, to suit the different sizes of timber to be operated upon; an index and pointer being arranged which shows at a glance the measurement of the object passing through. The illustration clearly shows the glass papering roller, which is placed at the upper part of the machine facing the operator. The main frame of the machine is all cast in one piece, and is very strong and self-contained, and does not require any special foundation.

SHIPBUILDING NOTES.

ON the 5th inst. the screw steamer "Zampa," recently completed by Messrs. Edward Withy & Co., Middleton Shipyard, Hartlepool, proceeded on her trial trip in Hartlepool Bay. This vessel is an excellent type of a modern cargo steamer, and has been built for the fleet of Messrs. Herskind & Woods, West Hartlepool. The steamer is over 300ft. in length, and is built throughout of Siemens-Martin steel. She has a long raised quarter-deck, short poop, long bridge-house, and topgallant forecastle. The holds and 'tween decks are fitted throughout with iron grain divisions. She is built on the web-frame system to give extra strength and to enable the vessel to stow cargoes of the bulkiest description. She has large water ballast capacity fitted all fore and aft. To facilitate the discharging of cargo she is fitted with four large steam winches and a large donkey boiler. The triple-expansion engines and boilers have been supplied by Messrs. T. Richardson & Sons, Middleton Ironworks, Hartlepool.

ON the 12th inst. the s.s. "Tandil" proceeded from the Tees on her trial trip. This vessel has been built for Messrs. Arthur Holland & Co., London, by Messrs. Raylton Dixon & Co., Middlesbrough. She is built on the web-frame principle, having a poop, raised quarter-deck, bridge, and topgallant forecastle. Her leading dimensions are:—Length over all, 287ft.; breadth, 39ft.; depth, moulded, 21ft. 3in.; and dead-weight capacity about 3,300 tons.

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Her engines have been fitted by the North-Eastern Marine Engineering Company, Limited, Sunderland, and on trial gave every satisfaction, developing a speed of 11 knots.

ON the 17th inst. Messrs. D. & W. Henderson & Co. launched, from their yard at Meadowside, Partick, four steel schooners, named respectively "Mosquito," "Avis," "La Honmiga," and "Arana." The schooners have been built to the order of Messrs. J. & A. Allan, of the Allan Line, and are intended for service on the River Plate.

ON the 17th inst. the s.s. "Strathavon," 2,500 tons, was launched from the yard of Messrs. Russell & Co., Greenock. The vessel will be supplied with triple-expansion engines by Messrs. Blackwood & Gordon, Port Glasgow. The dimensions of the vessel are:—Length, 306ft.; breadth, 41ft.; and depth, 22ft. 2in. The owners are Messrs. Birrell & Sons, Glasgow.

ON the 18th inst. Messrs. Raylton Dixon & Co. launched from their dockyard at Middlesbrough a steel screw steamer, which has been built to the order of Messrs. Arthur Holland & Co., London. She is built on the web-frame principle, having poop, raised quarter-deck, long bridge, and topgallant forecastle. She is of the following dimensions:—Length over all, 287ft.; breadth, 39ft.; depth, moulded, 21ft. 3in.; and dead-weight capacity about 3,300 tons. Her engines will be fitted by the North-Eastern Marine Engineering Company, Limited, Sunderland, and are to have cylinders 21in., 35in., and 57in. diameter, by 39in. stroke. On leaving the ways the vessel was christened "Alfalfa."

ON the 18th inst. Messrs. Richardson, Duck, & Co. launched from their yard at South Stockton a steel screw steamer of the following dimensions:—Length over all, 307ft. 4in.; breadth, extreme, 40ft.; depth of hold, 20ft. 2in.; and dead-weight carrying, about 365 tons. The vessel has a half poop aft; accommodation for captain, officers, and passengers amidships; a raised quarter-deck, and a long bridge from after engine-room bulkhead to stem. The engineers are berthed in a deck-house on the quarter-deck abaft the engine casing, and the crew in forecastle. She has a double bottom all fore and aft, on the cellular principle, capable of containing about 560 tons water ballast. She is fitted with an Emerson-Walker's patent steam windlass, four horizontal steam winches, &c. The engines have been supplied by Messrs. Blair & Co., Limited, and their cylinders are 22½in., 37in., and 61in. diameter, by 42in. stroke.

ON the 19th inst. Messrs. Ropner & Son launched from their shipyard at Stockton one of the largest vessels that has ever been built on the Tees. Her dimensions are:—Length over all, 378ft. 6in.; breadth, extreme, 47ft.; depth, moulded, 29ft. 9in.; and dead-weight, 6,300 tons. She is built of Siemens-Martin steel. She has full poop, long bridge-house, and T.G. forecastle and cellular bottom for water ballast. Her engines are by Messrs. Blair & Co., Limited, of 2,100 i.h.p., which will give a speed of over 10 knots laden. She will be fitted with direct steam windlass, Davis's steering engine placed abaft the engine skylight, with shafting connecting it to the main and upper bridges, six very large steam winches, horizontal multitubular donkey boiler, double derricks, and all the latest appliances for the quick loading and discharging of cargoes. The steamer has been built to the order of Mr. Christopher Furness, of West Hartlepool, and as she left the ways was christened "Pakeha."

ON the 19th inst. the clipper-stem spar-decked screw steamer "Prodano," built at Blyth, by the Blyth Shipbuilding Company, Limited, for Messrs. Pinkney & Sons' Steamship Company, Limited, of Sunderland, had a highly satisfactory trial trip. An average speed of 11¾ knots was steadily maintained. The North-Eastern Engineering Company, Limited, of Sunderland, supplied the engines.

ON the 19th inst. the s.s. "Duckenfield," recently launched by Messrs. Fleming & Ferguson, shipbuilders and engineers, Paisley, went down the river for her speed trial. On the measured mile she attained a mean speed of 11¼ knots. The "Duckenfield" is a steel twin-screw steamer, and is fitted with overlapping propellers. Her dimensions are:—Length, 220ft.; breadth, 31ft.; and depth, 15ft. 6in. The engines are of Messrs. Fleming & Ferguson's patent quadruple type, and indicate 1,200 h.p. with 200lb. steam pressure. This vessel has been built to the order of Messrs. J. & A. Brown, of Sydney, for their Colonial trade.

ON the 19th inst. there was launched from the shipbuilding yard of Messrs. D. & W. Henderson & Co., Glasgow, a steel screw steamer named the "Scindia." The dimensions of the vessel are:—Length, 375ft.; breadth, 46ft.; depth, 30ft.; and gross tonnage, about 4,300 tons. The "Scindia" is intended for Messrs. Henderson Brothers' Eastern trade. She is to be fitted with a complete installation of electric light, and a search light for night passage through the Suez Canal. She will also be fitted with patent steam steering gear by Messrs Napier Brothers, and steam windlass by Messrs. Harfield & Co. The builders are to supply triple-expansion engines, having cylinders 26¾in., 44in., and 72in. diameter, by 60in. stroke. She will be rigged as a two-masted schooner with square sails on foremast.

ON the 19th inst. the "Jose Romane," a screw steamer, was launched by the Grangemouth Dockyard Company. The dimensions of the vessel are:—Length, 170ft.; breadth, 25ft.; and depth, 11½ft. The vessel has been specially built for the Mexican passenger trade, and is to be supplied with triple-expansion engines by Messrs. Hutson & Corbett, Kelvinhaugh.

ON the 21st inst. the "Templemore," a three-masted steel sailing ship, was launched by Messrs. Russell & Co., Port Glasgow. The vessel has been built to the order of Messrs. Thomson, Dickie, & Co., Glasgow. Her dimensions are:—Length, 260ft.; breadth, 38ft.; depth, 23ft.; net register, 1,700 tons.

ON the 21st inst. the trial trip of the s.s. "Norna" took place in Hartlepool Bay. She has been constructed by Messrs. Edward Withy & Co., Hartlepool, for Messrs. Herskind & Woods, of West Hartlepool. Her engines are of the triple-expansion type, with cylinders 21½in., 35in., and 58in., by 39in. stroke, and have been built at the Central Marine Engine Works, West Hartlepool. During two hours' consecutive steaming a mean speed of 11 knots was obtained.

ON the 23rd inst. there was launched from the yard of Messrs. S. McKnight & Co., Ayr, the "Garnock," a screw steamer of the following dimensions:—Length, 160ft.; breadth, 25ft.; depth of hold, 12ft.; and dead-weight capacity, 560 tons. The engines will be of the triple-expansion type, with cylinders 14in., 22½in. diam., and 36in., by 27in stroke. The "Garnock" has been built to the order of the Garnock Steamship Company.

ON the 23rd inst. the "Glenbreck," a four-masted steel sailing ship of 1,930 tons gross, to carry 3,100 tons cargo, was launched by Messrs. Robert Duncan & Co., Port Glasgow. The "Glenbreck" has been built to the order of Mr. Robert R. Paterson, Greenock. Her dimensions are:—Length, 270ft.; breadth, 40ft.; depth, 23ft. 8in.

PRICES CURRENT, 25TH JUNE, 1890.

Quotations at per ton, unless otherwise specified.

ANGLES, PLATES, BARS.

Messrs. G. Bailey Toms & Co., London, quote as follows:—

	Com. £ s. d.		Best. £ s. d.	
Middlesbro' Bars	5 10 0	.....	6 0 0	f.o.t. wks.
„ Angles	5 5 0	.....	5 15 0	„
„ Plates	5 7 6	.....	5 17 6	„
Staffordshire Bars (cheaper makes)	7 10 0	.....	8 0 0	London.
„ Angles	7 10 0	.....	8 0 0	„
Crown Sheets	7 2 6	.....	7 12 6	„
„ Hoops	7 0 0	.....	7 10 0	„
"Siemens-Martin" Steel Boiler Plates			7 17 6	„
„ Ship and Girder			6 17 6	„

Market quiet.

PIG IRON.

Middlesbro' Warrants, No. 3	42/-	Cash
Scotch Warrants, m/n	45/1½	„
Hematite Warrants, m/n	51/1½	„

Stocks in Stores				
Scotch	720,146—Dec.	for week	6,249	Tons.
Middlesbro'	95,221—Dec.	„	2,762	„
Hematite	291,674—Dec.	„	5,674	„

Exclusive of stocks in makers' yards.

	No. 1.		No. 3.	
Coltness	61/6	.....	56/-	f.o.b. Glasgow.
Gartsherrie	59/6	.....	55/6	„ „
Langloan	61/6	.....	56/-	„ „
Summerlee	61/-	.....	56/-	„ „
Glengarnock	60/6	.....	54/-	„ „
G.M.B. ex Store	45/3	.....	45/6	„ „

PIG IRON—BRAND "CARRON."

Present prices of "Carron" Pig Iron are as follow:—

	No. 1.	No. 3.
Prices, per ton ...	65/-	..... 55/6

F.O.B. Grangemouth or F.O.R. Carron Works, Stirlingshire.
Terms: Cash on 10th of Month, following delivery.

	Per Ton Extra.
Delivery at Leith or Granton	1/9
Do. at Broomielaw, Glasgow	2/-
Do. at London (over ship's side in Thames)	6/-
Do. at Liverpool (alongside export vessel)	—
Do. at do. (traders' dock)	—
Do. at Hull (on quay)	5/-

METALS.

Spelter: Ordinary	£24	10	0		.....		
Copper: British Cakes and Ingots	64	0	0	to	65	0	0
„ Chili Bars, G.O.B.'s	58	17	6	„	59	5	0
„ Other sorts, G.M.B.'s (equal to Chili Bars)	58	17	6	„	59	5	0
„ Manufactured (strong)	72	0	0	„	.....		
Lead: Common Pig	14	0	0	„	14	2	6
„ English Sheet	14	15	0	„	14	17	6
Tin: Straits	94	12	6	„	95	0	0
„ Australian	96	0	0	„	97	0	0
„ English Ingots	99	10	0	„	.....		

Messrs. Carrick & Brockbank, Manchester, report as follows:—

COPPER: We have to report a strong market in copper, with large trade at advancing rates. During the greater part of the past week there has been a quiet market for raw, owing to slackening off in buying, but a large business is again taking place, and the market is firmer. The decreased stocks and increased demand caused by new outlets for consumption will tend to strengthen the market and maintain prices. Chili bar quotations to-day are £58 17s. 6d. to £59 5s. cash, and manufactured £72 sheets, £75 bottoms.

TIN has been dull and inactive throughout the week, and values have declined. To-day's market, however, is firmer, at improving rates.

LEAD steady, but with small business doing. Values are practically unchanged.

SPELTER continues firm, with small business doing. The market is, however, bare of stocks, and buyers have to pay full prices.

CHEMICALS.

		£ s. d.		£ s. d.
Acid: Carbolic Crystals	lb.	0 0 8	to	0 0 9½
„ „ Liquid	gal.	0 1 2	—	.....
„ Citric	lb.	0 1 4	—	.....
„ Oxalic	„	0 0 4	—	.....
„ Sulphuric	ton	1 12 0	—	.....
„ Tartaric	lb.	0 1 4	—	.....
Alum: Lump (powder 10/- ex.)	ton	4 17 6	—	.....
Ammonia: Carbonate	lb.	0 0 3½	—	.....
„ Muriate (Grey)	ton	22 15 0	—	.....
„ „ (White)	„	26 10 0	—	.....
„ Sulphate	„	11 0 0	—	11 2 6
„ Liquor	lb.	0 0 3½	—	.....
Antimony	ton	.....	—	.....
Bleaching Powder	„	4 15 0	—	4 17 6
Bisulphide of Carbon	„	13 10 0	—	.....
Borax	„	30 0 0	—	.....
Benzole (90 %)	gal.	0 3 10	—	.....
„ (50/90 %)	„	0 2 10	—	.....
Copper Sulphate	ton	24 0 0	—	.....
Copperas	„	2 0 0	—	.....
Kieserit	„	.....	—	.....
Lead: Nitrate	„	22 10 0	—	.....
„ White Sugar	„	24 0 0	—	.....
„ Brown „	„	19 0 0	—	.....
Potash: Bichromate	lb.	0 0 4	—	.....
„ Caustic	ton	22 0 0	—	.....
„ Carbonate	„	19 10 0	—	.....
„ Chlorate	lb.	0 0 4½	—	0 0 4¾
„ Prussiate (Yellow)	„	0 0 9½	—	.....
„ Sulphate (Basis 90 %)	ton	9 10 0	—	.....
Precipitate: Red	lb.	0 3 1	—	.....
„ White	„	0 3 2	—	.....
Salts: Epsom (Bags	ton	3 0 0	—	.....
Salts: Epsom (Casks	„	3 15 0	—	.....
„ Glauber	„	1 10 0	—	.....
Sulphur: Sublimed Flowers	„	9 0 0	—	.....
„ Recovered	„	4 10 0	—	.....
Soda: Ash	deg.	0 0 1¾	—	.....
„ Caustic (White 70%)	ton	8 12 6	—	.....
„ „ (60%)	„	7 12 6	—	.....
„ „ (Cream 60%)	„	7 7 6	—	.....
„ Crystals	„	3 2 6	—	3 5 0
„ Bicarbonate	„	6 0 0	—	.....
„ Hyposulphite	„	6 5 0	—	.....
Solvent Naphtha	gal.	0 4 0	—	.....
Tartar, Cream of	cwt.	5 12 6	—	.....
Zinc Sulphate	ton	7 10 0	—	.....

Messrs. S. W. Royse & Co., Manchester, report as follows:—

CHEMICALS: Caustic soda has had a firm market during the week, and has advanced a little. Bleaching powder, after declining somewhat, has recovered, and closes firmer. Soda ash is more plentiful at slightly lower prices. All transactions in these goods are, however, for early delivery, makers declining to sell far forward. Sulphate of copper is more freely offered for July delivery at considerably reduced prices. Acetates of lime are drooping. Acetates of lead and nitrate of lead are steady, with moderate inquiry. Recovered sulphur in demand.

OILS.

		£ s. d.
Cocoanut: Cochin	per tun	30 0 0
„ Ceylon	„	25 10 0
Cottonseed	„	22 10 0
Cod	„	20 0 0
Lard	„	35 10 0
Linseed	„	24 10 0
Palm, Lagos	„	25 10 0
Rapeseed: English	„	32 0 0
Seal: Pale	„	27 0 0
„ Brown	„	22 0 0
Sperm	„	45 0 0
Whale	„	24 0 0
Turpentine	per cwt.	1 9 3
Coal	per gal.	
Petroleum (Refined)	„	0 0 5⅞
„ Spirit	„	0 0 7

LAMPS.—Messrs. James Guthrie & Co., 9, Leather Lane, Holborn, E.C., have sent in a well-illustrated catalogue of the lamps for household use manufactured by them.

MESSRS. HETHERINGTON'S TOOLS.—We have received a magnificently illustrated catalogue of machine tools manufactured by Messrs. Hetherington & Co., Ancoats Works, Pollard Street, Manchester. Perhaps the best way to describe the style of this catalogue is to say that it is only equalled by the excellent workmanship for which this firm is so well known.

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HOME INDUSTRIES.

LONDON, 26th June, 1890.

THE MONEY MARKET.—Money has been growing increasingly dearer, and now it has reached very stiff figures. The approach of the end of the half-year always produces a strong demand for money, and the situation is complicated this week by the incidence of a Settlement and by the generally unfavourable nature of the monetary position. Gold continues to flow to the Continent. The maintenance of harder rates for loans and discounts seems inevitable for some considerable time. The stock markets have been quiet and dull in consequence of the Settlement. Sales to liquidate accounts open for the rise, so as to save the heavier carrying-over rates, were plentifully made at the beginning of the week, and though an occasional feeble rally set in, prices tended generally downwards. An attempt to support Brighton Deferred was not a conspicuous success, and the home railway list has not been strong. Americans have moved within restricted limits just as New York prices were higher or lower than London prices, but no new business has been initiated on this side. Foreigners have stiffened a little after a collapse at the close of last week, but are still far from vigorous. Foreign and Colonial railways are depressed in most cases. Copper mining shares are fairly well supported, but other mines are neglected. Industrial and miscellaneous securities have been inactive, but the most prominent of them have sought a slightly lower level of prices.

COMPANIES.—The following companies have been registered since our last report:—Thomas Ware & Sons, Ld., with a capital of £40,000, to carry on the business of tanners, &c.; The Eccles Spinning Co., Ld., with a capital of £90,000; The Astley Estate Co., Ld., with a capital of £100,000, to acquire collieries, &c., in Lancashire; The Colliery Trust Syndicate, Ld., with a capital of £6,000, to acquire collieries, &c.; Burals' Semi-Metallic Packing Co., Ld., with a capital of £5,000; The Mexican and Central American Railway, Ld., with a capital of £900,000, to construct or acquire railways, &c., in Mexico; The South American Light Railways and Tramways Trust, Ld.; Messrs. James Brierley & Co., Ld., with a capital of £30,000, to acquire lands and erect breweries; Balderstone Mill Co., Ld., with a capital of £20,000, to carry on the business of cotton spinners, &c.; Wellington Mills Co., Huddersfield, with a capital of £400,000, to carry on business as woollen manufacturers; Kent Patent Arc Lamp Co., Ld., with a capital of £10,000; General Phosphate Corporation, Ld., with a capital of £1,000,000, to acquire mines, &c.; British Ballarat Gold Exploration Co., Ld., with a capital of £60,000; Ore Reduction and Smelting Company of South Africa, Ld., with a capital of £50,000; Sir Elkanah Armitage & Sons, Ld., with a capital of £150,000, to carry on the business of cotton spinners, &c.; Birmingham Exhibition Hall, Winter Garden, and County Hotel Co., Ld., with a capital of £50,000; Letaba (Transvaal) Lands Co., Ld., with a capital of £200,000, to acquire lands, mines, &c.; Yew Mill Co., Ld., with a capital of £80,000, to erect a cotton mill, &c.

RAILWAYS.—The gross receipts of the twenty-three principal railways in the United Kingdom for the week ending June 15th amounted, on 16,186¼ miles, to £1,361,933, and for the corresponding period of 1889, on 16,057¼ miles, to £1,391,524, an increase of 129 miles, or 0·8 per cent., and a decrease of £29,591, or 2·1 per cent., the receipts for the corresponding period having included the Whit week traffic.

THE RAILWAYS IN TIME OF WAR.—On Friday afternoon last at the Royal United Service Institution, Whitehall Yard, Mr. George Findlay, Manager of the London and North-Western Railway, and lieutenant-colonel in the Engineer and Railway Volunteer Staff Corps, lectured on the subject of the "Transport of Troops by Railway within the United Kingdom." The view of the lecturer was that, in time of war, when, in accordance with the provisions of the National Defence Act, 1888, the railway companies might be called upon to suspend, as far as might be necessary, the ordinary traffic, in order that the railways might be devoted, in priority, to military purposes, the principal railway officials should become, for the time being, the servants of the State, and the railways should be worked and controlled, under the direction of the headquarters staff, by the officers of the Engineer and Railway Volunteer Staff Corps and the managers of the leading railway companies, that the headquarters staff would instruct them as to the transport required, and they would be responsible for providing it. The lecturer also gave in detail a scheme for working the railways in time of war, and for transporting large armies from one point of England to another.

THE SOCIETY OF ARTS.—The Council of the Society of Arts have awarded the Albert Medal to Mr. W. H. Perkin, Ph.D., F.R.S., "for his discovery of the method of obtaining colouring matter from coal tar, a discovery which led to the establishment of a new and important industry and to the utilisation of large quantities of a previously worthless material." This medal was struck to reward "distinguished merit for promoting arts, manufactures, and commerce," and it is awarded annually.

THE JUNIOR ENGINEERING SOCIETY.—A meeting will be held on the 27th, at the Westminster Palace Hotel, Victoria Street, S.W., at eight o'clock, to consider what steps must be taken in arranging for the summer excursion to the Edinburgh Exhibition. Two visits have also been arranged as follows:—On Thursday evening, the 3rd July, to Messrs. Brin's Oxygen Works, Horseferry Road, Westminster, meeting at the entrance at half-past six; on Friday evening, the 11th July, to the Richmond Gasworks. In connection with the latter, it may be of interest to note that the retorts are charged by West's mechanical stoker, the coal being broken and conveyed to machine by endless belts. The exhaust plant consists of two Galloway boilers and two engines, connected direct to the exhausters. There are eight purifiers, 30ft. by 20ft., capable of acting on 1,000,000 cubic feet per day. Atmospheric air is admitted to assist purification. A new telescopic 3-lift gasholder, 90ft. by 115ft. wide, capacity 750,000 cubic feet, is in course of erection. Total manufacture of gas is 180,000,000 cubic feet per annum. The sulphate of ammonia plant will also be shown.

THE OCCULTING TELEGRAPH.—On Friday, the 20th inst., Major-General H. P. Babbage gave a lecture before the Balloon Society, on the "Occulting Telegraph and its Inventor." The particular object of the lecturer was to claim for his father, the celebrated mathematician, Charles Babbage, the honour of inventing the first practicable occulting telegraph. In 1851 Charles Babbage proposed to number all the lighthouses in the world, giving to each lighthouse its own number, and arranging them so that in the adjacent lighthouses the digits of the numbers should be all different: thus, 271 - 385 - 694 - 781 - 352 - 469 - 827, and so on. The numbers would be indicated by an opaque shade brought down over the flame of the lamp at intervals of one second, with pauses of five seconds between the digits and of ten seconds between each repetition of the complete number. Thus, to represent 271, there would first be two occultations, then a pause of five seconds; followed by seven occultations, then a pause of five seconds; and then one occultation followed by a pause of ten seconds: thus in thirty seconds the lighthouse would have displayed its number, and would keep on repeating it throughout the night. During the Crimean War he also suggested the sending of messages at night by the same principle.

ELECTRIC LIGHTING.—The Metropolitan Electric Supply Company will shortly have their Manchester Square central station in operation. Babcock & Willcox boilers, Willans & Robinson high-speed engines, and Elwell-Parker dynamos will be employed.

MANCHESTER, 26th June, 1890.

THE IRON MARKET.—The rise in pig iron has caused a little more animation in this market, and there is somewhat more doing. Local irons are quoted about 50s. per ton, less 2½ per cent., but hematites are decidedly firm in tone owing to some of the makers having reduced their production. Bar iron is only moderately asked for, and makers are not pressed for delivery, although fairly well off for contracts.

COTTON TRADE WAGES.—The joint conference of manufacturers' and weavers' representatives was held on the 20th inst., and resulted in an agreement being arrived at with reference to a uniform wages list. It is proposed that the new list shall be gradually introduced from the 1st of September next, and be in full operation from the 1st of January, 1891.

THE MANCHESTER SHIP CANAL.—The Bill promoted by the Ship Canal Company empowering them to alter the position, size, and number of the tidal openings in the portion of the canal adjoining the Mersey estuary has been passed by a Select Committee of the House of Commons. The Bill was strongly opposed by the Mersey Dock and Harbour Board, but in spite of this it has been passed practically without alteration.

THE HYGRODEIK.—Under this title a patented instrument for graphically denoting the amount of moisture in the atmosphere of a shed is being introduced by Mr. Chas. Lancaster, of Manchester. The instrument consists of a graduated semi-circular scale, round the face of which the free end of a finger or pointer can travel. The finger is centred near one extremity on a short pin, the other end of which has a small lever or crank fixed on it. To the outer extremity of this one end of a hair is fixed, the other end being securely fastened to a light frame or pillar. As the temperature or humidity in the shed varies the hair expands or contracts, and, as the weight is always arranged to preserve it in tension, the indicator finger is moved across the face of the scale, and readings can be taken at any time as desired.

PREPAYMENT GAS METERS.—A new gas meter, known as the "March Thorp," is being made in considerable numbers by Messrs. Sawer & Purvis, of Manchester. By its aid a pennyworth of gas can be obtained by the consumer. The penny is dropped into a slot and pushed home by a piston or pusher, after which it drops into a locked drawer or receptacle. While the penny is being pushed through it releases a star wheel which is operated by fingers or pawls fixed upon the drum. At the same time a conical valve by which the admission of gas is controlled is raised to a certain height. The revolution of the drum moves this valve down at a speed proportionate to that of the passing gas, and by the time the quantity which can be sold for a penny is delivered the valve closes shutting off the supply. As soon as the gas is supplied the meter drum is again locked by the detention of the star wheel. If while a pennyworth of gas is being consumed the pusher is raised to repeat the action without a coin, no additional supply can be got, and the introduction of another penny insures the valve being opened as much further as is necessary to supply that value of gas, although the remainder of the first portion remains to be delivered. The mechanism is well designed to prevent any fraudulent use being made of it, and is very simple and easily adapted to various requirements.

THE LINEN AND JUTE TRADES.—There has not practically speaking been any change for the better in the condition of the home trade during the week. The wholesale houses are not purchasing, but several buyers are preparing to visit the producing centres both in Scotland and Ireland, and more will be doing shortly. The season has not been at all unsatisfactory, and payments on the part of the drapers have been very good this year. As a result of January–June trading, one of the largest houses in the city will, we are informed, be able to produce accounts which are not marred by a single bad debt—an unusual event where an annual turnover of hundreds of thousands of pounds is concerned. The uncertainty can still be noted in the shipping section, and the future, as far as the American department is concerned, appears gloomy. Very heavy stocks must now exist on the other side, and the increased duties will enable importers to realise large profits on the goods now held by them. Linen threads are quiet and there is not much doing in jute fabrics. The stocktaking is still in progress with many of the houses, but some have completed this semi-annual task. Yarns are quoted at about 1¼d. per bundle lower for certain descriptions of tows, but better qualities are firm.

GLASGOW, 26th June, 1890.

PIG IRON.—There has been a good deal of animation in our market the last few days, and some stir in various brands of makers' iron. Shipments are keeping up well, deliveries ex store continue longer and on a larger scale than had been anticipated, and it is understood that things are not quite so slack in manufactured iron as they were some weeks ago. Warrants advanced steadily to 45s. 9d. cash, but have relapsed since then to a little below 45s., as the impression is gaining ground that a reduction of wages is likely to be brought about without any serious difficulty or interruption of work among the colliers and miners here and in England.

EDINBURGH CALEDONIAN STATION.—The permanent way and the platforms of the old station having been renewed since the recent fire, the company intend to make it serve until the new station is built. This will be several months at least. Messrs. Kinnear, Moodie, & Co., who carried out the enlargements at Perth, have been entrusted with the contract. The new station will be about 800ft. long and 180ft. broad. The roof will be a single span resting upon girders.

SHIPBUILDING.—The shipbuilding yards on the Clyde are being rapidly denuded of the vessels on their stocks, and at Greenock large numbers of men have been paid off as the yards have been emptied. Very few orders are in the market, and prices are so low that both shipbuilders and shipowners evidently anticipate a serious depression. The amount of work on hand at present is about 170,000 to 180,000 tons. This is over 90,000 tons less than the amount on hand at this period last year. Then, new orders were being booked, and work was being refused owing to the difficulty of executing contracts within the required time; now there are practically no fresh bookings.

REDUCTION IN WAGES.—The Fairfield Engineering and Shipbuilding Company have intimated to their workmen that a reduction will be made in the rate of their wages. It is not yet known what the exact extent of the reduction will be; it is understood that the reduction will not take effect until after the Fair holidays. Then, however, it appears not unlikely that the reduction will be general. It is understood that the wages of joiners at the Fairfield Works are to be reduced ½d. per hour, and the workmen in the other departments at the same rate.

TECHNICAL SCHOOL AT COATBRIDGE.—A technical school is being established at Coatbridge, the seat of the iron smelting industry in Scotland. The foundation stone of the building will be laid in a few days.

EXTENSION OF THE TELEPHONE SYSTEM.—The telephone system in Scotland has been extended by the establishment of a direct line between Edinburgh and Dundee. This line will be shortened at an early date by the running of a line across the Forth Bridge. The National Telephone Company have also established a trunk line from Edinburgh to Galashiels, Selkirk, and Hawick, and have just increased the number of trunk lines between Edinburgh and Glasgow by two additional lines. The revenue of the company now reaches the large sum of £400,000 per annum.

(From our own Correspondents.)

LIVERPOOL, 25th June, 1890.

THE MARINE ENGINEERS' MOVEMENT.—The marine engineers of Liverpool intend making a demand, on the 1st of July, for an increase of wages, and also for the number of men engaged on steamers to be in proportion to the tonnage of the vessel and the power of the engines. They contend that, as they have practically the charge of costly ships, cargoes, and hundreds of passengers, they are entitled to the demands which they are about to make, especially as very little credit is given them for their services. A new tariff of wages has been drawn up and received the sanction of their society, and they feel very sanguine that the

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masters will accept their terms. The members of the Sailors and Firemen's Union in Liverpool and Birkenhead have also given notice that they intend adhering to the resolution, passed last week, not to sign articles with non-union men after the 1st of July. It is stated by the officials of the union that similar resolutions have been carried into effect at other ports for a considerable time.

SHEFFIELD, 25th June, 1890.

Iron and Steel Trades.—Business still continues satisfactory on the whole. Pig iron, which has fallen so much in value for the last few weeks, is now much firmer; one very large establishment has found a purchaser for some thousands of tons at 53s. 6d. There is evidently a feeling of distrust, however, as two blast furnaces in the district have been blown out for repairs. There are plenty of large contracts waiting to be given out in railway work. The Great Northern Railway, the Manchester, Sheffield, and Lincolnshire Railway, and Great Eastern Railway are wanting material; the Argentine Republic are also asking tenders for rolling stock and marine work. Messrs. John Brown & Co., Limited, have secured the contract for crank and straight shafting of the "Acolus" and "Brilliant," to be engined by Messrs. Hawthorn, Leslie, & Co., Newcastle; the firm will also supply "Purves" flues for the boilers. The Parkgate Iron and Steel Company have completed the extensive additions to their plant. Four 25-ton Siemens furnaces have been erected. Their new rolling mill is probably one of the best fitted up mills in the world; the largest rolls weigh about 25 tons, and are hydraulically balanced, the weight being put on by small reversing engines fixed to the housing tops.

Coal and Coke.—Coal and coke are rather quiet. Coal is rather firmer than last week. The railway contracts are now settled, and the average price to be paid is 10s. 6d. per ton.

LEICESTER, 25th June, 1890.

Wool Spinning and Yarn Trades.—There is, unfortunately, little alteration of the local wool market in the direction of improvement. Business remains in the same quiet and uncertain state as for some time past. Users are content to buy the smallest parcels to satisfy their wants. Prices are as uncertain as ever, and this effectually curtails business in the direction of any speculative purchases. It is probable that the Colonial wool sales this week will give some indication of the average prices, and it may be that the local wool fair held this week will further settle prices. Spinners are moderately busy, but the uncertain prices of the raw material seriously affect the placing of new orders. There is most doing in worsted yarns; some good contracts for these are in hand, for both home and foreign markets.

Hosiery Trade.—This department shows no great advance on the recent small improvement, and the trade on the whole is hardly up to the average. Some good orders are on hand for heavy Shetland goods and for natural wool goods, but in the fancy departments and in cotton hosiery there is room for much improvement.

Boot and Shoe Trade.—Manufacturers are still able to keep their workpeople fully employed, and a very large turnover is being made. But orders are not coming to hand now quite so freely as they have done. The shipping branch of the trade has not been so good this year as last, and it shows few signs of immediate improvement. Leather merchants are doing a good, steady trade. There has been an advance in the price of several descriptions of American leathers, and some little speculative trade has been done in view of a further advance, but that has subsided, and buyers are content to buy only for present wants.

SWANSEA, 25th June, 1890.

The Electric Light.—The work of lighting the whole of the Swansea Harbour Estate by electricity has just been completed, and the docks are now lighted nightly by the new illuminant. The installation has been chiefly carried out by Mr. Polyblank, the assistant engineer to the Trust, who has refitted the engines of the old Abertawe dredger to obtain the necessary motive power. At a meeting of the lighting and electrical committee of the Cardiff Corporation it was decided that the Council be recommended to apply for a provisional order to Parliament for the supply of the electric light within the county borough of Cardiff. In this connection it may be mentioned that by a majority of seventeen to five the general purposes committee of the Cardiff County Council rejected the recommendation of the lighting committee that the Cardiff gasworks should be purchased by the county borough for the sum of £505,000.

Local Dividends.—Messrs. W. H. Hancock & Co., Limited, brewers, have decided to recommend a dividend at the rate of 23 per cent. per annum for the last half-year. Messrs. John Bland & Co., Limited, timber merchants, pay 5½ per cent., which, with the interim dividend of 2½, makes 8 per cent. for the year. The Bute Shipbuilding and Dry Dock Company's report shows a profit of £20,789, and enables the directors to pay a dividend of 7½ per cent. for the year.

Re-starting of Briton Ferry Works.—A blast furnace has been re-started at Briton Ferry. The furnace has been re-modelled by the Briton Ferry Works Reconstruction Company for the making of hematite pig iron.

The Dockers' Strike.—The strike at the Swansea Docks, which lasted from Saturday night until Thursday last, has ended in a complete victory for the men. In consequence of this disturbance to trade the gross tonnage of imports and exports shows a decline of 34,000 tons compared with the previous week.

The Sliding Scale.—The decision of the masters, just made known, to terminate the sliding scale agreement for governing colliers' wages in South Wales and Monmouthshire has caused widespread surprise, not to say consternation, in view of the possible consequences.

CARDIFF, 25th June, 1890.

Iron and Steel.—Hematite pig iron shows a better tone, and some makers who had intended to put out some of their furnaces have decided to continue working, in the hope of business becoming consolidated. Steel bars are quoted at £5 10s. Business in steel rails is moderately active, but there is no disposition amongst buyers to contract heavily.

Coal and Coke.—The steam coal trade is even better than last week. Shipments have amounted to 270,000 tons, which is very close to the highest weekly figures ever reached. Colliery owners, with one or two exceptions, are booked forward for three or four weeks, so there is no prospect of a decline in prices for some time to come. Steam coal, first quality, is firm at 15s. 6d. to 15s. 9d.; seconds, 14s. to 14s. 9d.; and third, 13s. to 13s. 6d. Small steam is firm, at 9s. 6d. to 9s. 9d., and households, at 13s. 6d. to 15s. The coke market is without appreciable change.

BARROW-IN-FURNESS, 25th June, 1890.

Hematite Iron.—There have been fluctuations in the hematite pig iron trade during the past week, which, however, have left the market as before in a weak state. Prices of warrants stood at 51s. 9d. per ton, but makers are asking 55s. for mixed numbers of Bessemer iron net f.o.b. The output of the district has been further reduced by two furnaces at Maryport and two at Barrow being blown out, but an additional furnace has been lit at Cleator, and one at Workington. It is generally believed that it will be found necessary to damp down at least another half-dozen furnaces, so that the prospect cannot be considered bright.

Steel.—Little activity is observable in the steel trade. Orders for rails are not numerous nor of an important character, and prices of heavy sections still range from £4 10s. to £5 per ton. There are rather better prospects in the steel shipbuilding material trade, but blooms, slabs, billets, wire rods, tinplate bars, and merchant steel generally, show a very quiet tone, and prices on the whole are rather weaker.

Shipments.—The shipments of pig iron and steel from West Coast ports amount to 13,877 tons as compared with 20,885 tons for the corresponding week of last year, a decrease of 7,008 tons. Up to date 506,461 tons have been exported against 523,128 tons last year, a decrease for 1890 of 16,667 tons.

Reduction of Stocks.—Stocks of hematite warrants have been reduced during the week to the extent of 4,178 tons, and from the 1st of January last 86,171 tons. The total amount still held is 294,473 tons.

MIDDLESBROUGH, 25th June, 1890.

Pig Iron.—The market has been more active this week than we have had it for several months, and makers have done a large amount of business at prices 1s. per ton above those ruling last week; 42s. 6d. for prompt f.o.b. deliveries of No. 3 Cleveland G.M.B. is their regular figure, and in some cases 43s. has been secured. The prospects are undoubtedly good, though the warrant market is somewhat easier, and buyers are showing a disposition to purchase for delivery two or three months forward. It is not easy to get No. 3, either from makers or the warrant stores. Forge qualities are more plentiful, and are relatively cheaper than No. 3, for grey forge can be got at 41s. The stock of iron in Connal's public warrant stores is declining much less rapidly than it did last month, and the decrease this month so far has only been about 11,000 tons, a little over 95,000 tons being now held. The competition among local hematite pig iron makers has become less keen, and 55s. is the lowest that is asked for mixed numbers.

Pig Iron Shipments.—It was expected that June would be a very quiet month as regards exports, but the prophets have found themselves agreeably disappointed, seeing that so far the shipments are above the average of this period of the year, no less than 60,910 tons having been exported this month up to the 23rd, as compared with 60,183 tons to the 23rd May. To Scotland the shipments of Cleveland iron this month have been better than for some time past, but as the difference between Scotch and Cleveland has again got below 3s. per ton, we must expect the Scotch founders to take less Cleveland iron.

Manufactured Iron and Steel.—The improved tone in the finished iron market continues, and producers have less difficulty in keeping their establishments going regularly. The downward tendency of prices is checked, and some expect even an upward movement before long; indeed, some firms are asking more than they quoted a fortnight ago, the improvement being noticeable in steel rails and common bars. Inquiries for heavy rails are received from Canada and Australia, and small rails are wanted for plantation purposes. Common iron bars are £5 12s. 6d., best bars, £6 2s. 6d.; ship angles, £5 2s. 6d.; ship plates £5 7s. 6d., all less 2½ per cent. Heavy steel rails are £5; steel ship plates, £6 7s. 6d.; and steel angles, £6 2s. 6d. Cast-iron railway chairs are £3 10s.

Wages.—The Cleveland ironstone miners have agreed to accept till the end of August a 10 per cent. reduction in wages, and the blast furnace men, who had given notice of a termination of their wages sliding scale on the 28th inst., will agree to its renewal till the end of August. It is expected to bring a reduction of wages at the next ascertainment.

NEWCASTLE, 25th June, 1890.

Race Week Holidays.—Another of those frequently recurring holiday periods which tend so greatly to disorganise trade commenced yesterday, and for the remainder of the week the whole of the works in the district will be closed to give the operatives an opportunity of attending the annual race meeting at Gosforth. This course is pursued in accordance with old custom, and it is beyond a doubt that if the employers did not voluntarily permit the temporary cessation of operations for the purpose indicated the men would absent themselves without leave, and the employers would thus have the evil of insubordination to deal with as well as having to put up with the interruption to business. It is only by the help of the trade societies' governing authorities that the employers could bring any effectual pressure to bear on the men in the way of minimising the evil of prolonged holidays, and it is to be hoped that this kind of assistance, which has hitherto been given but stintingly, will in time be more freely accorded.

The Iron Trade.—There are evidences of greater firmness in the iron trade, and the general expectation in commercial circles appears to be that an improvement, though not a substantial one, is at hand. Stocks of pig iron are undoubtedly diminishing, and prices are tending upwards. Fluctuations in the value of this commodity, however, are of pretty frequent occurrence, and a small advance of prices does not afford much basis on which to found hopes of a general improvement. When the value of finished iron enters upon the stage of enhancement, speculations regarding the return of busy times may be entered upon with some approach to confidence, but up to the present the price of finished iron remains at the point where it has stood for several weeks past, and there does not seem to be any immediate prospect of a change.

Ordnance Works.—Messrs. Armstrong, Mitchell, & Co. are understood to have received further important orders for guns and their accessories, and the whole of the departments are now kept on the system of double shift. An immense new shop, that has been fitted up with effective modern machinery, has recently been opened, and the building of other shops is now in progress. Very little more, however, can be done in the way of extension of premises, all, or nearly all, the available ground being now covered, and in the immediate future the company will have to content themselves with what can be done by the continuous running of machinery and the acquisition of new labour-saving appliances. The building of the new ordnance works in connection with the shipbuilding yard and steel and iron mills of the Palmer's Company at Jarrow has been commenced, and as the execution of the contract will be pushed on with all possible despatch it may be looked upon as a certainty that the premises will be ready for occupation early next year.

The Coal Trade.—The shipments of coal and coke at Tyne Dock for the week ending June 21st amounted to 120,109 tons, being an increase of 16,696 tons as compared with the shipments for the corresponding week last year.

BELFAST, 25th June, 1890.

Shipbuilding and Engineering.—The stocks are still all filled, but there is evidence of a general slackness creeping over the trade. No new orders of any importance have been placed since the beginning of the year. Those which have been booked have been for small vessels to meet the requirements of the local trade, and do not point to any improvement in the general shipping trade. Inquiries for new steamers are made from time to time, but these are merely to test the state of the market. Wages still continue at their height, and no notice of reduction has yet been given, but the supply of labour is much increased. Engineers and boiler makers continue busy, and some good foreign orders are in hand. Machine makers are fairly well employed.

Main Drainage Scheme.—This important sanitary work is now making rapid progress. The tender of Messrs. H. & J. Martin, Limited, for No. 3 contract, for the completion of the pumping station, has been accepted, the amount being £6,395.

Linen Trade.—The proposed alteration in the American tariff still gives a degree of uncertainty to business, and sales have been much affected by it. However, latest advices are of a much more favourable character, and it is hoped that things will soon regain their normal condition. The latest proposals—*i.e.*, to add 5 per cent. on all goods up to 90s., and leave the finer sets unaltered—would make but little difference in the sales. Prices continue firm, and transactions are only for present requirements. No purchases on speculation are reported. Advices of the flax crop are most satisfactory, and although the average is below last year's, it is expected that both the quantity and quality will be in excess.

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THE SPIEGELBERG FLAX SCUTCHING MACHINE.

CONSTRUCTED BY MESSRS. URQUHART, LINDSAY, & CO., DUNDEE.

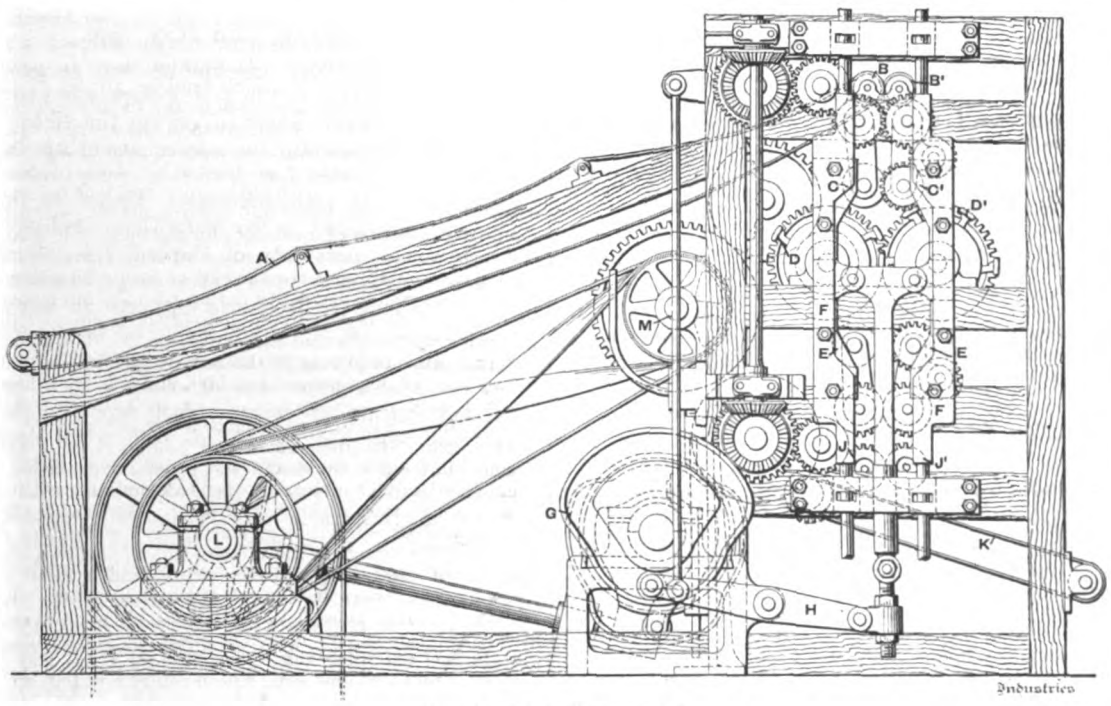


FIG. 1.—SIDE ELEVATION.

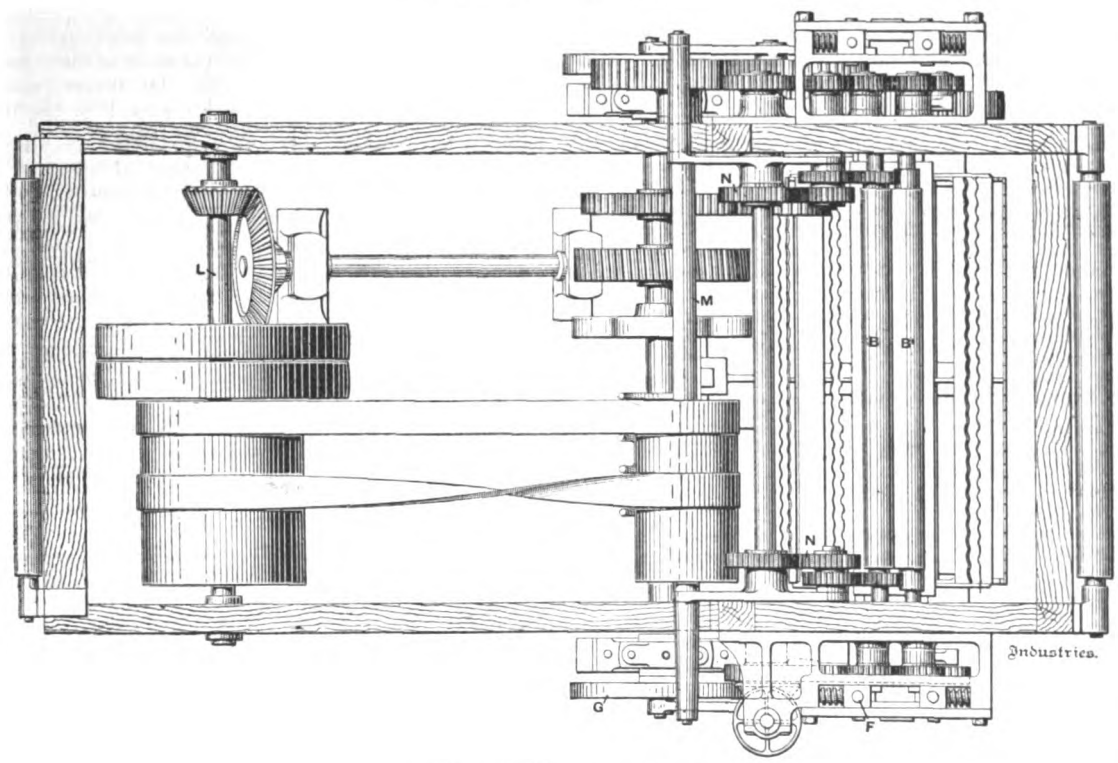


FIG. 2.—GENERAL PLAN.

THE LIVERPOOL ENGINEERING SOCIETY.

THE first excursion this season of the above Society took place last week, when nearly thirty of the members journeyed by train to Keswick, arriving there on Friday evening. After dinner a visit was made to the works of the Electric Supply Company, which are situated about a mile from the town. A representative of Messrs. Fawcus & Cowen—the engineers for the scheme—explained the working of the system; and as this possesses some novel features, we hope to describe it more fully at an early date. It is on the high-tension system, and the dynamos are driven by turbines supplied by water from the River Greta, which flows through the town. Most of the hotels, public buildings, residences, &c., are supplied with the light, and it is giving great satisfaction. On Saturday the party drove to Thirlmere, where they were met by Mr. Hill, the resident engineer for the new Manchester Water Works, who conducted them over, and explained the various works in progress. The excavations for the dam at the foot of the lake, which is to impound the water, was first visited, and was of considerable interest on account of the nature of the rock which has to be removed. The boring for the discharge culvert was next visited, and the action of the Larmuth pneumatic drill, which is being used for the boring, was observed. The tunnels were afterwards inspected, the one through Dunmail Raise being nearly completed. The boring is principally through rock, and when it is of a shaky nature it is lined with brickwork; the section of the tunnels is circular at the top, with a flat floor. The valve and straining wells were next examined, and after a visit to the siphon wells at Ambleside and a portion of the pipe line, the technical part of the visit concluded.

THE SPIEGELBERG FLAX SCUTCHING MACHINE.

WE had recently an opportunity of inspecting a new flax scutching machine, which has been invented and patented by Mr. Arthur Spiegelberg, of Dundee. Before we describe the machine, it may be well to state that when flax is pulled the stalk may be said to be made up of three distinct parts. In fact, it resembles a beech tree; there is first the wood, then the bark, and lastly the glossy varnish of the bark. The woody matter in flax is of no value; the difficulty is how to get rid of it, and to save the bark. To accomplish this the flax must be retted, and it is either spread over a field and exposed to the weather for some time, which is called "dew retting," or the straw is steeped in water. In a short time the vegetable part rots, the gum on the outside dissolves, and the stalks are taken out of the water and dried. But the wood is like a fixed finger inside a glove, and, although weakened, has still to be removed. Scutching is the process by which the wood is removed and the outside skin saved. The difficulty is to get the woody part out without injury to the skin, which is *the* valuable part of the plant and forms the flax fibre. There are four methods of doing this. The first is by striking the flax repeated blows, then taking it in handsful, holding it over a wooden rest, and striking it sharp blows with a wooden blade. This is hand scutching, and has been fully described in *Industries* (see Vol. V., page 420). The second plan is to run the retted straw through fluted iron rollers, and when the heart is thus broken into short bits, to take the straw in handsful, and hold it against two end blades rapidly revolving upon a shaft. This is mill scutching (see *Industries*, Vol. V., page 420). The process known as the "Cardon" process (see *Industries*, Vol. III., page 387), and which promised great things a short time ago, consists in pricking the straw with needles. This cuts the straw into lengths so small as to make it practically dust. The straw comes easily away. But it is obvious that the skin is damaged at the same time, because the heart of the stalk must be got at through this outer skin. The "Wallace" patent (see *Industries*, Vol. V., page 328) is another application of the pricking process.

The breaking machine of Mr. Spiegelberg, which we illustrated in the Patent Abstracts of our issue of the 16th of May, is a novel departure from the older processes. The flax straw is fed into the machine, one end always overlapping the preceding one. Heavy fluted rollers flatten the tubular stalks, which action does not spoil the fibre, but only takes the resistance out of the straw. Then the flax proceeds to the small rollers, lightly fluted, just sufficient to obtain a thorough grip of the flax, and by means of suitable mechanism these rollers receive a lateral or shaking motion which bends the stalks and allows the wood to fall out, and also prevents the outer skin from becoming crushed or cut, as is the case with the needle points, or the series of fluted rollers—run at a high speed—of other machines. The fibre then passes to the second part of the machine, as illustrated herewith, which somewhat resembles an intersecting heckling machine. The "strike" of flax is secured between a pair of indiarubber gripping rollers C C^1, which bring it into contact with a pair of rapidly revolving beaters D D^1. After this operation has gone on for a given time, the beaters are caused to revolve in the opposite direction, the gripping rollers C C^1 and E E^1 are respectively automatically opened and closed in the interval by means of cam bars F F^1, the cams G, and levers H. In this manner both ends of the strike are sufficiently operated upon before they are allowed to proceed downward to the delivery roller J J^1, and thence to the delivery apron K. L is the first motion shaft, carrying fast and loose pulleys, connected to similar pulleys on the shaft M, from which the beaters are driven. The taking-in rollers B B^1 derive motion from suitable gearing N, which is so constructed as to allow itself to become automatically disengaged upon the reversal of the machine.

The principal part of the process, however, is that involved in the breaking machine, which cannot be substituted by hand or other process, whilst the cleaning might be done in the ordinary way; in fact, when the flax is well retted the breaking is done so completely that a little handling cleans the fibre entirely from all shove. The two machines may be worked separately. It is obvious that, the fibre being uninjured, there is a much larger yield of fibre, and the heckle gives far more yield in line. About the importance of scutching there can be no question. Vast countries produce grasses and fibres which are of the highest value. The difficulty always has been to separate the fibre from the gummy exterior, and from the inside pith or wood. This machine may therefore become of the very highest importance, and further trials on a practical and commercial scale will be awaited with very deep interest by those connected with the flax trade.

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As we go to press early with certain of our advertisement pages, all Alterations to Standing Advertisements should reach the Publisher not later than 2 o'clock on Wednesday afternoon in each week.

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Engineers and manufacturers are invited to avail themselves of the files of British and Foreign Technical and Trade Journals, Catalogues, &c., which are kept under the care of an attendant in the Waiting Room at the Chief Offices of this Journal, for the use and benefit of visitors.

Contents.

	PAGE
Burnham's "Steam Loop" (*Illus.*)	601
The Royal Agricultural Society's Show at Plymouth (*Illus.*)	601
The "Victoria" Patent Cream Separator (*Illus.*)	604
Duplex Tyre Turning Lathe (*Illus.*)	605
Foreign Industries (Corres.)	606-607
Dutton's Signal Lamps (*Illus.*)	608
Planing, Thicknessing, and Glass Papering Machine (*Illus.*)	608
Shipbuilding Notes	608
Prices Current	609
Home Industries (Corres.)	610-611
The Liverpool Engineering Society	612
The Spiegelberg Flax Scutching Machine (*Illus.*)	612
The Load Line Act	613
The Institution of Engineers of Japan	614
The Disaster to the "City of Paris"	615
Russian Shipbuilding	615
The Late Sir Warington W. Smyth, F.R.S.	615
Letters to the Editor:—	
Wrought-Iron Chimneys	615
Howe's "Metallurgy of Steel"	615
British Manufactures on the Continent	616
Plumbago	616
Reviews	616
Elliott's "Smoke Annihilator"	616
The Lineff Electric Tramway	616
The Weymersch Battery	616
Electric Lighting at Bath	616
Remarks on the Theory of the Electric Welding Process	616
The Board of Trade and Electric Lighting	617
The American Institute of Electrical Engineers (Corres.)	617
The Deptford Central Electric Lighting Station (*Illus.*)	618
The Chemical Society	620
Notes	620
"Industries" Patent Record:—	
Applications and Acceptances	621-622
Illustrated Abridgments	622-624

To Correspondents.

All communications intended for insertion in this Journal, or relating to Editorial matters, should be addressed to "THE EDITORIAL DEPARTMENT," at our London Offices, 358, Strand, and must, in all cases, be accompanied by the name and address of the writer. No notice will be taken of anonymous letters.

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Industries:

FRIDAY, 27TH JUNE, 1890.

THE LOAD LINE ACT.

THE mercantile marine of this country has occupied a much larger share of the attention of Parliament during the past twenty years than in any other similar period of our national history. Considering that the greater part of the legislation relating to merchant shipping, which has been the outcome of that attention, is of a restrictive character, it is very remarkable that British tonnage should have simultaneously increased at a higher rate than when the business of the shipowner was severely let alone. It is not suggested that there is any association of cause and effect in the facts we have just recorded. On the contrary, it is very probable that but for the agitation conducted by Mr. Plimsoll there would be a greater tonnage of merchant shipping afloat at the present day than is actually the case. One thing, however, is certain, that, but for him and the legislation which he dragged out of Parliament, the shipping casualties of the past fifteen years would have reached far more appalling figures than those which even now distress the minds of people who give these matters their attention. The fact is that Mr. Plimsoll commenced his agitation against the employment of unseaworthy ships just at the period when wood was finally being superseded by iron for ship construction. Prosperous shipowners had for some time been selling their wooden ships and building new ones of iron, and these wooden ships had in many cases fallen into the hands of comparatively poor men, who sought for bargains, without having the capital to enable them to keep the ships in proper repair when they got them. The consequence was that, as old wooden ships require frequent overhauls in order to keep them efficient, the mercantile marine became rapidly crowded with unseaworthy vessels. The competition of steamers had, too, brought down freights to a low rate, and this contributed to further distress the men whose property consisted entirely of old wooden ships. Much as he was maligned at the time, Mr. Plimsoll did a valuable service to humanity when he caused the Government to interfere by detaining unseaworthy ships in port, and in eventually causing them to be broken up.

Having freed our merchant navy from the taint of rottenness, Mr. Plimsoll next felt it his duty to save seamen from other dangers which attend the pursuit of unholy gain. The chief of these is overloading; and when we bear in mind that every extra ton of cargo which a ship carries is an additional source of revenue to her owner, for which he pays scarcely anything appreciable in the form of extra wages, coals, or stores, and nothing extra in working capital, it will be evident that the disinclination to stop pouring in cargo at the hatchways is, with many shipowners, very great. And this disinclination has always been stimulated by the vague uncertainty which surrounded the problem of what is a safe loading for a ship. That the line between safe and unsafe loading must exist somewhere on a vessel's side all shipowners would admit; but then, they would ask, where is that line, and who is able to fix it with accuracy? And so with this excuse of uncertainty, and in the absence of authoritative pronouncement on the subject, a shipowner might say that his opinion was as good as any other person's, and in giving expression to that opinion he was not likely to err on the light side. To further complicate the matter steamships began to assume peculiar forms, such as were unknown in the days of sailing vessels. Either to dodge tonnage assessment or to make deep loading less apparent the ingenuity of shipbuilders and shipowners evolved new types of steamships, to which the rules of thumb for freeboard hitherto in use were inapplicable. With the old-fashioned sailing ship a rough and ready approximation to the height of side out of the water was determined by allowing so many inches of side per foot depth of hold; but what was the use of this rule when dealing with well-deck steamers or those with spar and awning decks? It was just coincident with the advent of these new types that the long-talked-of legislation in regard to the safe loading of ships became the subject of popular agitation. For many years all attempts at laying down rules for the freeboard of ships had been opposed by shipowners, upon the grounds that no regulations could be framed which would apply fairly to every case. Let each ship, said they, be judged upon her merits, and not only each ship, but also each cargo she may carry, the mode of its stowage, and even the nature of the voyage she enters upon, with the time of year, and every other condition which can affect the question. This, let it be remembered, was the argument put forward in the days when the sailing ship with a poop and top-gallant forecastle was the prevailing type, and when ship differed from ship more in regard to her form below water than in any other respect. What, then, about assigning hard and fast lines of freeboard to the many types of steamers which have of late sprung into existence? What about judging every ship upon her merits to-day? Surely, if the problem of the load line was a difficult one twenty years ago—so difficult, in fact, as to deter the officials of Lloyd's Register from meddling with it—what must it be to-day? A walk round the shipyards on such a river as, say, the Clyde, will show in course of construction three-decked, spar deck, awning-deck, shade-deck, shelter-deck, and well-deck steamers. There will be found sailing ships with short poops and top-gallant forecastles, and some with bridge houses besides. Beside them will be seen steamers with long bridge houses and short poops and top-gallant forecastles; others with raised quarter-decks and sunk fore-castles; some with raised quarter-decks joined to bridge houses, and some with no bridges at all; while others, again, will have a combination of top-gallant forecastle, bridge house, raised quarter-deck, and poop besides. Then, let it be further borne in mind that there are iron ships and steel ships, and that with both iron and steel there are various modes of construction, some of which are superior to others.

What would at first sight appear as the greatest obstacle in assigning a fair load line to each of these different classes of vessels will, upon closer examination, be found to furnish the most cogent reason for legislation upon the subject. So long as mercantile ships were of a tolerably uniform type, the common experience of sailors might be accepted as a fairly safe guide in fixing the depth of their lading; and there can be little doubt that, before the steamship became a keen competitor with the sailing vessel, the latter was, as a rule, laden to a safe immersion. It is the great variety in the types of ships, and the variety therefore of their qualities as regards strength, stability, and general seaworthiness, which

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renders it more than ever necessary for a presiding and competent authority to regulate the depth of their loading. This necessity was foreseen by the Committee of Lloyd's Register of Shipping so far back as fifteen or sixteen years ago, and their officials drew up at that time a series of Tables of Freeboard which formed the basis of the rules laid down by the Freeboard Committee in the year 1885. These rules of Lloyd's Register were determined upon the twofold considerations (1) of experience and (2) of calculation. The mercantile marine was appealed to for its best practice and safe results, and the data so obtained was supplemented by calculations of strength and stability. Upon the foundation so formed the Freeboard Committee built up that creditable structure which is now the highest existing standard of reference to guide shipowners in regard to the loading of their vessels. The Act to amend the Merchant Shipping Acts relating to the Load Line, which received the Royal assent on the 9th inst., makes that standard no longer optional, but compulsory, for all vessels flying the British flag. After the 9th December of this year no British vessel will be able to enter outwards without producing her load line certificate; but this provision of the Act will not be extended to ships registered in a British possession until six months afterwards. There are, however, two principal points in its provisions, which are left somewhat open and indeterminate, and one of these is of the greatest importance in regard to the future working of the measure and its successful operation. These points are (1) the extent of its application and (2) the mode of its administration.

It is sought by all who realise the importance of legally fixing freeboards in the interest of safety of life at sea to bring all vessels, both foreign and British, under the operation of such a restrictive law, and in pursuit of that object our representatives at the recent Maritime Conference in the United States sought to obtain an international agreement to that effect, but without success. While provision is made in the Act that under certain circumstances the State may interfere in preventing foreign vessels dangerously overladen from leaving British ports, it is evident that without the full concurrence of other Powers we can do nothing of an effectual character in putting a stop to overloading except in ships owned by British subjects. It is alleged that foreigners do not load their ships so deeply as we do, and that the casualties in the mercantile fleets of other countries are fewer in proportion to tonnage than in our own. Statistics may, perhaps, show this to be so, but observation points to a different state of affairs. Certainly, if the casualties among foreigners are comparatively few, it is not because of anything connected with their loading. The principal point remaining to be determined is, however, that of the mode of administering the Act just passed. At the present time shipowners are at liberty to place their freeboard discs wherever they please, but should disaster overtake their vessels, and it be proved that the latter were laden deeper than the Freeboard Committee's Rules and Tables would indicate, they find themselves in a very awkward plight. Either from an honest desire to load their ships fairly, or through a prudent anxiety to keep themselves out of trouble, a great many shipowners have accepted the Freeboard Committee's Tables, and had their ships' discs marked thereby. Two public bodies are at present empowered to interpret and apply those Tables—viz., the Board of Trade and Lloyd's Register of Shipping—but, as a matter of fact, the duty has almost entirely fallen upon the latter. This is probably due to the circumstance that the Board of Trade have not such a staff as would be required for dealing with the subject, and consequently they prefer that the Society which had the chief hand in constructing the Tables should have the further labour and responsibility of interpreting and applying them. Be this as it may, the fact remains that Lloyd's Register have assigned more than three thousand freeboards, nearly all of which are recorded in their Register Book. That these records have been made further shows that the shipowners have not much, if any, cause to complain of the Society's action in the matter.

It should be clearly understood that the assignment of a freeboard by the Freeboard Committee's Rules and Tables is not like working with a ready reckoner or with a slide rule. There are very few ships presenting so simple a case for treatment that the "wayfaring man," even if above the average intelligence, could determine her freeboard from these Tables. The Rules and the Tables decide a very great deal, but then it is necessary to know something about the ship over and beyond the facts which the Tables take hold of. She may be of relatively unstable proportions or have elements of weakness in her construction. She may be old and neglected, or she may be new and strengthened beyond what is usual in vessels of her type. There are, in fact, a multitude of considerations to be noted in assigning a safe freeboard and one that is scientifically fair between ship and ship. Upon all these grounds, then, it will be seen how important it is, now that Parliament has determined upon a compulsory freeboard for British ships, that it should at the same time entrust the administration of the measure to a competent authority. The Act provides that "The Board of Trade shall appoint the Committee of Lloyd's Register of British and Foreign Shipping, or, at the option of the owner of the ship, any other corporation or association for the survey or registry of shipping approved by the Board of Trade, specially selected by the Board for that purpose, to approve and certify on their behalf, from time to time, the position of the freeboard disc, &c." This arrangement will evidently permit of more than one one authority acting at the same time; but to us it seems that the wisest course is to leave the administration of the Freeboard Act in the hands of one central public body, whether it be the Board of Trade or Lloyd's Register, or a department in which the two are combined. If it be decided to confer the power of interpreting the Freeboard Tables to other authorities than these, then it is most important that every care should be taken to ensure that such authority is competent, and that their decisions do not clash with each other. To us it appears that a uniformity of result cannot possibly be attained with several assigning authorities acting at the same time, and that the operation of such a system would lead to endless confusion and trouble. Above all, it is essential that the element of partiality to ships or persons should be entirely absent. Lloyd's Register of Shipping, as a voluntary association, lives upon nothing but the confidence of the mercantile world, and when once it forfeits that confidence its decline will commence and it will soon cease to exist. And so it will be in regard to whatever other body has delegated to it the duty of assigning freeboards to ships under the new Act. If that body inspires the shipping community with confidence it will continue to exercise its functions usefully; but if the contrary is the case there will be no finality in the matter.

THE INSTITUTION OF ENGINEERS OF JAPAN.

Recent advices from Japan give us an account of proceedings in that country which will be of interest to engineers and others who study the developments of technical education and its applications to engineering. It is now seventeen years since the Imperial College of Engineering, Tokio, was instituted, and a little over ten since the first graduates completed their course. At the first graduation ceremony Mr. Henry Dyer, who was the first Principal and the organiser of the College, in his address to the students, suggested the foundation of an Institution of Engineers somewhat on the lines of those in this country, and he subsequently drew out and printed a set of regulations to guide those who were likely to be the first members of the Institution. The matter was taken up with great energy and spirit, and the new Institution was organised and managed without further foreign assistance. For some years the members were entirely graduates of the Imperial College of Engineering, but when the Public Works Department was abolished, and the College was incorporated with the University, the Institution was placed on a wider basis, and members were admitted who had studied in other colleges at home and abroad, or who were otherwise qualified, and the Institution of Engineers is now one of the largest and most prosperous in Japan, having one thousand members in the departments of civil, mechanical, electrical, mining, and chemical engineering, and in those of architecture, metallurgy, and naval architecture. At the beginning of May there were held a series of meetings of various kinds to celebrate the tenth year of the existence of the Institution, and the further fact that it had now 1,000 members. The extraordinary session of the Society lasted six days, and was evidently planned in imitation of the meetings of the British Association and similar Institutions, and was carried out with as much *éclat*. The programme included banquets, lectures, reading of papers, excursions to works, and garden parties and picnics. A very artistic medal had been struck for the occasion, and was worn by all the members, while pocket maps and programmes, together with historical and descriptive accounts of the works to be visited, were distributed, and served to make the business of the gathering clear.

The President of the Society is Viscount Yamao Yozo, formerly Minister of Public Works, and to whose sagacity was due the founding of the College; its Vice-President, Mr. Watanabe Hiromoto, President of the Imperial University; its Chairmen, Mr. Shida and Mr. Nakamura, both graduates of the Imperial College of Engineering; its secretaries, Mr. Shinudza and Mr. Matsuo. Among the guests on the first day were several Ministers of State, past and present, the Directors and Professors of the various colleges, the President of the Chemical Society, and the editors of most of the leading newspapers. The proceedings were opened in the afternoon of the 3rd of May in the fine hall of the buildings which were erected for the Imperial College of Engineering, at Tora-no-mon, and which were appropriately decorated for the occasion. On the right of the President sat some distinguished guests and honorary members; on the left the officers of the Institution. President Yamao having in a few words opened the proceedings, the history of engineering education and enterprise in Japan, and the nature of the occasion of the extraordinary meeting of the Institution, was given by two of the leading members, Messrs. Tatsuno and Furuichi. In the course of his remarks, the latter announced that His Majesty the Emperor, having heard of the doings of the Institution, had generously expressed his approbation and presented $1,000 to its permanent funds. Thereafter various congratulatory addresses were delivered, and thus terminated the first part of the proceedings. The evening was taken up with a banquet in a large hall in Shiba Park, which was attended by a large number of guests and of the members who were then in Tokio. The *menu* card was a beautiful work of art, being bordered with allegorical figures of architecture, civil engineering, mining, chemistry, naval architecture, mechanical and electrical engineering, in which the old Japanese household deities had been made to do service. It had been designed and prepared by some members of the Society, and showed that engineering had not stamped out art. The toast of the evening was given by H.E. Count Yamagata, in which he commended the work of the Institution. Of special interest was the speech of the Vice-President of the Institution in honour of Mr. Henry Dyer, the organiser and first Principal of the Engineering College, and of H.E. Otori Keisuke, now Minister at Peking, who was for a long time the Director of the same Institution. Dr. Divers, Mr. Dyer's successor as Principal of the College, was asked to write to Mr. Dyer and convey to him the sentiments of regard and esteem in which he was held.

The 4th and 5th of May were partly occupied with popular lectures on engineering subjects, and with original papers in different departments. As is usual, however, on such occasions, the out-of-door attractions proved the stronger. Excursions to engineering works in and about Tokio filled the 6th and the 7th of the month, and occupied the time of the members and associates most pleasantly and usefully. The works are now so numerous, and so many invitations had been received, that several had to be declined from the impossibility of finding time to make so many visits. A full description of these excursions would occupy too much of our space, but the following series may be mentioned: (1) The Shinbashi railway works, Tokio Bay dredging operations, Ishikawagima docks. (2) Furukawa copper refinery at Fukugawa, where the Ashiwo copper is prepared for the market; fertiliser works, also at Fukugawa, where all sorts of artificial manures are manufactured, which are said to be proving very valuable to Japanese farmers; the Furukawa coke ovens; and the Kanegafuchi cotton spinning mills, which are newly erected, and are of enormous dimensions. (3)

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Paper mills at Oji, where newspaper, post-card, and many other kinds of paper are made; the sulphuric acid, bleaching powder, and soda works; the Koishikawa Arsenal; and the Electric Light Company's works at Kojimachi. (4) The Dai Nippon medicine factory near Shinbashi; the steel works of the Naval Department; the Portland cement works at Fukugawa; the Senjū woollen mills. In the evening of the 7th there was a *conversazione* in the works of the Electric Light Company, to which were invited the ladies of the families of members. Many interesting experiments were shown, and the phonograph and other instruments exhibited.

The whole proceedings were carried out with remarkable order, and reflect great credit on the special committees and the secretaries. They are interesting as a striking example of what can be done in a short time, by a well-devised system of education, in practically revolutionising the industry of a country. The Institution of Engineers in Japan has already done good work in the ten years of its existence, and it is destined to have most important effects on the future of the country. We wish it all success.

THE DISASTER TO THE "CITY OF PARIS."

On Tuesday judgment was delivered by the Liverpool stipendary magistrate, with whom were Captain Bragg and Messrs. Eames and Hallett, assessors, in the case of the steamship "City of Paris." The magistrate said that on the arrival of the "City of Paris" at Queenstown after the accident she was only drawing 8in. mean draught more than when she left New York. The Court were of opinion that full provision was made to insure the ship's safety as an ocean-going steamer, and that the safety of the vessel was not sacrificed to speed. They considered cast steel to be a proper and suitable material to be employed generally in various parts of the engines, and the cylinders, piston rods, and other parts of the machinery of the starboard engine were generally of suitable material, and the engine room was properly constructed. The Court proceeded: We are of opinion that the primary cause of the casualty was the extraordinary wearing down of the bearing of the bracket which supported the extreme end of the propeller shaft, by which that end had dropped from its original and proper position about 7in.; that the fact of this bearing down of the after end, coupled with the weight of the propeller and of the shaft itself, produced a bending effect on the shaft at its forward support, co-existent with each revolution of the engine; that this probably produced rupture of the external surface, which gradually extended inwardly, and, finally, total fracture of the shaft; that the engine, being thus relieved from resistance beyond the friction of its own movable parts, would almost instantaneously have acquired a greatly accelerated velocity, the result of which would probably be sufficient, by the additional strain on the various connections, to diminish the clearance allowed between the piston and cylinder cover of the low-pressure engine at the top end of its stroke; that the cover was struck by the piston and moved off, the piston probably being broken up in the act, the cylinder being torn asunder, the condenser being seriously broken, and the destruction of the various other parts rapidly accomplished. The report refers to the admirable manner in which the captain, deck officers, chief engineer and his assistants, and the crew generally, performed their duties and conducted themselves in the trying position in which they were placed after the accident.

RUSSIAN SHIPBUILDING.

Considerable activity has been displayed for some time in connection with the Russian fleet, and it now begins to attain sufficient magnitude to make it a factor which cannot be neglected in calculating the chances in any war which may occur. The programme which was laid down some years ago is being steadily carried out, subject, of course, to the modifications which are required by the continual developments in naval science. From an industrial point of view, moreover, the movement has considerable importance, when we consider that two keels which were recently laid down for the Russian Navy are for ships of 10,000 and 11,000 tons, and of the style of the "Sanspareil" and "Trafalgar." These were recently laid in the presence of the Emperor and Empress, and a large company of notables. The largest of these ships, the "Ruric," will be 426ft. long at the water-line, 67ft. broad, and with a draught of 27ft., and will have side armour 10in. thick and deck armour 2½in. thick. She is to be built for a speed of 18 knots an hour, and will have a coal capacity for taking her 20,000 miles at 10 knots. She will be supplied with very powerful guns, and when completed will form a very strong addition to the Russian Navy. After the conclusion of the ceremony connected with the "Ruric," the Imperial party performed a similar one in a neighbouring shipbuilding yard for the armoured turret-ship "Navarino." Its length will be 360ft., its breadth 68ft., and its draught 25ft. There will be two engines of 4,500 h.p. each, with 12 boilers, and the speed is expected to be 17 knots. The armament will consist of four 12in. guns in two turrets, and there will be the usual complement of quick-firing and other guns. The next part of the day's performance was launching the new yacht for the Emperor, and which is named the "Polar Star." She has been built by Captain Kazi, at the Baltic Works on the Neva, and is intended to be used as a yacht in time of peace, but also as a despatch boat in time of war. She will be the only sea-going yacht of modern type possessed by the Emperor, as the "Livadia" lies unused in the Black Sea, while the older ship, the "Derjiwa," in the Baltic, is now out of date. The "Polar Star" is 315ft. long by 46ft. broad, with 18ft. mean draught of water, and 3,600 tons displacement, and is intended to have a speed of 16 knots. The boilers were intended for a pressure of 130lb. on the square inch—that is, for triple-expansion engines—but the Emperor has decided that the engines shall be of the ordinary compound type with a steam pressure of 75lb., showing that he is willing to sacrifice efficiency for what he supposes greater safety.

On the same day was launched an armoured gunboat 229ft. long and 41ft. deep, and having a displacement of about 1,500 tons. It is of the same type as those which are being added rapidly to the British Navy, and is intended to sweep the seas of the enemy's mercantile vessels. Besides these there are three large ships being completed on the Baltic, and a similar number on the Black Sea, while several torpedo boats are being built in Germany, St. Petersburg, and Odessa. Altogether, either for offence or defence, the Russian Navy is being rapidly developed, while the proportion of the work which is being done in the country shows that great advances have recently taken place in the arts of construction.

THE EDINBURGH UNDERGROUND RAILWAY.

The Parliamentary Committee on the Caledonian Railway Bill, which proposed to construct a tunnel along the whole length of Princes Street and under the Calton Hill, have decided that such a case of public interest has not been made out as to outweigh the serious objections of the Corporation of Edinburgh and other objectors, and have therefore rejected that part of the Bill. They have, however, agreed to pass the remaining parts, subject to some modifications. These are chiefly for the purpose of affording greater railway facilities to Leith, and none of them were seriously opposed. While sympathising with the wish to preserve the amenity of Princes Street, we may repeat the opinion which we have previously given, and which has since been supported by the strongest evidence, that if it were not for the mutual jealousies of the Caledonian and the North British Railway Companies it would be possible to make out a scheme which would afford great conveniences to the public, without interfering in any way, or at least to any appreciable extent, either with the beauty of the city or the comfort of its inhabitants. It is very probable that this question will be one of the chief points which will decide the municipal elections in November, as there can be no doubt that the present decision will be challenged.

THE LATE SIR WARINGTON W. SMYTH, F.R.S.

Sir Warington Smyth, the leading British authority on all matters connected with mines, died suddenly at his residence in Inverness Terrace, on the 19th inst. He was born in Naples in 1817, his father, Admiral W. H. Smyth, F.R.S., being at that time engaged in making a survey of the Mediterranean. He was educated at Westminster and Bedford Schools, and took his B.A. degree in 1839, at Trinity College, Cambridge. At Cambridge his academical career was a brilliant one. Having gained a fellowship he travelled for four years through the mining districts of Europe, and acquired a thorough knowledge of the Continental systems of mining. His experiences in Turkey and Asia Minor he recorded in a book published in 1854, entitled, "A Year with the Turks." In 1844 he was appointed to a post on the Geological Survey of the United Kingdom, and in the course of his professional duties surveyed the principal coalfields and metalliferous districts of England, Wales, and Ireland. On the foundation of the Royal School of Mines in 1851, he was selected as the first lecturer on Mining, and lectured every year until his death. A great part of his life was devoted to the official work on mine inspection. He was inspector of the mines in the Duchy of Cornwall, and since 1857 acted as comptroller of all the mineral properties of the Crown under the Commissioners of Woods, Forests, and Land Revenues. He was President of the Geological Society in 1866, and has been Foreign Secretary since 1874. In 1879 he was appointed Chairman of the Royal Commission on Accidents in Mines, and devoted seven years of labour to the duties of this honorary post. For this and other public services he received the honour of knighthood on the occasion of Her Majesty's Jubilee. Besides various technical reports and papers read before the learned societies, Sir Warington's chief literary work was his "Rudimentary Treatise on Coal-Mining," written in 1867, and now in its seventh edition. It is the standard text-book on the subject, and has been translated into Chinese and into the principal European languages. Besides this, he was the author of the articles on Mining in Ure's Dictionary of Arts, Manufactures, and Mines, and in Stanford's British Mining Industries. A paper he wrote in 1871, on the sinking of pit shafts by boring under water, attracted considerable attention among colliery engineers. To Sir Warington Smyth and his teaching must be ascribed a foremost share in the great progress that has taken place in British mining in the fifty-two years during which he was engaged in business connected with mining. Although he had been out of health for some months, his death was quite unexpected. He attended the Royal Society *soirée* the evening before his death, and was engaged in looking over examination papers when he died. He was an enthusiast in his work. The large pecuniary rewards offered by a career in the commercial branches of mining never tempted him. In the study of mining he found so much that was vast, so much that is worthy of man's highest powers, that he did not stop short at that point when he could obtain his worldly ends, but continued to persevere towards that goal of higher knowledge which has always been the object of the noblest of mankind.

Letters to the Editor.

WROUGHT-IRON CHIMNEYS.

To the Editor of "Industries."

Sir,—In the letter from your Paris correspondent, published in your issue of the 6th inst., I notice an account of "A Novel Wrought-Iron Chimney."

I have for several years studied the construction of tall chimney shafts, and I know a considerable number of wrought-iron shafts have been erected during the last twenty years. The one mentioned in your paper was built about 1869-70, and is fully described in my book on "Tall Chimney Construction," and previous to the building of this particular shaft MM. Schneider & Cie., Creusot, had erected a similar one, 197ft. high.

Messrs. Witherow & Gordon, of Pittsburgh, Pennsylvania, have since 1876 built upwards of thirty wrought-iron chimney shafts, varying in height from 100ft. to 190ft.; the latter they constructed for the Cleveland Rolling Mills, Ohio, U.S.A., in 1881.

Messrs. Francis & Co., Nine Elms Cement Works, Rochester, in 1878 had a wrought-iron chimney shaft erected at their works 160ft. high.

In Russia I am informed wrought-iron chimneys are very common. One built in 1874 at Adeshavo, near the town of Kineshma, is 170ft. high.

Messrs. Robert Heath & Sons' Iron Works, Tunstall, Staffordshire, have a wrought-iron shaft 75ft. high from the ground line, built up parallel, 6ft. diameter, from bottom to top.

You will see from the above, that wrought-iron chimney shafts are not so novel as many persons think.

Yours, &c.,

R. M. Bancroft,
Past-President Civil and Mechanical Engineers' Society.

London, 19th June, 1890.

HOWE'S "METALLURGY OF STEEL."

To the Editor of "Industries."

Sir,—Mr. Howe, in a recent communication to me, writes as follows:—

"Hoosick Falls, N.Y., U.S.A.
"June 9th, 1890.

"Dear Mr. ——.

"I have just been looking over your kind contributions to *Industries* on my 'Metallurgy of Steel.' I note that I have not made my meaning clear to you in one place, on page 475, top of last column, where I say that 'the former view that nitrogen or other gases played an *essential* part.' I meant essential in its strictest sense, while I think you have taken it to mean merely *important*. Now, in fact, I repeatedly point out the enormous effect that certain gases—*e.g.*, N. and H.—not only may but do have on the properties of steel.

"What I referred to in the sentence quoted above, was Fremys and similar exploded hypotheses, that nitrogen was an *essential*

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element of steel—*i.e.*, that you could not have steel without nitrogen, and that it was nitrogen that made it steel. This statement of mine, moreover, occurs where I am speaking of the constitution and nature of steel.

"I do not know whether you will think it worth while to call attention to this misapprehension on your part, as you have, I think, put me in rather false position before the readers of *Industries*.

"Again, on page 451, second column, I think that if you had weighed my words a little more closely, you would have seen that you and I are more nearly of the same mind than you have given your readers to think. Indeed, I think that you and I think very closely alike on these points. Now what I said referred to the '*intimate* knowledge which the public and many non-metallurgical engineers, &c. &c.' I do not suggest that metallurgists have no knowledge, nor that they have not a fair knowledge, but merely that they have not so intimate a knowledge as they are credited with.

"Nor is it true that I think that analysis can do little for the steel-maker. I do not think, but I *know*, that it can do much; my contention is that it cannot do everything, and that it cannot do so much as is expected of it by many, or perhaps by most. So while I think that you have treated my work in the fairest and most friendly spirit, and while I feel very much gratified and complimented by your contributions, I think that you have not caught my meaning in the passages which you criticise. This, I believe, is in part due to the necessary condensation in a treatise, and to the fact that the work, appearing in instalments, is not so readily grasped as when in book form.

"Thus, as to the resemblance between iron and crystalline rock, I give in a later chapter a great deal of evidence supporting my view. This, I think, can hardly have been before your mind when you speak of it as you do.

"Yours faithfully,
"HENRY M. HOWE."

With regard to the general merit of Mr. Howe's work, I can only reiterate that its value must be inestimable to all concerned in iron and steel manufacture. I think Mr. Howe has very fairly met my criticisms, and it remains only for your readers to judge for themselves. Yet throughout the book there is much matter which cannot well be dealt with unless fully discussed; and in the interests of all the sooner this is done the better.

Mr. Howe has given us so much fresh matter for consideration that we cannot do better than show our appreciation by applying our best energies, together with such knowledge as we possess, to the elucidation of much problematical matter which, as he himself says, may be due to the necessary condensation in a treatise, and therefore needs further amplified discussion.

I hope shortly to specially review the section on gases in iron and steel, mainly, however, with the object of contributing some facts and experiments on a subject at which I have been working for a long time, and have had considerable experience.

Yours, &c.,
METALLURGIST.

South Wales, 21st June, 1890.

BRITISH MANUFACTURES ON THE CONTINENT.

TO THE EDITOR OF "INDUSTRIES."

SIR,—I did not intend to convey the meaning that protective duties abroad affected us more than competing countries desirous of sending goods of the same class to any given locality, but merely that they prevented us doing business which under a system of free imports we should be able to transact. That a greater knowledge of languages is desirable among our business men is a point which no one will dispute, but "Trader," I think, lays somewhat too great a stress upon it. Those whose trade requires the use of foreign languages employ foreign clerks, and I am consequently doubtful that any great loss of trade abroad has arisen from the causes which your correspondent states.

Yours, &c.,
T. R.

London, 24th June, 1890.

PLUMBAGO.

TO THE EDITOR OF "INDUSTRIES."

SIR,—I should be glad if any of your readers could give me information as to the lower grades of plumbago or blacklead, and what percentage of carbon is contained and required in those grades most used for other than the manufacture of pencils.

Yours, &c.,
GALICIA.

Galicia, 21st June, 1890.

Reviews.

TECHNICAL EDUCATION IN ENGLAND AND WALES. London. 1889.

The Secretaries of the National Association for the Promotion of Technical and Secondary Education have prepared a report to the Executive Committee on the existing facilities for technical and scientific instruction in England and Wales, which will be found most useful to all who are interested in the subject. and who have not time to study the details of Blue Books. The information given as to secondary and higher institutions is somewhat meagre, but the authors hope in another report to grapple with some part of this wide question more fully. The report is divided into three sections, in the first of which is given an account of the organisations of the Science and Art Department and of the City and Guilds of London Institute; in the second, of the different classes of schools and institutions; and in the third, of the work done in special districts. It is illustrated with four coloured maps showing the distribution of the various agencies throughout the country. It concludes with an interesting summary, in which valuable suggestions are given, some of which we have often insisted upon. It points out, for instance, that, if the present movement for technical education is to end in the mere multiplication of science and art classes, farmed by incompetent teachers, dependent on grants for their livelihood, it may be that the resulting evil may outweigh the good. If the technical school of the future is to consist of an ill-assorted collection of such classes as are found by experiment to be the most "paying"—from the point of view, not of the education of the boy, but of the remuneration of the teacher, omitting all those harmonising studies which are "merely" educational and not grant-earning—the cause of secondary education will not be advanced, but rather thrown back by the change. What is wanted is more elasticity in method and more intelligence in teaching, and unless these results are achieved very little good can be done.

ELLIOTT'S "SMOKE ANNIHILATOR."

WE were enabled on Wednesday to be present at the trial of a new apparatus for getting rid of the smoke from the chimneys of factories, mansions, and other large buildings, patented by Mr. Samuel Elliott, of Newbury, the owner of the well-known wood moulding manufactory in that town. The "Smoke Annihilator," as it is christened, has now, we understand, been in operation for some weeks at Mr. Elliott's own works, where, according to all accounts, it appears to have been much needed, as the proprietor has been several times fined by the local authorities for creating a nuisance by allowing smoke to escape from the chimney of his boiler furnaces. Testimony as to the efficacy of the remedy applied was borne by no less authority than the Mayor of Newbury, who had himself been instrumental in fining the inventor, and, with other local magnates, was present at the trial. In our next issue we hope to illustrate and describe Mr. Elliott's apparatus; in the meantime, we may state that it appeared to successfully accomplish its purpose.

THE LINEFF ELECTRIC TRAMWAY.

WE had an opportunity of examining the Lineff electrical tramcar at Chiswick on the 25th inst. Mr. Lineff has dispensed with the slot in the roadway which was employed in his former system, and has modified the car and the track on which he experimented some two years ago to exhibit his electromagnetic system of completing the electric circuit. The conductor is laid in a closed conduit a few inches below the level of the road, and lying loose above it are a series of loose strips of galvanised iron. Iron rails, also galvanised, form the top of this conduit, and a powerful electromagnet carried beneath the car picks up these strips, and thus makes connection between the conductor and the rail. We propose to describe the method more fully next week.

THE WEYMERSCH BATTERY.

MESSRS. ALABASTER & GATEHOUSE have made a series of very exhaustive tests on the Weymersch battery. Forty-two cells were run on a batch of incandescent lamps, and thirty-six on an arc light, for 24 hours in each case. There were two $7\frac{1}{2}$in. square zinc plates to each cell, giving $7\frac{1}{4}$ amperes, and corresponding carbon and porous plates. One charge of the depolarising liquid lasted the whole 24 hours, and gave very constant electromotive force. There is very little local action on the zinc, and the cost of materials used is exceedingly small. Though only intended for use where steam power is not available, the Weymersch battery gives results almost comparable with steam engine and dynamo. As Messrs. Alabaster & Gatehouse have posed as enemies of the fraudulent primary battery, a favourable report from them may be taken to mean a great deal.

ELECTRIC LIGHTING AT BATH.

THE cause of electric lighting has been advanced a stage by the arrangements worked out in Bath. On Tuesday evening that historic city was the scene of a unique pageant. The occasion was the inauguration of the electric light, the outcome of a contract which Mr. H. G. Massingham had entered into with the Corporation to light the streets of Bath by electricity for seven years. By nine o'clock the dynamo room was filled with visitors from towns in the West of England and Wales. Precisely at nine o'clock the Mayor of Bath was led up to the Thomson-Houston machine, which was chafing its brushes and grinding its bearings in useless animation. He mounted the steps without any support, and with no outward manifestations of fear. For a moment, resolutely oblivious of the harrowing records of American experience, he seized the switch, and the blaze of light told that the current had done its work. After this the company went in procession through the streets to witness the novel effects. The visitors were able to observe subdued and bilious-looking gas jets down side streets, oil lamps in the tramcars, and candles with street artists on the pavement. Everything contributed to emphasise the contrast, and when, unexpectedly, as the party turned a corner, the moon itself "obliged," Mr. Massingham—who saw in it no possibilities in the way of a dividend—felt that his triumph was complete. On the conclusion of the street trip the guests were entertained at supper by Mr. Massingham in the Grand Pump Room Hotel, which was brilliantly illuminated by incandescent lamps. In the course of the supper a change of engine and dynamo was carried out without producing any appreciable effect on the lights in the hotel.

The business of installation was commenced early in the present year, and the incandescent lights in shops and private houses have been at work since March. The street lighting was inaugurated, as above described, last Tuesday. We hope to give a detailed description of this plant in a later issue.

REMARKS ON THE THEORY OF THE ELECTRIC WELDING PROCESS.

BY PROFESSOR OLIVER J. LODGE.

IN the current columns of the *Electrical Review* Mr. S. A. Varley has adduced an interesting little apparent difficulty in reconciling the doctrine that a rapidly alternating current flows mainly in the outer layers of a conductor with the fact utilised in electric welding that a bar gets thoroughly heated all through.

Now, first of all, we must remark that the thing being heated in the process of welding is not a single bar, but two bars pressed together end to end. Heat is thus primarily developed at the bad joint, no distribution of current other than one across the few points of contact being there possible. This amply accounts for the initial rise of temperature. As soon as the bars are softened by heat, no doubt they touch better, but by that time the temperature is so high that the portion near the joint is a very much worse conductor than the cold portions. Hence the heat continues to be localised where it began. But as soon as the joint is fairly good the whole can be regarded as a single bar with a peripheral distribution of current, and hence it may be thought that, although most of the heat must be generated at the already hot (and therefore highly resisting) place, yet the outside must get more heated than the inside. But remember that it is the great magnetic susceptibility which causes the extreme crowding of current into the skin of an iron bar. Taking its permeability for strong oscillating currents as about 6,000, the skin utilised for conduction in a non-magnetic substance like copper or zinc is 80 times as thick as it is for magnetic soft iron at the same frequency. Now, iron loses its permeability at a little above a red heat, and accordingly the laws of conduction through hot iron are the same as in a non-magnetic material. There is peripheral crowding, but it is not excessive.

But go a step further. Grant excessive peripheral crowding of current in the colder portion, does it follow that the outside will be hotter than the inside? By no means. The outside is subject to rapid air cooling; the inside is completely enclosed. So soon as the loss by cooling is equal to the rate at which heat is supplied in the outer skin, all inward gradient of temperature ceases: the whole section becomes exactly uniform. The next point to consider is the rate at which conduction is likely to equalise the temperature of a bar which is so rapidly supplied with heat in its outer skin as to maintain a falling gradient towards the centre. The heating of a current differs from the heating of a furnace, in that it is really generated inside the metal, instead of having to penetrate by radiation through a non-conducting film of gas and oxide, which, though truly excessively thin, yet constitutes a great obstruction. Heat is generated in the outer layer of the bar, and then flows by conductors into its interior, according to laws for which it is easy to write down equations, and at a pace of which it is not difficult to form a notion without any calculation. Notice that the central portion is but of small bulk, that it is subject to no cooling action, that it has not got to pass on the heat received to some other part of the rod; and then, even allowing that the material is not a good conductor, it will be perceived that an approximate equalisation of temperature from circumference to centre must occur very speedily—in far less time than the $\frac{1}{4}$ or $\frac{1}{2}$ minute during which the

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bar is kept hot by the welder. If heat were generated at the centre of a bar or globe the gradient of temperature from within outwards, having to warm larger and larger volumes, would be both steep and permanent; but when heat is generated in the outer shell the gradient of temperature from without inwards is never steep and is only temporary.

Lastly, it may be convenient to point out that the hotter the joint locally is, the less heat will be developed in the cooler portions of the bar. This is a consequence of the law of electric induction. The bar forms a portion of a secondary loop round an alternating magnetic circuit, and is thus subjected to a given alternating e.m.f. equal to the rate at which the lines of magnetic force are cutting it. Under these circumstances the rate of production of heat in the bar is directly proportional to its total conductance. A secondary circuit of copper would be heated more rapidly than one of iron or lead. Anything which tends to diminish conductivity diminishes also the rate of heat production. At first the nature of the contact, and at last the hotness of the junction, has this effect: one or other cause keeps down the total conducting power of the welding circuit and causes less heat to be developed in it as a whole than might at first sight be supposed. But, as already said, the different sections of the bar will be heated just in proportion to their resistances, and hence whatever heat is developed is largely concentrated in the highly resisting already hot parts.

All these things are susceptible of being put quantitatively, and their statement makes an interesting problem. Meanwhile, perhaps, enough has been said to indicate that there is no real difficulty in reconciling theory with observation, because they have never really quarrelled. Moreover, it is plain that the considerations to which we have been led regarding the theory of the welding process are very favourable to the scientific character of that process as conducted by alternating currents.

THE BOARD OF TRADE AND ELECTRIC LIGHTING.*

(*Concluded from page 594.*)

Safety Regulations.—These were embodied in the old Orders, and were in great detail, such points as the distance apart of terminals, and the maximum current to be taken from any pair of terminals, being specified. The pressure on distributing mains and service lines was not to exceed 200 volts continuous or 100 alternating; and no portion of any electric line placed above ground, and not enclosed, was to be at a pressure from earth exceeding 200 volts. The St. Austell Licence of 1885 is, I think, the first licence or Order in which separate regulations have been issued; and the same form has been used in the Kensington and Knightsbridge Order of 1889 and the St. James's Licence of 1888, and nearly the same form in the Chelsea Order of 1886. These are more general in character. The limit of low pressure has been raised to 300 volts continuous, while alternating currents are not to be used except with the approval of the Board of Trade, and under such further regulations as may be considered necessary. A very important innovation has also been introduced in these regulations, providing that the undertakers shall cut off any consumer upon whose premises they find that a leakage exists having a resistance to earth of less than 5,000 ohms. This is to some extent a departure from the policy of the Board of Trade to leave the regulation of the circuits on private premises to the insurance companies; but, unfortunately, electricity does not conform to these arbitrary distinctions, and a bad leak on a consumer's premises is just as much a source of danger and difficulty as one on the main outside—in the case of direct supply systems at any rate.

The general regulations for overhead wires, made under section 4 of the Act of 1888, are pretty generally known at the present time, and I need not dwell upon them. As you are aware, they were thoroughly revised by your Council, who have also given their powerful assistance to the Board of Trade in the matter of some new proposed general regulations for undertakers of electrical supply, which, however, are still under discussion. The principal features of the new draft regulations are—(1) The division of the various systems of supply into three classes, viz., low pressure, high pressure, and extra high pressure: low pressure to extend to 300 volts continuous or 150 alternating; high pressure from above this to 3,000 volts, either continuous or alternating—that is, to as high a pressure as we have had practical experience of in distribution systems; extra high pressure, above 3,000 volts. (2) A general provision that where high-pressure conductors or apparatus are exposed in such positions as to be possibly touched by persons, or brought into contact with low-pressure conductors, they shall be entirely enclosed in strong metal casing efficiently connected to earth.

Supply Regulations.—These have been subjected to less alteration than the Safety Regulations. The variation of standard pressure permitted has been reduced, and in the new draft it is proposed, as already stated, to introduce the idea of a pressure to be declared at the consumer's terminals, which is not to vary more than 4 per cent., and the variation of which may be tested for the consumer on his application by the electric inspector. It is also proposed to take advantage of the powers of the transformer system and provide that the consumer supplied from a transformer on his premises shall have the choice of two pressures given him, one about half the other. No doubt many of the regulations that have been made are open to criticism; but I would point out that they are in every case the result of very careful consideration, and that observations on them from many different points of view have been submitted, and given, as far as possible, their due weight. It is not unlikely, therefore, that a criticism, even from a high electrical authority, may be unjust and erroneous, from the critic not being acquainted with all the circumstances and conditions which have guided the Board of Trade; and it should also be borne in mind that the Board are empowered to alter any regulations issued by them, or to repeal them and issue fresh ones, should the progress of electrical discovery and further experience make such a course desirable. And whatever imperfection may become apparent in these regulations, I can confidently affirm—and I feel sure that this proposition will receive the support of those among you who have experience of its methods of procedure—that the Board of Trade has been guided solely by the desire to do the duty imposed upon it by Parliament, and to serve the best interests of producers and consumers alike.

The Standardising Laboratory.—I should now like to say a few words about the standardising laboratory. You are probably aware that the Board of Trade have, in deference to the wishes of the large body now interested in practical applications of electricity, as expressed by a powerful deputation to the President last year, undertaken to provide something in the nature of a testing establishment for instruments intended for the measurement of electrical quantities, analogous to the Standards Department of the Board of Trade for weights and measures of the more gross and material quantities. They have also taken powers under the Weights and Measures Act of last Session to undertake such testing and verification, and to charge fees for it; so that these verifications, whatever their scientific value, will possess a legal value. A general scheme for the scope and working of this laboratory was drawn up very carefully last year by a committee of your Institution, in connection with which I should like to mention especially the hard work done by Dr. Fleming, in a cause which he has given abundant proof that he has at heart. The general idea embodied in this, in which I personally entirely concurred, is that the thing should grow from small beginnings. This, I think, is the English way, and I need only point to the present position of our own Institution as an example of its success. Our more impressionable neighbours on the other side of the Channel like to start these things in a different way. They must have something grand and striking, and of course there is much to be said for this view, if you have the means to carry it out; but it sometimes leads to, as it were, setting up a steam hammer to crack nuts. No doubt the steam hammer can do it very well, but a pair of nut-crackers is cheaper. Now I can promise that there will be nothing grandiose about our laboratory—we are starting with a very ordinary pair of nut-crackers. It is hardly necessary to observe that the small beginnings idea was the part of the scheme most to the taste of the Treasury; in fact, to use an electrical metaphor, my Lords would have liked our electric particle to have acquired its potential of doing work by starting in the legitimate way at an indefinite distance from the charged body (the national purse), and to have been a long time on the road too. However, let us not forget that if we are electricians we are also taxpayers? Now what we hope to do in this laboratory is, first of all, to get the true values of the electrical units, within a very small possible percentage of error. We are not tied to the so-called legal units, which I may remark have no legal value in England; but with the assistance of Lord Rayleigh and the Standardising Committee of the British Association we hope to get even nearer the truth than was arrived at with this set of units. Secondly, having got there, we hope to keep there by well-devised checks and frequent reference to the fundamental measurement. This, as we are at present advised, will be the measurement of current by the quantity of silver deposited from solution in a determined time. Thirdly, so soon as we are satisfied that sufficient accuracy and permanence has been arrived at with our instruments and methods, we shall be ready to receive instruments, either for simple verification in the case of ordinary commercial instruments, at a small charge for each reading, or for thorough testing and certification in the case of instruments submitted as sub-standards. The rules and charges have not yet been drawn up, but it is probable that instruments will be required to be marked with a clear and intelligible scale—whether of degrees, or volts, or amperes, is quite immaterial; the extreme range of the instrument must be given approximately and whether it is intended for alternating or continuous currents or pressure, or for both. The reading given by the instrument on its own scale for each current or pressure asked for will be taken, probably, in all cases both with increasing and with decreasing readings. No extreme accuracy will be guaranteed for these readings, but it is hoped not to exceed an error of ½ per cent. from the true value. Of course, in the case of ordinary commercial instruments, we should give no sort of guarantee that the instrument will remain constant for any time, or under different conditions. Sub-standards will be subjected to long and rigorous testing, including the determination of their variation under different temperature and the permanence of their constants. I am afraid, however, that in most cases there will be some difficulty in giving any guarantee of the constancy of an instrument after it has passed out of our hands. The power for laboratory purposes will be supplied from two batteries of accumulators—one of four very large cells simply to give steady continuous currents up to 2,000 amperes; the other, consisting at first of 100 smaller cells, will be used directly for continuous pressures up to 200 volts, and also to run the machinery. The machinery referred to is two pairs of dynamos, one of each pair being energised by the cells as a motor and driving the one connected to it as a generator. One of these generators will be an alternate-current machine, and the other a high-pressure continuous-current machine. In connection with the alternate-current machine we shall have a set of transformers. In this way we hope to get currents practically as steady as if taken direct from the accumulators, and in the case of alternating currents and pressures any frequency within the limits of practice. The limits we propose to work up to at first are:—Continuous current, 2,000 amperes; continuous pressure, 2,000 volts; alternating current, 500 amperes; alternating pressure, 2,000 volts. The building and alterations necessitated are now nearing completion, and we hope to have the laboratory in working order in about two months' time.

* Paper read by Major Cardew before the Institution of Electrical Engineers on the 17th ult.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

(*From our New York Correspondent.*)

(*Concluded from page 595.*)

In his "Note on a New Photometer," Dr. Edward L. Nichols said that methods of photometry which take no cognisance of quality were ill adapted to the study of sources of light which differ widely in temperature, and his instrument has been devised to determine both the character and intensity of an illuminant. Existing types of the spectrophotometer could be made to give good results, but they are expensive and difficult to use. The new "horizontal slit" photometer is really a spectrophotometer in which the polarising device is dispensed with. In it the simple principle of the Bunsen photometer is applied successively to the various regions of the visible spectra of the source of light which are to be compared. A direct vision spectroscope of Browning's form is attached to the usual bar of a Bunsen photometer from which the disc and mirrors have been removed. The optical axis of the collimator is horizontal and at right angles to the photometer bar. The slit is horizontal, and lies in a straight line joining the sources of light set up in the usual manner at the ends of the bar, which is of considerable length, in this case 500 c.m., and should be divided into thousandths. In front of the spectroscope slit are two right-angled prisms of equal size and of the same glass. Their vertical adjacent edges bisect the slit, and light travelling from either end of the photometer bar is totally reflected by them, entering the right and left hand end of the slit in a direction parallel to the optical axis of the collimator tube. The two sets of rays are vertically dispersed by the prisms, and appear in the field of view as two vertical spectra standing side by side. Equal wave lengths are in the same horizontal line, and any desired region may be brought into the centre of the field by an angular movement of the ocular telescope. The telescope moves along the arc of a suitably divided semicircle, to which it may be clamped. Wave lengths, corresponding to the various circle settings, are determined once for all by observation of the more prominent of the Fraunhofer lines. When the instrument is placed at the middle of the photometer bar between lamps identical in intensity and quality, the two spectra are of equal brightness throughout, wave length for wave length, from red to violet. If the two lamps differ in intensity but not in quality, the two spectra will differ in brightness by the same amount from end to end, and a position may be found upon the bar for which they will be identical throughout. Under these circumstances the instrument may be used as a simple photometer, the setting for any wave length whatever giving the candle-power. For the comparison of lights of similar character, the instrument offers certain manifest advantages over the various forms of the Bunsen photometer. Various measurements were presented by the author proving the merits of the instrument.

"Magnetic Data of the Sprague Street Car Motor" was the title of a paper by Mr. H. F. Parshall.

At the opening of the afternoon session, the newly elected President, Professor W. A. Anthony, took the chair, and a paper was read by Mr. Oscar T. Crosby, on "The Limitations of Steam and Electricity in Transportation." The author began by stating these propositions: That it is possible to construct motors capable of doing the required work in transportation; that it is possible to continuously generate electric energy equal to the capacity of any number of such motors; at any desired loss, and any desired distance, it is possible to supply by running contact the necessary current at considerable pressure for the working of such motors. He had seen 75 amperes at 500 volts continuously supplied to a car moving at over 110 miles per hour. With these premises established, the discussion resolved itself into three parts—first, the possibility, without reference to economy, of steam and electric propulsion under given conditions; second, as to the relative cost; and third, as to the relative amount of power required, the comparison being made with the direct application of steam power on the tracks. It was his experience that the adhesion coefficient was not increased to any practical degree by the passage of current from wheel to rail. Since January 1st, 1890, a speed of 86 miles per hour in England and 87 miles per hour in America had been reported. So far as steam supply was concerned, he believed it possible to attain a speed of 150 miles per hour. The train resistance is due to motion through the air, to friction and blows between vehicle and track, and between different parts of the vehicle. He had found that at 100 miles per hour the air pressure was 13lb. to the square foot, which, by proper shaping of the front, could be reduced to 6½lb. The tonnage resistance on a first-class track with good rolling stock was 20lb.

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per ton, at 125 to 150 miles per hour. With 20 per cent. loss, electricity becomes cheaper than steam at about 70 miles per hour; while at 40 per cent. loss, which is about the lowest with electric propulsion at present, electricity becomes more economical than steam only at 140 miles per hour. The general conclusions arrived at were that—(1) A slow-speed armature on the axle would place the electric motor in the lead at all service speeds. (2) Above 70 miles per hour an electric motor of 90 per cent. efficiency, with gearing of 90 per cent. efficiency, would prove more economical than steam, excepting for infrequent service on long lines. (3) For heavy traffic steam would be more economical up to 100 miles per hour, if the electric motor and the gearing had a combined efficiency as low as 60 per cent. (4) At 100 miles per hour and upwards, neither steam at 90 per cent., nor electric apparatus at 60 per cent. efficiency, is commercially practicable. (5) The economy of electricity through the stationary engine will depend upon the cost of coal. (6) Bad roadways, and large areas exposed to atmospheric influence, as in street railway work, reduce the speed at which electric motors of any efficiency become cheaper than steam. (7) With small locomotive units the electric motor loses less relatively of its advantage. (8) Multiplying the number of motors should be avoided as far possible. (9) Cleanliness and compactness of electric machinery may be of great value in special cases. The possibility of returning to line the energy now wasted in brakes may be of value. Loss due to low efficiency in starting can scarcely be avoided either in steam or electric engines.

The paper by Mr. Hermann Lemp, on "Automatic Electric Welding Machines," was accompanied by practical demonstrations of the working of the apparatus, and was listened to with great interest. The ordinary welding process, he said, required the greatest skill of the smith in heating the metals to the proper temperature at the right spot, and preventing the accumulation of scale. While skill may be successful with metals of high melting points and low heat conductivity, easily fusible metals, and especially good conductors, baffle all attempts as long as an exterior heating source is employed. The electric process has made it possible for less skilled operators to make good welds, and has created an art equally adaptable to all metals and combinations of metals. Sixty-seven metals, alloys, and combinations were named as having been successfully welded, among them wrought and cast copper, lead, tin, zinc, aluminium, silver, platinum, gold, magnesium, steel castings, tool steel, Bessemer steel, cast brass, type metal, German silver, fuse metal, &c. Among the combinations were copper to brass, wrought iron, and German silver, wrought iron to brass, steel, and German silver, tin to lead, &c. The inventor was not satisfied with this advance over ordinary welding methods, but laboured with the problem of producing a machine in which all conditions for successful operations were mechanically controlled to attain uniform results, combined with rapidity, and requiring little attention. This led to the invention of the automatic welding machine, which has proved to be of special importance in connection with easily fused metals, leading to the successful welding of aluminium, silicon, and aluminium bronze, which, even with the electric process, requires considerable skill. Electric welding has been accomplished with continuous and alternating currents; secondary batteries and unipolar machines may and have been used. In certain locations it may be desirable to use the continuous current, but the alternating has been found best adapted by reason of its more economical production at low e.m.f. and large volume. There is, however, another advantage, arising from the fact that self-induction assists materially in heating the exterior of the bar to be welded, thus compensating for the loss by radiation which is apparent in the continuous current process. Two methods of distribution are in use, the direct and indirect. In the former an alternating dynamo is used, having two windings on the armature, one of which furnishes currents rendered continuous by a commutator to excite the field magnets, and is controlled by switch and rheostat; the other, consisting of a single turn of heavy copper cable, furnishes the welding current, which is led through collector and brushes to movable copper clamps arranged to receive and guide the welding objects during the operation. In other forms the field magnet is the movable part, in which case no heavy currents have to be carried through the collector and brushes. No direct welders are built at present for currents above 4,000 amperes. The indirect method of distribution is now almost exclusively used. In its simplest form it consists of one alternating dynamo, self or separately excited, and one welder, which is a transformer, with the necessary clamping and operating appliances. The self-exciting dynamos used are from 1,000 to 20,000 watts output, and may be regulated by means of a reactive coil to give a varying e.m.f. never to exceed 300 volts. The perfection of the work is influenced by the projection of the abutted pieces in the path of the current; the e.m.f. of the welding current; the end pressure applied to force the abutting ends into each other at welding heat; and the interruption of the current at the proper time.

The projection of the abutted pieces varies with their diameter. For copper a projection twice the diameter gives the most economical results, while with steel and iron the projection equals the diameter. For a large class of work, carriage hardware for instance, the surfaces coming in contact have a light scale which must be removed by grinding, or overcome by the e.m.f. of the current. In many cases the cleaning is found more expensive than the extra power to force through the scale. For uniform results the end pressure is found to be the most important factor. It varies with the materials, being approximately 1,800lb. per square inch for steel, 1,200lb. for iron, and 600lb. for copper. The interruption of the current at the completion of the weld is important for all easily fused metals, otherwise a large portion of the conductor on either side as well as the weld itself will be melted and torn asunder before any pressure device could follow and bridge the gap.

THE DEPTFORD CENTRAL ELECTRIC LIGHTING STATION.

The Deptford Station is, as is well known, anything but completed, as far as erection of the plant goes, but in one sense it may be said to have been complete before it was begun, because every detail was planned out with the greatest care and forethought before the actual work was commenced, and a description of this station now will probably give a fairly exact idea of what the finished station will be like, and will be more interesting to our readers, as the Deptford scheme is exciting so much attention at present.

We have already published accounts of the work at Deptford, and may refer the reader to our issues of the 26th October, 1888, and 19th July, 1889. As we have already said, the designs have not been altered since the station was begun, so it is unnecessary to repeat the general description.

The visitor on entering the building is struck with its enormous size. At first one is lost in admiration of the pluck and enterprise shown in setting up business on such a scale, but the feeling is soon qualified by an uneasiness as to whether the pecuniary risk is not unnecessarily great in proportion.

The present position of the Corporation as regards mains may be stated. They have made and put down a mile or so of their own mains, but they are not in use. They have, therefore, to depend on the Fowler-Waring concentric mains. These are too small, and with the load now in use the loss over them amounts to over 1,200 volts. The outer conductor is only lightly insulated, and would not stand this, and the leakage all along the line from it to earth has given considerable trouble to the telephone companies. The Corporation has therefore been obliged to use only the inner conductors of the cables, leaving the outer conductors idle. The action on the telephones due to the use of separate cables is avoided by crossing the leads frequently. Transformers have also been inserted at Deptford to get rid of the earth in the primary circuit.

One engine and dynamo is now doing the Grosvenor Gallery work, and another engine and dynamo are ready for work. The cables now in use are Siemens' concentric for distributing mains at 2,400 volts, and Fowler-Waring for temporary trunk mains. The Ferranti concentric mains are being made, and about a mile has been put down, but they are not in general use yet. They have been officially and otherwise tested, by cutting through the outer insulation with a pick-axe until the outer conducting tube is exposed. It may be safely grasped in the hand, as might be expected. The joints are long cones, so that any leakage would have to pass along a considerable distance to get to the other conductor. No doubt the ozokerit will really unite perfectly. In fact, ozokerit has, we believe, properties analogous to pure rubber, in the facility with which it will unite under pressure. A little warmth would certainly unite it. In this point vulcanised rubber is inferior. It will never repair a leak in its substance, whereas pure rubber, and probably ozokerit, will.

As there is little new to describe, we may devote some space to a critical discussion of the Deptford scheme; not with the object of giving the London Electric Supply Corporation good advice, as we do not know that it has any need of it, but because the success or failure of the Deptford scheme is a matter which concerns not only the Corporation itself, but also, and that perhaps to an even greater pecuniary extent, the whole electric light industry in the kingdom, and, to a considerable degree, even abroad. A great deal of the criticism with which the Deptford scheme has met has been biassed by rival interests. We do not mean that anything unfair has been said, but it is not possible for engineers who are throwing their whole energies into direct current work to be quite unbiassed in discussing alternate distribution. The London Electric Supply Corporation's Provisional Order also came first at the recent Board of Trade inquiry, and the Corporation had thus not only to defend its own particular system, but had to bear the whole brunt of the battle waged against alternating current system in general.

It has been said over and over again that the Deptford scheme is a wild experiment, and is more or less certain to end in a dismal failure which will do incalculable harm to the industry generally. The first novelty is transmitting electrical energy at 10,000 volts. This is simply a question of insulation, but that is no small matter. The whole question of insulation for very high electromotive forces is very obscure. It would seem quite likely that it is not a question of the maximum difference of potential between the two leads—in this case two concentric tubes—but of the rate of fall of potential; that is to say, the difference of potential between the faces of each little element of insulation. For instance, we can easily imagine that indiarubber will stand a stress of say 1,000 volts per millimetre, so that a large sheet one centimetre thick would stand 10,000 volts. In this case all the portions of the rubber have to stand equal stresses. But if the rubber is wrapped round a cylindrical conductor, the inner layers will be subjected to a greater stress than the outer; and if the stress is near the maximum, thickening the coating of insulation can do little good. The rate of fall of potential depends on the diameter of the cylinder, so that the larger the conductor the easier it is to insulate it so as not to break down. On the other hand, the larger the conductor the lower the insulation resistance measured in megohm miles, so that we have the paradox that a small conductor which shows a high insulation resistance may be more likely to break down than a large one with a comparatively low insulation resistance taken in megohm miles.

Then, again, there is the question of insulation conductivity; it may or may not follow that a material which conducts slightly is likely to break down. It is most probable that a dielectric breaks down suddenly, and that a microscopic conduction has nothing to do with this. If that is the case, insulation resistance measurements give no indication as to safety against breakdowns, except in so far as they localise an incipient fault.

These speculations may be considered somewhat crude and unsatisfactory. They are brought forward, however, merely as suggestions, as it does not seem as if these questions had ever been studied. We may find that a material which does not easily develop local faults, and is therefore best for telegraphic purposes, is apt to break down suddenly under a high electromotive force on account of a totally different order of properties. We may also find tubular conductors more easily insulated than solid rods of same cross-section.

Returning to the Deptford trunk mains, there seems to be no reason why 10,000 volts is not practicable, especially with a conductor an inch in diameter; but great difficulty may be expected in the joints, even when coned, and especially if expansion and contraction has any chance of "working" the joints. We would again suggest that the difficulty may, perhaps, not be in making the joint to give a high insulation resistance, but in arranging it so that the fall of potential over the insulation is always gradual. The problem is, in fact, analogous to designing a static electric machine so that it has no corners to form discharge points. Ozokerit is tougher and more elastic than paraffin wax, and does not seem to develop minute cracks on solidifying.

It must be borne in mind that even if the mains should prove incapable of standing 10,000 volts, which seems hardly likely, the only result will be increased capital expenditure for working at 5,000. The cost of leads would, of course, be serious, and the Corporation shareholders will have lost some money from their capital account, but it will make no difference to the public at large. The money will simply be written off; competition will prevent its interest being charged on the consumers. The lead question is, then, not so important from our point of view as might at first sight appear.

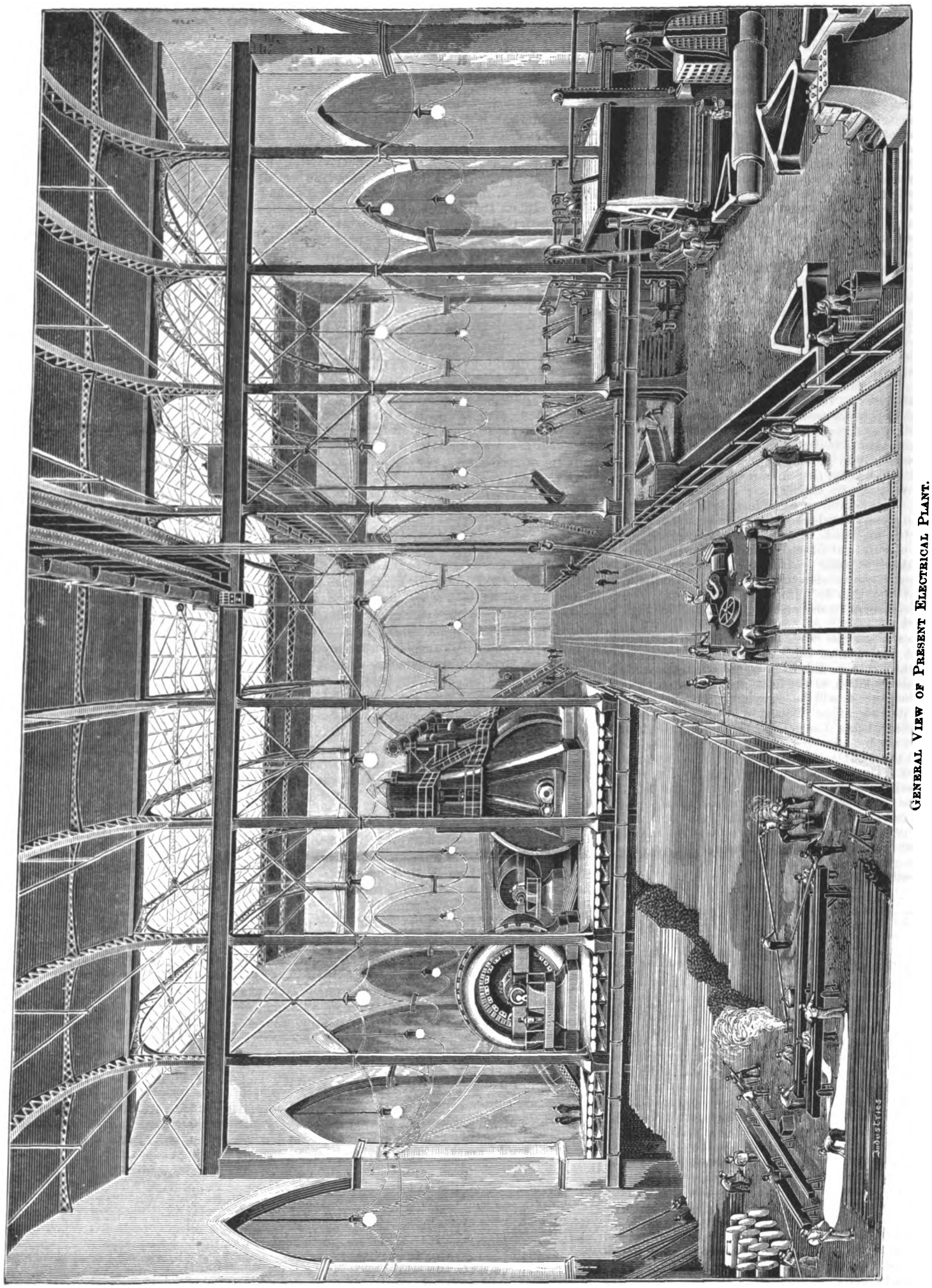
Some trouble has already arisen from the action of the alternate current on the various telephone circuits with the temporary mains as already mentioned. Another difficulty may be expected with the permanent mains, with one end earthed, and at first sight it appears very serious. There are, however, several ways of arranging such circuits, so as to have neither leakage effects nor inductive influence on the telephones.

The enormous size of the dynamos has caused a great deal of comment. In one way the dynamos are experimental, as nothing of anything like the proportions has ever been made before. In making a very large dynamo after experience confined to small ones, there are two

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THE DEPTFORD CENTRAL ELECTRIC LIGHTING STATION.

(For description see opposite page.)



General View of Present Electrical Plant.

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ways a designer is likely to come to grief. The purely electrical part of the calculations are as accurate when applied to a large, as to a small machine. The mechanical stresses can be got out with equal certainty. But there is uncertainty about Foucault currents which generally cannot be even approximately estimated, because of the irregularity of the masses in which they are induced; and there is still greater uncertainty about ventilation. In Mr. Ferranti's large machines, however, the pole pieces, and the armature conductors themselves, are small—in fact, much smaller than in many machines which have already been made—so there is no room for errors as regards Foucault currents, and the machine is so proportioned that there is no chance of the armature heating at full load. In fact, alternate machines with strip armatures are always limited as to output by the mechanical strength of the armature, or the drop of electromotive force due to armature reactions, and not by the heating of the armature. The size of the dynamos and the general design of the station unfortunately gives trouble as to running in parallel. The large dynamos would, of course, have some tendency to keep in step, but whether they can be commercially run in parallel is another matter. The introduction of the high electromotive force into the dynamos, though it saves some expense, demands special insulation. Though this has been carried out very thoroughly, it would have been simpler to have made it unnecessary by transforming up. The pole pieces have to be covered in with ebonite caps.

The use of ebonite for protecting the pole pieces seems a little risky. Ten thousand volts is probably quite enough to produce ozone. Ozone acts very readily on indiarubber, and it seems likely that the ebonite, which contains about 50 per cent. of sulphur, will soon be coated with a film of sulphurous, and perhaps sulphonic, acid. Not only, therefore, may the ebonite be itself destroyed, but its surface may gradually become conductive. This action, or something similar, has, we believe, been observed where ebonite has been used for statical electric machines. Perhaps some varnish might protect the ebonite, but linseed oil is acted on by ozone, and copal itself is easily oxidisable. Perhaps a thin coating of pyroxylin varnish, thick enough to protect the ebonite, but too thin to burn easily, might do. The question may be of considerable importance in high tension work.

Mr. Edison's "quarter of an inch of ebonite between the current and human life" is, we think, nonsense, because if the armature did short circuit on to the fields no one would be killed, as the fields are already earthed.

When the station will be completely at work on a large scale it is somewhat difficult to say. It has been remarked that when a man reaches fifty he realises that things take much longer than is expected. But there is little doubt that the Deptford Station will, in the long run, be a success. The work is engineered by Mr. Ferranti, with the assistance of his partner, Mr. Sparks, and of Mr. Kolle. The Corporation also owes much to the vigorous policy of Lord Crawford. If there is any one who, with practical commonsense, careful forethought as to minutest details, and thorough knowledge of his subject, can successfully begin and complete this work, we believe it is Mr. Ferranti.

THE CHEMICAL SOCIETY.

On the 19th inst., at the last meeting of the Chemical Society for the session, a paper was read by Mr. Mond, who, in conjunction with Drs. Langer and Quincke, has studied the "Action of Carbonic Oxide on Nickel." When carbonic oxide is passed over the heated nickel it is absorbed with the formation of a black powder containing 11 per cent. of nickel, of which the whole cannot be removed by acids. A small quantity of nickel appears to be able to decompose an almost unlimited amount of carbonic oxide. There has also been obtained a colourless volatile liquid containing nickel, the composition of which corresponds to the formula $Ni(CO)_4$. This remarkable substance has a specific gravity of 1·3185 at 17° C., and boils at 43° C.; it is soluble in alcohol, benzene, and chloroform, and is not acted on by dilute acids and alkalies. At 60° C. its vapour explodes. Its vapour density at 50° C., determined by Victor Meyer's method, is 6·01, instead of 5·9, the number demanded by theory, a fact of special interest, as this is the first substance from which it has been possible to determine the vapour density of nickel. This value corresponds to an atomic weight of 58. The nickel obtained from it has been deposited as a mirror on glass tubes, and proved to be exceptionally pure. This affords an excellent source of the metal for the determination of its atomic weight, which was done, the values obtained being 58·58 and 58·64, as against 58·52, the generally accepted number. From this it is plain that the nickel which we have been accustomed to regard as pure is really so; and that the statements of Kruss and Schmidt to the effect that nickel, hitherto thought to be an element, actually contains two bodies —(1) true nickel, and (2) a new element (*gnomium*)— are due to misconception.

In the discussion which followed, Professor Ramsay commented on the extraordinary fact that a compound of nickel of this description should be *colourless*. Mr. Howard pointed out that a knowledge of such a substance might furnish a key to the action of carbonic oxide in many metallurgical operations, too often obscured by the convenient term "catalysis." Mr. Page reminded the meeting of the compound of carbonic oxide with potassium which was formed in the preparation of that metal, and its similarity to this substance in its explosive tendency. The structure of such a body was fraught with interest. The president (Dr. Russell) inquired whether the freedom of the nickel from cobalt had been proved by means of the spectroscope, to which Mr. Mond replied that it had not, but its absence had been demonstrated by the ordinary tests. It was a remarkable thing that no similar body could be obtained from cobalt, and, in fact, a method of separation might possibly be based on this fact.

Notes.

PHOSPHATES IN ALGERIA.

Deposits of phosphate of lime have been discovered in the West of Oran, but the distance from the sea is great, and there are no good roads. It is therefore unlikely that they will be turned to good account for a good many years yet. There are other deposits near Souk Ahras, in the department of Constantine, but these have not been much utilised hitherto, as the colonists have not yet learnt the value of chemical manures.

TEXTILES IN ROUMANIA.

Consul-General Sanderson, of Galatz, reports that cotton twist is almost entirely imported from England, and that the most of the T-cloths and shirtings are also English; but German and Swiss productions are gradually ousting Manchester cotton prints. Of lighter goods the bulk is obtained from Germany and Switzerland. Sacking and jute carpets are still in large demand from Great Britain. In woollen goods Bradford maintains its position; the chief opposition is from Germany. The nearest suppliers have a considerable advantage over us, owing to their being able to meet a change of demand or fashion more rapidly and having cheaper transport. Austria, for example, has a great advantage, and both the Germans and Austrians establish branch houses in Roumania, while we have only an occasional agent. English circulars are of little use.

PUBLIC WORKS IN FRANCE.

From Consular reports from the Boulogne and Calais district we learn that the virtual completion of the new harbour and large floating dock at Calais has not yet attracted trade to the port. The floating dock is completed, as are also the warehouses, hydraulic cranes, apparatus for lighting with electricity, lines of rails, &c.; all that is wanting now are ships to fill it; these have not yet arrived. So far, it has only afforded accommodation to the few vessels which formerly used the old floating dock; this latter will continue to be used for vessels with petroleum, as also for small vessels. The dry dock is not yet ready for use, the caissons and pumping machinery not being completed. Quays have been levelled, roads made, bridges built over the new canals and lines of rail—indeed, an immense amount of work has been done, and very thoroughly too, but there are many things still to be completed; for instance, the entrance from the old tidal harbour has to be rounded off, and the old and new quays united. A scheme was started some time ago to improve Boulogne Harbour, but beyond some dredging little has been done.

RAMIE CULTIVATION IN ALGERIA.

Great hopes have been founded in Algeria on the successful cultivation of the ramie. This subject has engaged the attention both of the cultivator and the manufacturer, but it cannot be said that from their united point of view the question has been definitely settled. There appears to be no great difficulty about the cultivation of the plant. Experiments have been made at Algiers, Boufarik, Staoueli, Bône, Perrégaux, and St. Denis du Sig, and wherever it has been planted it has succeeded—at least, in land capable of irrigation—and it has yielded three and sometimes four "cuts" per annum. The first year is devoted to planting and preparing the soil, without any return; the second may be expected to yield half a crop: the third, three-quarters; and by the fourth it should be in full bearing. It is planted out in rows 50 centimetres apart, and at distances of 25 centimetres from each other in the lines, thus giving 80,000 plants per hectare. In the fourth year the plant is expected to produce twelve useful shoots, each of which will weigh about 12 grammes. Allowing four "cuts" per annum, and 75 per cent. for loss after drying and cleaning, there should be produced in the fourth year 46,000 kilogs. of stalks, yielding 11,500 kilogs. of fibre. One hectare, therefore, should produce: First year, nil; second year, 5,752 kilogs.; third year, 8,625 kilogs.; fourth year, 11,500 kilogs. The fibre will cost the producer 10fr. per 100 kilogs.; add to this 8fr. per 100 kilogs. for decortication, 7fr. for transport, and we have a total cost of 25fr. per 100 kilogs. for the cleaned fibre, landed at its destination. It is stated that this produce will never fail to command a price of 35fr. per 100 kilogs., so that the cultivator may expect a profit of 10fr. per 100 kilogs., or 1,150fr. per hectare, a return which can hardly be expected from any other kind of culture—even that of the vine.

TELEPHONES AND ELECTRIC TRAMWAYS.

The Telephone Company and the Weston-super-Mare Tramway Company had a skirmish before a Select Committee of the House of Commons last week. The Tramway Company had Messrs. Taylor and Graham, and Messrs Pember, Moulton, and Pollock appeared for the Telephone Company. The Telephone Company applied for a clause to bind the Tramway Company not to disturb existing or future telephone lines. The Tramway Company objected to this, as it would necessitate an insulated return, instead of the rails. They offered to put up metallic returns to the existing telephone circuits if the Telephone Company agreed to do so in erecting future lines. The Telephone Company wanted to continue their use of the earth return in existing lines, and to secure it for future lines without disturbance. The Tramway Company called Mr. S. Sellon, their engineer, who gave evidence as to the cost of insulated returns for tramways and telephones, and Mr. J. Swinburne, who gave electrical evidence. The Telephone Company called Sir W. Thomson, who held that it was not fair for the Telephone Company to be debarred from free use of the earth return in future. Sir Frederick Bramwell and Dr. Hopkinson were ready to corroborate his evidence, but the Committee discouraged further testimony. The Committee finally inserted a clause whose meaning is enigmatical. Apparently they have been not only eager to prevent the telephones being disturbed by the tramways; but they have also taken measures to guard the tramways from being disorganised by the intrusion of telephone currents. It is to be earnestly hoped that this Bill may come before a strong Committee in the House of Lords, so that a clause doing justice to both sides can be inserted which may become a good precedent. The matter is of enormous importance to tramway and telephone companies.

PREPARATION OF PICRIC ACID.

A process has recently been patented in Germany for the production of picric acid from crude phenol. It is based upon the following observations:—(1) Phenolsulphonic acids are much more easily nitrated than phenol itself. (2) The sulphonic acids of crystalline phenol are more readily formed than the corresponding compounds of cresol, &c. (3) The uncrystallisable constituents of crude phenol may be first nitrated and then removed, (*a*) by the use of the calculated quantity of acid, (*b*) by regulating the temperature. The residual pure phenol is then nitrated and treated in the usual manner. Following on the above observations two processes have been worked out. In the first, the crude phenol is treated with a quantity of sulphuric acid equivalent to the crystallised phenol present; the resulting sulphonic acid is dissolved in water, and decanted from oily impurities, and the solution treated with nitric acid. Should any cresol be present it will be unattacked, and may be separated by treating the picric acid with sulphuric acid, and afterwards washing with water. In the second process the crude phenol is treated with a large excess of sulphuric acid. The sulphonic acids are dissolved in water, and treated with sufficient nitric acid to nitrate the cresol compounds. On cooling, the nitro-cresol separates as an oil, and may be removed. This process may be varied by treating the mixed sulphonic acids with an excess of nitric acid. If the resulting compounds be then treated at 90°–100° C. with water containing 12 per cent. sulphuric acid, the trinitrocresol will separate as an oil from the picric acid.

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Patent Record.

APPLICATIONS FOR PATENTS.

(The names in italics within parentheses are those of Communicators of Inventions.)

ENGINEERING.

9th June, 1890.

8864. Breakell, T. ..... Grinding machinery.
8865. Jones, B. ..... Buffers.
8866. Hepenstal, G. ..... Wheel tyres.
8867. Beardmore, W. ..... Armour plates.
8870. Haigh, W. C. ..... Washing machines.
8873. Daw & Daw ..... Valves for rock drills and pumps.
8877. Rollinson, T. ..... Looms.
8885. Woodville, G. ..... Brakes.
8887. Abercrombie, D. ..... Adjusting bearings.
8903. Barraclough, F. ..... Flying machines.
8904. Krell, O. ..... Hydraulic lifts.
8906. Jenin, O. ..... Propulsion of vessels.
8909. Woodall, H. ..... Charging gas retorts.
8910. Heathorn, T. B. ..... Steering and propelling boats.
8913. Wells & Cunnington... Hot air engines.
8918. Tellier, C. ..... Production of motive power.

10th June, 1890.

8924. Cockroft & Farmer ... Sewing machines.
8925. Allison, H. J. ..... Refrigerating apparatus (*Wood*).
8926. De Castilho, S. A. ..... Boat releasing gear.
8930. D'Iszoro, L. S. ..... Charging gas retorts.
8937. Poole, G. A. ..... Steam engines.
8940. Ashlin, H. C. ..... Oil-carrying vessels.
8947. Thompson, W. P. ..... Utilising wave power (*Doire & Rifenburg*).
8948. Everson, G. H. ..... Cold rolling tubes.
8949. Oemler, G. L. (of the Firm of Leipziger Strikmaschinen Fabrik) ..... Knitting machines.
8952. King, J. T. ..... Hot blast stoves (*Kennedy*).
8954. Harrop, J. ..... Furnaces for heating metal bars.
8961. Thorpe, R. H. ..... Regulating hydraulic power.
8963. Taylor, W. H. O. ..... Valve gear.
8969. Lindsey, C. C. ..... Cloth-cutting machine.
8972. Schermerhorn, G. W.... Folding boats.
8974. Newton, H. E. ..... Printing machinery (*Hoe & Co.*).
8975. Timmis, I. A. ..... Railway signals.
8981. Jensen, P. ..... Pneumatic ordnance (*Pneumatic Dynamite Gun Company*).
8983. English, T. ..... Working ordnance by compressed air.
8984. Michelin & La Société Michelin et Cie. ..... Wheel tyres.
8985. Lake, F. C. ..... Machines for sewing thatch.
8986. Morecroft, G. T. ..... Power traction ploughs.
8987. Thirion, A. R. ..... Steam boilers.
8990. Lake, H. H. ..... Typewriters (*Hammond*).
8991. Lake, H. H. ..... Iron and steel (*Brown*).
8996. Wade & Cherry ..... Lubricating shafts.

11th June, 1890.

9003. Gell, W. J. ..... Disengaging gear for boats.
9010. McPhun, J. P. ..... Mortising machine.
9016. Morrison & Harper ... Steam engines, &c.
9018. Scott, R. ..... Lace machines.
9019. Shaw, E. ..... Hoisting machinery.
9020. Smith, F. E. ..... Rack pulley.
9025. Barsby, W. ..... Sewing machines.
9026. Roberts & Wheater ... Brakes.
9028. Brooks, S. H. ..... Spinning machinery (*Clarté*).
9035. Bayly, J. P. ..... Compound engines (*Rickie*).
9040. Bayly, J. P. ..... Windmill (*Ball & Ingram*).
9043. Bayly, J. P. ..... Plough (*Dodd*).
9045. Fisher, C. U. ..... Sugar cane mills (*Leblanc*).
9046. Haddan, H. J. ..... Air brakes (*Griffin*).
9051. Luke, J. ..... Paper-making machinery.
9055. Galloway & Beckwith Steam boilers.

12th June, 1890.

9067. Lucas, Lucas, & Loosley Crank drawer.
9069. Wrigley, M. H. ..... Rotary engines.
9071. Winter, T. ..... Yarn-sizing machines.
9077. Simpson, W. H. ..... Ring spinning.
9084. Moore-Thompson, A. ... Staff apparatus for controlling traffic on single-line railways.
9087. Masey, J. T. ..... Steam valve.
9092. Tozer & Stanton ..... Tramway wheels.
9094. Livesey, Sen., Livesey, & Livesey, Jun. ..... Looms.
9097. Freiber, C. ..... Feeding steam generators.
9098. Miller, J. (of the Firm of Smith Brothers & Co.). ..... Lubricating apparatus.
9099. Thomas, J. L. ..... Grist mills.
9102. Glover, L. ..... Looms.
9105. Mills, B. J. B. ..... Steam tow boats (*McDougall*).
9113. Afzelius, C. J. M. ..... Breechloading guns.
9117. Heintzenberg, J. ..... Looms.
9123. Dauber, A. ..... Iron and steel.
9126. Turner, E. R. ..... Roller mills.
9127. Donnithorne, E. G. M. Engines and pumps.
9131. Renouf, P. L. ..... Self-adjusting anti-friction bearings.
9132. Ball & Renouf ..... Tyres for wheels

13th June, 1890.

9134. Adams, R. B. F. ..... Locomotive regulators.
9137 9139. Lever, Holland, & Todd ..... Boiler furnaces.
9144. Bamford, S. B. ..... Grinding mills.
9149. Southall, C. H. ..... Boot machinery.
9153. Ubrig, E. ..... Moulding machines.
9156. Mintoft & Mintoft ..... Reaping machines.
9171. Smith, H. J. ..... Castings.
9173. Kern, F. A. ..... Bolting machines.
9174. Rickaby, A. A. ..... Packing for pistons.
9180. Waddle, H. W. ..... Ventilating fans.
9181. The Lucigen Light Company, Ld., & Jarmain ..... Oil flame furnace.
9186. Grimes, W. ..... Steam boilers.
9188. Wallace, J. ..... Marine governors.
9191. Sandino, A. ..... Boot machine.

14th June, 1890.

9201. Werner, J. R. ..... Marine governors.
9202. Werner, J. R. ..... Metallic packing.
9204. Waddington, J. ..... Looms.
9208. Teasdale-Buckell, G. T. Printing in colours.
9210. Casebourne, C. B. ..... Boiler cleaning tools.
9213. Brunton & Statter..... Valves for steam engines.
9215. Casebourne, C. B. ..... Boiler cleaning tools.
9220. Griffiths, W. B. ..... Sewing machines.
9221. Harmer, J. ..... Railway signals.
9223. Bradbury, A ..... Tentering machines.
9226. Strauss, J. ..... Lubricator for slide valves.
9229. Richardson, J. ..... Sand moulds.
9232. Gledhill, A. ..... Economiser speed-wheel engine.
9241. Mudd, W. R. ..... Boot burnishing machines.
9242. Thompson, W. P. ..... Machinery for tapping nuts (*Cook*).
9243. McClements, J. A. ..... Rollers for mangles, &c.
9249. Abell, G. C. ..... Propelling and steering vehicles.
9256. Baldock, W. H. ..... Winding yarns.

ELECTRICITY.

9th June, 1890.

8872. Suter, F. ..... Electrical lamp holders.
8892. Muirhead & Wright ... Insulating electrical conductors.

10th June, 1890.

8933. Felt, G. H. ..... Electro-deposition.
8959. Thomson, Sir W. ..... Mariner's compass.
8964. Kennedy, R. ..... Electromotors.
8988. Lake, H. H. ..... Magnetic separator (*Ball & Norton*).

11th June, 1890.

9030. Freedman, C. H. ..... Primary battery.
9061. De Ferranti & Wright Electric meters.

12th June, 1890.

9089. Henrie, Pückert, & Toennies ..... Arc lamps.
9101. Verity & Sons ..... Push switch.
9124. Aubert, J. J. A. ..... Electric counter.
9125. Kingsbury, J. E. ..... Telephonic apparatus (*Western Electric Company*).
9130. Heap & Sharp ..... Regulation of currents.

13th June, 1890.

9138. Bigland & Burns..... Arc lamps.
9163-4-5. Newton & Hawkins Switch.
9166. Newton, F. M. ..... Switches.
9197. Alexander, P. P. ..... Electrical fuses.

14th June, 1890.

9212. Statter & Brunton..... Electromotors for elevating.
9246. Ronczewski, J. ..... Electromagnetic separator.

CHEMISTRY.

9th June, 1890.

8884. MacFarlane, J. W. ..... Extracting gold.
8895-6. Read Holliday & Sons, Ld., & Holliday ..... Azo colours.
8900. Butterfield, J. C. ..... Sulphurised ores.
8901. Davidson & Davis ..... Treatment of alkali waste.
8908. Jordan, F. G. ..... Extracting gold.
8914. Crossley & Jones..... Ferric oxides.
8915. Guttmann, O. ..... Nitric acid.
8916. Ellershausen, F. ..... Extraction of lead.
8922. Peters, T. ..... Application of iron residues.

10th June, 1890.

8929. Cowper-Coles, S. O..... Coating metallic surfaces with alloys.
8942. Leith, J. ..... Sulphuretted hydrogen, sulphide of ammonium, and alkali.
8989. Lake, H. H. ..... Treating copper (*Cummins*).
8992. Lash & Johnson ..... Reduction of ore.

11th June, 1890.

9001. Willcox, B. ..... Colouring matters (*Farbenfabriken vormals Friedrich Bayer & Co.*).

12th June, 1890.

9080. Dawson & Hirsch ..... Phenolether and oxydiphenyl.
9112. Ellershausen, F. ..... Caustic soda.
9115. Bowman & Anderson ... Extracting precious metals.
9129. Lake, H. H ..... Artificial manure (*Nenninger*).

13th June, 1890.

9182. Western, C. R. ..... Extracting gold.
9183. Tichborne, Darley, Purcell, & Geoghegan ... Collection of carbonic acid gas.
9198. Wise, W. L. ..... Treatment of waste potassium salts (*Chemische Fabrik Buckau Actiengesellschaft*).
9200. MacIvor, R. W. E. ..... Ultramarine.

14th June, 1890.

9203. Millbourn, A. R. ..... Recovery of waste products.
9247. Edwards, E. ..... Desilverising lead (*Honold*).
9257. Wohle, S. ..... Aluminium.
9258. Imray, O. ..... Colouring matters (*Marburg*).

MISCELLANEOUS.

9th June, 1890.

8876. Hart, F. B. ..... Compensating signal wires.
8886. Garton, R. ..... Preserving and storing grass.
8905. Loftus, A. J. ..... Lamps for signals.
8919. Wilson, D. ..... Cement.

10th June, 1890.

8931. Parker, R. ..... Belt fastener.
8943. Thompson, W. P. ..... Artificial fuel (*Paternoster*).
8993. Daguzau, V. L. ..... Cement.

11th June, 1890.

9021. Rothwell, J. ..... Humidifying apparatus.
9060. Chabrand, L. V. ..... Ship's telegraph.

12th June, 1890.

9090. Moennich, P. ..... Automatic temperature regulators.

13th June, 1890.

9135. Craig, J. ..... Manufacture of paper.
9190. Gibb & Pierjus..... Manhole covers.
9195. James, T. S. ..... Cold dry air producers.
9199. Bowing, J. ..... Artificial fuel.

14th June, 1890.

9234. Mitton, T. E. ..... Heat regulator.

COMPLETE SPECIFICATIONS ACCEPTED.

Notice is given that all persons interested in opposing the grant of a Patent on any one of the under-mentioned Applications may, at any time within Two Months after the date given, give notice at the Patent Office, in the prescribed form of such opposition.

Year 1889.

6458. Hoho.
9904. Burn.
9949. Morrison.
10038. Wedlake.
10359. Maxim.
10538. Watson & Watson.
10879. Kreiss.
11063. Wills (*Armani*).
11349. Addison & Lloyd.
11393. Parker.
11445. Leadbeater & Leadbeater.
11528. Beyer & Hagen.
11582. Morgan.
11640. Bruce.
11667. Abel, Dewar, & Anderson.
11832. Dolby.
11844. Sleeman.
11879. Stelzner.
11889. Owen.
11981. Diesseldorff.
12012. Boult (*Contardo & Mimi*).
12180. Willcocks & Harrison.
12360. Lake (*Nörlöw*).
12387. Garroway.
12545. Northam.
12581. Sinton & Byers.
12585. Wilkinson.
12612. Sanders.
12652. Warrington.
12662. Smith.
12702. Albert.
12707. Harris & Harris.
12732. Robertson.
12770. Hodgetts.
12785. Hussonmorel.
12809. Maxwell.
12821. Robertson.
12847. Hillman.
12901. Crompton.
12930. Brailsford.
12941. Bloxsom & Douglas.
13040. Turnbull.
13055. Alford.
13123. Lones, Vernon, Holden, & Bennett.
13343. Lake (*Kalle & Co.*).
13577. Sugar (*Laselle & Mautter*).
13939. Hölzle & Spranger.
14172. Crisp.
14376. Wagner.
16634. Bremme.
17437. Bedingfeld.
18164. Bryan.
19538. Thompson (*John James Bordmann*).
20175. Pybus.
9616. Henderson.
9942. Tyzack.
9967. Musci.
10039. Clegg & Kirby.
10382. Gaunt.
10855. Shaw.
10930. Krügener.
11098. Arnfield.
11357. Edwards.
11410. Douse.
11452. Stott.
11520. Perry.
11555. Smith.
11617. Nordenfelt.
11658. Long.
11715. Broughton.
11826. Jones.
11837. Haddan (*Richebourg*).
11857. Walker.
11883. Trivick.
11918. Holloway.
12020. Taylor.
12117. Mattioli.
12169. Little.
12258. Scott.
12365. Nicholson & Mather.
12506. Goss & Goss.
12558. Redfern (*Hessé*).
12583. Woodhouse.
12587. Barlow & Brook.
12629. Rylands.
12654. Wilkie.
12688. Furness & Furness.
12705. Lake (*Desant*).
12720. Dawson.
12756. Dick.
12775. Distin.
12805. Walker.
12811. Hydes & Wilkinson.
12839. Bromfield.
12866. Shorrock & Hacking.
12906. Hermite, Paterson, & Cooper.
12963. Mellor.
13041. Phalp.
13071. Howard & Gibbs.
13264. Farmer.
13322. Mercadier.
13390. Fritsch.
13588. Hughes.
14008. Tangye & Gay.
14313. Bone.
15397. Samson & Benvie.
17092. Chapman (*Vaslin*).
17638. Dardier.
19075. Hubbard.
19539. Thompson (*John James Bordmann*).
20964. France.

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1890.

1727. Saunders.
1968. Booth & Beaumont.
2233. Lake (*Olcese*).
2679. De Eneer.
2995. Brady.
8924. Lake (*Crosby Electric Company*).
4095. Bergmann.
4896. English.
4960. Kellner.
5003. Asahel Knowlton, Eaton, & Kezia Ann Van der Bilt.
5659. Marble & Simons.
5707. Jacker.
5728. Lake (*Foote*).
5782. Hiorth.
6033. Fornander. (23rd September, 1889).
6259. Makepeace.
6421. Cunningham.
6542. Justice (*Drake*).
6581. Lake (*La Société L'Incandescence Electrique*).
6948. Mankowski.
7050. Pitt (*Weber*).
7209. Saunderson. (4th December, 1889).
7235. Mullineux.
7285. Lake (*Continuous Rail Joint Company*).
7383. Levsen.
7391. Thompson (*Schutte*).
7407. Huntington.
7444. Million & Bony.
7448. Green.
7461. Lake (*Russell and Erwin Manufacturing Company*).
1794. Pfeiffer.
2170. Mitchell.
2302. Weymersch & McKenzie.
3722. Wittorf.
3984. Duval & Nelson.
4010. Barton.
4257. Thompson (*Young & Robinson*).
4995. Mansfield.
5050. Harris.
5285. Kellner.
5445. Crocker.
5697. Seabury.
5725. Bowen.
5768. Desgoffe&DeGiorgio.
5969. Baldwin. (18thNovember, 1889).
6168. Gully.
6360. Bollé (*Moser*).
6479. Haddan (*Beatty*).
6558. Schjott.
6587. Whiteman (*Haeck*).
6797. Cherkassov.
6863. Haddan (*Soetje*).
7045. Thrower.
7208. Wellerа, Wellerа, Jun., & Uffenheimer.
7282. Ambler.
7304. Imray (*Mannesmann*).
7380. Lake (*Snyder*).
7388. Thompson (*Schutte*).
7392. Boult (*Knappe*).
7431. Rothwell.
7447. Lake (*Cotrell*).
7459. Schoff.
7465. Kingsbury (*Western Electric Company*).
7516. Henricl.

ABSTRACTS OF BRITISH PATENT SPECIFICATIONS.

ENGINEERING.

Driving Pulleys.—*H. Lea, Birmingham.*—This pulley is designed for use on machines running at a high velocity, and where a good gripping surface for the belt is required, such as the small driving pulleys of dynamos. The body of the pulley is metallic and formed with a flange upon one side of its rim, whilst a loose flange is made to fit over the other side of the rim. Between these two flanges are wound round the pulley strips of leather with their edges at right angles to the axis of the pulley. When the surface of the pulley has been covered in this way by leather, bolts are passed through the loose and fixed rim and through the leather strips, and the whole bolted up. The leather is thus squeezed tightly between the flanges, and so held in place. Claims: (1) Covering metallic pulleys with leather or other like material in such a manner as to present the edge of the material to the surface of the driving belt for the purpose described; (2) the combination of the shroud—the metallic ring—and the screw bolts and nuts with the rings or strips of leather or other like material for the purpose described.—No. 12312. August 2nd, 1889. 8*d.*

Packing for Piston Rods, &c.—*A. M. Grant, Kilmarnock.*—The packing is metallic, combined, if desired, with the ordinary fibrous packing. It consists of a number of rings made of phosphor-bronze, whose inner surfaces are lined with some soft metal such as Babbits metal. The rings employed are of two sections; those that are placed against the ends of the glands are beveled, and their beveled surface faced with the soft metal, so that when the glands are tightened up the rings are forced against the piston rod, &c.; those rings between the end rings differ in section only by having square edges. The joints of the rings are alternately covered by outer rings of triangular form, one of the flat surfaces covering the joint. The other alternate joints are made by providing the rings with outer flanges upon the adjacent sides. These flanges thus make a broad joint, and are kept closed together by coiled springs. These springs surround each packing ring, and exert a pressure upon the sloping sides of the flanges and the similar sides of the triangular outer rings. As the packing rings are in segments, the force exerted by the coiled springs keeps them in close contact with the rod. Three claims are made.—No. 1213. January 23rd, 1890. 8*d.*

Friction Gearing.—*G. F. Evans, Somerville, U.S.A.*—To increase the friction of the driving and driven pulleys in machinery the inventor interposes between their faces a number of endless belts. The driven pulley is made with flanges, which may be removable. On the surface of this pulley are placed, side by side, three, four, or more endless leather belts, which are in length greater than the periphery of the pulley, but smaller than that of the flanges. The belts consequently hang loosely upon the pulley, yet cannot come off because of the edges. The driving pulley is brought to bear against the surface of one side of the belt, and the pulley bears against the other; thus the belt forms a friction-producing medium for the two. Claims: (1) The mechanism for transmission of power between two lines of shafting, composed of two shafts, two pulleys thereon, one being flanged, and a series of endless bands, which loosely encircle the flanged pulley and are adapted to travel independently between and be gripped by the pulleys; (2) (3) (4) approximately the same as claim (1).—No. 6139. April 22nd, 1890. 6*d.*

Propelling Vessels.—*J. S. Morton, New York, U.S.A.*—A new motor is the basis of this invention. A number of vessels, in shape a cone with a hemispherical base, are placed at the bow and stern of the vessel, with the apex of their conical ends protruding from the sides. In the apex of each vessel is a small aperture, through which water is forced or spurted, and the reactionary force of this water against the surrounding water propels the boat. Four or more of these vessels are placed at the stern, four at the bow with their axes longitudinal, and one upon each side of the forward part of the boat. They are all connected by pipes to a pair of double-acting force pumps, which are worked in any suitable manner by a motor. Water is sucked by the pumps from beneath the vessel, and forced by them through the pipes to one set of the vessels according to the direction in which the ship has to be moved. If the ship has to go ahead, the water is forced from the apertures of the vessels at the stern and *vice versâ*. The vessels at the side in forward part of the ship are used to assist the rudder in steering. Instead of making the pumps and conical vessels separately, they may be combined, and the plungers of the pump connected to the motor by suitable rods and levers. Six claims are made.—No. 6050. April 22nd, 1890. 8*d.*

Pumps.—*H. R. Cussons, Kingston-upon-Hull, Yorkshire.*—In this pumping apparatus the inventor makes use of a quantity of water previously raised to assist in raising more. The illustrations represent:—Fig. 1, a vertical section of the apparatus; Fig. 2 and 3, details of the same. As illustrated the pumping

FIG. 1

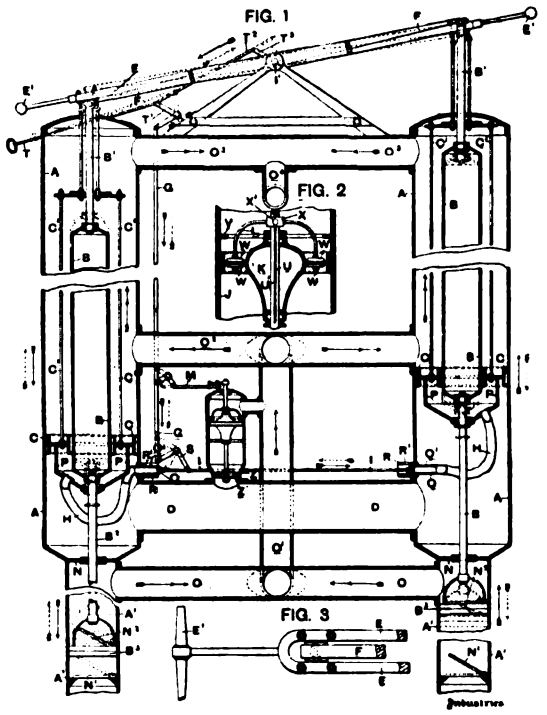


FIG. 2

FIG. 3

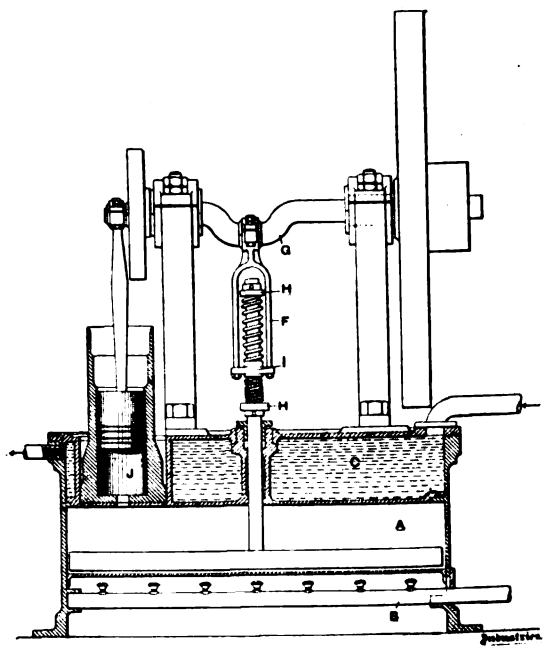
machine is constructed to be worked by hand, the levers E and F being provided for that purpose, the one working within the other as shown in Fig. 3. To each end of the lever F is secured a pump bucket B^3, which works in a barrel A^1 attached to the bottom of the main barrel A. The piston rod of the bucket B^3 passes through the bucket C of the main barrel, and it is enlarged into a hollow cylinder to constitute a piston for a purpose to be explained. The main buckets C are secured to the ends of the levers E. When the hand levers E and F are rocked it will be seen that the buckets in the pump barrels partake of a reciprocating vertical motion, and water is raised through the main valves N^1 and forced through and delivered from the apparatus in the direction of the double-headed arrows. Thus the buckets B^3 first raise the water and deliver it through the pipes O O^1 O^2 to the top part of the main barrels. It is then forced upwards by the buckets C to the pipes O^3 and delivery pipe O^4. To assist in raising the water as described the inventor admits water from the pipe O^1 to the pipe D and the under surfaces of the buckets C. The water is admitted to the pipe D through a float valve Z, part of which is illustrated in Fig. 2. In addition water is admitted and exhausted to and from the chamber P in the lower part of the bucket C, so forcing the hollow shaft B upwards to assist in pumping. The water is admitted from the pipe D to the chamber P through a flexible pipe H and valve Q. Upon the down-stroke of the buckets the valve Q exhausts the water from P and discharges it to the atmosphere. Claims: (1) The improvements in apparatus for pumping, raising, and forcing liquids as set forth and shown; (2) the method of and means employed for working the pumping apparatus referred to in the preceding claim by utilising a predetermined quantity or head of water as set forth; (4) the combination with the hereinbefore described pumping or liquid raising and forcing apparatus of a hollow pump spear or air vessel B, cap or plunger C, beams E F, and means for alternately filling and expelling water into and out of the chamber in the cap C, as and for the purposes set forth.—No. 4459. March 21st, 1890. 8*d.*

Drilling Hard Rock.—*E. Edwards, London.* (*O. Terp, Breslau, Germany*).—In order to drill deep holes in hard rock, and to obtain specimen cores from the holes, diamond rock drills have hitherto been used, and the well-known diamond drill system has been found to be both effective and reliable, but at the same time so expensive that it cannot be used under all circumstances. The present invention consists in the application of metal tubes to the above work. The tubes are made of soft metal, and work in conjunction with granular emery or other hard material. They are revolved upon their axes, and the emery or other substance fed to the working end of the tube. By these means holes can be drilled through hard rock easily and evenly, the cores so produced showing correctly the strata passed through. Instead of a tube of soft metal a hollow or solid cylinder of emery may be used with like results. When a metal tube is employed it is usually made of copper, zinc, tin, or soft iron. The method of working is the same as that when the diamond drill is employed. As very little emery need be used, and the tube is very slightly worn, the cost of working is small. Claims: (1) The apparatus for drilling deep holes in hard rock, consisting of a tube of soft metal, such as copper or soft iron, in combination with emery powder or other hard grinding material, which, by rotation of the tube, bores an annular hole, leaving a central core which can be withdrawn with the tube; (2) in drilling apparatus of the kind described in claim (1), the use of a hollow or solid cylinder of emery as described.—No. 122. January 3rd, 1890. 6*d.*

Transmitting Power by Chains.—*Avon Babo, Washington, U.S.A.*—By the employment of this invention reversible motions can be imparted to a wheeled vehicle from a chain running continuously in one direction along the track of the vehicle. This system is particularly adapted for use on cable traction railways where there is but one cable working in a street. When the car is running in the same direction as the cable, the former is rigidly secured to the latter, but when the motions are opposite there is brought into action a reversing device which transmits the motion of the chain to the wheels, and causes the car to travel in the opposite direction. Upon one of the axles of the car there is mounted a grooved wheel of such diameter as to extend through the slot into the conduit. This wheel is fitted loosely upon the axle, but may be secured to it at any time by a suitably arranged clutch. Immediately before and behind the grooved wheel, and in the same vertical plane, are two small sheaves mounted upon a frame suspended from the under part of the car. The cable passes over these sheaves and under the grooved wheel, the former keeping the cable up to and in contact with the latter. The frame upon which the sheaves are mounted can be raised and lowered at will so as to bring more or less of the cable in contact with the grooved wheel. When driving in the direction of the motion of the cable, the large grooved wheel is disconnected from its axle, and the sheaves are raised until the cable is bound between them and the grooved wheel. The grooved wheel is thus held stationary, constituting a grip for the cable whilst its axle revolves freely. To reverse the motion the wheel is secured to its axle by the clutch, and the sheaves are slightly lowered, so that the wheel is revolved by the motion of the cable, and the car is driven in the reverse direction. Six claims are made.—No. 678. January 14th, 1890. 8*d.*

Working Guns on Railways.—*T. English, Hawley, Dartford.*—This is a method of working and transporting guns on railways. The gun is preferably of the disappearing class, and it is mounted on a wheeled carriage, but the ordinary road wheels are replaced by flange wheels mounted at a width apart to suit the railway gauge. In addition to the gun carriage there is a four-wheeled truck similarly adapted to the railway, and having a hook which can be lowered by hand and made to engage with the trail eye of the gun carriage. When the hook has been so engaged it is re-raised, lifting the trail and securing the truck to the gun carriage ready for transportation. At the place where the gun is to be worked there is provided a strong and heavy foundation plate, having a pivot projecting up from it, and a circular path formed between the rails to the same gauge. The axle-tree of the gun carriage is brought directly over this pivot, and a shoe, which is rigidly attached to the trail brackets of the carriage, is made to engage upon the pivot. There is also provided outside the rails level circular segment plates on which the trail of the carriage slides. When in place the gun carriage is detached from its truck, and the gun revolved about the pivot, its wheels travelling upon the circular path whilst the trail slides over the segment plates. Claims: (1) For transporting a gun along a railway, the use of a four-wheeled truck with hook engaging the trail of the gun carriage as described; (2) for working a gun on a railway, the use of a foundation plate with pivot and circular faces or treads for traversing the gun as described.—No. 4825. March 27th, 1890. 6*d.*

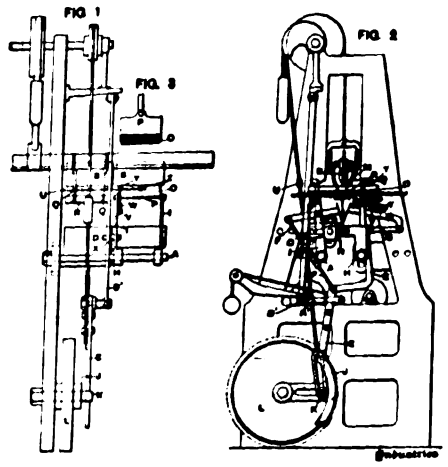
Hot Air Engines.—*C. Wells, London.*—The air of this engine is heated by atmospheric burners consuming gas, and a more effectual and rapid heating of the air is obtained by making the stroke of the displacer shorter than that of the crank and causing the displacer to come into contact with the hot and cold plates of its vessel. To make the stroke of the displacer shorter than that



of the crank, the rod of the displacer is connected to the crank G by a forked connecting rod F. The fork F is jointed to the displacer rod by a loose collar I, which slides upon the rod between the springs H. By the use of these springs, the difference in the strokes of the displacer and crank is compensated for by the compression of the springs, so causing the displacer to come into contact with the plates at the ends of its strokes. The bottom end plate of the displacer chamber A is heated by the gas burners B, and the upper end plate is cooled by a circulation of water in the vessel C. The air, after having been heated in the chamber A, passes to the motor cylinder J, whose piston works the crank G. Claim: The combination with cylinder piston crank and displacer of displacer connecting rod as the latter is described with reference to the illustration.—No. 12999. August 17th, 1889. 6*d.*

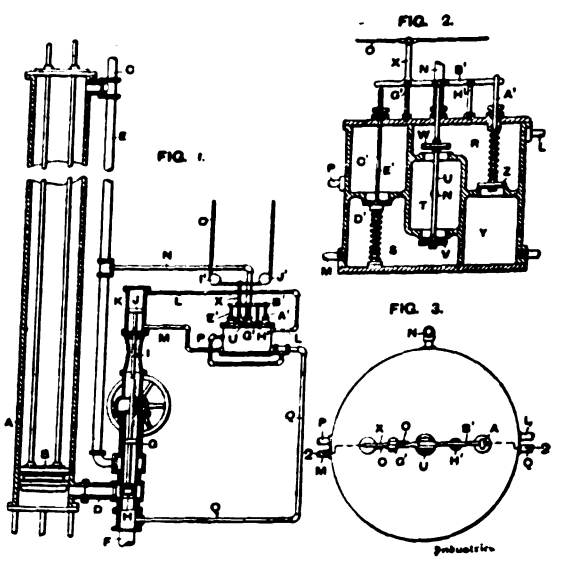
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HACKLING FLAX, &c.—*J. Erskine, Belfast, Ireland.*—These improvements are to dispense with the hand process of "ending" the fibrous material in hackling machines. There is employed in connection with the flax holder a nipping device which nips the fibre at a distance below the ordinary holder and removes the short ends as the fibre is raised and lowered by the holder. The illustrations represent Fig. 1 a longitudinal sectional view of the nipping or "ending" device and tumbling hackle, Fig. 2 an end elevation of the same, and Fig. 3 a hackling comb. The fibre M suspended from the ordinary holder B is gripped between a pair of nippers C D. One of these nippers C is stationary, and the other D is made to open and close upon the other by the lever E actuated by a bowl K in the disc L. Pivoted above the nipping device are levers F, which carry at one end the plates T and are



combined at the other end with the lever E. The action of this part of the device is as follows:—When the holder B is making a down-stroke the nipping device is opened and the fibre falls down between the nippers. Upon the holder making its up-stroke the nippers are closed by the bowl K pressing against the lever E, and the ends are removed from the fibre as it is drawn upwards. As the holder makes its down-stroke and the nippers are opened, the plates T are lowered by their levers and remove the ends from the face of the nippers. Between the nippers C D and the holder B are hackling combs O. The combs O have imparted to them a horizontal reciprocating motion, and are thus made to close over the fibre in its upward movement. India-rubber-faced pressers R are also arranged between the nippers and holder to press the fibre for "breaking." Claims: (1) The use and employment of a fixed nipping device for effecting the "ending" of the flax or fibre, operating and operated by means such as described and illustrated; (2) the use and employment of a finishing hackle either before or after the "ending" operation has been performed as described, such finishing hackle being employed in combination with the fixed nipping device; (3) the use and employment of a finishing hackle either before or after the "ending" operation has been performed, as described and illustrated.—No. 7695. May 8th, 1889. 11*d.*

VALVES OF LIFTS AND ELEVATORS.—*W. P. Gibson, London.*—The improvements relate to the auxiliary valves for controlling the movements of the main valve in elevator mechanism. In the accompanying illustrations Fig. 1 is a vertical section of an elevator of the vertical type equipped with the improved auxiliary mechanism, Fig. 2 is a vertical section upon the auxiliary valve, and Fig. 3 a plan of the same. The hydraulic elevator has the usual power cylinder A and piston B, provided with the usual supply, discharge, and circulating pipes C D E. The main valve H has a vertical motion in the barrel C, and is controlled by the piston J in the cylinder K. Fluid under



pressure is admitted to the cylinder K by the auxiliary valve shown enlarged in Figs. 2 and 3. At the junction of the pipes D and E with the barrel G the outer casing is formed into an annular chamber and the barrel is perforated. The auxiliary valve casing is divided into five compartments; the compartment T communicates to the pressure fluid supply, R S communicate with the top and bottom of the cylinder K, and the compartments Y C¹ with the discharge pipe F. The operation of the auxiliary valve mechanism is as follows:—The parts are shown in their normal positions. To cause the downward movement of the main valve H, to permit the circulation of water from the upper te the lower end of the cylinder A, the attendant in the car draws the hand-rope O upwards around the pulley I¹. The lever X will then depress the valve D¹ and raise the valves V W, thus putting the chamber S in communication with the discharge pipe F through the pipe Q, and the supply chamber T in communication with the chamber R, so that the piston J is forced downwards. This downward motion of the piston J continues until the communication is formed between the top and bottom of the cylinder A. When the motion of the car is to be reversed the rope O is drawn upon in the opposite direction and the lever X moved in a contrary way, so closing the valves previously opened and opening those that were shut. The piston J is raised and the pressure fluid exhausted from A through D and F. To hold the piston J and valve H in any position it is only necessary to release the hand-rope; the valves V W are then both open, and the working fluid is admitted to both sides of the piston J. Three claims are made.—No. 20,959. December 31st, 1889. 8*d.*

RAMIE MACHINERY.—*M. J. Renaut, Paris, France.*—The improved machinery which forms the subject of this invention is for breaking and decorticating fibrous vegetable substances, and more particularly ramie, in a green state. Only the decorticating part of the machinery is here shown, Fig. 1 being an elevation and Fig. 2 a plan. The breaking machine consists of a pair of fluted crushing rollers to which the ramie is fed upon an endless band or apron. As the stalks leave the rollers they pass between a pair of circular rotary brushes for the purpose of removing the pellicle which covers the fibre and the pith which forms the inside of them. The broken stalks are then placed by an attendant upon a second apron A, which conducts them to the decorticating machine illustrated. They are next put with their heels across an endless rope C, and are kept there by a guide D until the moment when the rest of the stalk falls off the apron A. The rope C engages in the groove of a large pulley E, tightly

FIG. 1.

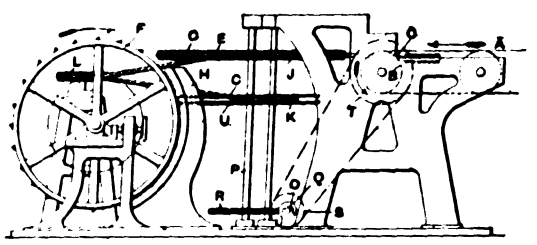
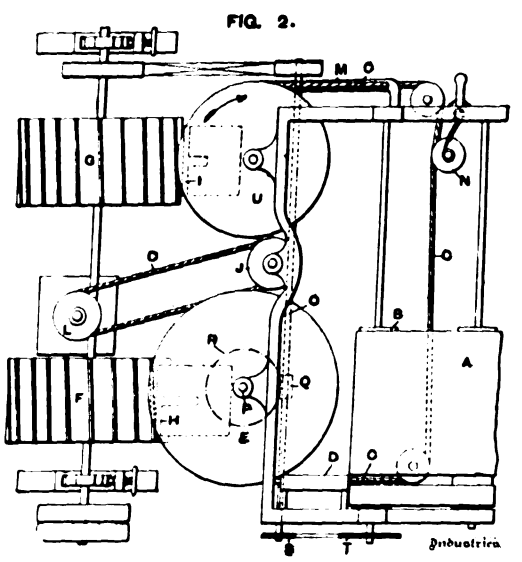


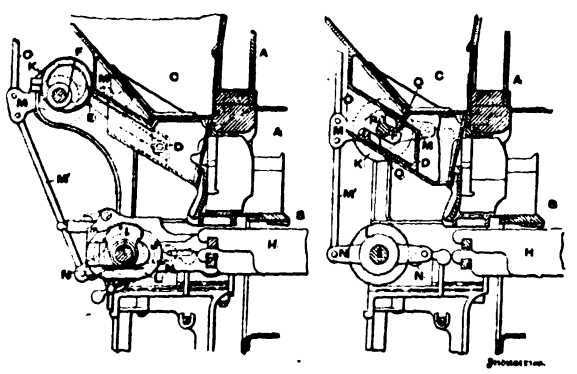
FIG. 2.



locking therein the stalks that it carries, and it brings them to a drum F fitted with blades and turning opposite a concave wooden block H so that the stalks pass between the drum and the concave block. By the friction of these the epidermis or pellicle which covers the fibre is removed and the ligneous part which was disaggregated by the breaking machine expelled. This first drum effects the complete decortication of three-fourths of the length of the stalks, but the heels held in the groove of the pulley have not been acted upon by the blades. The rope then leaves the large pulley E, and, still carrying the stalks, enters the groove of a small pulley J, about which it makes a half-turn, and the decorticated part of the stalks which hangs down is seized below by the rope on its entrance into the groove of a second large pulley U placed on a lower plane than the pulley E. The decorticated part of the stalks held in the groove of the second large pulley U draws the heels before the second drum G, which, like the drum F, has blades, and turns opposite a concave wooden block I. After the passage of the heels between the drum G and curved block I the decortication of the stalks is complete. On leaving the second drum the stalks present themselves across the rope in perfect parallelism and collect on a fork M, between the arms or prongs of which the rope passes to return by guide pulleys to the first large pulley E. For the purpose of keeping the rope of the machine tight a spring-mounted pulley N is brought to bear upon it. Claims: (1) The combination with a decorticating machine of several or a number of breaking machines which feed the decorticating machine by means of an endless apron common to all the machines as described; (2) in a breaking machine a regulating or controlling board for the purpose of feeding the ramie to the machine; (3) in a decorticating machine such as described, the arrangement or means described for tightening the cord while allowing it a sufficient amount of flexibility or "give"; (4) the decorticating machine constructed and working substantially as described and illustrated.—No. 12448. August 6th, 1889. 8*d.*

FEEDING FUEL TO FURNACES.—*J. J. & T. Vicars & J. Vicars, Jun.*—Reference is made to self-stoking furnaces in which fuel is fed to grate-bars by means of reciprocating plungers, and the fuel caused to travel through the furnace by means of grate bars carried forward in a body from the front towards the rear of the furnace and moved back in detachments, or one at a time. The mechanisms for feeding the coal to the bars, and moving it forward

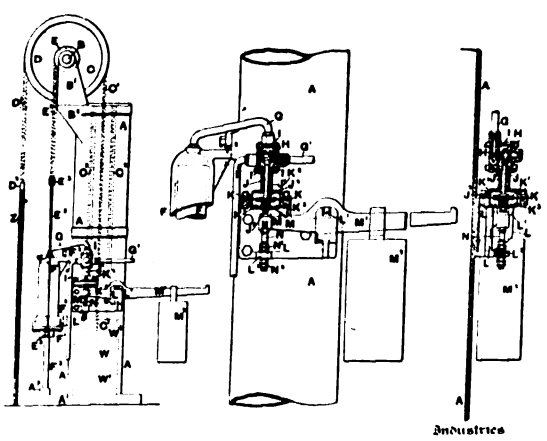
FIG. 1. FIG. 2.



on the bars, have hitherto been worked together; by the present invention they are worked independently, so that the rates at which they act may be better regulated. Fig. 1 is a vertical longitudinal section of the apparatus, A represents the furnace end of an internally fired boiler, B is the furnace, C is the fuel hopper, D are the reciprocating plungers for feeding the fuel to the furnace bars, and E is an eccentric and rod for giving reciprocating motion to one of the plungers. As many eccentrics and rods are used as there are plungers to be driven. H are the movable fire-bars, F the shaft for driving the plungers, and I the shaft for driving the bars. The above parts are of usual construction. To drive the motor shafts there are mounted on them the ratchet wheels K and L, and into the teeth of these engage the pawls M and N. The pawls are coupled together by the rod M¹, and a reciprocating motion given to them by a rod O connected to a suitable motor. As the feed plungers D and fire-bars H are actuated by means of separately operated driving shafts the speed of either portion of the apparatus may be varied without affecting the other portion. Fig. 2 is a vertical longitudinal section of a modification of part of the invention. Equivalent parts are denoted by the same letters as in Fig. 1. The fire-bar driving gear is the same as that shown in Fig. 1, whilst reciprocating motion is given to the plungers D by means of tappets P secured to the shaft F. Claim: In apparatus for feeding fuel to and in furnaces the combination of reciprocating plungers and movable fire-bars with separate driving shafts substantially in the manner and for the purposes set forth.—No. 10945. July 8th, 1889. 6*d.*

BOILER FURNACES.—*T. White & W. Carson, Govan.*—In a former specification, No. 6889 of 1887, the inventors described a damper regulating and actuating device for steam boiler furnaces; the present patent is for improvements in it. The damper is raised and lowered as the pressure of steam falls or rises. Fig. 1 of the illustrations shows an elevation of the complete apparatus, Fig. 2 is a sectional side elevation, and Fig. 3 a sectional elevation at right angles to Fig. 1. A is a hollow open-ended cylinder, which supports the whole of the mechanism, and encloses the counter-weights W W¹ W² of the damper Z. The weights W W¹ W² are connected to the damper by a chain passing over the pulley C, and they are in excess of the weight of the damper, so that the latter has a tendency to rise. A plunger F¹ of a ram cylinder F is connected by a frame and chain to a second pulley E upon the shaft of the first pulley C. By the connections it will be seen that as the plunger is forced out of its cylinder downwards the damper Z is lowered and *vice versâ*. Steam from the steam generator or water under pressure, is admitted by a D valve H to work the ram. The valve H is enclosed in a steam chest I, and it is coupled by a rod J to a diaphragm K¹. Communication is made between the steam chest I and the upper surface of the diaphragm, so that steam admitted from the generator to the valve-chest exerts its force upon the surface of the diaphragm. A lever M¹ is pivoted to a bracket on the side of the cylinder A, and its short arm made to

FIG. 3. FIG. 2. FIG. 1.



bear upon the under surface of the diaphragm with a force produced by the weight M² suspended from its longer arm. The action of the ram and valve fittings is as follows:—When the pressure of the steam in the boiler rises above the desired normal pressure, it acts on the diaphragm K¹ with a greater pressure than that due to the weight M² on its reacting lever M¹, and so presses down the diaphragm and opens the valve H of the inlet port I³ to the cylinder F, and presses out its piston or ram F¹ and so closes the damper Z proportionately to the outward

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motion of its ram or piston. Immediately the pressure in the boiler *falls* again towards or below its normal pressure, the reacting weight M^2 and lever M^1 raise the diaphragm K^1 and spindle J of the valve H, so as to close the inlet port I^3 to the cylinder F, and open the exhaust port to the outer atmosphere through the valve, and allow the piston or plunger F^1 to rise again, and the damper Z to open, by the action of its counterweights W W^1. Claims: (1) The construction or arrangement and combination of the parts of a damper actuating and regulating apparatus for steam boiler furnaces, with a slide or equivalent valve connected to a disc or diaphragm within a close pressure chamber, and having a valve-chest and ports and a steel yard or other sensitive acting weighted lever, substantially as and for the purposes described in reference to the illustrations; (2) the fitting and use of a slide or equivalent valve connected to a disc or diaphragm within a close pressure chamber, and having a valve-chest and ports, substantially as and for the purposes described in reference to the illustrations.—No. 8600. May 23rd, 1889. 8*d*.

Vertical Boilers.—*G. Cawley, London.*—In this new form of vertical boiler greater strength and evaporative efficiency is gained, and economical working is ensured in boilers of larger size than those at present found practicable. The accompanying illustrations show—Fig. 1, a vertical section of the boiler, and Fig. 2, a horizontal section, half upon the line S T and half upon the line C C, looking upwards. The boiler has the appearance of a cylindrical vessel pinched in or reduced in diameter about midway of its length. The top and bottom parts thus formed are chambered out, the lower chamber A constituting the fire-box and the upper the uptake. A chamber H is formed around the boiler by neclosing its reduced portion. Communication is formed between this chamber H and the crown of the fire-box by short oblique tubes M; similar tubes are also used for the passage of the products of combustion from the chamber H to the uptake. It will thus be seen that in working the heated products of combustion

FIG. 2.

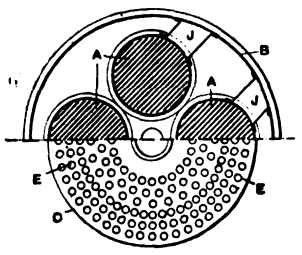
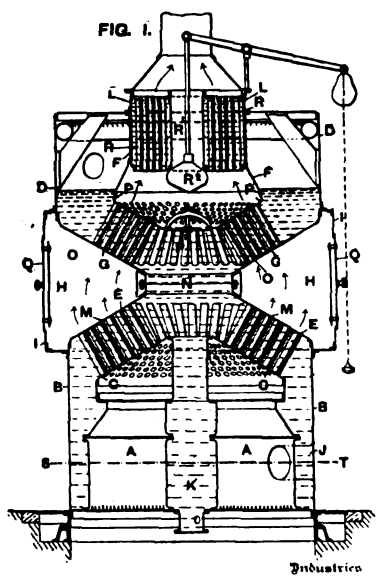


FIG. 1.



play first upon the inner shell of the boiler, next upon the outer shell, and then again upon the inner shell, as is indicated by the arrows in Fig. 1. A feed-water heater L, fitted with vertical heating tubes, is arranged in the upper part of the uptake, the heating effect being regulated by the valve R^2. To increase the resistance to collapse the cylindrical parts may be fitted with Adamson's rings or any other device. Claims: (1) In a vertical steam boiler, the combination and arrangement of a fire-box having its upper part of a conical shape, a lower shell surrounding the fire-box, and having its upper part formed to the frustum of a cone, and terminating in a short tube or opening, tubes connecting the coned top of the fire-box with the frustum of the lower shell, an upper outer shell terminated below by an inverted frustum of a cone and a short tube or opening connected to the tube or opening of the frustum of the lower shell, an inner tube in the upper part of the boiler having its lower end formed to the inverted frustum of a cone, tubes connecting the frusta of the shell and of the inner tube of the upper part of the boiler, and a plate or plates connecting the inner tube and the shell of the upper part of the boiler so as to enclose the steam space, as described and illustrated; (2) in a vertical steam boiler having the combination and arrangement of parts set forth in the preceding claiming clause, the construction, combination, and arrangement of two or more fire-boxes opening into a combustion chamber immediately below the conical top C as described and illustrated; (3) in vertical steam boilers a feed-water heater consisting of a vessel having tubes through which the hot gases from the boiler pass on their way to the chimney, constructed and arranged in the boiler as described; (4) the arrangement and combination of parts constituting the boiler described and shown in Figs. 1 and 2; and (5) the arrangement of a slight modification.—No. 10540. June 29th, 1889. 8*d*.

Separating Water from Steam.—*A. G. Brown, Bolton.*—This apparatus is for use in separating water from steam as the steam is passing away from a generator, so that the steam is practically dry before it is employed. It consists of a cylindrical chamber, having fitted in its upper part tangentially disposed inlet ways, these ways being prolonged helically within the cylinder. Concentric with the cylindrical chamber there is a large outlet pipe, which enters the chamber at the top and reaches nearly to its bottom. The action in the apparatus is as follows:—Steam from the generator enters the cylindrical chamber through the tangential ways, and has a centrifugal descending motion imparted to it. By this motion any water contained in the steam falls to the bottom of the chamber, and flows past a balanced valve back to the generator. The steam passes downwards until it reaches the lower edge of the outlet pipe, when it reascends and passes off to be employed. Claims: (1) Apparatus for separating water from steam, consisting of a chamber or vessel having two or more tangentially disposed inlet ways, a central uptake, and a balanced or weighted discharge valve as described; (2) apparatus for separating water from steam, consisting of a chamber or vessel having two or more tangentially disposed inlet ways, formed with spiral passages leading downwards, and a balanced or weighted discharge valve; (3) the combination of apparatus under the invention for separating water from steam with a steam generator as described.—No. 11600. July 20th, 1889. 6*d*.

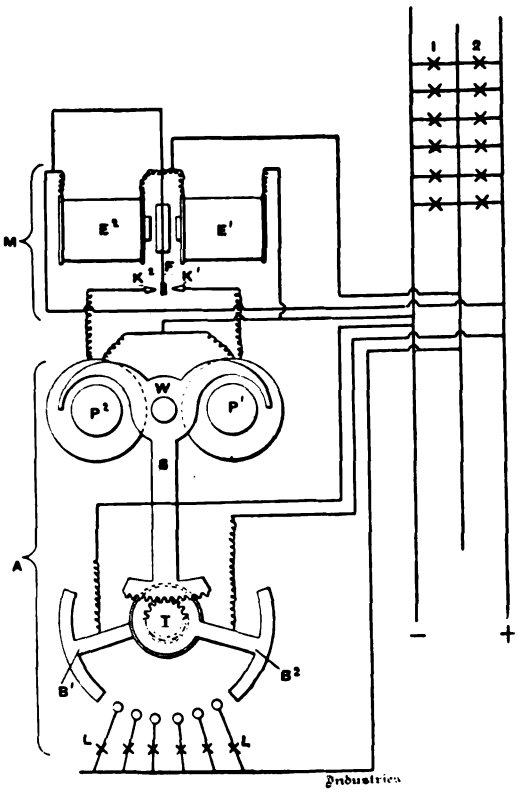
Steam Boilers.—*D. T. Lawson, Wellsville, Ohio, U.S.A.*—In the specification of a former patent is described a process of preventing steam boiler explosions by retarding or prolonging the flow of steam from the water space to the steam space. This is done by means of a diaphragm or partition separating horizontally the top part of the boiler from the lower part at a point just above the water level. The theory by which the use of such a diaphragm is suggested is this—that the explosions in boilers are caused by the reduction of the pressure in the boiler by the sudden consumption of steam, and the consequent rapid evolution of more steam whose momentum is sufficient to burst the boiler. One of the causes which produce this sudden reduction of steam pressure is the sudden opening of the throttle valve to admit steam to the cylinder of an engine at starting, followed by the almost instantaneous closing of the steam ports. In the specification referred to communication between the two spaces in the boiler above and below the diaphragm is made through an adjustable valve. As this valve, however, requires very nice adjustment, the advantage of the invention could only be attained by skilled engineers. To make the invention more universally employable the inventor makes the communication between the spaces automatically adjustable. In the diaphragm are formed several openings, and over each opening is arranged a check valve opening upwardly and held down by a weight or spring. The aggregate size of these openings is considerably less than the size of the steam outlet from the steam space, so that steam will pass from the lower space to the upper somewhat slower than it will escape from the upper through the steam outlet. Another advantage of the valves so arranged is that they trap sedimentary matters that are thrown up through the valves on to the top of the diaphragm. The sediment can then be drawn off from the boiler by pipes suitably arranged. In addition to the check valve openings the diaphragm is pierced by a number of small holes which always remain open. Claims: (1) The steam boiler having its steam space separated from the water space by a horizontal diaphragm provided with openings in the same and combined with upwardly opening check valves arranged above the diaphragm as described; (2) the combination, with a steam boiler, of a horizontal diaphragm separating the steam space from the water space, and provided with upwardly opening check valves and gathering troughs for sediment and blow-out pipes extending through the boiler from the level of the troughs.—No. 11726. July 23rd, 1889. 8*d*.

Steam Engine Cylinders.—*L. St. Lawrence Pendred, Colchester.*—It is well known that when steam is exhausted from a cylinder the metal of the cylinder becomes cooled, and causes a portion of the steam admitted in the next stroke to condense. In order to reduce this condensation the inventor proceeds as follows:—An engine is made with one or more single-acting cylinders, and steam is supplied to these cylinders by separate pipes. One pipe conveys steam to one end of the cylinder for heating it, and the other conveys steam to the other side of the piston for working the engine. The end of the cylinder containing the heating steam is always in communication with the boiler. As the piston moves in the cylinder during the exhaust stroke, the heating steam follows it up and raises the temperature of the metal. The working steam will then find during the next stroke the metal at the same heat as itself instead of cooler. In applying the invention to compound engines, two pistons of different diameters are fixed to one rod and worked in tandem cylinders opened to one another. The heating steam is introduced between the two pistons, while the working steam is admitted first to the small cylinder and then exhausted to the larger in a manner which will be readily understood. Claim: Heating the metal of steam engine cylinders and preventing or diminishing evaporation in them by maintaining steam pressure in them as described. No. 12134. July 31st, 1889. 8*d*.

ELECTRICITY.

Fixing Electric Lamps.—*H. D. Ryder & H. E. Dopson, London.*—A convenient appliance is described in this specification for placing incandescent lamps into their places or for removing them, without the use of ladders or steps of any sort. It consists of a holder secured to the end of a wooden rod of convenient length to reach the different heights at which the lamps are placed. The holder is formed in the shape of a cup, whose internal diameter is approximately that of the external diameter of the lamp about one-third up. The inner edge of this cup is padded with a soft material such as rubber. To hold the lamp firmly in this cup, three spring fingers are secured to its edge, and project upwards so as to grasp the part of the lamp not entering the cup. The lamp is placed in the holder with the crown innermost, so that the stem remains free for insertion into suitable sockets permanently fixed in place. When the appliance is to be used for putting lamps into or taking them from suspended sockets, which can swing to and fro, or be easily lifted upwards, there is placed upon the rod just below the holder a tubular slide. To the slide are jointed, in the manner of scissors, two curved levers, which pass up upon opposite sides of the holder, and have their ends bent over the top of the holder. The lower ends of these levers are secured to a bow-shaped spring, which normally keeps the ends apart, but when pulled downwards by a wire attached to its centre, the ends of the levers are brought towards each other. The upper ends of the levers are made to seize the socket of the lamp and hold it firmly, whilst the holder seizes the lamp and removes it from the socket. Claims: (1) A friction clip-holder for electric incandescent lamps carried at the end of a rod as described, to enable such lamps to be readily put up or taken down; (2) the construction of the friction clip-holder in the manner described; (3) the construction of apparatus for putting up or taking down electric incandescent lamps as described.—No. 11296. July 13th, 1889. 8*d*.

Regulating Electric Potential.—*Siemens Bros. & Co., Ld., London.*—The accompanying diagram illustrates apparatus for the purpose of equalising the potential in the supply of two sets of lamps 1 and 2, notwithstanding that several of the one or of the other set may be cut out of the circuit. The apparatus consists of two main parts, what may be termed a meter M and a regulator A. The meter M consists of two electromagnets E^1 and E^2, with a spring armature F between their poles, which armature, according as it is attracted by the one or the other, makes contact at K^1 or K^2, and thereby closes the circuit for the one or the other of two relay electromagnets P^1 or P^2. Between the poles of these magnets is pivoted at W a three-armed iron lever S. Two of the arms are curved, so as to partly encircle the two poles P^1 P^2; the third arm terminates in a toothed segment, which gears with a pinion T. To the pinion are attached two contact arcs B^1 B^2, the one or the other of which is brought by the partial revolution of the pinion T to make contact introducing one, two, or more of a set of resistances, which may be lamps L The two main leads + and −, and the intermediate lead for the two sets of lamps 1 and 2 being connected as shown to the magnet E^1 E^2, P^1 P^2, and to the arcs B^1 B^2 and resistances L, when



the potential for the one set of lamps, say the set 1, exceeds that for the other set 2, the armature F makes contact at K^1, the magnet P^1 is excited, causing the lever S to move and the pinion T to turn so as to bring the arc B^1 over one, two, or more of the resistances L, which are thus introduced in the circuit of the lamps 1, making up for those of the lamps of the set 1 that may have been cut out of circuit. In like manner, should the potential for the set of lamps 2 be in excess, the regulating apparatus operates so as to introduce one, two, or more of the resistances L into the circuit of the lamps 2. When there are more than two sets of lamps, several of the above-described apparatus have to be used. Claim: Apparatus for automatically regulating the potential in the conductors for two or more groups of electrical lamps, consisting of the combination of a measuring and regulating apparatus, of which the former serves to compare the potentials existing in the said groups, and on the occurrence of any difference between such potentials, causes the regulating apparatus to be actuated so as, by means of a contact arm or other equivalent device, to include one or more resistances in the one group or the other, whereby the potentials in the two groups will be equalised as described.—No. 10699. July 2nd, 1889. 8*d*.

Copies of the British specifications may be obtained on application to H. Reader Lack, Esq., *Comptroller-General, Patent Office, Southampton Buildings, London, W.C. The published price must be remitted, together with a sum sufficient to cover postage, which may be reckoned at ½d. for every* 10*d*. *or fraction of* 10*d*. *Remittances exceeding one shilling must be made by Post Office Order.*

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PREFACE.

When the future historian—in the calm seclusion of his study, and at a period sufficiently removed from the present to enable him to pronounce an impartial judgment—comes to give proportional values to the leading elements which have mainly constituted the material progress of the nineteenth century, he will, we believe, allot to the work of the engineer a highly important position. We use the term "engineer" in its widest sense, as we are thinking of the engineer's work as lying in no restricted technical groove, but rather in that extended domain where it has acted as a potent agent in bringing about social progress and international amity. The mechanical skill and daring enterprise of engineers have virtually reduced the surface of the earth and have brought the inhabitants of its various countries closer together. The latest and—as an isolated feature of engineering skill—the greatest example of such work is the Forth Bridge, to be opened by H.R.H. the Prince of Wales on the 4th March. The progress made with this magnificent structure has always been an attractive subject to place before our readers, and through the kindly assistance afforded us by the Engineers and Contractors, and their able lieutenants, we have been enabled very fully to describe and illustrate it from time to time. We have thought, however, that now the Bridge is finished, a complete illustrated description would be of interest to both technical and general readers, and with this object we have prepared the **Industries'** Special Number on the Forth Bridge.

The descriptive matter has been taken from the writings of several prominent members of the Engineers and Contractors' Staffs, and is therefore authentic. To the eminent Engineers and Contractors, and to each member of their respective staffs, we beg to offer our grateful thanks for their uniform kindness and courtesy. They have successfully brought to completion a gigantic piece of work which renders the nation indebted to them.

LIST OF AUTHORITIES CONSULTED IN THE PREPARATION OF OUR DESCRIPTION OF THE FORTH BRIDGE.

Sir John Fowler, K.C.M.G.	1882	Address to the Mechanical Science Section of the British Association, Southampton.
Mr. B. Baker, M.I.C.E.	1882	Paper read before the British Association, Southampton.
" "	1884	" " " Montreal.
" "	1885	" " " Aberdeen.
Mr. R. E. Middleton, M.I.C.E.	1885	"The Triangulation of the Forth Bridge." *The Engineer.*
Mr. B. Baker, M.I.C.E.	1887	Lecture delivered at the Royal Institution.
Mr. William Arrol, M.I.Mech.E.	1887	Paper read before the Institution of Mechanical Engineers, Edinburgh.
Mr. E. M. Wood, M.I.Mech.E.	1887	Paper read before the Institution of Mechanical Engineers, Edinburgh.
Mr. E. W. Moir, A.M.I.C.E.	1887	"Hydraulic Appliances at the Forth Bridge Works," *Minutes of Proceedings Inst. C.E.*, Vol. XCI.
Mr. F. E. Cooper, M.I.C.E.	1888	Paper read before the Iron and Steel Institute, Edinburgh.
Mr. Andrew S. Biggart, A.M.I.C.E.	1888	Series of Papers before the Institution of Engineers and Shipbuilders in Scotland.

We have likewise availed ourselves of lectures delivered at intervals by Mr. B. Baker, M.I.C.E., before various learned societies throughout the Kingdom, and reported in more or less detail by our daily contemporaries.*

The Editor of **Industries.**

Offices of "Industries," 358, Strand, London, W.C.,
February 20th, 1890.

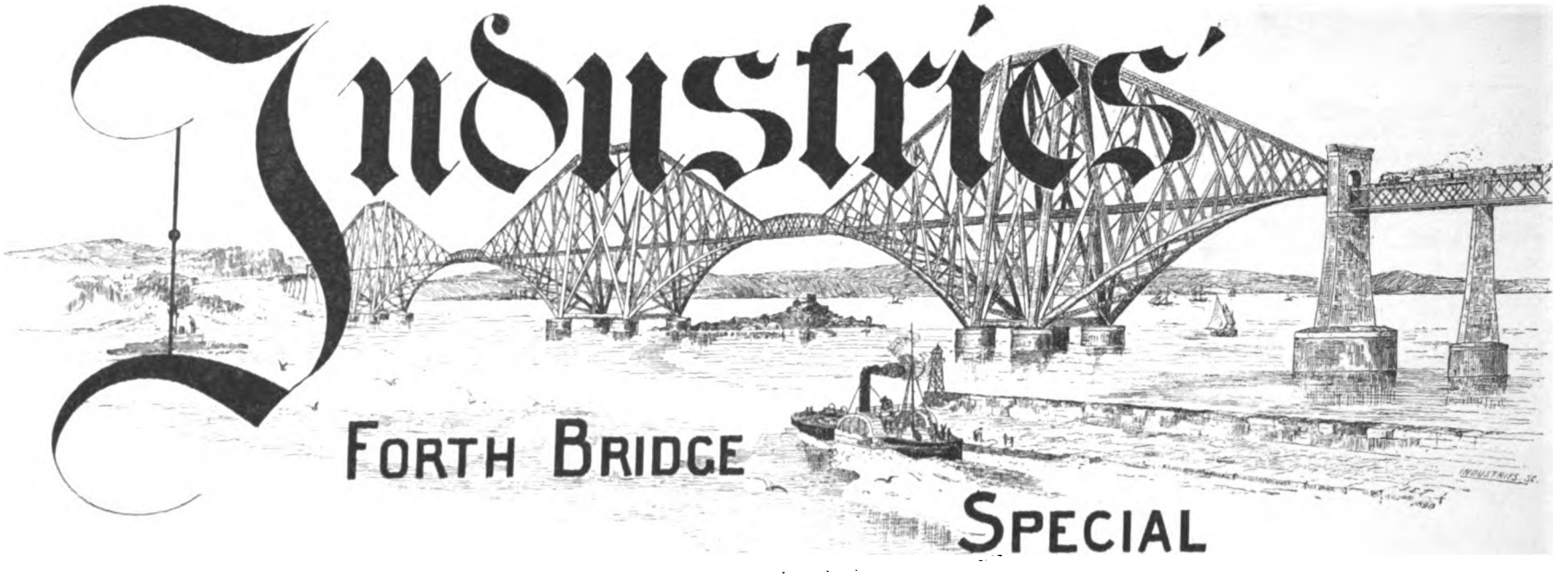
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* We have also drawn from matter published in our own columns during the past three years and a half, from the pens of Mr. Frederick E. Cooper, M.I.C.E., Messrs. J. E. Tuit, Ernest W. Moir, and E. G. Carey, Assoc. Members I.C.E., and Mr. Alfred Mayor. We are indebted to Sir John Fowler and Mr. B. Baker for having courteously placed at our disposal the photographs taken while the work was in progress, from which our illustrations have been reproduced. Most of these photographs were taken by Mr. E. G. Carey, of the Engineers' Staff, but a number were taken by Mr. Philip Phillips, of the Contractors' Staff. Several illustrations (including Figs. 2, 3, and 4) have been reproduced from drawings which the Engineers and Contractors have kindly allowed us to copy.

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Industries' Forth Bridge Special



View of Bridge from South-West.

CONTENTS.

	PAGE
PREFACE	1
EARLY DESIGNS	3
INCEPTION OF THE PRESENT UNDERTAKING	3
THE CANTILEVER SYSTEM	3
ILLUSTRATIONS OF THE CANTILEVER SYSTEM	6
LEADING DIMENSIONS OF BRIDGE	6
COMMENCEMENT OF THE PRESENT UNDERTAKING	7
PROGRESS DURING 1883	7
PROGRESS DURING 1884	9
PROGRESS DURING 1885	11
LIFTING THE VIADUCT SPANS	13
THE CAISSONS	13
THE MASONRY OF THE BRIDGE	19
PROGRESS DURING 1886	19
THE SUPERSTRUCTURE	19
THE BED-PLATES AND SKEWBACKS	22
PLATFORMS FOR ERECTION	24
PROGRESS DURING 1887	26
ERECTION OF THE BOTTOM MEMBER	28
ERECTION OF LOWER PORTION OF BAY 1	28
THE RIVETING	29
THE RIVET FURNACES	29
PROGRESS DURING 1888	29
ERECTION OF TOP MEMBERS AND UPPER PORTIONS OF STRUTS AND TIES	30
ERECTION OF INTERNAL VIADUCT	30
PROGRESS DURING 1889	31
COMPLETION OF THE CANTILEVERS	31
THE CENTRAL GIRDERS	34
PLANT USED IN BUILDING THE BRIDGE	38
HYDRAULIC BENDING AND SETTING MACHINERY	38
PLANING MACHINERY	38
DRILLING MACHINERY	38
THE STEEL USED IN THE CONSTRUCTION	40
THE WIND PRESSURE ON THE BRIDGE	40
THE APPROACH RAILWAYS	41
SIR JOHN FOWLER	49
MR. BENJAMIN BAKER	49
MR. WILLIAM ARROL	50
THE LIGHTING OF THE WORKS	50
CONCLUSION	52

EARLY DESIGNS.

No novelty attaches to the idea of throwing a bridge across the Firth of Forth. As far back as the early part of the last century a proposal to construct a bridge carrying the main road to the North across the estuary was mooted; and again, at the commencement of the present century, an Edinburgh surveyor designed a suspension bridge on the same site, and with the same span, as the one whose successful completion marks so important an epoch in the annals of engineering. The drawings of this early proposal are still extant (See Figs. 2, 3, and 4), and show coaches and four being driven across the structure, whose total weight did not exceed 200 tons of iron!—the suspension parts being of wire ropes. The project fell into abeyance until about the year 1860, when the North British Railway Company experimented with the bed of the river opposite Charlestown. This point is some six miles west of the site of the present structure; and, though the Forth here widens out to some 2½ miles, the greater shallowness of the water compared with that between North and South Queensferry afforded grounds for hoping that a suitable route had been discovered. Four central spans, each 500ft., were proposed; the remaining ones being from 200ft. downwards. The sanction of Parliament was obtained, and land lines in connection were duly designed. The bed of the Forth proved, however, so unsuitable for founding piers—the soft soil being exceedingly unreliable and treacherous—that after a brief trial this route was definitively abandoned. A ferry scheme between Port Edgar and North Queensferry was next proposed, on much the same lines as that now plying between Granton and Burntisland further down the Forth. Details were even worked out, and the difficulty of transferring the trains to the boats, and again of disembarkation, was to be met by providing pontoons at the ends of the piers to rise and fall with the tide. This scheme, however, fell into abeyance. We now pass to Sir Thomas Bouch's proposed suspension bridge (See Figs. 5 and 6). This structure was to have occupied the exact site of the present one. Each large span was to have been 1,600ft. The main towers were designed to be 550ft. in height, and a clear headway of 150ft. at high water spring tides was provided for. In 1873 the Forth Bridge Railway Company was formed, and in the same year obtained the necessary legislative sanction for this structure, the estimate for which was placed at about £1,250,000. Although this type of bridge was not one generally considered applicable for the passage of railway trains, no positive objection was taken to it. The contract was let, workshops erected, brick yards laid out, and a commencement made. A small brick pier on the island of Inch Garvie in mid-channel, still standing, marks the inception of an undertaking destined so shortly to abandonment. How little thought Sir Thomas Bouch and the party accompanying him, that fresh breezy day, when they sailed from South Queensferry to Inch Garvie, and there laid the foundation stone of the projected work, that a terrible disaster was impending, which should cause the cessation of all their designs, and that finally the Forth Bridge should be accomplished on other lines and by other hands! Operations were suspended owing to the fall of the Tay Bridge during the destructive gale that raged in December, 1879; and an Abandonment Bill was consequently promoted in the Session of 1881.

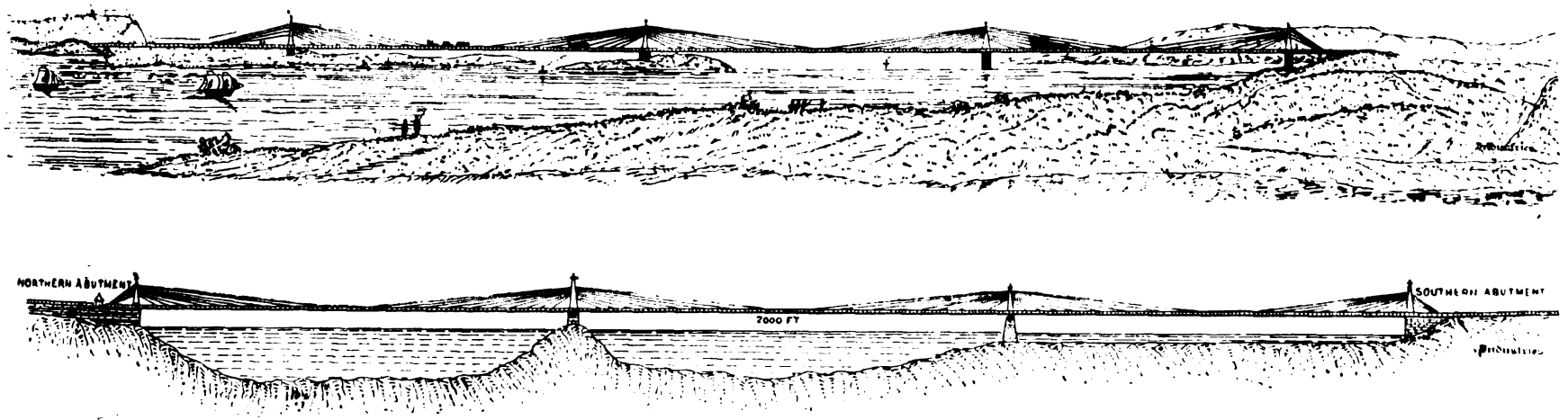
INCEPTION OF THE PRESENT UNDERTAKING.

At this stage the North British, Great Northern, North Eastern, and Midland Railway Companies, being interested in securing direct communication to the North of Scotland, which should enable them to compete with the West Coast Companies for traffic on equal, if not more favourable terms, and wishing to save an enterprise so advantageous, instructed their respective consulting engineers, Sir John (then Mr.) Fowler, Mr. Harrison (since deceased), and Mr. Barlow, to fully investigate and report on the whole undertaking. On the 4th May, 1881, the above-named engineers submitted their joint report, unanimously agreeing that the steel bridge (See Figs. 7, 8, and 9, subsequently adapted to Figs. 10 and 11) on the cantilever and central girder system, designed by Sir John Fowler and Mr. Benjamin Baker, was not only the least expensive, but the best suited for the situation. The Abandonment Bill, which had passed the House of Commons, was accordingly withdrawn, and in 1882, the necessary plans having been deposited, an Act was obtained authorising the construction of a continuous girder bridge across the Firth of Forth from North to South Queensferry, having two spans of 1,710ft., two of 675ft., fourteen of 168ft., and six of 50ft.; a clear headway of 150ft. at high water spring tides being allowed; the engineers for the work being Sir John Fowler, K.C.M.G., and Mr. Benjamin Baker.

THE CANTILEVER SYSTEM.

Pausing now to consider briefly the principle on which the bridge has been built, we are led to examine the word "cantilever"—a scientific term, now rapidly becoming popularised through its intimate connection with the Forth Bridge. A cantilever may be defined as a bracket, those composing the Forth Bridge being double brackets—*i.e.*, like two ordinary jib cranes placed back to back. The connection between the ends of each set of double brackets is made by a central girder. No novelty attaches to this principle; as a matter of fact, it is a pre-historic arrangement. In the earliest Egyptian and Indian temples will be found the stone corbel and lintel combination, which illustrate this mode of construction, whilst in the oldest, as also in the most modern, wooden bridges will be seen practically the same thing in timber. Skeleton bridges on the same principle have for ages past been thrown by savages across rivers, a very interesting example having been found on the route of the Canadian

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FIGS. 2 AND 3.—PERSPECTIVE VIEW AND LONGITUDINAL SECTION OF A DESIGN MADE EIGHTY YEARS AGO.

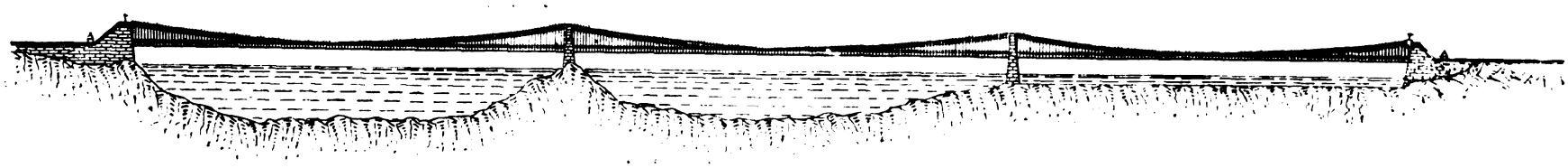
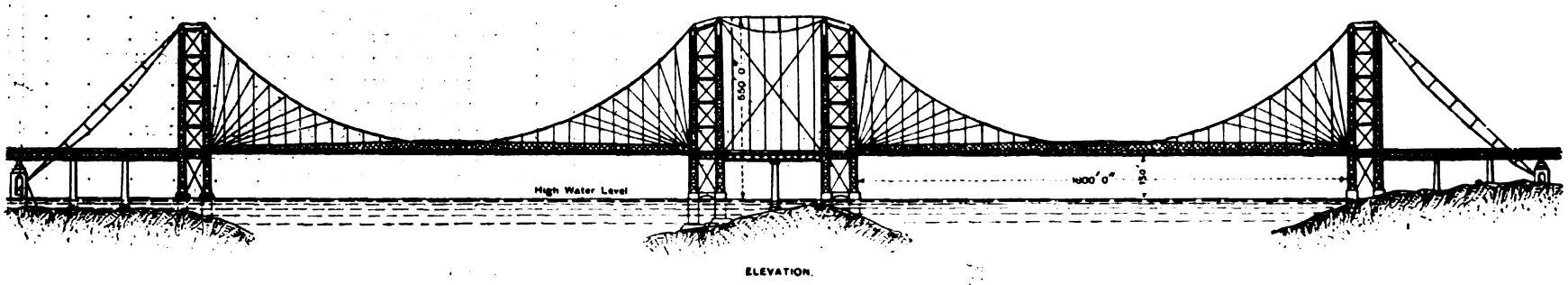
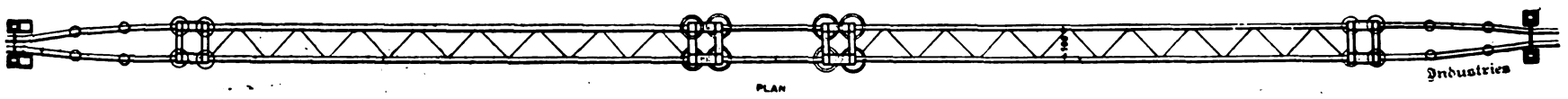
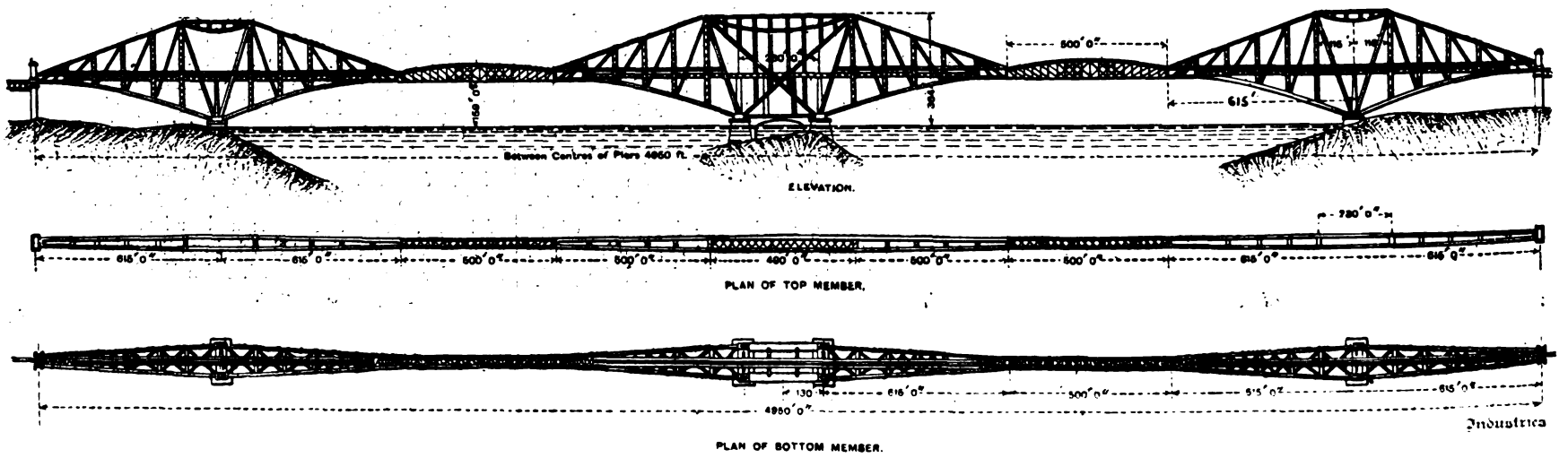


FIG. 4.—ALTERNATIVE DESIGN EIGHTY YEARS AGO. SEE PAGE 3.





FIGS. 5 AND 6.—SIR THOMAS BOUCH'S DESIGN. SEE PAGE 3.

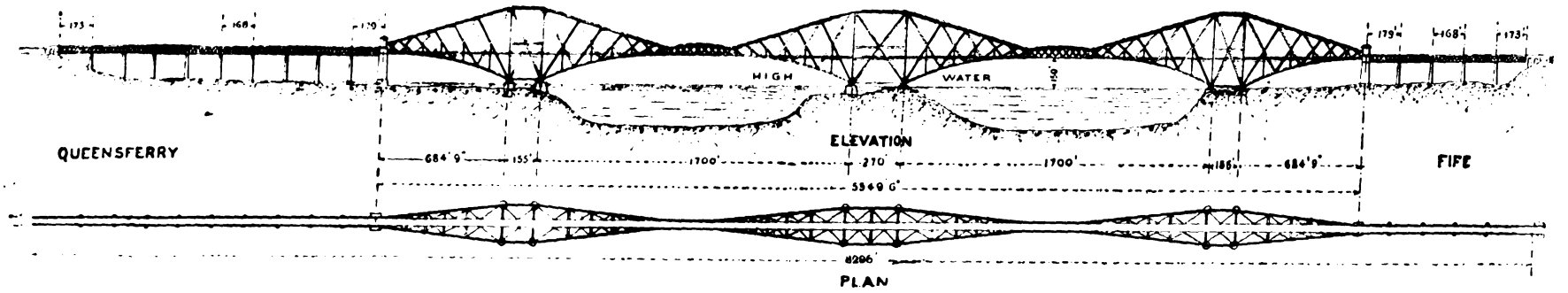


FIGS. 7, 8, AND 9.—PRELIMINARY DESIGN OF PRESENT STRUCTURE. SEE PAGE 3.

Pacific Railway. A bridge built in Thibet some 230 years ago forms another interesting illustration of the principle under discussion. Lieutenant Davis, R.N., who formed part of the embassy to the Court of the Teshoo Lama in Thibet, sketched this bridge in 1783, and published an illustrated account of it in London in 1800. The book was a popular one, and was translated and republished in German. It contains probably the first published description of a "cantilever and central girder" bridge. "The bridge of Wandipore is of singular lightness and beauty in appearance. The clear span measures 112ft.; it consists of three parts, two sides, and a centre, nearly equal to each other; the sides, having a considerable slope, raise the elevation of the centre platform, which is horizontal, some feet above the floor of the galleries. A quadruple row of timbers, their ends being set in the masonry of the bank and the pier, supports the sides; the centre part is laid from side to side." "Making allowance," says Mr. Baker, "for difference of material, this work may faintly be looked upon as the prototype of the Forth Bridge."

Passing on to more modern times, we find the cantilever and central girder system in constant application in designs by engineers. Thus, in 1850 Mr. Edwin Clark touched on the principle; Sir John Fowler, in 1845, experimented with a large wooden model; whilst Mr. Barton in 1855, Mr. Latham in 1858, and Professor Ritter, of Hanover, in 1862, all drew attention to the principle, and wrote concerning it. In 1859 Mr. W. H. Barlow, and again, in 1864, Mr. Sedley, took out patents in connection with bridges of this class; whilst a further patent in 1865 by Mr. E. W. Young had reference to the same subject. The Forth Bridge is by no means the first proposal of Sir John Fowler and Mr. Baker on the cantilever principle. In 1864 these engineers designed a proposed Severn Bridge on this system. The struc-

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FIGS. 10 AND 11.—DESIGN OF BRIDGE EVENTUALLY ADOPTED. SEE PAGES 3 AND 7.

ture was to be built in steel, a span of 1,000ft.—subsequently, however, reduced to 600ft.—being provided. The Act was obtained, and the contract duly let, when financial difficulties supervened, and the bridge fell into abeyance. Similarly in 1871, and again in 1873, they designed bridges on this system for crossing the Severn and the Tees respectively—the one to be 800ft. span, the other 650ft. span; whilst, in his well-known book, "Long-span Bridges," a work republished in Philadelphia, and translated into German and Dutch, and published in the *Transactions of the Austrian and Dutch Engineers*, Mr. Baker in 1867 enforced the economical advantages of the continuous girder of varying depths. In 1876 two of the designs for the proposed New York and Long Island Bridge—viz., those by the Delaware Bridge Company and by Colonel Flad—were on this system. In 1876 a railway bridge of 148ft. span, across the Warthen, near Posen, was erected on the cantilever and central girder principle. From the foregoing remarks it will be seen that no novel or untried principle is claimed in the construction of the Forth Bridge. Turning now to applications of the cantilever principle since the inception of the gigantic undertaking at Queensferry, we note the almost universal adoption of the system, a fact abundantly speaking for itself. On the Canadian Pacific Railway numerous bridges are designed on the cantilever principle. The cantilever bridge at Niagara Falls, designed by Mr. Charles C. Schneider, has a span of 470ft., and is composed of two cantilevers The central girder is 120ft. long, the shore ends of the cantilevers being held down by anchorage piers of masonry. Work was commenced at the site on April 15th, 1883, and the structure was opened for traffic on December 20th of the same year. This bridge, the total length of which from centre to centre of anchorage piers is 910ft. 3in., carries the Michigan Central Railway across the Niagara River, about two miles below the celebrated Falls, and about 300ft. above the Railroad Suspension Bridge. The steel cantilever railway bridge across the St. John's River, at St. John, province of New Brunswick, Canada, was completed in 1886:—Messrs. J. & T. Abbott being the engineers. The total length of the bridge is 813ft., the centre span being 477ft. The shore arms of the cantilevers are of unequal length, being 143ft. and 191ft. respectively. The centre span is 143ft. 6in. This work was carried out by the Dominion Bridge Company, Montreal.

The "Jubilee" Bridge, carrying the East Indian Railway across the River Hooghly, is another example of a cantilever bridge. The structure, which is built for a double line of railway (5ft. 6in. gauge), has a centre double cantilever 360ft. long, the two main side spans being each 420ft. long, giving a total length of 1,200ft. for the bridge. The total weight of steel employed is 3,900 tons. The greatest height of the cantilever is 52ft., the girders being 30ft. 8in. apart from centre to centre. The side spans are 47ft. deep in the middle, and the girders 30ft. 8in. apart from centre to centre. Work was commenced on the site in 1882–3, the actual bridge construction not being begun till March 2nd, 1884, when the first caisson was launched. The structure was completed in December, 1886. The total cost of the bridge, including the approach viaducts, was £261,000.

The bridge over the River Indus, at Sukkur, is another example of the cantilever type, and was designed since the commencement of the Forth Bridge. The Sukkur Bridge carries the N.W. State Railway of India over the Indus, which at that point is divided by the island of Bukkur into two channels. The Sukkur channel is crossed by three spans, 278ft., 238ft., and 95ft. respectively; whilst the second, or Rori channel, is cleared by one single cantilever span of 820ft. The maximum height of the bridge is 169ft., the central girder being 206ft. span. The circumstances of this channel—viz., a depth at low water of about 80ft., with a rise of 16ft., and a current in flood of some nine miles an hour—rendered desirable the adoption of cantilevers and the overhang method of building, with consequent dispensation of all staging. The bridge was completed in the middle of 1889. Sir A. M. Rendel was the engineer. A feature of interest was its erection in this country in 1886–7 at the works of the builders, Messrs. Westwood, Baillie, & Co., of Poplar, previous to being despatched. A huge temporary staging, employing some 2,300 loads of timber, was required for this purpose.

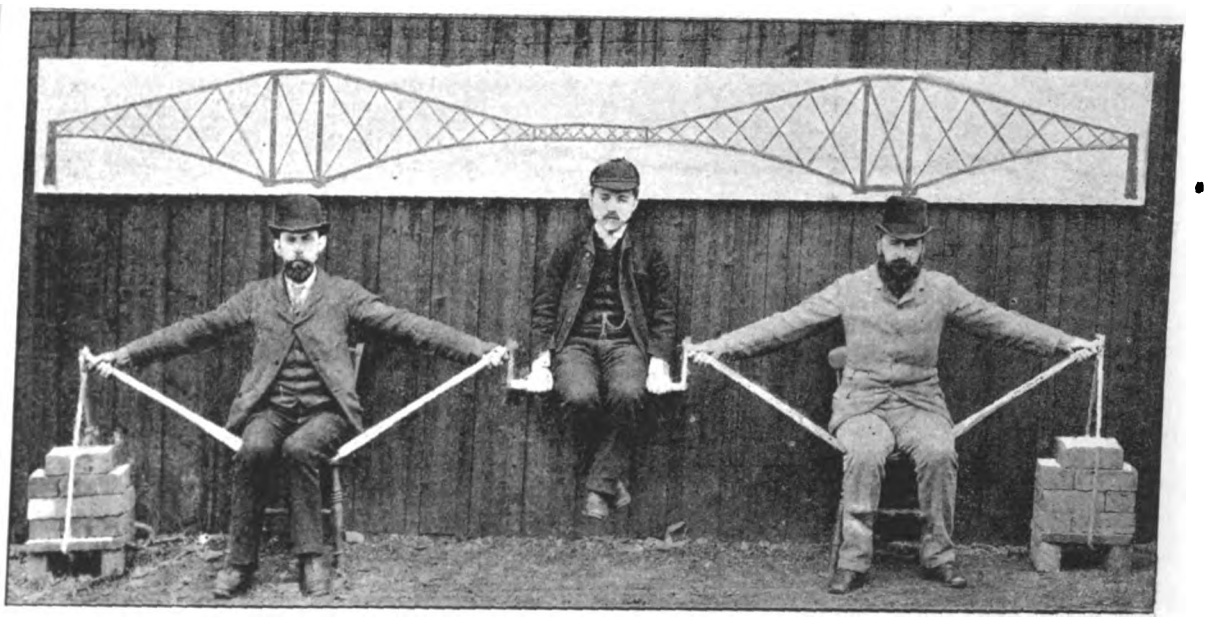


FIG. 12.—THE HUMAN CANTILEVER. SEE PAGE 6.

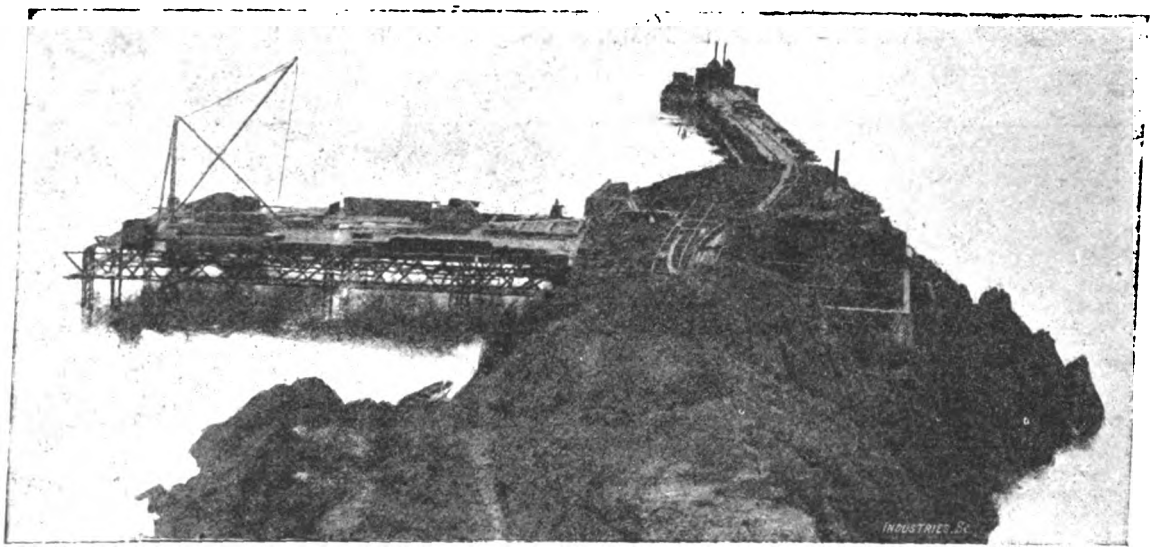


Fig. 13.—INCH GARVIE, JULY, 1883. SEE PAGE 8.

Passing on to proposed bridges in which it is intended to have recourse to the cantilever principle, we may briefly note the designs for a bridge at New York, with a span of 2,800 feet, by Mr. Lindenthal, with whom is associated in this enterprise Mr. B. Baker. The Channel Bridge, a stupendous undertaking recently mooted by Messrs. Schneider & Co., of Creusot, and M. H. Hersent, with Sir John Fowler, K.C.M.G., and Mr. B. Baker as consulting engineers, is designed with cantilever spans. This gigantic proposal to connect England and France by a bridge 24½ miles in length is estimated to require one million tons of steel, and to involve an expenditure exceeding £34,000,000. The main spans are 1,640ft. and 984ft., the lesser ones 830ft. and 328ft., a clear headway of 150ft. at high water being provided for. The piers, 120 in number, founded in a maximum depth of some 30 fathoms, present features of considerable difficulty. The project has been gone into with great consideration and elaboration, and

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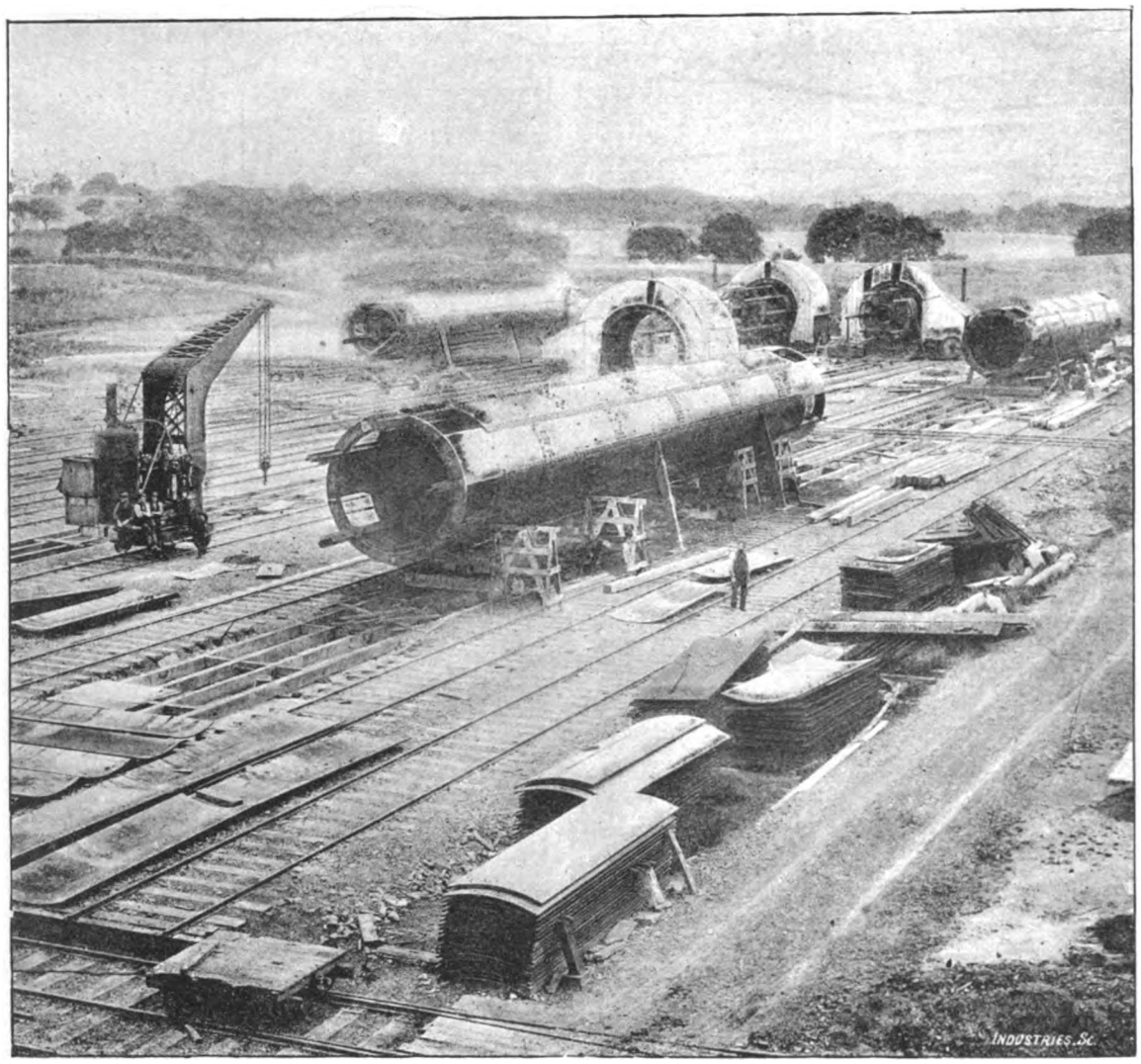


FIG. 14.—THE DRILL ROADS, AUGUST, 1884. SEE PAGE 8.

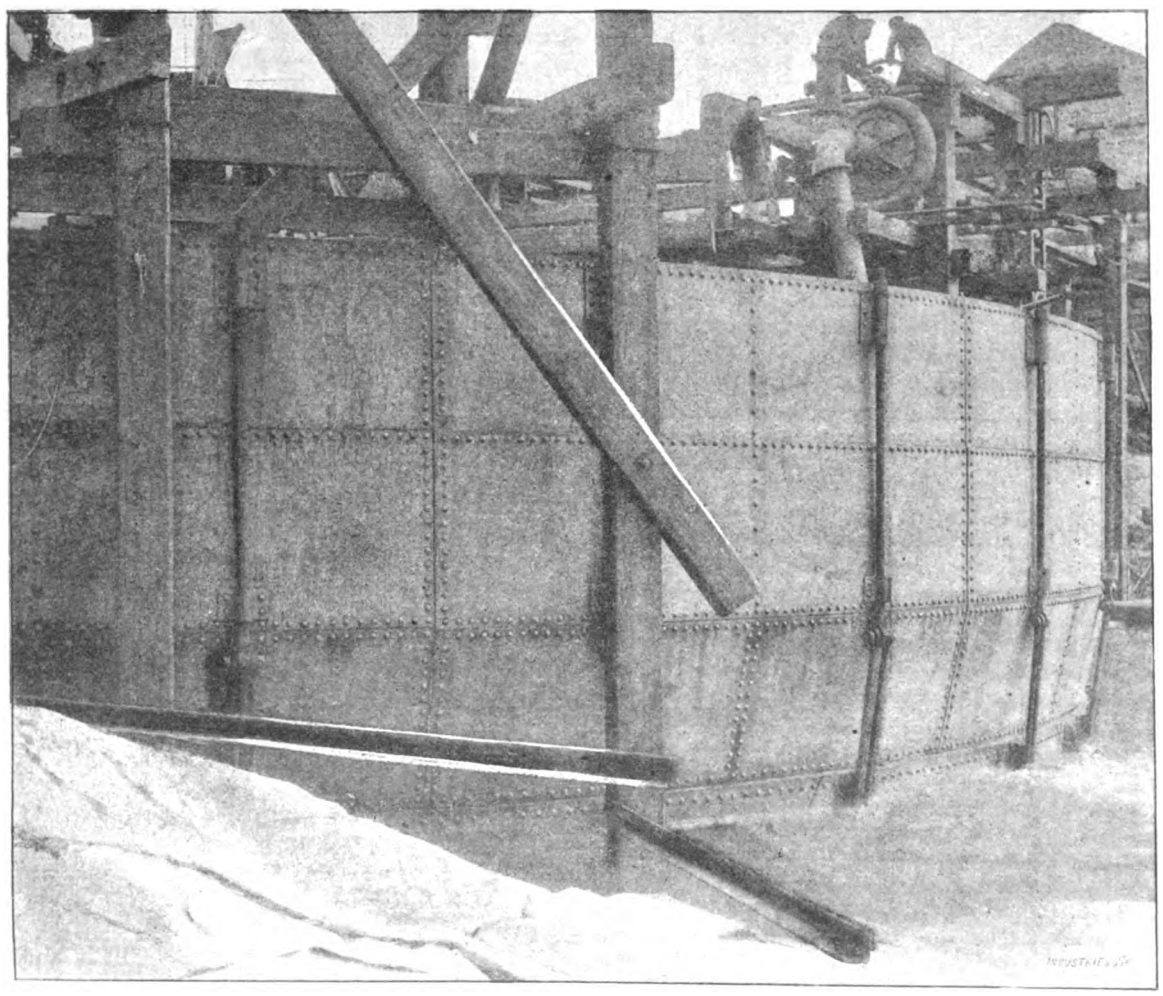


FIG. 15.—INCH GARVIE NORTH-EAST CAISSON AT LOW WATER, MARCH, 1884. SEE PAGE 9.

was prominently brought forward at the recent meeting of the Iron and Steel Institute in Paris.

ILLUSTRATIONS OF THE CANTILEVER PRINCIPLE.

"You, who have seen," remarked Mr. Baker in his lecture before the Literary Institute in Edinburgh in November last, "the three great steel piers spring out of the ground, and spread their branches right and left, will know that Nature has herself bridged many streams on the same principle that we have bridged the Forth. You have only to imagine two trees on opposite banks of a stream, and a third tree on an islet in the middle, extending their branches until they are mutually interlaced, and you have the natural cantilever bridge." What is known as the "Human Cantilever"—viz., a living representation of the principle introduced in the Forth Bridge—is now so fully popularised as to need but passing notice. The simile is best described by quoting Mr. Baker's own words. When lecturing before the Royal Institution, on May 20th, 1887, he first made his illustration of the living cantilever public, and said:—"Owing to the arched form of the underside of the bridge many persons hold the mistaken notion that the principle of construction is analogous to that of an arch. In preparing for this lecture the other day, I had to consider how best to make a general audience appreciate the true nature and direction of the stresses on the Forth Bridge, and, after consultation with some of our engineers on the spot, a living model of the structure was arranged as follows:—Two men, sitting on chairs, extended their arms, and supported the same by grasping sticks butting against the chairs. This represented the two double cantilevers. The central girder was represented by a short stick slung from one arm of each man, and the anchorages by ropes extending from the other arms to a couple of piles of bricks. When the stresses are brought on this system by a load on the central girder, the men's arms and the anchorage ropes come into tension, and the sticks and chair legs into compression. In the Forth Bridge you have to imagine the chairs placed a third of a mile apart, and the men's heads to be 360ft. from the ground Their arms are represented by huge steel lattice members, and the sticks or props by steel tubes 12ft. in diameter and 1¼in. thick." (See Fig. 12.) Further similes have been applied to the principle involved in the Forth Bridge. Two men, endeavouring to shake hands across a stream a little too wide, form a connection by grasping each end of a walking-stick. The men form the cantilever, the walking-stick the central girder.

LEADING DIMENSIONS OF THE BRIDGE.

The length of the structure is 8,296ft., or 376ft. over 1½ miles. The south abutment consists of four elliptical arches, each 57ft. span and 19ft. rise. It is built of rock-faced granite, with dressed granite parapet and strong corners, and carries the Forth Bridge Railway over the existing North British line. The viaduct spans, each 168ft. from centre to centre of piers, bring us to the south cantilever end pier. A side span of 675ft. carries the bridge to the Queensferry main piers, spaced 155ft. centres in the line of the structure and 120ft. centres apart at right angles to that line. The main span to Inch Garvie is 1,710ft., a similar distance separating the north shore from Inch Garvie—the spans over both north and south channels being identical. The Inch Garvie main piers are spaced 270ft. by 120ft. from centre to centre. The Fife main piers are spaced similarly to those at Queensferry. A half-span, corresponding to that on the south, brings us to the north cantilever end pier, and the bridge finishes in five viaduct spans similar to those already described, and three masonry arches of granite, 50ft. span. The clear headway under the centre of the bridge is 150ft. above high water, and the highest part of the bridge is 361ft. above the same datum. In the centre of each main span is a central girder of 350ft. span. From the base of the deepest pier to the top of the cantilevers the

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total height is 450ft. (See Figs. 10 and 11.) The ratio of the size of the Forth Bridge to that of the other largest railway bridges was shown by a simile of Mr. Baker's, in his paper before the British Association in 1882. This now famous comparison took a powerful hold on the popular imagination, and it is not too much to say that scarcely a popular article relating to the bridge has since appeared in which some reference is not made to Mr. Baker's happy illustration of the magnitude of the giant structure. We append the words he then used:—"On glancing through the last volume of 'Reports of the British Association,' with a view to obtain a notion as to the ordinary length of papers in Section G, I incidentally obtained a notion also for illustrating in popular, but perfectly accurate, terms the size of the Forth Bridge as compared with the largest bridge in this country. In the report of the Anthropometric Committee it was stated that the average stature of a new-born infant is 19·34in., whilst the average height of the Guardsmen sent out to Egypt has been officially given at 5ft. 10½in. The figures have a ratio of 1 to 3·65; and, singularly enough, as the largest railway bridge in this country, the Britannia Bridge, has a span of 465ft., and the Forth Bridge a span of 1,710ft., the ratio there also is 1 to 3·65. Hence, to enable any one to appreciate the size of the Forth Bridge, we have merely to suggest the following simple rule-of-three sum:—As a Grenadier Guardsman is to a new-born infant, so is the Forth Bridge to the largest railway bridge yet built in this country. Bridges a few feet larger in span than the Britannia have been built elsewhere, but they are baby bridges after all."

COMMENCEMENT OF THE PRESENT UNDERTAKING.

In the autumn of 1882 tenders were invited for the Forth Bridge, and from the applications sent in two were selected, and on December 21st, 1882, the contract with the combined firm of Messrs. Tancred, Arrol, & Co., was signed, the members of this firm being Sir Thomas Selby Tancred, Bart., Mr. William Arrol, Mr. Travers Hartley Falkiner, and Mr. Joseph Phillips.

The Forth Bridge Railway Company, though supported by four leading railway companies, is a separate undertaking. The shares possess an absolute and perpetual guarantee of 4 per cent. per annum, as from July 1st, 1882, by the Midland, Great Northern, North Eastern, and North British companies, and debenture stock interest is also guaranteed by the same companies, the payments under the guarantee, if any, to be made in the following proportions:—Midland, 32½ per cent.; Great Northern, 18¾ per cent.; North Eastern, 18¾ per cent.; and North British, 30 per cent. After payment to the several companies of the amounts advanced under their guarantees, all surplus revenue is to go to the North British Company. The directors of the company at the present time are Lord Colville, K.T., and Lord Hindlip, representing the Great Northern Railway; Mr. J. D. Dent and Sir Matthew White Ridley, Bart., representing the North Eastern Company; Mr. W. U. Heygate and Mr. M. W. Thompson, representing the Midland Company; the Marquis of Tweeddale and Lord Elgin, representing the North British Railway Company; and Mr. S. Brunton and Mr. J. H. Renton, appointed by the shareholders—Mr. G. B. Wieland being secretary. Owing to the absence of Lord Hindlip Mr. F. W. Fison occupies his seat on the board.

PROGRESS DURING 1883.

Active operations were commenced on the site early in this year. The first thing to be done was the setting out of the centre line, and subsequent determination of the positions of the piers on the ground. A special observatory was erected at Port Edgar, to the west of the bridge, and, by means of a 12in. theodolite and standard measuring rods, 12ft. in length, the utmost accuracy was sought. We do not propose, in the limits of this account, to enter into any minute details of the setting out, a work of no small anxiety, when the responsibility thereby entailed is considered, and of no slight difficulty in a locality rugged and precipitous, and with all the accompanying hindrances of exposure to weather on the banks of a Firth notoriously squally, and frequently so hazy that the best instruments procurable would fail to detect marks and posts painted as conspicuously as possible at only a few yards distance. Every device in the shape of shelters, wind screens, and heavily loaded plumb-lines was adopted to avoid delay in windy weather.

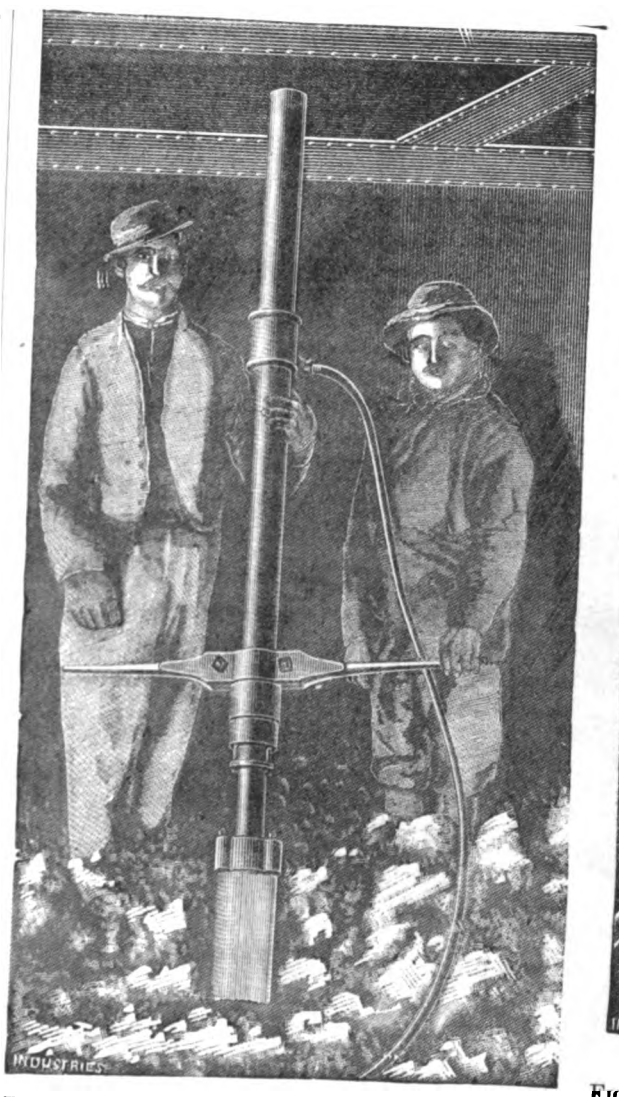


FIG. 16.—HYDRAULIC DIGGER. SEE PAGES 10, 15, 19.



FIG. 17.—ROCK DRILL USED FOR THE FOUNDATIONS OF THE PIERS. SEE PAGES 15, 18, AND 19.

SETTING OUT.—The following interesting account of the setting out, and the method adopted of finally checking by direct measurement the results arrived at by triangulation, appeared in the *Times* newspaper of October 10th, 1883:—

"To fix the position of the piers of a bridge, having two clear spans of 1,700ft., and two of 700ft., across a channel 200ft. in depth, is not so simple a problem as may appear to some persons. In the case of the Forth, the banks are more or less precipitous and the country undulating, so that it was difficult to get a base line for a trigonometrical measurement. At the request of Mr. Fowler, the Ordnance Department kindly sent a party of sappers to recover the old stations used in the Ordnance Survey of Scotland, and to take the necessary additional observations to determine the width across the Firth of Forth. The calculated result differed about 1ft. from that obtained by Messrs. Fowler and Baker's engineers, which is not much, perhaps, in a difficult measurement of over a mile across deep water, but enough to make it desirable that it should be set right. Mr. Baker held the view that it was possible to measure the 1,700ft. span to the eighth of an inch if necessary, and last week the measurement was made without any difficulty whatever. A length of 1,700ft. was first measured, with what may be termed absolute exactitude, along a straight piece of the North British Railway, and posts of a certain height were firmly fixed at each end. A steel pianoforte wire was then hung from these posts, with a sag or droop of 24ft. at the centre, and marks were fixed at each end of the wire to indicate the 1,700ft. length. The wire was then coiled on a roller and taken on board a steam launch, from which it was laid, like a submarine telegraph cable, across the channel of the Forth. It was then hauled up above the surface of the water, till it hung with the original droop of 24ft., when, assuming the temperature to be the same, the marks put on the pianoforte wire should indicate the required span of 1,700ft. This process was repeated several times, and the wire taken ashore to the railway, to test whether it had stretched, but all the observations were in exact accord. The sensitiveness of this simple mode of measuring the span with a wire weighing only 8lb. in all was quite astonishing. Thus, when Mr. Baker slacked out the wire only ¼in. in the 1,700ft., Sir Thomas Tancred, one of the contractors, who was in a boat in the centre of the Forth, at once signalled there was too much droop in the wire. At another time he signalled that it was too high, but a reference to the thermometer showed that the temperature had fallen two degrees, so that the wire proved itself a most delicate indicator of changes of temperature. The officers and crew of Her Majesty's ship 'Lord Warden,' the ironclad guardship anchored immediately above the site of the bridge, have always taken much interest in the works, and while the measurement was being made they very kindly manned their boats and regulated the traffic past the spot. Engineers and contractors engaged in carrying out a giant bridge across a stormy estuary, and reaching to a height twice as great as that of the topgallant masts of the 'Lord Warden,' could desire no better neighbours than Captain Kennedy and his well-disciplined and willing crew of 300 bluejackets."

The base line, measured along a straight siding connecting the Forth Bridge works with South Queensferry Station, had a total length of 4,013·2ft. The triangulation was then proceeded with by means of a 7in. theodolite made by Messrs. Negretti & Zambra, a 12in. transit theodolite, divided to 10 seconds, by Messrs. Cooke & Sons, of York, being

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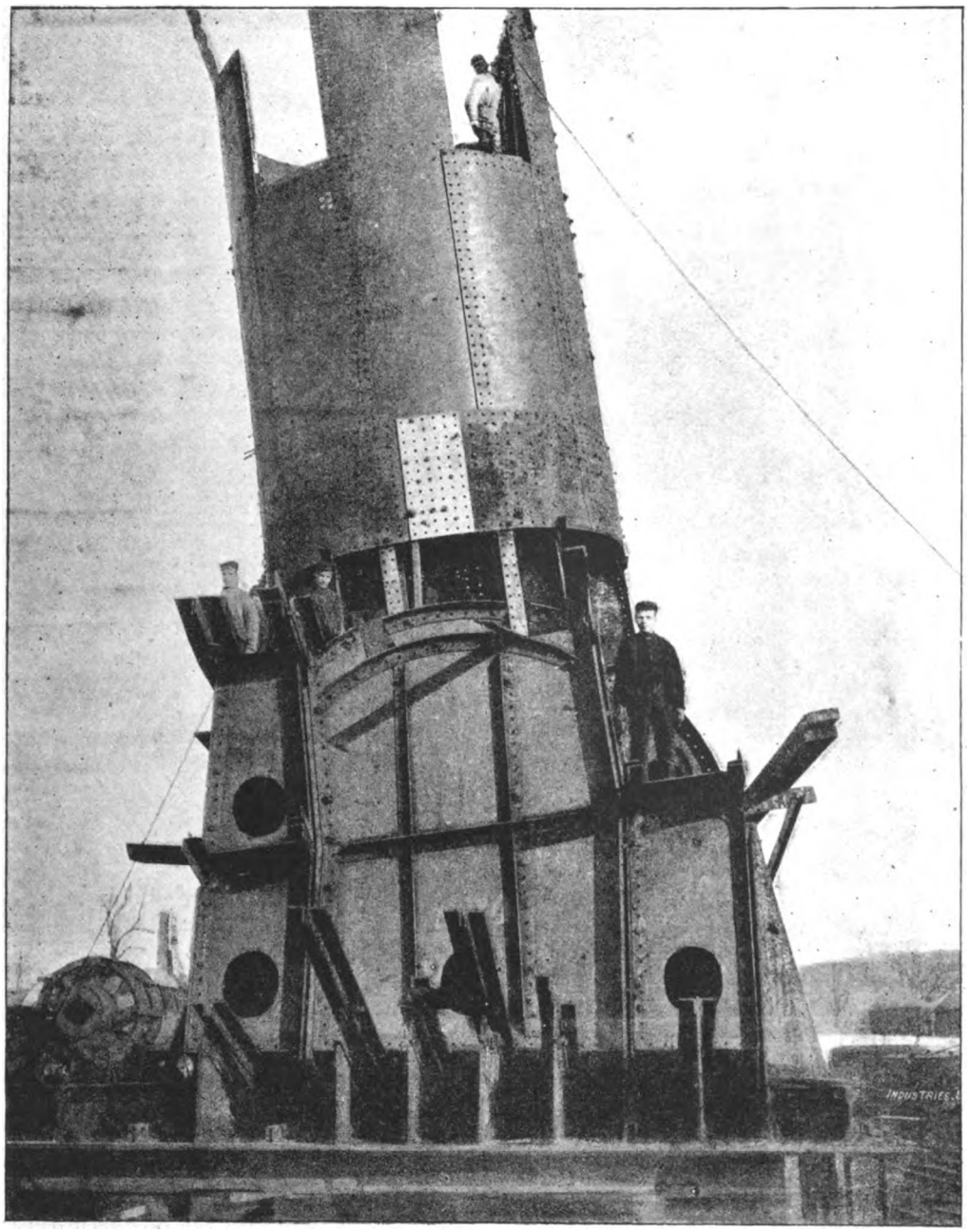


FIG. 18.—ONE OF THE SKEWBACKS, FEBRUARY, 1885. SEE PAGES 11, 13, AND 22.

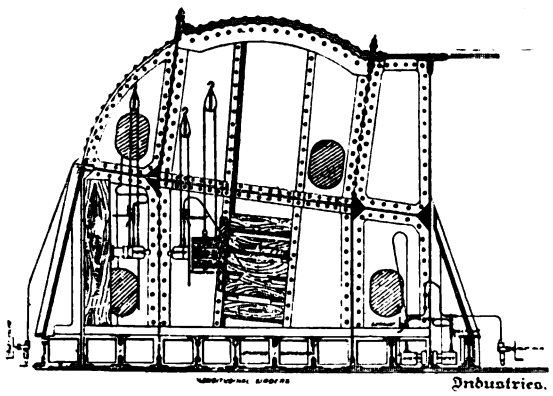


FIG. 19.—SECTION OF SKEWBACK. SEE PAGES 11, 13, 22, AND 24.

subsequently procured and used for the work. The 12ft. standard rods already referred to were of white pine, and 3in. square, the ends being of brass for 6in., with steel faces cast in. One end was rounded, the other forming an obtuse angle; both ends had screws for adjustment, and the latter one also a hardwood wedge, held in position by a split pin. The stations were marked by white poles, with three or four black rings some 2in. deep painted on each, such arrangement being found to be most easily distinguished. A 20in. reversible level, tripod type, by Messrs. Cooke & Sons, York, was employed for the main levels. With this instrument placed on the island of Inch Garvie, levels on the south or north shore, at some 2,000ft. distance, could be read with accuracy. It may be here noted that the principal theodolites and levels had cross-lines scored on glass diaphragms, an arrangement which showed them sharp and clear, with the further additional important advantage of being comparatively practically indestructible. The greatest nicety being required, copper bolts, with centre punched marks, were employed as bench marks, in lieu of the ordinary crosses or arrows cut on stone or baulks of timber. The usual steel bands and steel tapes were employed, care being taken to allow for changes of temperature, &c.

TEMPORARY WORKS, 1883.—Passing on to consider the temporary works erected during the first year of active operations on the south shore, the sheds which were erected when Sir Thomas Bouch's scheme was commenced, and had remained since the abandonment of that project untouched, were forthwith overhauled, and prepared for the reception of further machinery, an additional shed being added at a slightly higher elevation to the south. Twenty acres of ground around these sheds at the summit on the Hawes Brae, and to the south of the road leading from South Queensferry to Edinburgh, were enclosed, and substantial brick offices for the engineers and contractors' staffs were forthwith erected on this site. The equipment of the workshops was at once commenced, and gas furnaces, engines, and a large hydraulic accumulator, capable of working the whole of the hydraulic cranes, bending presses, &c., at a pressure of 1,000lb. to the square inch, were put in hand. Before the close of the year numerous hydraulic cranes, several drilling machines (See Figs. 101–107, &c.), the hydraulic bending machine (See Figs. 94 and 95), and two large travelling cranes, in addition to a large quantity of other plant, were in operation. The drill roads (See Fig. 14), on which the skewbacks were subsequently fitted and the tubes drilled, were laid down, and the temporary wooden jetty, on the east of the bridge, was built for some 1,800ft. from the south side, and the spurs to the viaduct piers added. An inclined plane of timber, connecting the jetty with the workshops above, was also completed in this year. Numerous cement stores, general stores, cottages for workmen, a large canteen and reading-room were also built, and the nucleus of the large fleet of steam barges, tugs, and launches subsequently employed was formed. On Inch Garvie (See Fig. 13) a large wrought iron landing-stage was erected, and a viaduct of the same material, connecting the island with a detached rock, Craig Sparry, to the west, completed. Air compressers were erected, and hydraulic accumulator plant was also laid down. On the north shore the temporary works erected during 1883 comprised two timber landing-stages, numerous cottages, workshops, and stores. Air-compressing machinery was also laid down, to work the drills employed in clearing away the rock for the foundations of the main piers.

COMMENCEMENT OF PERMANENT WORK.—Turning now to the permanent work executed in this year, and examining that carried out on the south shore first, good progress was made with the viaduct piers. Nos. 1 to 6 inclusive were successfully founded, and the masonry carried up to heights ranging from 2ft. to 32ft. above foundation. A commencement was made with the cofferdam of No. 7, and that for the south cantilever pier was in hand. The foundation of No. 1 viaduct pier was on boulder clay and above high water mark. No. 2, also above high water, was on hard freestone. Nos. 3, 4, and 5, also on hard freestone, were between high and low water, and were performed by tidal work; whilst Nos. 6 and 7 were founded in timber cofferdams of the usual construction. The viaduct piers were 25ft. by 8ft. at the top, and 50ft. by 20ft. at the base. The batter was 1 in 32, with a radius of curvature of 320ft. "The masonry of the viaduct piers and cantilever end piers consists of an Aberdeen granite facing, averaging a little over 2ft. in thickness, of rock-faced work, backed up with cement concrete or with rubble masonry set in cement, and bonded, about every 12ft. in height, with courses of large stones carried across the entire area of the piers." The first of the Queensferry caissons was commenced this year, being built up on the beach at South Queensferry, a little to the east of the bridge, on launchways. At Inch Garvie the excavation of the rock for the foundations for the north-west and north-east piers was commenced, and by the end of the year that for the latter was completed and progress with the caissons well advanced.

On the north side all four main piers were in hand before the close of 1883. The south-west pier was well advanced, and nearly ready for the caisson. A large amount of excavation had been done on the south-east, whilst a commencement had been made with the north-east. The north-west pier, situated above high water mark, was well advanced this year, the masonry being begun; the first wrought iron bond belt, 18in. deep by $\frac{3}{4}$in. thick, riveted up in position; and the 48 holding-down bolts, $2\frac{1}{2}$in. diameter and 24ft. long, being fixed in position and partially built in. The holding-down bolts are of steel, and fasten the bed-plates and superstructure of the main span to the piers. A cast iron anchor plate is placed at the root of each bolt. Progress was also made with the north cantilever pier, and the north approach viaduct piers and the north abutment.

The former, founded on whinstone rock benched out had been built by the end of this year some 16ft. above foundations, whilst the four viaduct piers had all been founded on whinstone rock, and the masonry carried up to heights ranging from 8ft. to 34ft. above foundation level—viz., to the same level above O.D.—and the height at which the viaduct girders were to be built on them preparatory

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to the "lift and build" process by which they were elevated to their final position, the piers being built up under them as they rose.

During this year the whole of the holding-down bolts (576 in number) were delivered at South Queensferry. These bolts were made at Landore, in Wales, and had a tenile strength of 30 tons per square inch, with an elongation of 20 per cent. in a length of 8in. The whole of the screwing was done on them in a special screw-cutting machine at the bridge works. Upwards of 1,000 tons of steel plates and bars were delivered up to the end of the year under consideration at South Queensferry, and a commencement made with the construction of the internal tees and angles in the large tubes. The bed-plates for the North Queensferry north-west main pier were also delivered, and planed. Some 70,000 cubic feet of granite were delivered, of which 38,000 cubic feet were set, and about 5,000 cubic yards of concrete were put down during this year.

PROGRESS DURING 1884.

The temporary work executed during this year at South Queensferry comprised the completion of the timber jetty, 2,200ft. in length by 50ft. wide, and fixed about 7ft. above high water; the erection at the head of this staging of three powerful air-compressers, with engines and boilers, for supplying air to the four Queensferry caissons; and the construction of about half of the staging between the south viaduct piers, on which the viaduct spans were subsequently to be built, previous to the commencement of lifting operations. The question of water supply was carefully considered during this year, and before its close storage reservoirs, one at the Dalmeny Oil Works, and the other on a piece of rising ground to the south of the drill roads, were in operation. Amongst a large amount of plant added to the workshops may be more especially mentioned two machines for cutting the key-holes in the bed-plates; also a special tool for riveting them by hydraulic pressure; whilst a third seven-ton travelling crane was added to the drill roads. Additions were made both to No. 1 and No. 2 workshops, and the drill roads were likewise added to; besides an immense amount of other necessary temporary work imperative for the execution of so vast an undertaking.

On Inch Garvie progress with the wrought iron staging on the south-east portion of the island was steadily continued during this year, and additions to the main landing platforms were also carried out. The old castle on the summit of the rock was roofed in and modernised, affording accommodation for the workmen. Various minor shops, sheds, and smithies were also erected.

On the north side a landing stage was made at Carlinose, and those portions of the old coastguard station which were left standing were adopted for offices and dwelling-houses. The new coastguard station on the cliff above the former one was erected, as its predecessor stood on the centre line of the bridge, and on the spot now occupied by the Fife north main piers. Numerous minor sheds, &c., were erected on the north side during this year, and stone-crushing machinery to prepare material for concrete was set to work at Carlinose.

Passing on to the permanent work executed during this year, and commencing as usual at the southern side, and with the viaduct piers, the cofferdam for the last viaduct pier (No. 9) was completed by the end of the year, and the remaining piers carried up to the final level of the first stage—27·00 O.D.—viz., the height at which the viaduct spans were erected on them previous to the commencement of lifting.

A commencement with the erection of the viaduct span was made in the autumn of this year, staging for the erection of the five southernmost spans between pier and pier at level 27·00 O.D. having been previously fixed. The viaduct girders, it may here be explained, were 168ft. spans centre to centre of piers. The girders, which were continuous over two spans, have a depth of 22ft. 6in., and are 16ft. apart from centre to centre. They are of the lattice type, the permanent way being laid on the top. The weight of each span is about 200 tons, and the camber given was 1½in. The troughs for permanent way, floor plates, and wind fence are identical with those for the internal viaduct subsequently described.

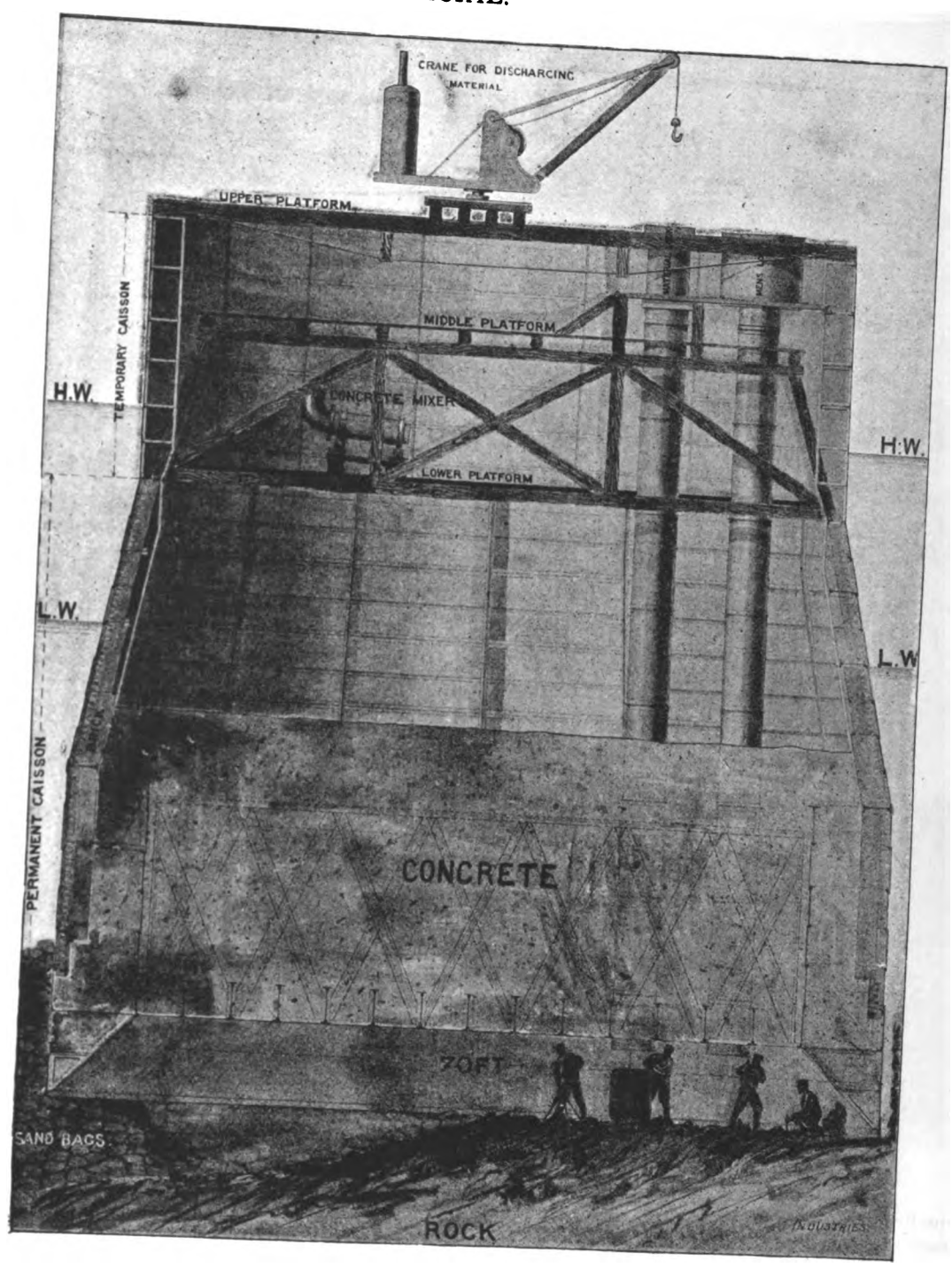


FIG. 20.—INCH GARVIE DEEP CAISSON, 1885. SEE PAGES 13, 15, AND 18.

The steel used throughout in the viaduct spans is mild steel, having a tensile strength of 30 to 33 tons per square inch, with an elongation in 8in. of 20 per cent., the customary requirements as to bend-tests being fulfilled. It is interesting to note that, originally designed for iron, they were constructed of steel to amended drawings, at the request of the contractors, with a view to economy.

Leaving now the south cantilever end pier, the cofferdam, begun in 1883, was completed during 1884. It "was necessarily a very substantial structure, being a quarter of a mile from the shore. It measured 126ft. by 75ft. over all, and had a double row of whole timber piles, with 4ft. of puddle between, and internal struts, chain cable ties, and external raking struts, and piles of great solidity and strength. A highly satisfactory bottom on boulder clay of rock-like hardness was found at a depth of 35ft. below high water." The cofferdam was very successfully constructed, being absolutely dry. The masonry was raised to the coping during this year.

At Inch Garvie the north-east main pier (See Fig. 15) was successfully founded, and the masonry completed. This pier was founded by means of a half-tide cofferdam of wrought iron segments, well shown in the illustration, a good deal of tidal work having to be done on this pier, as well as on the north-west one, before the cofferdams could be placed in position. In his paper, before the British Association at Montreal, in 1884, Mr. Baker thus alludes to this work:—

"At Inch Garvie delay and trouble were experienced in carrying out the shallow piers. Some of the work could only proceed at low water of spring tides, and it generally happened to blow hard just at that long-waited-for moment. Tidal work, and even half-tide work, are proverbially slow and worrying; but we were all determined that, as the rock varied in quality, no foundation should be put in until the bottom had been laid dry. By perseverance and patience this has hitherto been accomplished, and we have the satisfaction of knowing that both the rock foundation and masonry are unexceptionable in strength and solidity. In our shallow rock foundations at the Forth we had much the same problem to deal with as Stephenson encountered thirty years ago when building the fine bridge across the St Lawrence at this city, and our contractors dealt with it in much the same way."

The foundations of all four main piers on Inch Garvie are on whinstone rock. The main piers themselves, the first of which, on Inch Garvie, was completed this year, are thus described by Mr. Baker in his paper just quoted, and as the account is

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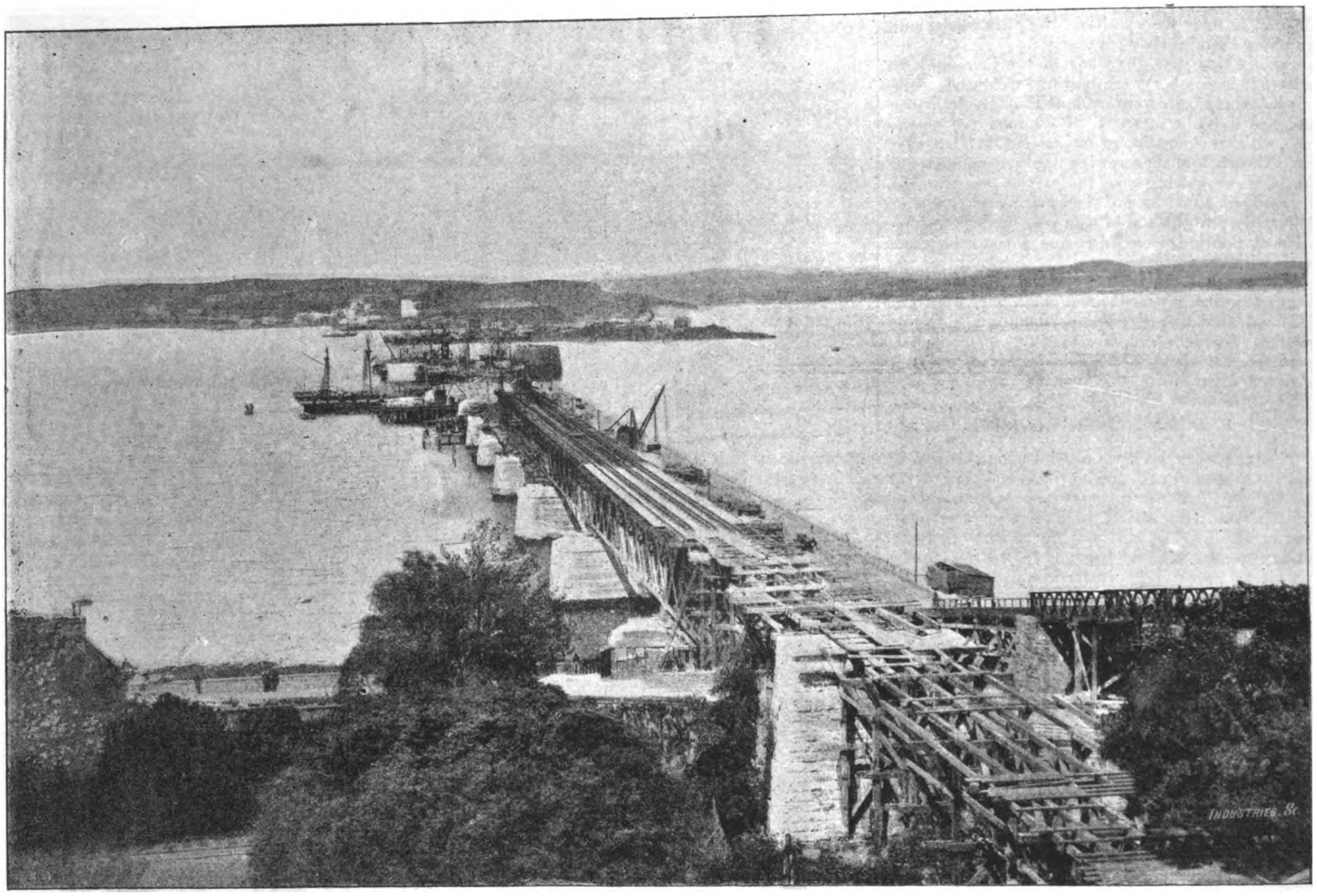


FIG. 21.—VIEW FROM SOUTH SHORE LOOKING NORTH, JUNE 9TH, 1885. SEE PAGE 13.

equally applicable to all the main piers it is now given *in extenso*:—"Above low water, the cylindrical piers, which are 49ft. in diameter at the top, 55ft. at the bottom, and 36ft. high, consist of the strongest masonry, the hearting being flat-bedded Arbroath stone, with both horizontal and vertical bond, and the facing Aberdeen granite, the whole set in two to one cement mortar, and built in the dry, within temporary wrought iron caissons. In the shallow piers, where the rock is stepped, the masonry is carried down to the rock itself, and wrought iron hoops, 36in. by 1¼in., bind the bases of the piers. At the top of all the piers, 18in. by 1½in. hoops, and midway down 18in. by ¾in. hoops, are also built in, and it is believed that these cylindrical masses of masonry are as completely monolithic as can be attained or desired. In each cylindrical pier there are 48 steel bolts, 2½in. in diameter and 24ft. long, to hold down the bed-plates and superstructure of the main spans."

The half-tide caisson for the north-west pier on Inch Garvie was successfully fixed in 1884, and pumped on for the first time in October of that year, and before the close of the year the masonry foundations were well advanced.

On the north side during this year progress had been made with the main piers, the south-west, north-east, and north-west being completed so far as the masonry was concerned, whilst the lower bed-plates of the two latter piers were riveted. Timber staging was erected between the north viaduct piers, and three spans were partially erected before the close of the year, at the level from which lifting commenced.

During 1884 the caissons both for the Queensferry and Inch Garvie piers were pressed forward. The whole of the Queensferry caissons were launched this year, and towed into position, their respective progress being as follows:—The south-west caisson had been sunk to its final depth —62·00 O.D.—through boulder clay, with a bed of mud overlying. This boulder clay, which afforded an excellent foundation, was of so hard a nature that special appliances were devised for dealing with it in the shape of hydraulic spades, the following account of which is taken from Mr. Andrew S. Biggart's paper, read in 1885 before the Institution of Engineers and Shipbuilders in Scotland:—

"Mr. Arrol visited the air-chamber, to see what could be done to hasten the work, and one result was his invention of a hydraulic spade. It consists of a wrought iron cylinder, having a brass casting screwed on to the one end through a stuffing box, on which the shaft of the spade passes, while to the other end is similarly fixed a cap capable of having screwed into it short wrought iron pipes, to vary the length of the spade as required. The spade proper is forged on one end of the shaft or piston rod, while to the other the piston, with the necessary cap leather, is securely fixed. A cock is screwed into the lower casting, communicating with both ends of the cylinder, and to it high pressure water is led through a small flexible hose. Another hose is employed to carry off the exhaust water. When working each spade is served by three men, and the action required is very similar to that in the ordinary hand tool of that name. A working face about 15in. deep is necessary, above which two men (one on either side of the spade) stand, while a third man is stationed immediately behind. (See Fig. 16; also *Industries*, Vol. IV., page 400.) The two men lift the whole machine by a cross-handle, and place the point of the spade on the ground a few inches behind the working face. The third man now opens the cock, and this allows the water to enter the top, which causes an upward movement of the cylinder, until the pipe screwed into the upper end bears against the roof of the chamber and that immediately over a rivet head to prevent it from slipping. The upward movement of the cylinder being thus effectually arrested, the spade is forced into the ground till the piston reaches the end of its stroke, and then, upon reversing the cock, the cylinder falls and sets free its upper end. The clay in front of the spade, being loosened, is finally brought away by the men taking advantage of the leverage of the cylinder which pushes the material off before the spade. What with difficulty was before taken away in pieces about the size of one's hand, was by this spade dug out in lumps so large that they had usually to be re-cut before they could with ease be lifted into the buckets. The whole of the ground within the chamber was accessible to the spade, even to that portion underneath the sloping part of the shoe of the caisson, where it was often held to its work at an angle of about 60 degrees."

Returning to the progress made in 1884 with the Queensferry caissons, by the close of that year that on the south-east was being sunk through the upper layer of mud over the boulder clay, being loaded with some 3,600 tons of concrete. The north-east pier caisson had been successfully launched and towed out to its permanent site, 3,400 tons of concrete having being filled into it, whilst the fourth and last caisson for Queensferry—viz., the north-west—was launched and towed into position.

Progress in the workshops had been steadily maintained during this year, some 5,000 tons of plates and bars having been delivered, of which about 2,000 had been duly manipulated and were ready for erection. The Fife bed-plates, both upper and lower, were finished, and those for Queensferry

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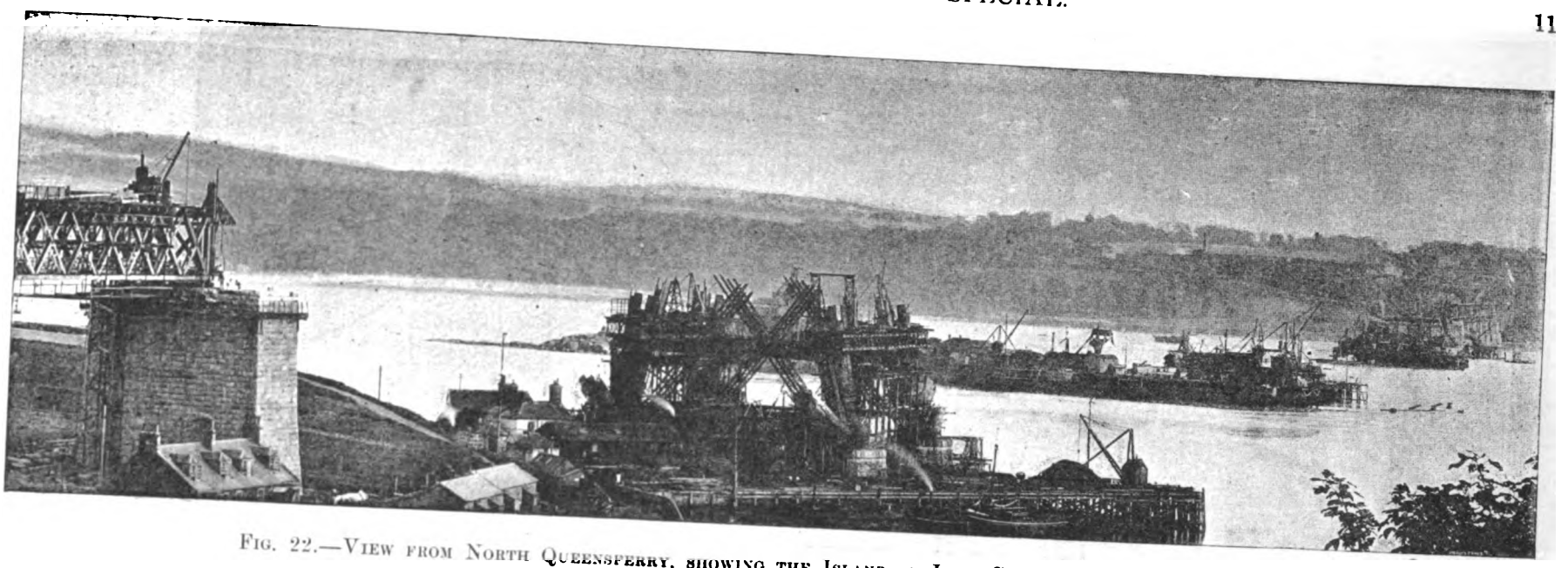


FIG. 22.—VIEW FROM NORTH QUEENSFERRY, SHOWING THE ISLAND OF INCH GARVIE, 1886. SEE PAGE 22.



FIG. 23.—VIEW OF THE WORKS FROM SOUTH QUEENSFERRY, 1886. SEE PAGE 22.

were in hand. A commencement had also been made with the skewbacks (of which more hereafter). (Figs. 18 and 19.) Over 200,000 cubic feet of granite were delivered up to the close of 1884, of which about 150,000 cubic feet were set, whilst some 32,000 cubic yards of concrete and masonry, requiring 8,500 tons of cement, were built. The number of men employed on the undertaking at the close of this year was about 1,900.

PROGRESS DURING 1885.

The close of the year 1885 may be said to finish what may be called the "foundations" or first period of the bridge, the succeeding years, 1886–9, being principally devoted to steel work and erection. The construction of the bridge thus naturally divides itself into two epochs, and we propose at the close of our description of progress in this year (1885) to devote some attention to a general account of the caissons and compressed air work, and generally to conclude our remarks on the first period, in addition to those made in sketching out the progress made year by year, before passing to the second and final part of our description.

Proceeding with the temporary works executed in 1885, and commencing as usual at the south shore, a large additional portion of land was acquired for erecting yards, storing purposes, &c., to the west of the existing shops, and two temporary bridges were thrown across the North British Railway to form connections with the rest of the works. Much interest on the part of visitors attached to these small temporary bridges, on account of the girders being from a portion of the old Tay Bridge. Further additions and extensions were also made in this year to the offices and drill roads, whilst a new drawing loft was erected, and the equipment of plant for dealing with the steel work was largely augmented.

At Inch Garvie further progress was made with the iron staging around the sites of the southern caissons, and additional hydraulic plant was laid down.

On the north shore operations as regards temporary plant were chiefly confined to the erection of timber staging between the main piers, for the subsequent putting together of the steel tubes and bracing.

The permanent work executed at South Queensferry during 1885 on the viaduct piers consisted of the founding and building of No. 9 up to the level 27·00 O.D., so that the first stage in the masonry—*i.e.*, that at which the viaduct girders were built and lifting commenced—was completed during this year for all the south approach viaduct piers. Further progress was made this year with the timber staging between the piers at level 27·00 O.D., and by the close of the autumn seven spans had been erected at this level, and were ready for lifting. A detailed account of the method of lifting the viaduct spans will be found on page 13.

Passing now to the main piers, the chief feature of this year's operations was the unfortunate accident to the caisson for the north-west main pier, which proved a source of much anxiety and trouble to engineers and contractors alike. This caisson, the last one of the group, was floated into position on the 4th of December, 1884, and some 4,000 tons of concrete filled into it, so that, but for an hour or two at high water, it rested on the bed of the Forth. Unhappily, on the night of January 1st, 1885, from causes never clearly ascertained, the caisson tilted over northwards, and settled down into the mud, with the lower end of its upper edge 5ft. below low water mark. Mr. Baker, in lecturing before the Royal Institution on May 20th, 1887, thus describes the accident, and the methods finally adopted in raising the caisson:—"With one of our caissons we unfortunately had an accident and loss of life, which, although it had nothing to do with the sinking of the caisson, as in the Neva Bridge, was indirectly due to the same cause—viz., the softness of the mud bottom. On New Year's Day, 1885, the north-west Queensferry caisson, which had been towed into position and weighted with about 4,000 tons of concrete, stuck in the mud, and, instead of rising with the tide, remained fixed, so that the water flowing over the edge filled the interior. The influx of water caused the caisson to sink further in the mud, especially at the outer edge, and to slide forward and tilt. The contractors determined to raise the skin of the caisson until it came above water level, and then pump out and float the caisson back into position. About three months were occupied in doing this, but when pumping had proceeded a to certain extent the caisson collapsed, owing to the heavy external pressure of the water, and two men were killed. It was necessary then to consider very carefully what had better be done, as the torn caisson was difficult to deal with. Consequently it was determined to case it in 'tubbing' of whole baulks of timber, strutted with ring girders and rakers. This was a very tedious work, as every baulk had to be fitted water-tight to its neighbours by divers. Finally, on October 19th, 1885, or between nine and ten months after the first accident, the caisson, to the relief of every one, was

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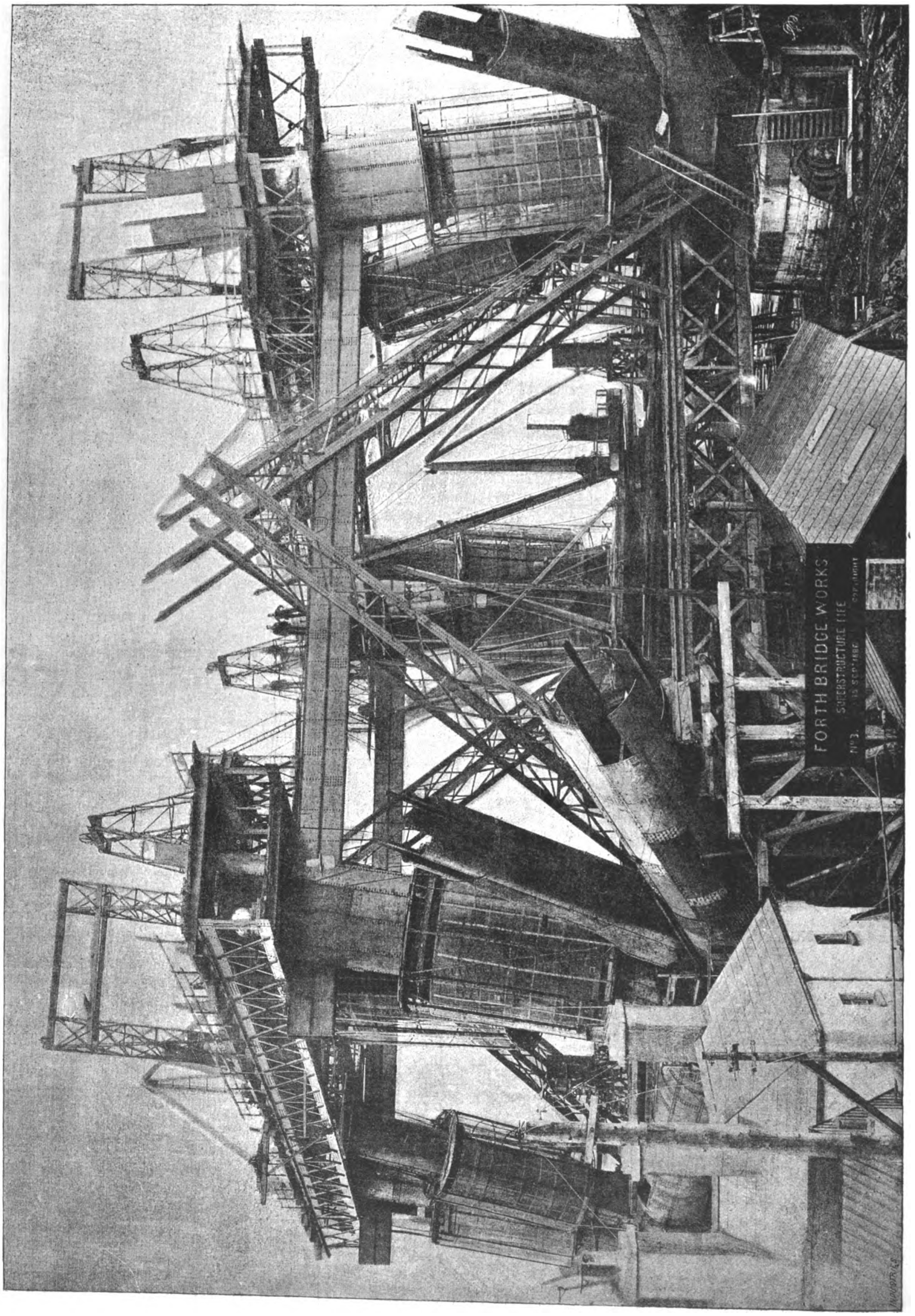


FIG. 24.—GENERAL VIEW OF THE SUPERSTRUCTURE ON THE FIFE PIER, SEPTEMBER, 1886. SEE PAGES 22 AND 24.

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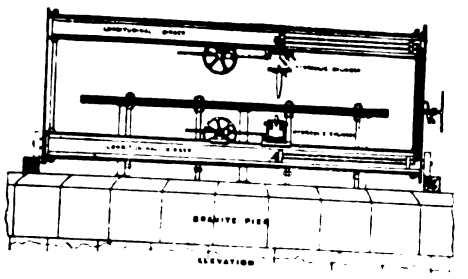


FIG. 25. SEE PAGE 22.

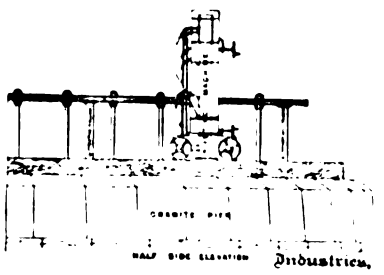
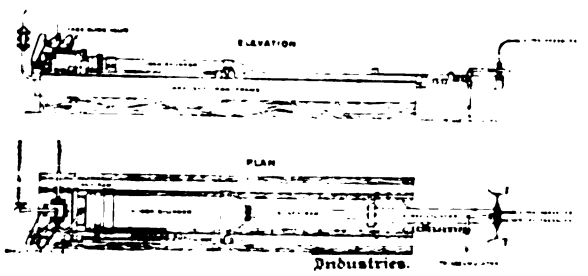


FIG. 26. SEE PAGE 22.



FIGS. 27 AND 28. SEE PAGE 24.

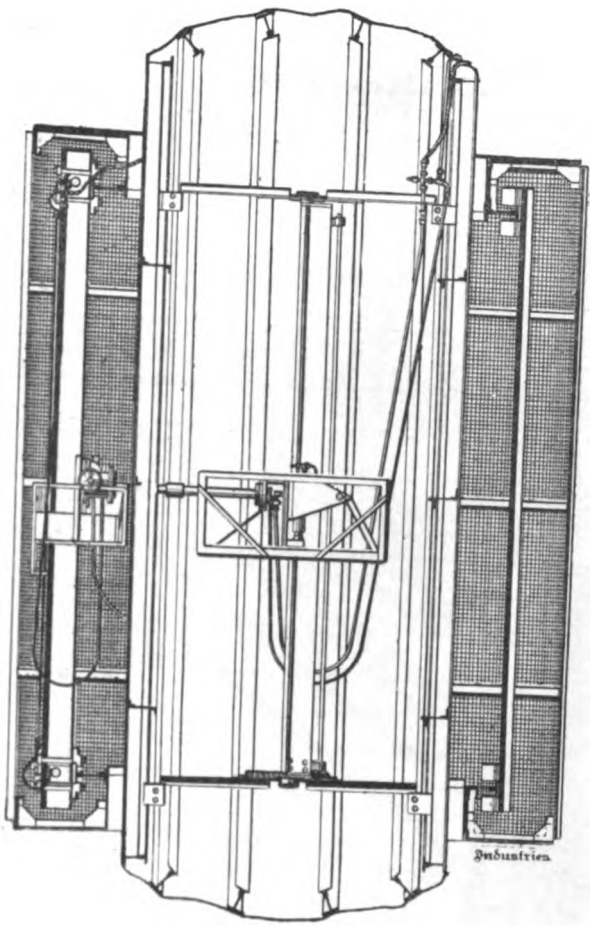
floated into position—this, the last of the main piers, being completed in March, 1886, or almost exactly two years after the first caisson was floated out."

Returning to the three other main piers, excellent progress was made during 1885, for by its close both south-east and south-west had been successfully founded, the masonry pier built and finished, and the lower bed-plates (of which more hereafter) fixed. Similar progress had been made with the north east pier, except that the lower bed-plate on it had not been put in position.

Passing on to Inch Garvie, and examining the permanent work executed there during the year in question, the north-west main pier was founded in a half-tide caisson, and the masonry completed; whilst on both north-east and north-west main piers the lower bed-plates (subsequently described) were fixed. The caisson for the south-east main pier was launched at the commencement of the year, and sunk to its final depth—54·75 O.D. to the cutting edge; the caisson was filled with concrete, and the masonry pier above it built before the close of the year. (See Fig. 20.) The caisson for the south-west main pier (the last built) was launched on May 29th, 1885, reaching its final depth—63·08 O.D. to the cutting edge—on October 2nd in the same year. Concreting and the superincumbent masonry pier were practically completed by the close of this year. A detailed account of the methods of sinking the caissons will be given further on.

On the Fife shore the south-east main pier was successfully founded and built by the close of this year. The foundations of this pier, formed inside a cofferdam of iron segments, occasioned much labour and trouble. The lower bed-plates of both south-east and south-west main piers were duly fixed this year, leaving all this group ready for the erection of the superstructure. Further progress was made with the north abutment, and the erection of the viaduct spans was completed; lifting commenced on August 25th, 1885, and a height of 10ft. was gained and built up before operations at this point were suspended for the winter.

Although the superstructure is dealt with in its entirety in the succeeding part, it may here be stated that during 1885 the two horizontal tubes between the north and south main piers on the Fife



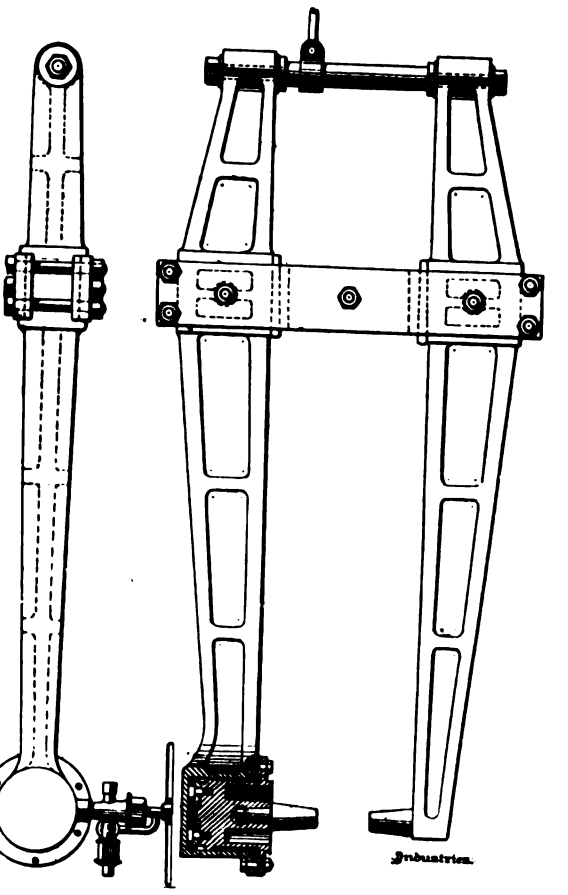
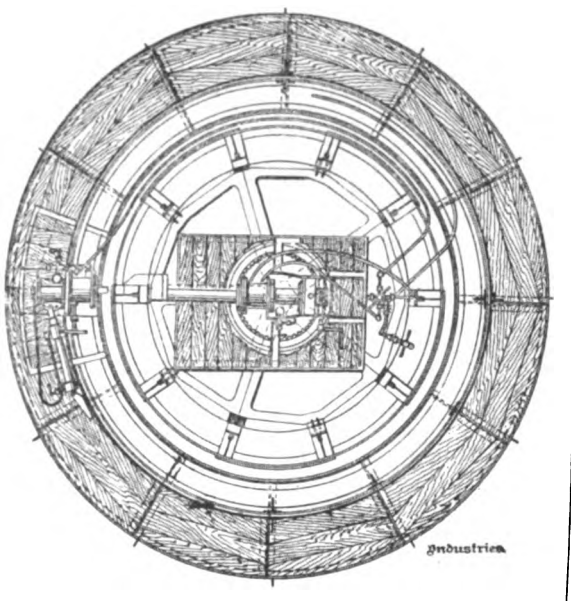


FIG. 31.—PORTABLE HYDRAULIC RIVETER. SEE PAGE 29.



FIGS. 29 AND 30.—ELEVATION AND PLAN OF CAGE FOR RIVETING THE TUBES. SEE PAGE 29.

shore were erected, also a portion of that between the north-west and south-west main piers; whilst on this group a commencement was made in the autumn on the upper bed-plates (of which more hereafter) and also on the skewbacks. (See Figs. 18 and 19.)

Up to the close of this year upwards of 300,000 cubic feet of granite had been delivered, of which about 200,000 cubic feet had been set, whilst some 85,000 cubic yards of rubble masonry and concrete, involving some 15,000 tons of cement, had been built.

The resident engineer for the years 1883–5 was Mr. P. W. Meik, Mem.Inst.C.E. Though the steel work is dealt with subsequently *in extenso*, it may be added that up to the period reached, all the twelve skewbacks were in hand; two for Fife were under erection *in situ*, and the two remaining ones were completed on the drill roads, whilst the Queensferry group were well advanced and those for Inch Garvie in hand. 2,300 lineal feet of 12ft. tubes and 2,000 lineal feet of 8ft. tubes, also 3,200 lineal feet of ties, were drilled, and good progress made with the top junctions. Over 18,000 tons of steel had been delivered, and the average number of hands employed was about 2,000.

Fig. 21, taken from the south shore looking north, gives a general idea of the progress on the date on which it was taken, June 9th, 1885.

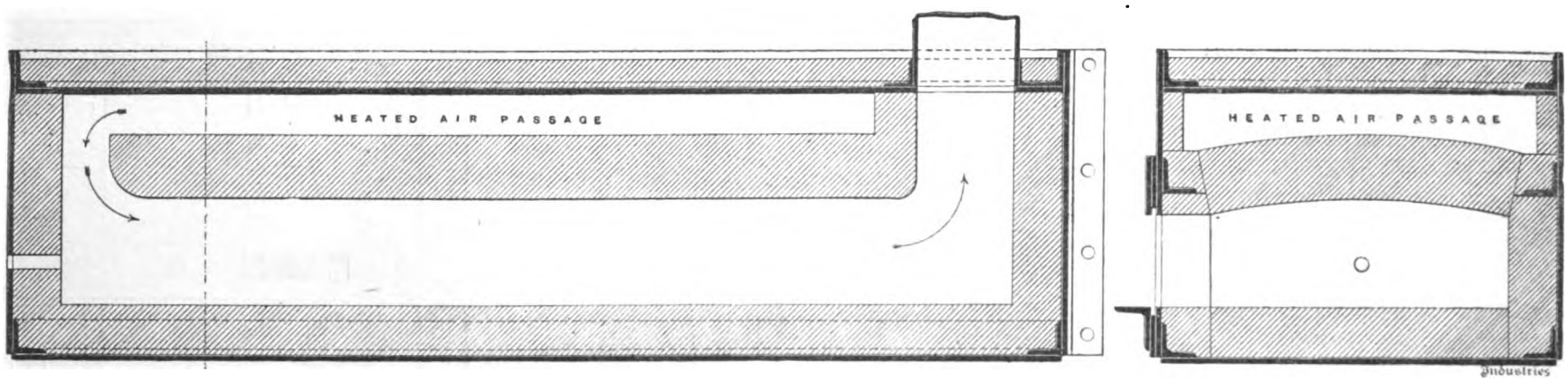
Before closing this portion of our description, which refers chiefly to the foundations, and which comprises the period 1883–5, both years inclusive, we proceed to supplement our remarks on the progress by concise accounts of the lifting of the viaduct spans, the caissons and compressed air plant, and the material employed during this period.

THE LIFTING OF THE VIADUCT SPANS.—The whole of the spans were lifted simultaneously as soon as the riveting was completed on them. Steel cross-beams, with pairs of hydraulic jacks, were placed under the ends of the girders over the piers, and a stage surrounding the piers was suspended from the main girders. From this platform the men in charge of the rams conducted the operations of lifting and blocking up the girders, and the masons afterwards completed the stonework in the vacant spaces. The materials for the piers were first raised in trucks by a steam hoist on the jetty to a tramway laid on beams between the bottom members of the girders, and afterwards lowered into position by winches over each pier, these winches being driver by running ropes from engines on the girders at alternate piers. The southern viaduct spans have a total length of 1,680ft., and weigh altogether about 2,000 tons.

The hydraulic jacks referred to above were 15in. in diameter, with water pressure of 34cwt. per square inch, supplied by steam pumps. Forty-eight hours were allowed for the proper setting of the cement between the finishing of the courses in one lift and the commencement of the lifting for the next. The average rate of progress attained in lifting and building was about 10ft. per month. The actual raising of the girders occupied on an average about two hours for each lift.

THE CAISSONS.—Of the four Queensferry caissons the deepest was 72ft.—*i.e.*, the cutting edge was 89ft. below high water. The diameter in each case was 70ft. at the base. Seven feet above the cutting edge was a floor of iron plating, which formed the air chamber roof. Above the floor the caisson was double-skinned, angle irons for stiffly bracing it together being introduced between the skins. In the outer skin the lower plates were made to lap outside the upper

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FIGS. 32 AND 33.—SECTIONS OF OIL FURNACE FOR HEATING RIVETS. SEE PAGE 29.

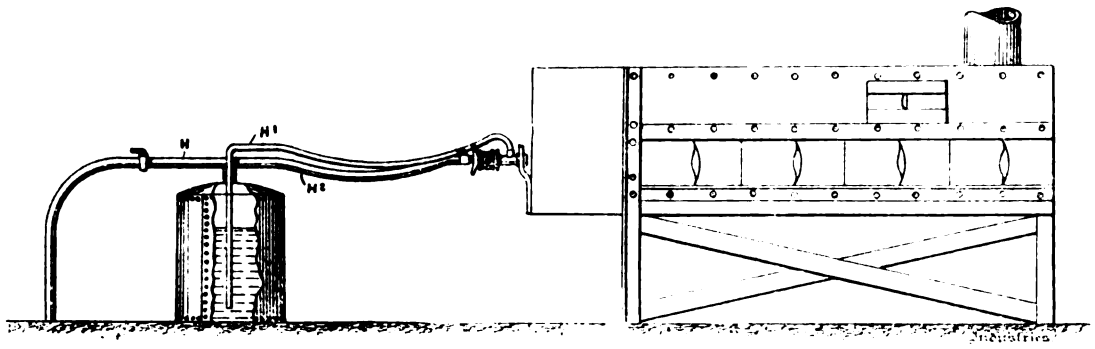


FIG. 34.—OIL TANK AND FURNACE. SEE PAGE 29.

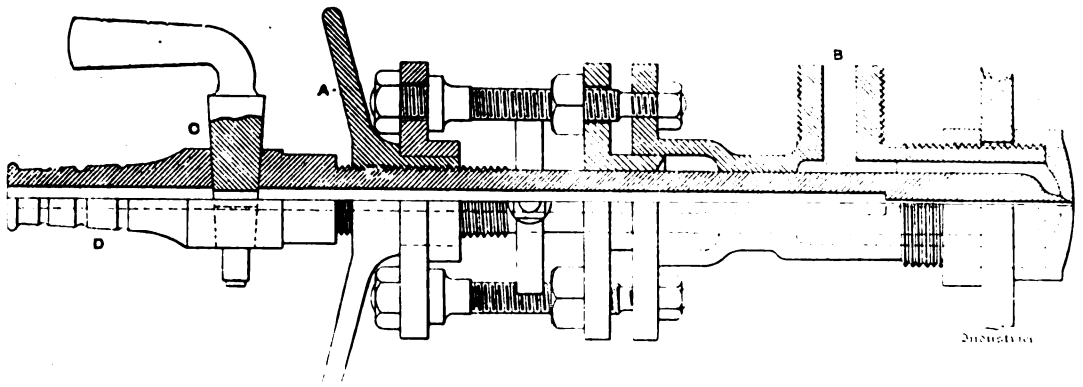
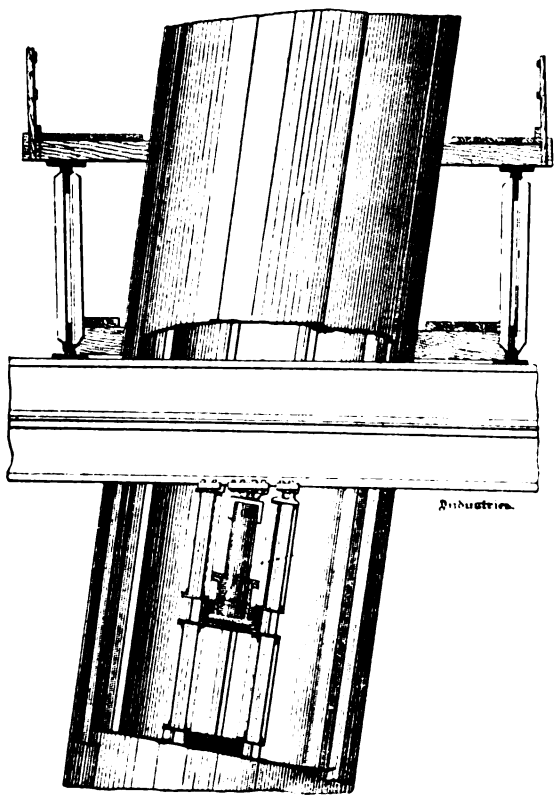
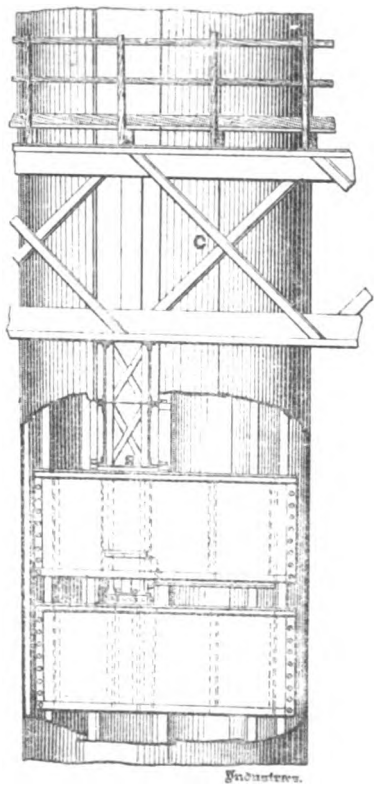


FIG. 35.—NOZZLE FOR OIL FURNACE. SEE PAGE 29.





FIGS. 36 AND 37.—PLATFORMS FOR ERECTING THE VERTICAL MEMBERS SEE PAGE 25.

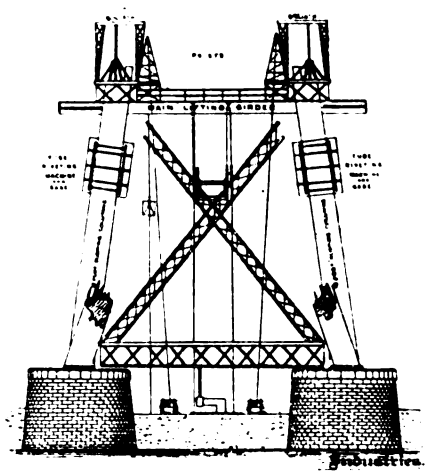


FIG. 38.—SEE PAGES 24 AND 26.

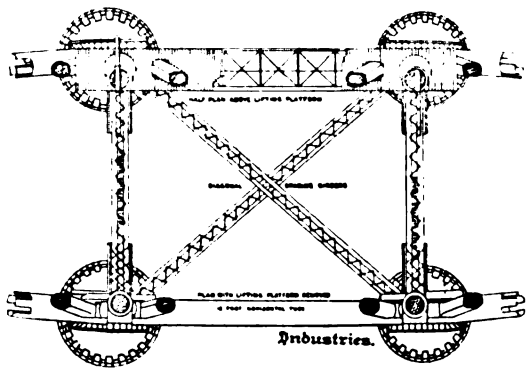


FIG. 39.—SEE PAGES 24, 26, AND 28.

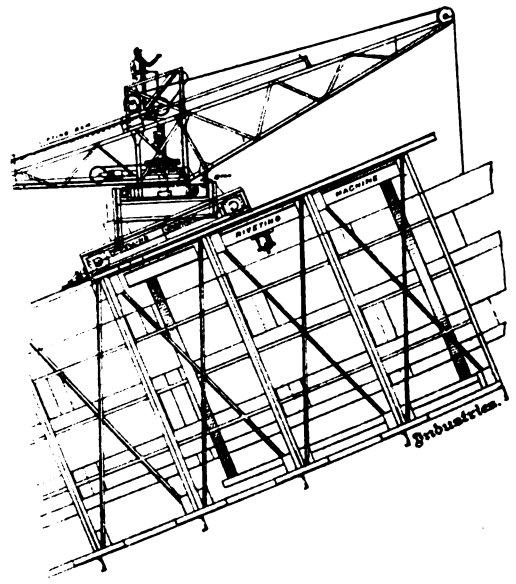


FIG. 40.—SEE PAGES 26 AND 28.

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ones, so that the joints should cause no obstruction in sinking. The outer skin had a batter of 1 in 46, extending to 27ft. above the cutting edge; from this point to within 18ft. of the top the sides were vertical, and then tapered quickly to the top, which had a diameter of 60ft. The cutting edge was formed by a steel plate 1in. thick and 18in. deep, the shoe being firmly stiffened by stout diaphragms spaced 4ft. apart. Four main girders, 18ft. deep, and a series of cross girders, 3ft. in depth, were placed above the floor, and supported it. The four main girders were connected at each end with both skins, by means of bulkheads between the skins, to which they were riveted. Previous to launching some concrete was filled into the shoes to give increased stability. When towed into position at the end of the jetty, piles were driven in round each caisson, and it was further secured with mooring chains. Concrete was then filled in until the caisson sank on to the bed of the river. Each caisson was provided with three shafts, 3ft. 6in. in diameter; one was furnished with a ladder for the men, and the two remaining ones were for the buckets containing the "spoil"; all three were of course fitted with air locks, which were on the surface.

The lock for the men consisted of an outer tube enclosing the upper end of the shaft, an air-tight door being fitted in each and lined with india-rubber facings. A cock was used for admitting compressed air from the shaft into the lock, and a similar communication between the lock and the outer atmosphere was also provided. On entering the annular space around the inner tube, the door in the latter was found closed. The outer door was then shut, and pressure gradually admitted until that in the lock was equal to the pressure in the vertical shaft. The inner door could then be opened, and the descent made; in ascending the process was reversed. The mud was removed by means of ejector pipes, having been previously mixed with water introduced through a supply pipe, the air pressure in the chamber forcing the mud through the ejectors. "It was found that the mud scaled the caissons," says Mr. Baker, in lecturing, in May, 1887, before the Royal Institution, "so that a pressure of air considerably in excess of that of the water outside could be kept up, and it was unnecessary to vary the pressure according to the height of the tide.

"In working through this soft mud, both intelligence and courage were called for on the part of the men, and it is a pleasure and duty for me to say that the Italians and Belgians engaged on the work were never found wanting in those qualifications. There was always a chance of the caisson sinking suddenly or irregularly, and imprisoning some of the men, and indeed on one occasion a few men were buried up to their chins in the mud, and on another the caisson gave a sudden drop of 7ft. Happily no serious accident happened, although I confess that I felt a little apprehensive myself, as I was familiar with the details of an accident with a similar caisson sunk in the bed of the Neva, at St. Petersburg, in 1876. In that case the wet mud rose rapidly in the working chamber when the caisson sank suddenly 18in. one day, and of the twenty-eight in the chambers nine remained imprisoned. Of these two managed to get their heads into the shaft of access, and were taken out alive after twenty-eight hours, and the remaining seven were smothered in the mud. It was nearly a year before sinking was renewed.

"Again, in 1877, one of the air locks suddenly gave way, and of the men then in the chamber three escaped uninjured; nine were blown out by the rush of air, and, falling into the water and on craft, were mortally injured, whilst twenty were smothered in the caisson. It was thirteen months before the chamber was accessible, and then the vitiated atmosphere in the charnel house below rendered it very difficult to work. Happily we had no such experiences at the Forth."

The excavation of the boulder clay underlying the soft silt was performed by means of hydraulic spades, already described in detail. (See Fig. 16 and page 10.) The best progress made in excavating this material was about 1ft. per day of 24 hours, over the whole area of the caisson, with 27 men and four hydraulic spades, filling a bucket every five minutes.

This is equivalent to a digging power of 35 cubic yards per spade, and of 5 cubic yards per man, for each day of 24 hours. The men worked in six-hour shifts, and excavation was carried on continuously day and night, each squad performing two shifts. The south-west caisson was sunk 39ft. in 99 days, the south-east caisson 37ft. in 72 days, whilst in the same number of days (72) the north-east caisson was carried down through 43ft.

"A matter of the utmost importance, and one requiring vigilant watchfulness, was the sinking of the caisson vertically. If not in its true position when operations were commenced, it was so guided as to bring it to the correct place when down. This was generally accomplished by tilting its top in the direction opposite to that in which it was intended to move it, and, sinking being continued while so tilted, the lower edge gradually approached its true position. On this being attained the whole caisson was righted, and, if still true, was sunk vertically till it reached the proper depth. Another way of effecting the same purpose was to tilt the caisson as before but immediately afterwards to right it, when it was found to have moved through a certain distance sideways, and that in the direction required, owing to the side first tilted having pressed against the lower and harder ground, thus causing the caisson when righting to move a little in the one direction. A secondary assistance was to place heavy timbers at an angle against the top of the shoe. These timbers were made to bear against the ground, so that when the caisson was subsiding their tendency was to push it from them, and thus help to bring it back to its true place."

We pass on now to the caissons for Inch Garvie south-west and south-east main piers (See Fig. 20); but little difference is to be noted in their construction, except that the lower half of the shoes had supporting brackets instead of sloping shoe plates, thus stiffening the cutting edge at the bottom and permitting readier access to the rock beneath. The sides of the caissons were built vertical until within 24ft. of the top, when there was a quick batter from 70ft. to 60ft. diameter at the top. This upper part, more-

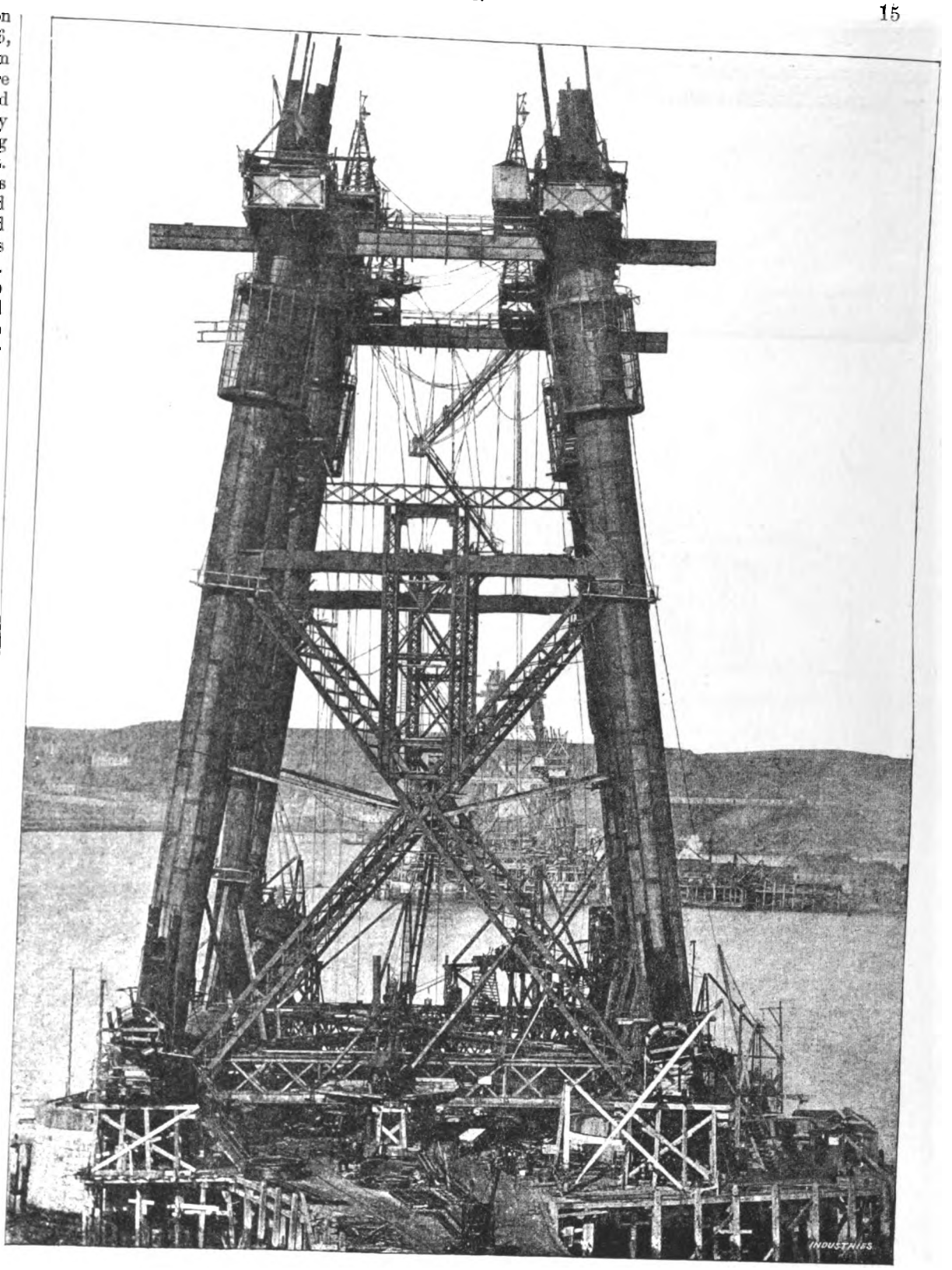


FIG. 41.—SOUTH QUEENSFERRY PIER, 1887. SEE PAGE 26.

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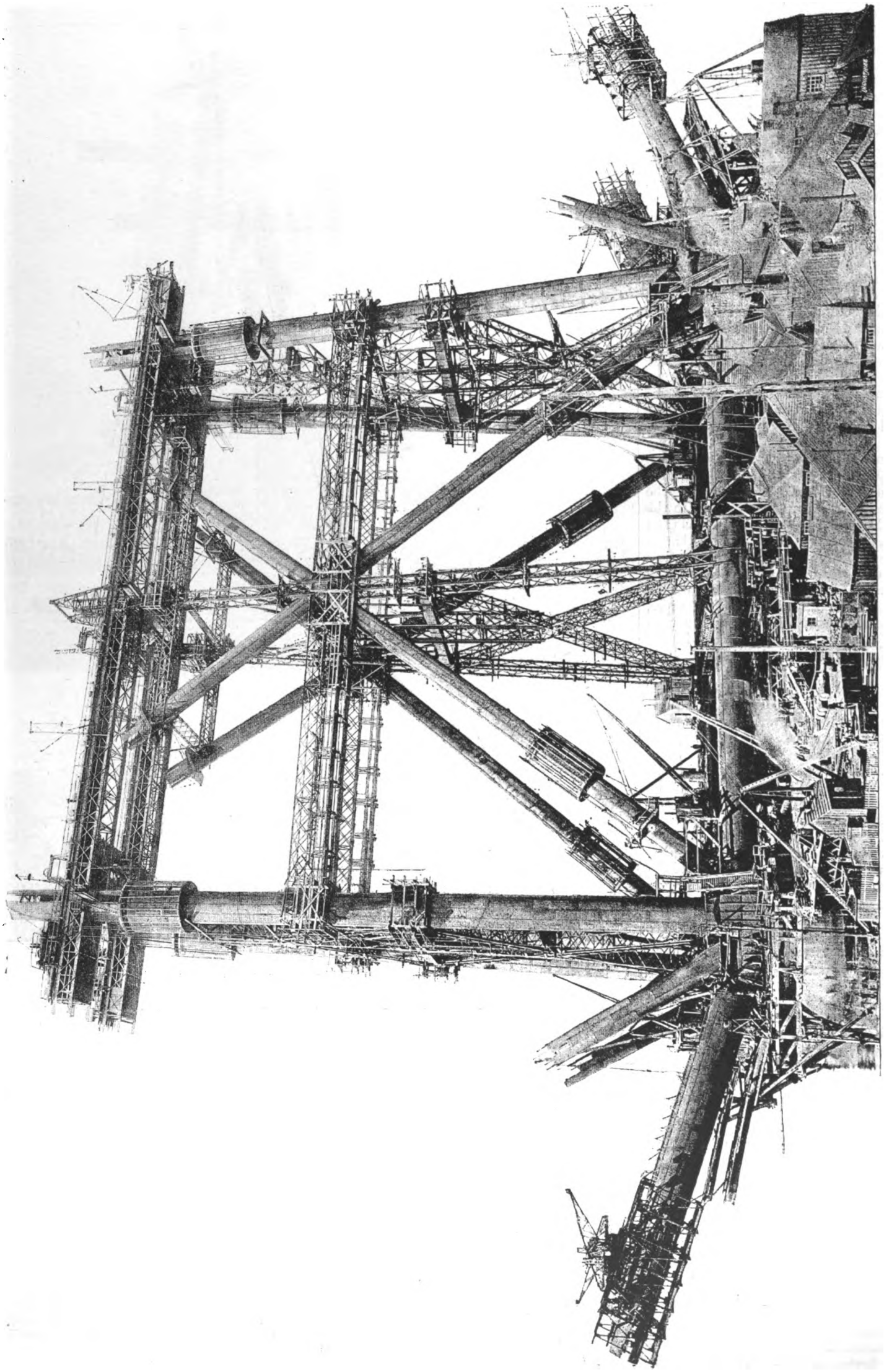


FIG. 42.—VIEW OF THE CANTILEVER PIER ON INCH GARVIE, SHOWING INTERNAL VIADUCT IN POSITION. SEE PAGE 26.

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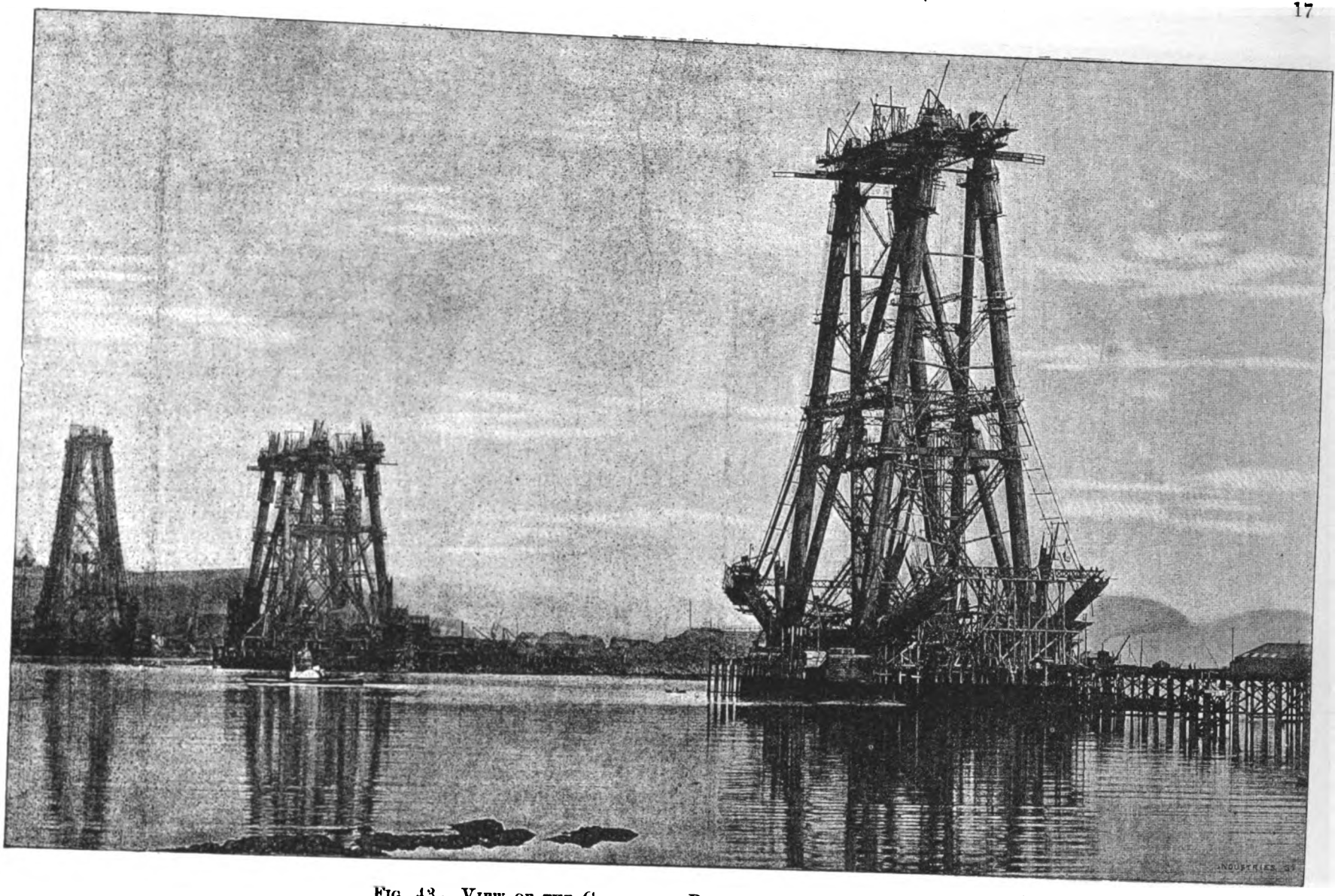


FIG. 43.—VIEW OF THE CANTILEVER PIERS IN 1887. SEE PAGE 28.

over, had only one skin, which was stiffened by circular girders and a brick lining 2ft. 4in. thick.

The soundings taken previously at the sites of the Inch Garvie southern main piers present some features of interest. A timber raft, with a diameter of 69ft. 8in., was towed out, and moored over the site of the pier, its position being taken by means of two theodolites on the island sighting on to the centre of the raft, and in the case of one of them on to a point on the circumference also. A circular road was laid on the outer edge of the raft, on which travelled a light carriage, supporting the lifting and lowering drum. The wire finally adopted for sounding was of steel and $\frac{1}{10}$in. diameter. Copper wire was tried, but abandoned. The "sinkers" were a source of considerable trouble. The strong tide running off Inch Garvie necessitated the adoption of heavy sinkers, and, even with all the care exercised, it was impossible to avoid their occasional loss. The type eventually adopted was a 10ft. bar of iron $\frac{3}{8}$in. diameter, with a lead weight cast around its centre, the whole weighing about 60lb. Care had, of course, to be exercised that the sinkers did not lie down at the bottom, and augment the reading by an erroneous 10ft. After a variety of experiments, brass tallies, secured by string to the sounding wire, were adopted for giving the reading. The raft was held in position by four moorings, and had four crabs on board to admit of its movement. The diameter of the caissons was 70ft. Soundings were, however, taken for a radius of 70ft. from the centre of each caisson, thus affording not only an accurate plan of the bed of the Forth beneath the caissons, but also for 35ft. outside all round. The raft was marked at every foot of its circumference, and readings were taken at every foot inside the caisson area, and at every 5ft. outside that limit. A tide gauge on Inch Garvie was read every five minutes, so that, by similarly noting

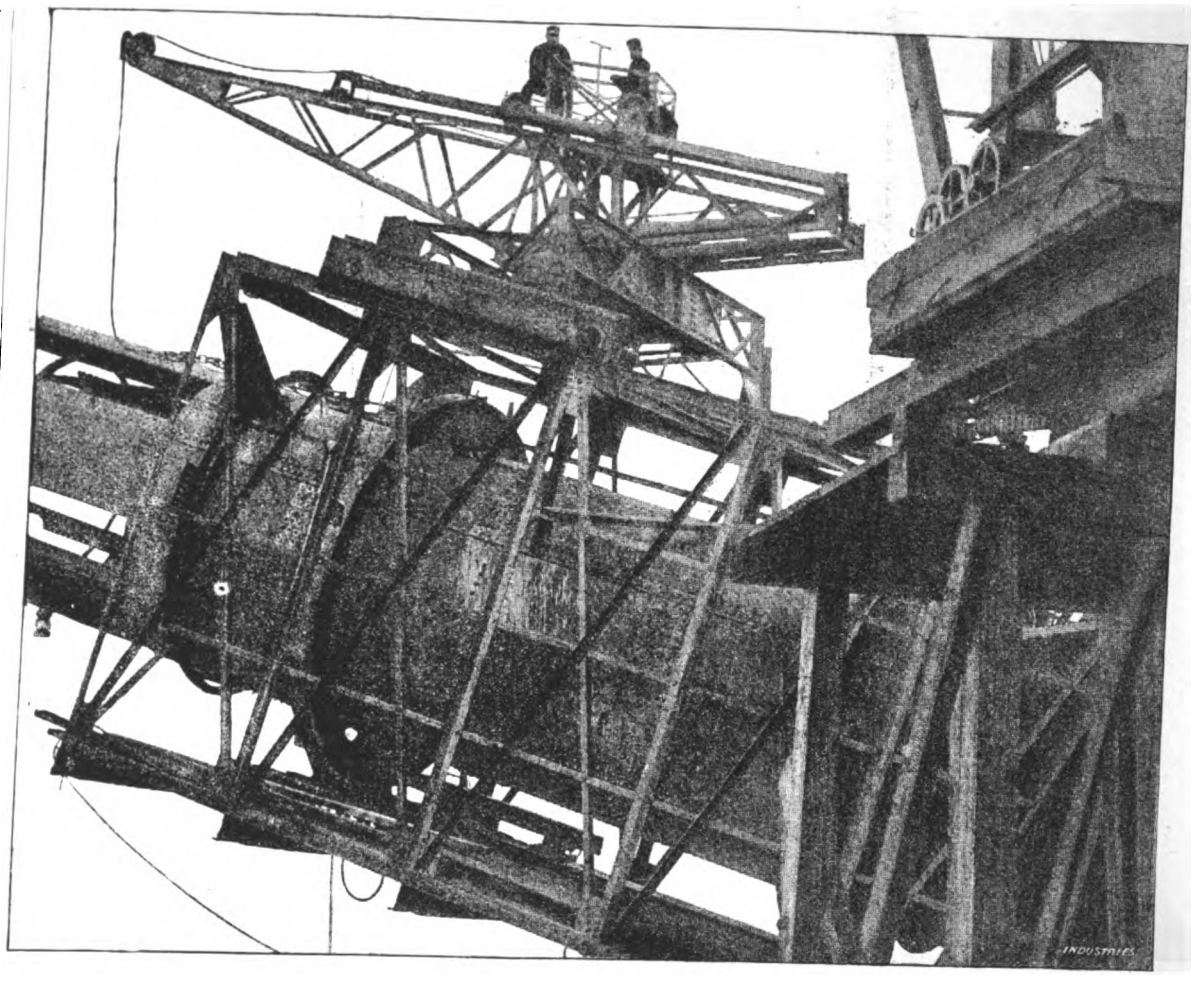


FIG. 44.—BUILDING OUT THE BOTTOM MEMBER OF CANTILEVER, 1887. SEE PAGES 26 AND 28.

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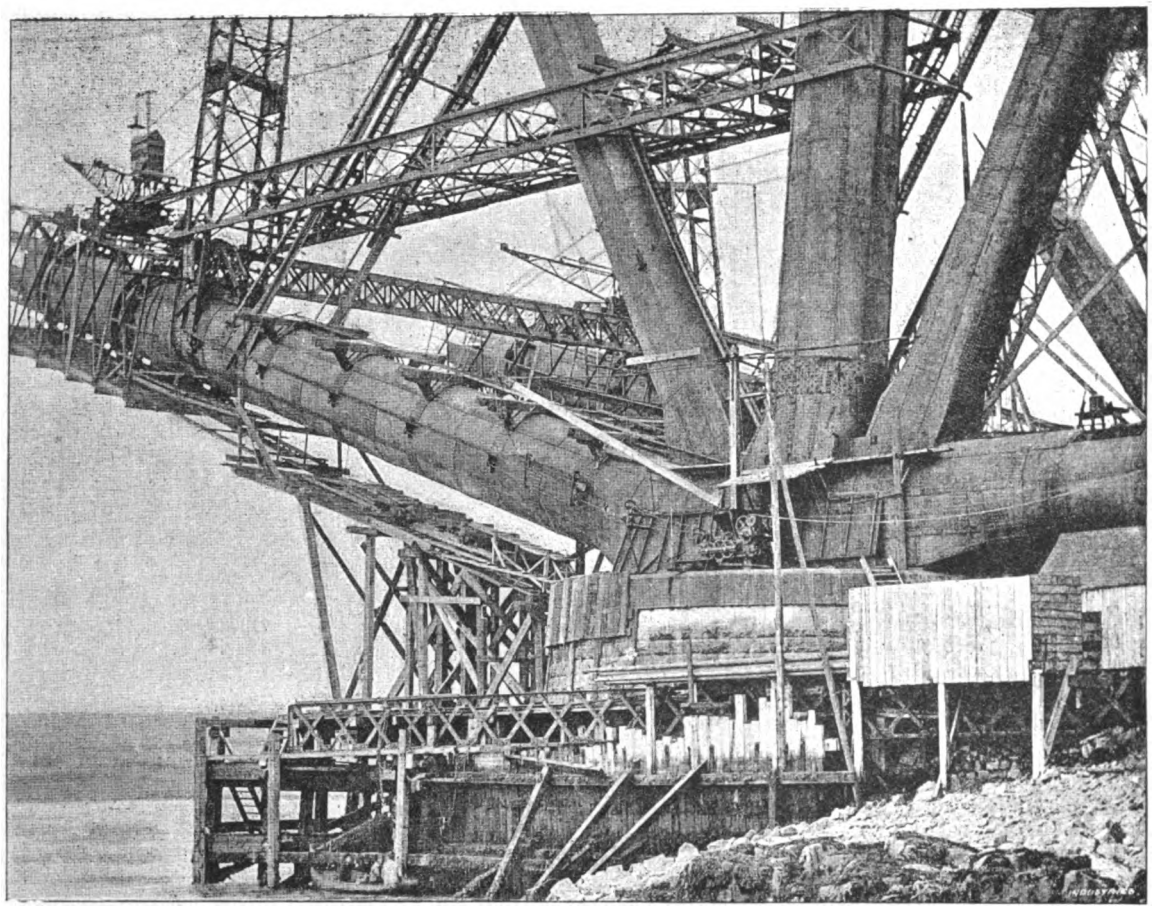


FIG. 45.—VIEW OF LIFTING PLATFORM ON ONE OF THE FIFE PIERS, 1887. SEE PAGE 26.

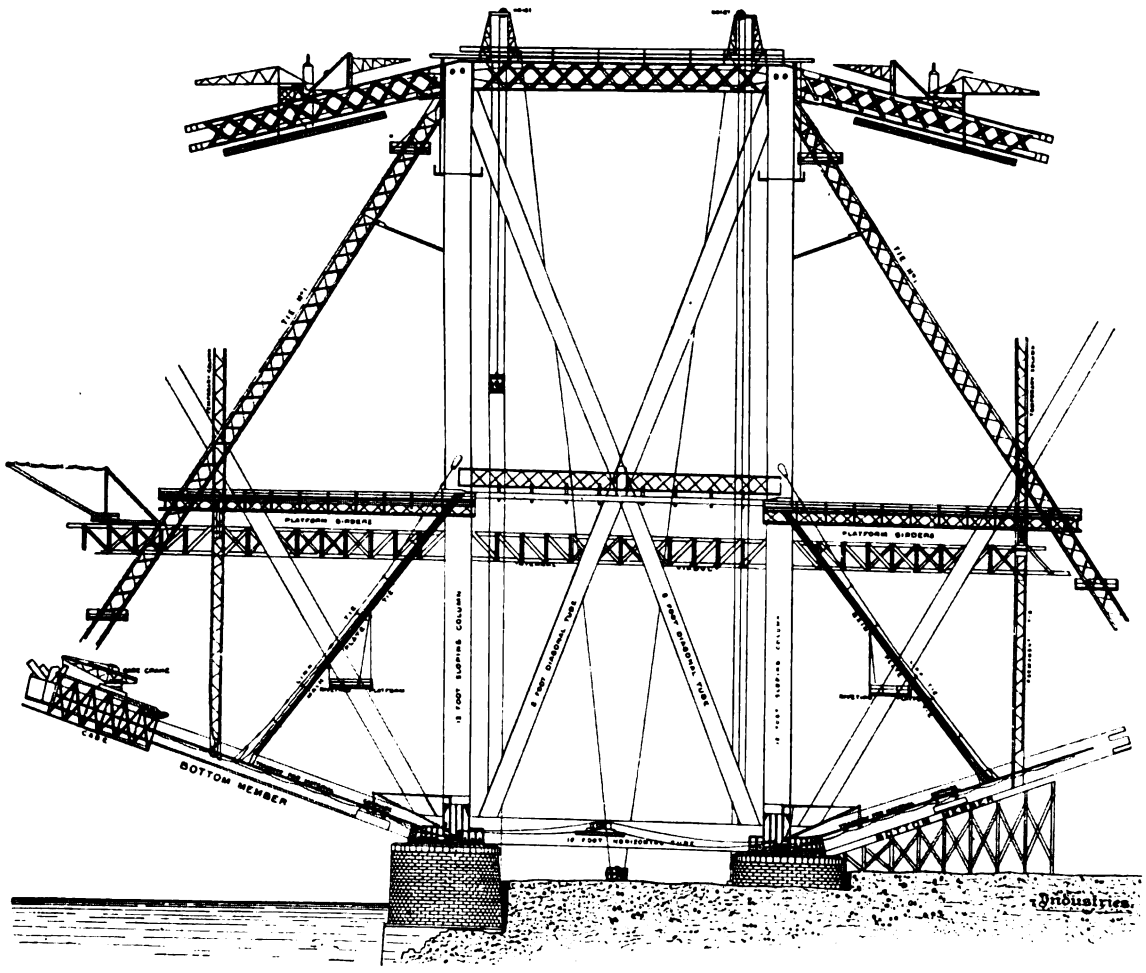


FIG. 46.—DIAGRAMMATIC VIEW OF NORTH QUEENSFERRY PIER, 1887. SEE PAGE 28.

the time of the readings from the raft, they could be subsequently reduced to Ordnance level.

Operations were carried on as much as possible at slack water, as the strength of current was very considerable at other times. The rate of progress was estimated at about two soundings per minute, and in all some 3,000 soundings were taken. These, after being carefully plotted, were utilised in the construction of models of the bed of the river at the caisson sites. Wires were cut off to heights corresponding to the different readings, and fixed upright into a stout board. Cement was then filled in so as just to cover the heads of the wires. By these means an exact reproduction of the rock to the south of Inch Garvie was obtained on a reduced scale, and afforded valuable and ready means of seeing at a glance the slope on which the caissons had to rest when first sunk into the respective positions. Fig. 20 shows how this difficulty was eventually met and overcome. The lower portion of the rock was levelled up by divers with bags filled with sand and concrete, so that the cutting edge of the caisson when sunk rested on a level surface. Excavation of the rock was then proceeded with at the north end, and the sand bags gradually cut away as the caisson descended. Rock drills, driven by air of 70lb. per square inch, led into the caissons by special pipes, were employed for this purpose. (See Fig. 17.) The rate of excavation of the rock at Inch Garvie averaged some 18 cubic yards per 24 hours, exclusive of the removal of any sand.

In the south-west caisson the highest point of the rock was 60ft. below high water and the lowest 74ft. below the same level; and in the south-east caisson these figures were 47ft. and 67ft. respectively. The removal of the rock was practically a matter of ordinary quarrying, with the additional necessity of working in compressed air. Dynamite fired by electricity was employed for blasting purposes. The maximum pressure of high tide in these caissons was about 33lb. per square inch above the atmosphere.

We will turn now to a general consideration of compressed air, its effect on the workers, and the more salient features in regard to its employment. We may point out that the result produced varies with each person, the usual sensation being one of considerable pain in the ears, owing to inequality of pressure inside and outside the tympanum or drum. Numerous curious phenomena were apparent in the air chamber. Whistling became impossible, and bottles of effervescing drinks opened flat and insipid, the pressure of the atmosphere being equal to that previously forced into them in manufacture. So long as the pressure did not exceed some 18lb. no ill effects were felt by the workers. Above this pressure, more especially when excavating mud, severe pains in the legs and arms, accompanied in the worst cases by a kind of paralytic stroke, were experienced, generally after leaving the caisson.

Two interesting incidents in connection with the caissons may be quoted in Mr. Baker's own words:—"Probably the most astonished visitors were some salmon, who, attracted by the commotion in the water caused by the escape of the compressed air under the edge of the caisson, found themselves in the electric-lighted chamber. When in the chamber, the only notice of this escape of large volumes of air was the sudden prevalence of a dense fog, but outside a huge wave of aërated water would rise above the level of the sea, and a general effect prevailed of something terrible going on below. No doubt the salmon thought they had come to a cascade turned upside down, and, following their instinct of heading up it, met their fate. Another astonished visitor was a gentleman who took a flat-sided spirit flask with him into the caisson and emptied it when down below. Of course the bottle became filled with compressed air, and it exploded when passing through the air-lock into the normal atmospheric pressure, the pressure in the bottle being 33lb. per square inch." All the air chambers were lighted by electricity, those at Queensferry having from 16 to 20 incandescent

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Swan lamps of 20 candle-power each, the current being supplied by a Siemens dynamo actuated by an 8 h.p. engine. The Inch Garvie caissons were lighted by arc lights, incandescent lamps being too fragile to withstand the blasting. Three arc lights were employed, each having 1,200 candle-power. A Crompton compound dynamo, driven by a 14 h.p. engine, supplied the current. Photographs were taken in the caissons (see Figs. 16 and 17), a lighting power of 6,000 candles being employed, and an exposure of as much as fifteen minutes being given in some cases. The fog at all times present in the caissons militated against successful photography under such novel circumstances. (For a full account of these experiments, see *Industries*, Vol. IV., page 400.) The sinking of the deep caissons was sublet to Messrs. Croiseau. They employed Italian workmen, having previous experience of compressed air.

THE MATERIALS EMPLOYED IN THE CONSTRUCTION OF THE MASONRY OF THE BRIDGE.—The main and viaduct piers were built of granite, and headed with concrete and Arbroath rubble. The caissons were filled with concrete. The granite was almost entirely from the Aberdeen quarries, being brought to the site of the bridge by water. The class of work put into the piers is known as "rock-faced," the imposts, string courses, and copings being "dressed." The material was shaped and prepared at the quarries previous to shipment by Messrs. Fyfe, of Aberdeen. The concrete filling the caissons consisted of 27 cubic feet of broken whinstone, 7 cubic feet of sand, and 5½ cubic feet of cement. The crushing strength of the concrete was about 50 tons per square foot. Cement mortar, composed of two parts of sand to one of cement, was employed. The cement employed was the best quality of Portland cement, ground so fine that the residue on a sieve 2,500 meshes to the square inch (equal to 50 per lineal inch) did not exceed 5 per cent. by weight. The neat cement (gauged with a proper proportion of water) was specified not to set in less than one hour during any season of the year, whilst when formed into briquettes it was required to bear after four days, without breaking, a tensile stress of 300lb. to the square inch of section, and after seven days a stress of 400lb. to the square inch of section. The cement was further required, after gauging with three times its weight of dry sand, which would pass through a sieve 400 meshes to the square inch but would be retained upon one of 900 meshes, and mixed with the proper proportion of water, to be made into briquettes, which, having been kept in a damp atmosphere for 24 hours, and then immersed in water for 28 days, to stand without fracture a tensile stress of 170lb. per square inch of section. The cement weighed from 112lb. to 116lb. per bushel, and about 21,000 tons were used in the entire undertaking, being supplied by Messrs. Hilton, Anderson, & Co., and J. Bazley White & Co. The total amount of granite was 707,000 cubic feet, whilst 117,000 cubic yards of masonry and concrete were set. The quantity of timber used in the entire undertaking for temporary purposes, stages, jetties, &c., is estimated at 1,000,000 cubic feet.

PROGRESS DURING 1886.

THE SUPERSTRUCTURE.

The temporary work executed during 1886 consisted mainly of appliances to aid in the erection of the superstructure, and under the subsequent heading of plant a detailed description, with illustrations, will be found of the more important. Suffice it, therefore, to briefly point out that during this year hydraulic apparatus for riveting and lifting; powerful and specially designed machines for riveting the 8ft. and 12ft. tubes; goliath cranes, hoists, and steam winches; compressors, accumulators, and rams for high pressure riveting, were constructed, along with other appliances too numerous to catalogue, to aid in the erection of the steel work.

To dispose of the masonry work executed in this year, before considering in detail the erection of the superstructure, which necessarily forms the leading

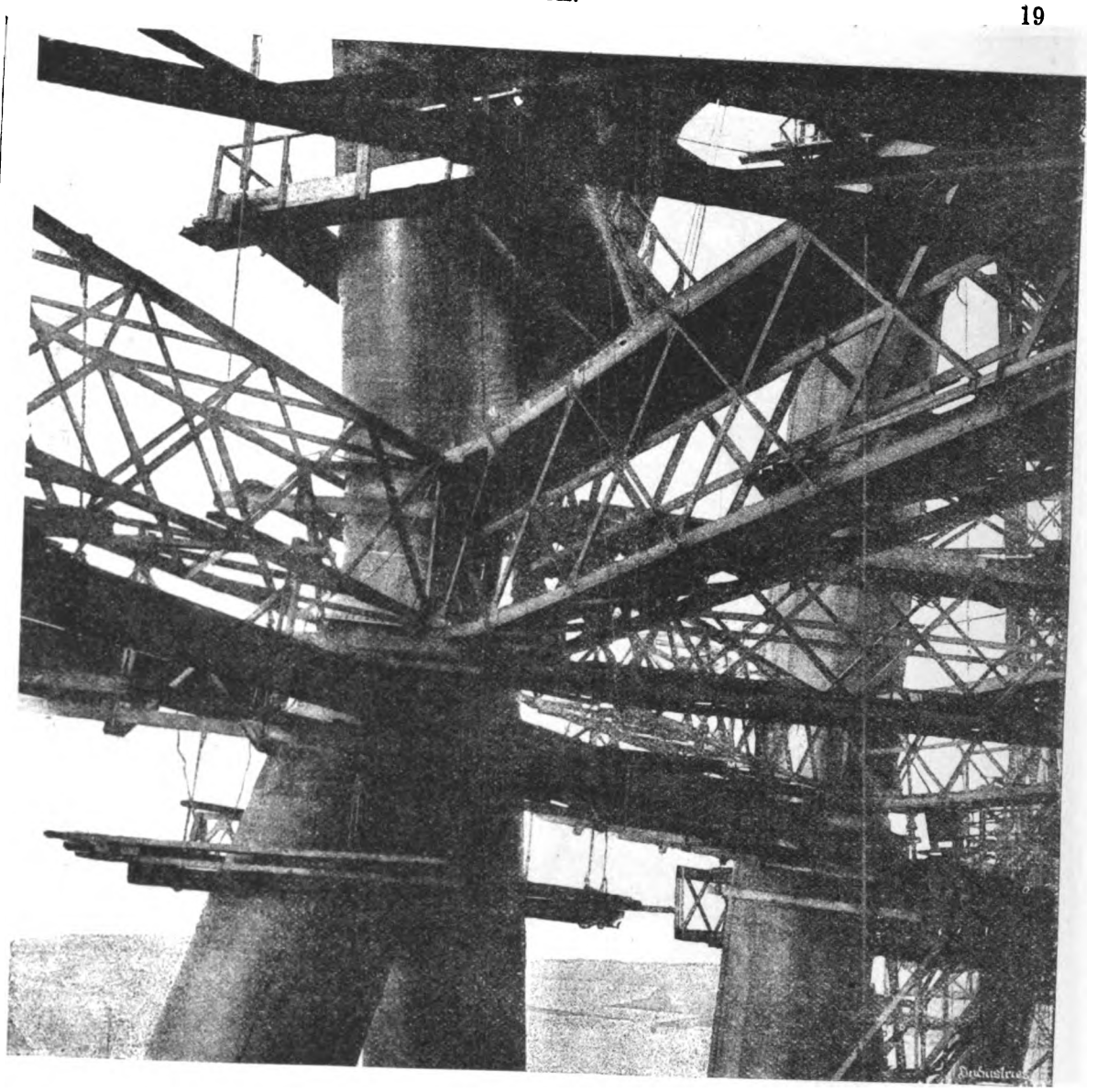


FIG. 47.—INTERSECTION OF DIAGONAL TUBES, 1887. SEE PAGE 26.

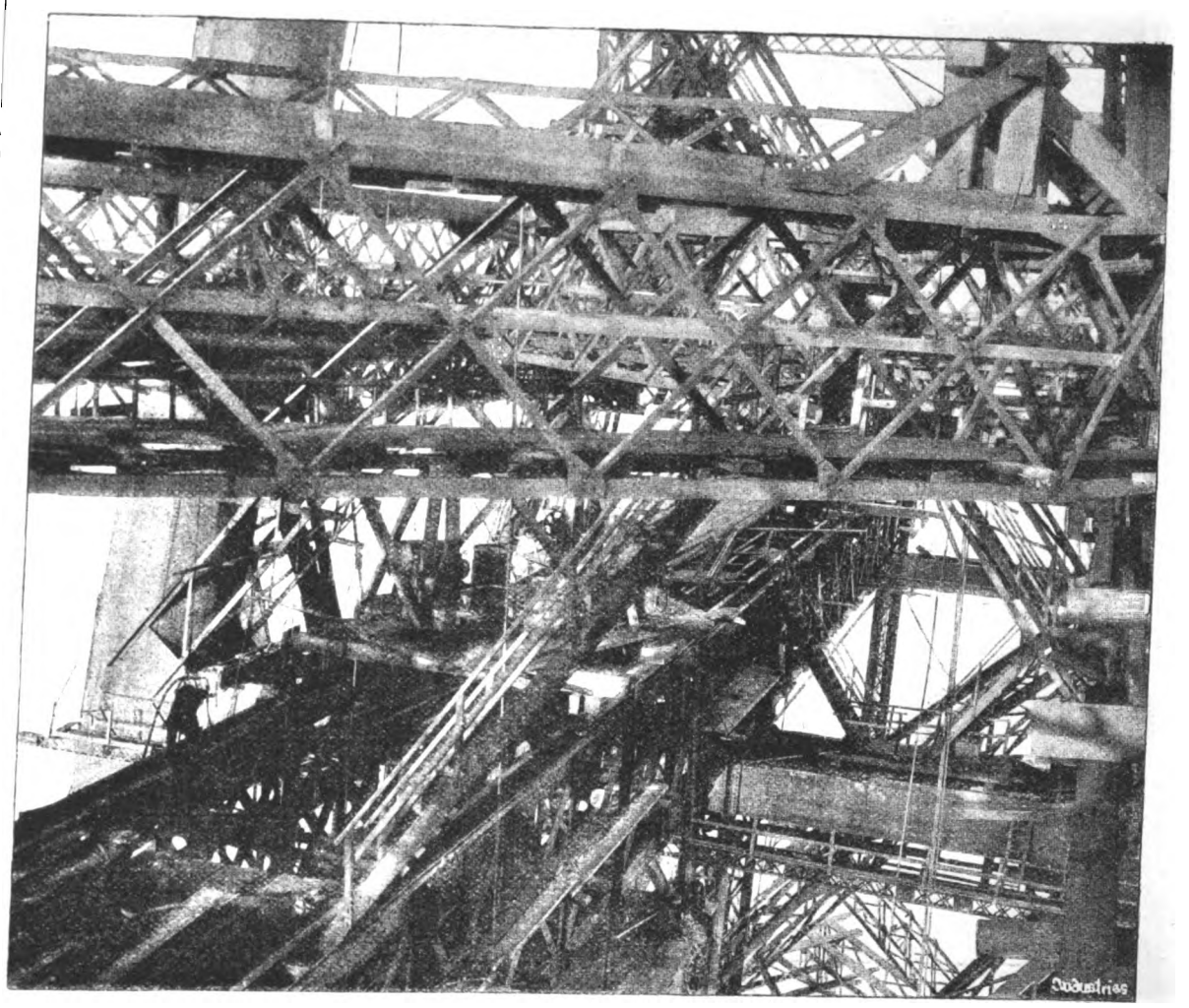


FIG. 48.—INTERNAL VIADUCT, WITH HORIZONTAL AND DIAGONAL BRACINGS. SEE PAGE 30.

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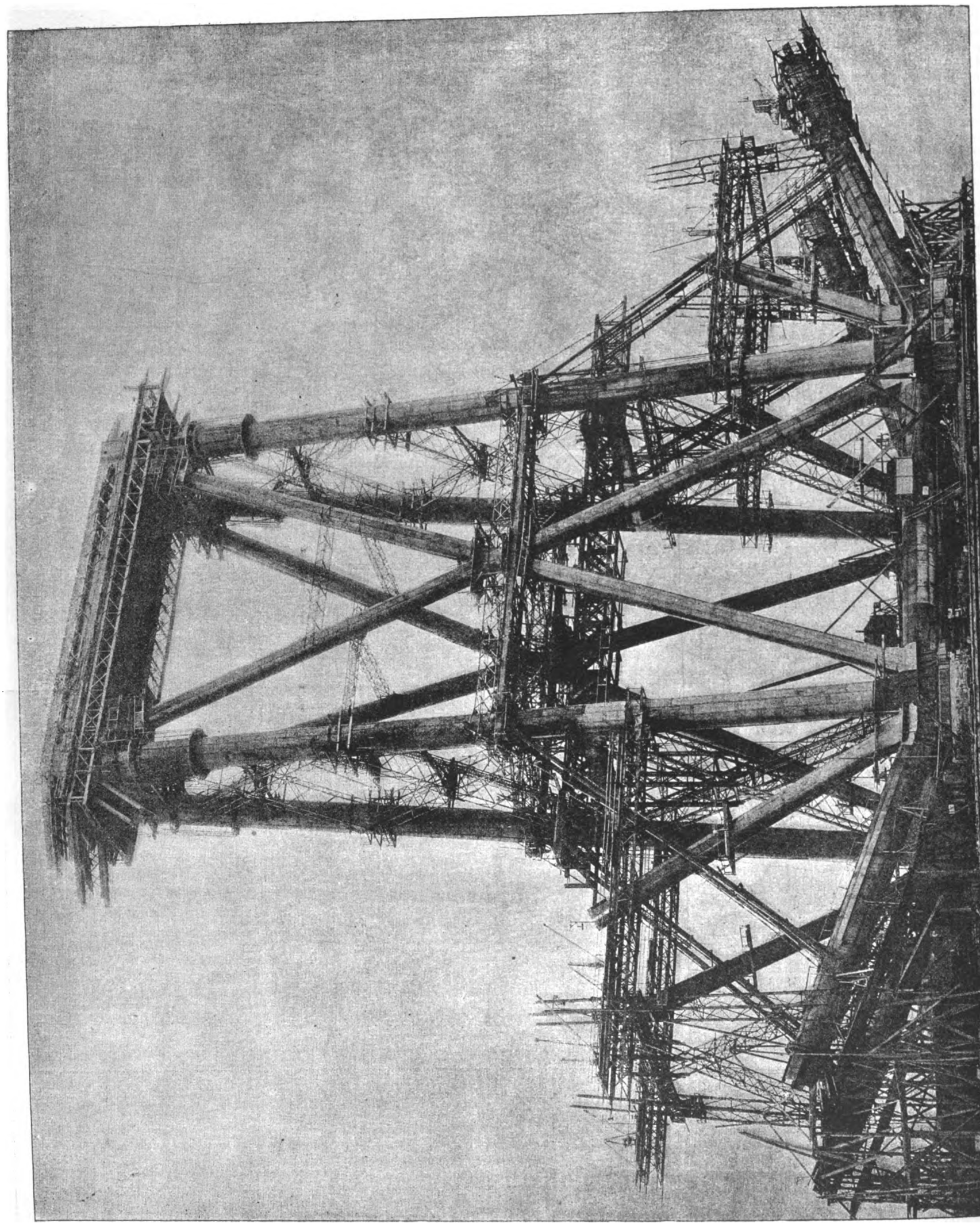


FIG. 49.—NORTH CANTILEVER IN COURSE OF CONSTRUCTION, 1887. SEE PAGES 25 AND 26.

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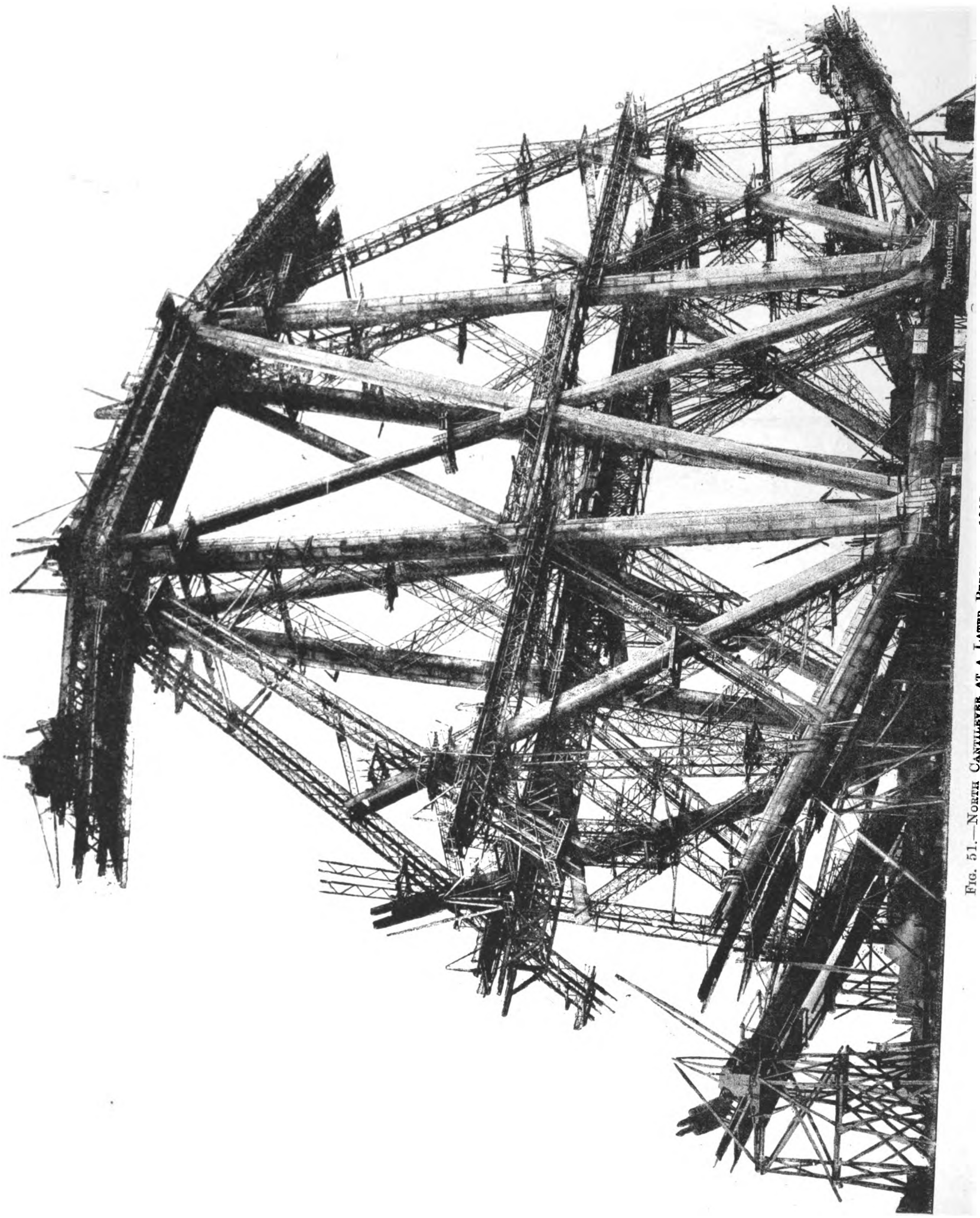


FIG. 51.—NORTH CANTILEVER AT A LATER PERIOD IN 1887. SEE PAGES 28 AND 30.

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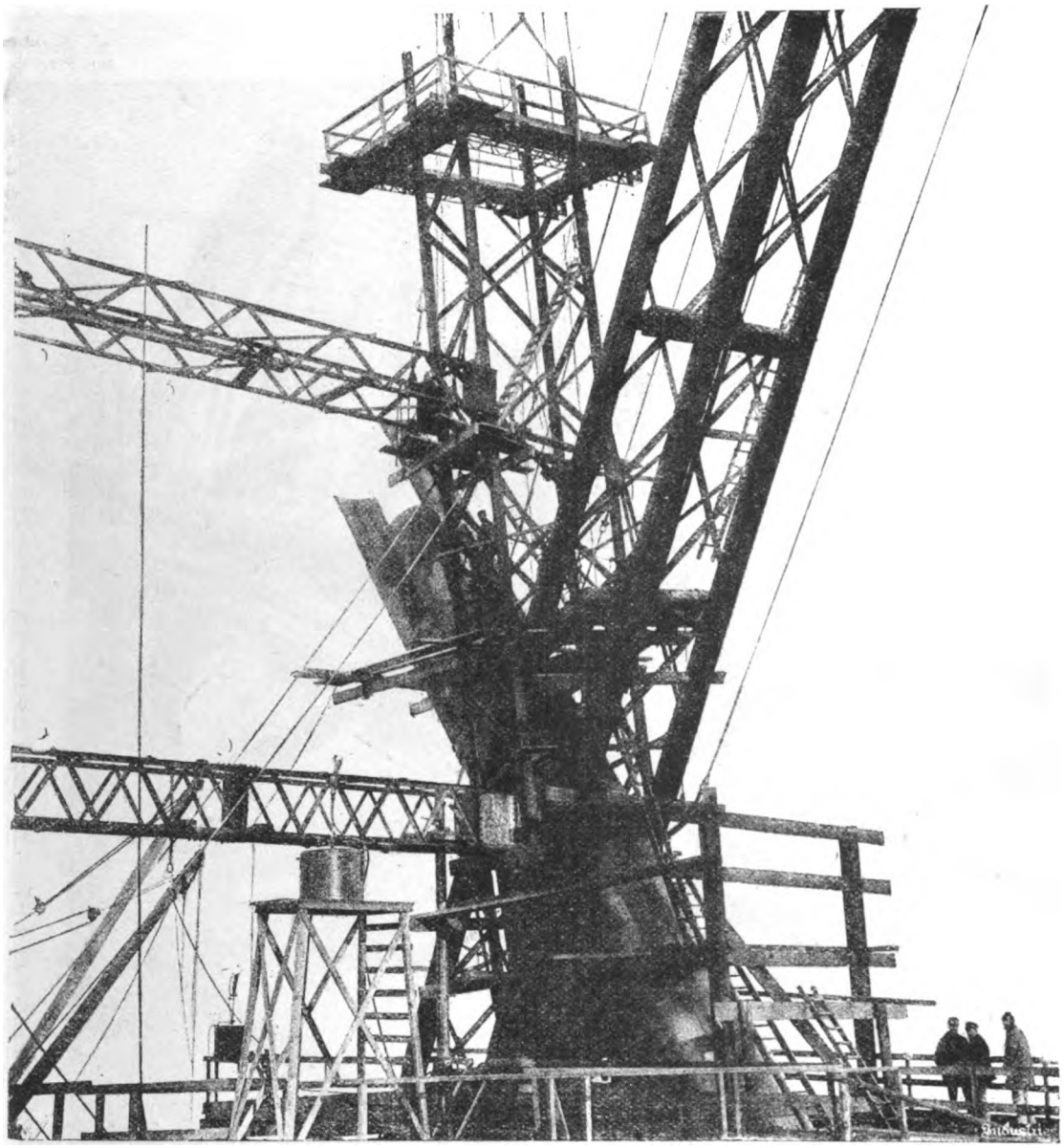


FIG. 52.—CROSSING OF TIE 1 AND STRUT 1, AND TEMPORARY VERTICAL COLUMN, 1888. SEE PAGE 30.

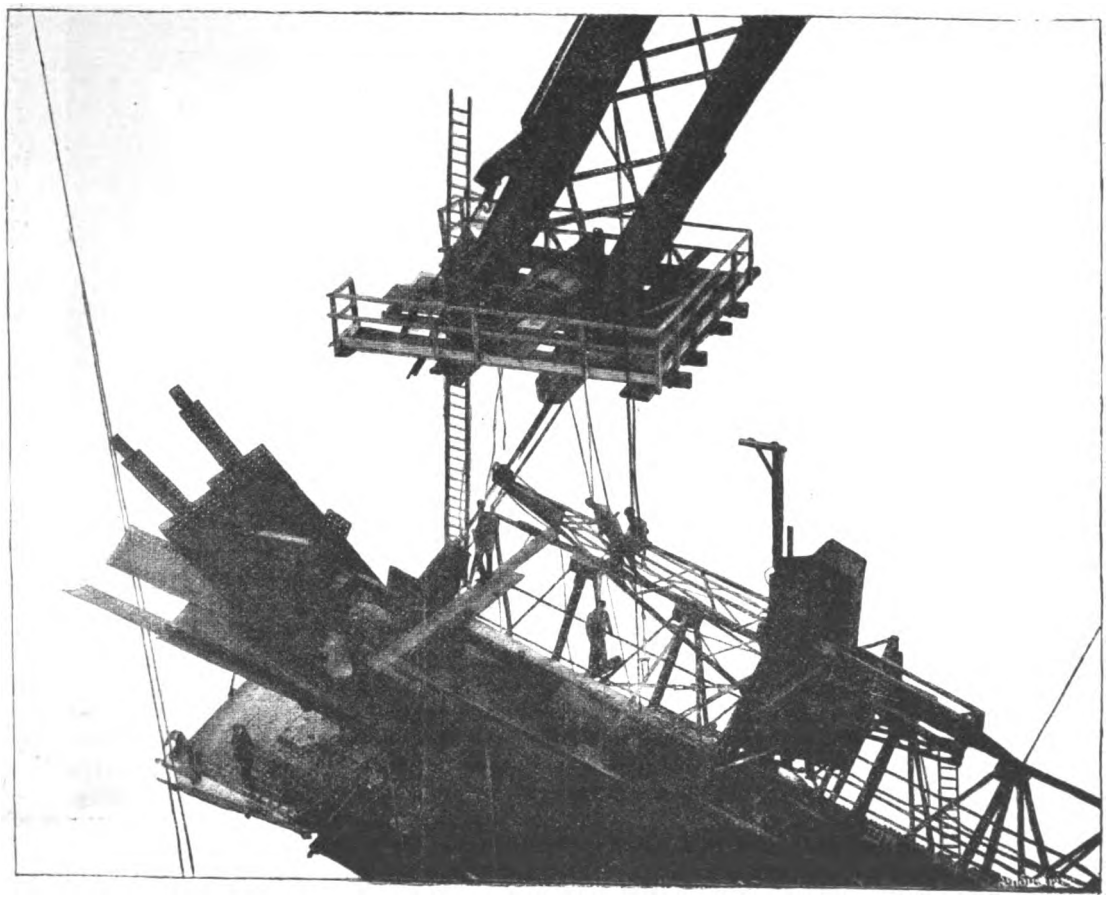


FIG. 53.—JUNCTION OF STRUT 2 AND TIE 1 WITH BOTTOM MEMBER, QUEENSFERRY, N.E., 1888. SEE PAGE 30

characteristic of this and the three succeeding years, we may briefly state that, on the south shore, Queensferry north-west main pier was completed, the viaduct piers raised to about half their total height, and the south abutment founded; whilst, on the north side, the cantilever end pier and the north approach viaduct piers were carried up to within a few feet of their ultimate height; and that, by the close of the year, upwards of 450,000 cubic feet of granite had been delivered, of which some 410,000 had been set, whilst over 100,000 cubic yards of masonry and concrete work had been built.

We pass on to the consideration of the steel work (See Figs. 22 and 23), and we will commence at the south end of the bridge; the lower bed-plates (of which more hereafter) of the north-east and north-west main piers were fixed, and the upper bed-plates (of which more again) of all four main piers were erected and riveted. The skewbacks (See subsequent detailed account), with horizontal tubes and bracing girders connecting them, were practically complete, and a commencement had been made with the erection and riveting of the bottom members. The vertical columns and diagonal struts had been erected for nearly one-third of their total height by means of an erecting platform (a description of which, and methods of raising, will be given later), and in all nearly 2,000 tons of tubes and lattice-work had been riveted up.

Turning now to Inch Garvie, the lower bed-plates on the south-east and south-west main piers were riveted and lowered into position during this year, whilst the upper bed-plates of the whole group were erected and riveted up; the four skewbacks, together with the horizontal tubes and bracing girders, were complete, and a commencement was made with vertical columns, diagonal struts, and bottom members, as also with the temporary erecting platform. Riveting on the tubes and girders was completed on over 2,000 tons of material.

At North Queensferry the progress which was made by the end of 1886 was as follows:—The whole of the bed-plates and skewbacks were completed and the riveting up of the latter about two-thirds finished; the vertical columns and diagonal struts had been raised to fully half the total height; and a commencement made with the erection of the bottom members. Upwards of 2,000 tons of steel work was riveted. (See Fig. 24.) In addition to the amount of work erected in this year, as described, progress had been carried on in the workshops, with the result that by the end of 1886 the internal viaduct was well in hand, as far as drilling and fitting were concerned, and the junctions of bay 1, were considerably advanced, in addition to further lengths of the bottom member prepared for erection. Over 33,000 tons of steel were delivered by the close of this year, and the average number of hands employed was approximately 3,000.

THE BED-PLATES AND SKEWBACKS.

The lower bed-plates, having been fitted and drilled in the shops, were put together over the masonry piers upon iron supports, sufficiently high to enable the hydraulic riveting to be proceeded with. The lower bed-plates were then lowered into position over the heads of the foundation bolts, and they will ultimately transmit to the masonry the whole weight of the superstructure, rolling load, &c. (See Figs. 25 and 26.) The surfaces of the lower bed-plates were ground smooth by emery wheels in special machinery designed to travel over them, and were subsequently coated with crude petroleum before the upper bed-plates were laid on them. These latter were fitted, erected, and riveted in the same manner as those below them, and for similar reasons. The riveting of the bed-plates (See Figs. 25 and 26) was performed by two longitudinal girders, connected together, one on each side of the work, each being provided with a ram travelling along it for closing the plates.

"The skewbacks" (See Figs. 18 and 19), says Mr. A. S. Biggart, in his paper read, on January 24th, 1888, before the Institution of Engineers and Shipbuilders in Scotland, "are the most complicated parts of the entire structure, the difficulties at this point arising

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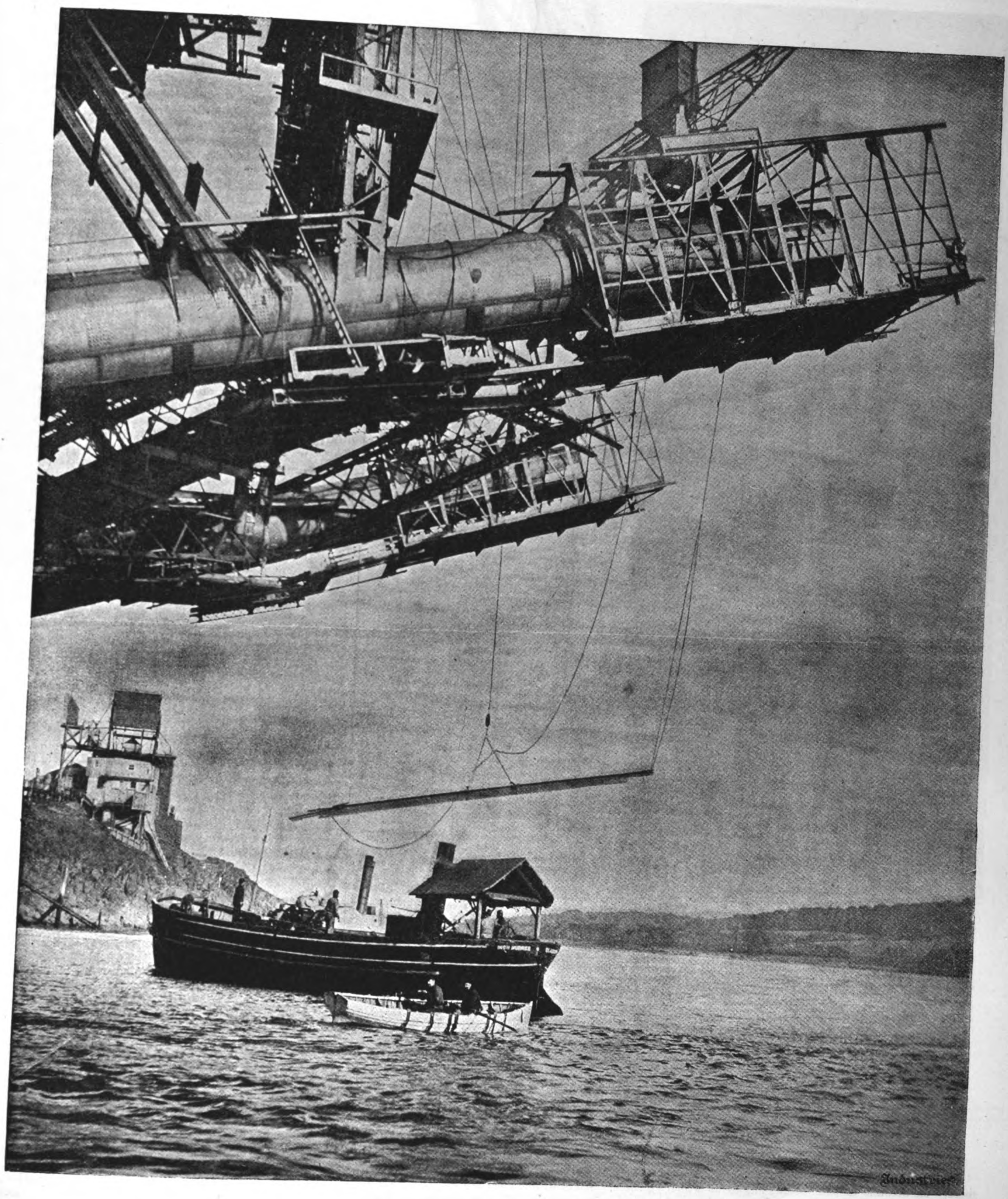


FIG. 54.—SOUTH CANTILEVER OF INCH GARVIE MAIN PIER, 1888. SEE PAGES 26 AND 30.

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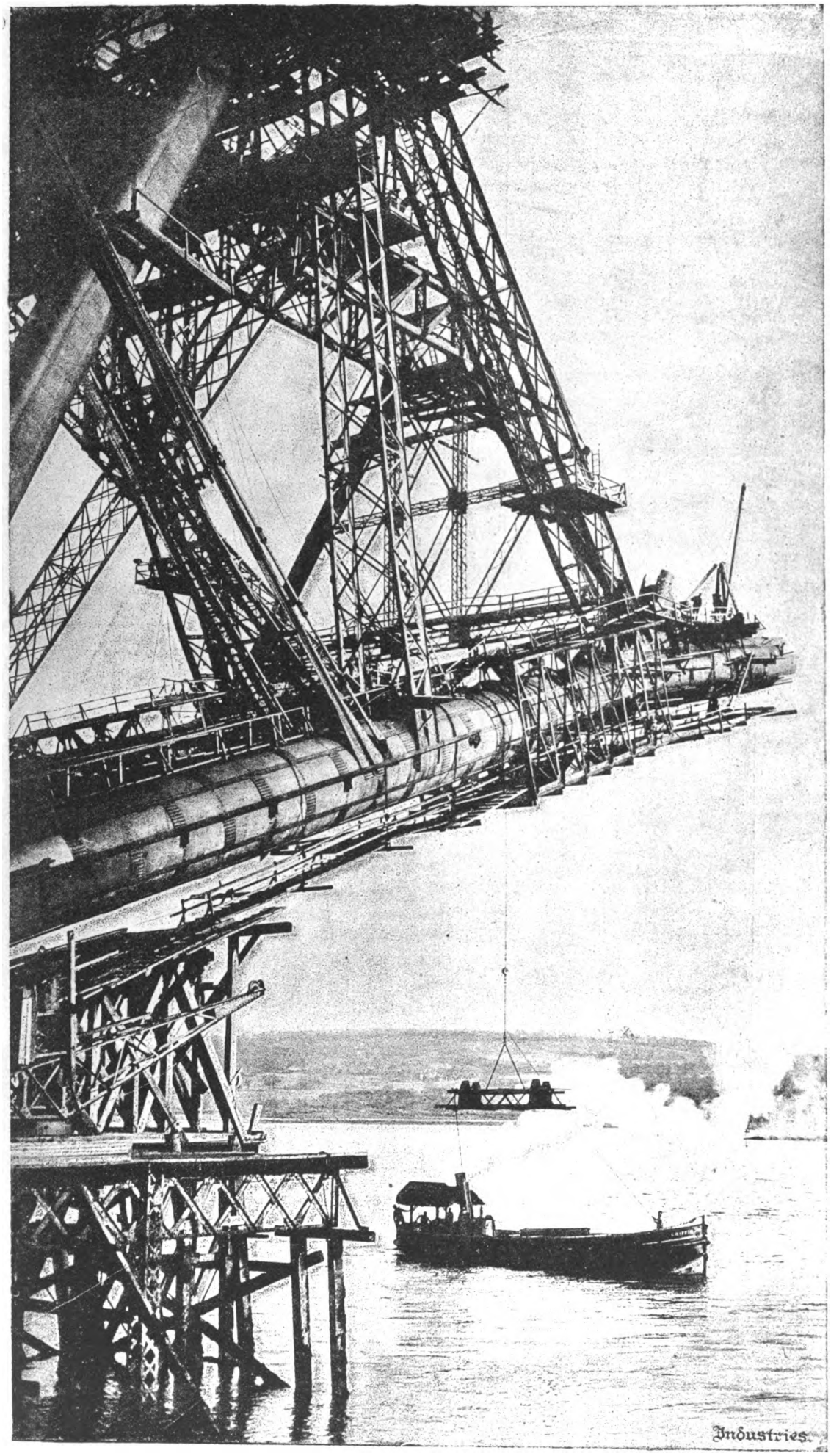


FIG. 55.—SOUTH CANTILEVER OF THE FIFE MAIN PIER, 1888. SEE PAGE 30.

mostly on account of the various angles at which the different parts lie in relation to one another and to the skewback. Each skewback may be looked upon as being either the starting point or termination of five separate tubes and five distinct box girders. All these members are so joined to it as to transfer into or through the various parts of the skewback the stresses of each member. The skewbacks also act as the upper or sliding bed-plates, on which some of the movements of the piers and cantilevers, due to expansion and contraction, take place. The sliding surface is the lowest course of several layers of steel plates, which form the base of the skewback (described already as the "upper bed-plate"). On the top of these bed-plates a series of longitudinal girders are riveted, while in section these girders are crossed at short intervals by one central and two smaller side diaphragms. Small stamped diaphragms are also placed between the longitudinal girders immediately under the main ones. Between the centre and side diaphragms, and beyond the latter, are riveted four longitudinal lines of plates, as also a top plate, all of which merge into the horizontal and cantilever tubes at the opposite ends of the skewback. To the inner lines of the plates the sides of the two small 8ft. tubes are riveted. These also serve as part of the connection to the vertical column. Gusset plates and angles are principally used in making the connections of the girders to the skewbacks."

The riveting up of the skewbacks required special appliances, and was a task involving much ingenuity and time. In the interior portions riveting by hand was altogether impracticable, owing to lack of space, and the ordinary rams were also, for a like reason, unavailable. They were dealt with by special rams 4in. in diameter, one acting as the holder-up, the other as the snap. (See Fig. 19.) The water pressure on the works of 1,000lb. per square inch was increased to about 6,000lb. per square inch for the service of these rams by special intensifiers with rams 4in. and 10in. diameter. (See Figs. 27 and 28.) The riveters worked in spaces as small as 2ft. 6in. long by 15in. high by 15in. broad, access to this limited area being still further reduced by a 4in. angle running around the top. The timber backing to the rams required careful management. Working under such conditions, with constant shifting from cell to cell, a riveting squad could close about 100 rivets per day.

PLATFORMS FOR ERECTION PURPOSES.

The erection of the vertical columns was performed by means of a platform supported by the columns themselves and carried up with them. (See Fig. 25; also Figs. 19 and 24.) The principal conditions laid down with reference to the erection of the central portions of the double cantilevers were, as stated by Mr. F. E. Cooper, M.I.C.E., Resident Engineer of the Forth Bridge from 1885 to 1890, in his paper before the Iron and Steel Institute in 1888:—

"1. That in order that the men should be able to work at any height in as great security and comfort as if on the level of the ground, platforms or scaffolding of considerable area should be provided.

"2. That the raising into position of the several parts of the structure should be as little as possible interrupted by wind, the ordinary derrick cranes not being then considered applicable.

"3. That the weight of the platforms and apparatus should not much exceed 400 tons.

"4. That the connections forming the supports should not bring excessive strains upon any part of the permanent structure.

"5. That no rams of the lifting apparatus should have to exert a lifting force of much more than 100 tons.

"6. That the platforms should form ultimately stages for building the top members over the piers.

"7. That, for the sake of economy, material forming part of the permanent structure should be made use of temporarily as much as possible."

The platforms were two in number, one on each side of the axis of the bridge. Each consisted of two parallel lattice girders (placed 18ft. 6in. apart), with all bracing required and a timber floor, holes being of course left for the vertical columns of the bridge. The platforms were 20ft. wide and 200ft. long at Fife and Queensferry, that at Garvie being 350ft. in length, owing to the greater distance the main piers were apart in the line of the bridge at that place. The longitudinal girders formed subsequently part of the permanent ties of the structure, thus effecting a saving of material. The main

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girders carrying the platform were in turn supported by short cross girders (See Figs. 36 and 37), inside the vertical tubes of the structure.

The following account of the method of raising was given by Mr. E. M. Wood, in his paper before the Institution of Mechanical Engineers in 1887:—

"The lifting gear for raising the erecting platforms consists of a pair of plate frames, one below the other, fixed inside each 12ft. pier-column, by pins passing through the wings of the frames and the ribs of the column. The lower frame supports the hydraulic lifting press; and upon the upper rests the through box-girder cross-beam, at right angles to the length of the bridge, passing through voids in the columns, where plates are temporarily left out for this purpose. These cross-beams support lattice-girders in pairs, one on each side of the column, which extend a little more than the full length of the side of the quadrangle formed by the piers. Upon the top of all comes the main deck, furnished with gantries, cranes, oil-heated rivet-furnaces, &c., complete in all respects for carrying on the chief operations of erection. On the bottom level of the girders is a lower deck, with the ends housed in to form temporary shelters for the men. The box and other girders are built up of parts which will eventually be used in the permanent structure. Communication between the level of the jetty and the platforms is made by hoists, drawn up between wire-rope guides by the winding engine on the level of the jetty, which lifts the material by wire ropes to the platform; safety clutches are attached to each cage, for seizing the guide ropes in case the hauling gear were to give way. During lifting operations, access to the platforms is gained by ladders laid up the cross-bracing between the main columns over the piers.

"The process of raising the platforms is as follows: Water-pressure at about 30cwt. per square inch is conveyed from pumps on the jetty to the lifting presses by wrought iron piping taken up the inside of the columns, and is turned into the cylinder, lifting the load off the series of pins in the top frame. The pins are then withdrawn, and the ram lifts the box-girder, carrying with it the loose frame, until it comes oppposite the next series of holes in the ribs of the columns, into which the pins are then inserted; the pressure is released, and the box-girder again rests upon the upper frame. In the return stroke the ram, hanging by its shoulders from the upper frame, by means of its piston form now hauls up the lower frame, from which the pins have been withdrawn; and when this has been re-pinned, it is ready to support the press for another upward stroke. By this means the platforms have been gradually raised, generally through lifts of 16ft. at a time, until arrival at the summit. On their way up they have been utilised for building the tubular cross-braces and other work; and at the present time those at the southern and northern piers form the stage for erecting the top members between the heads of the main columns.

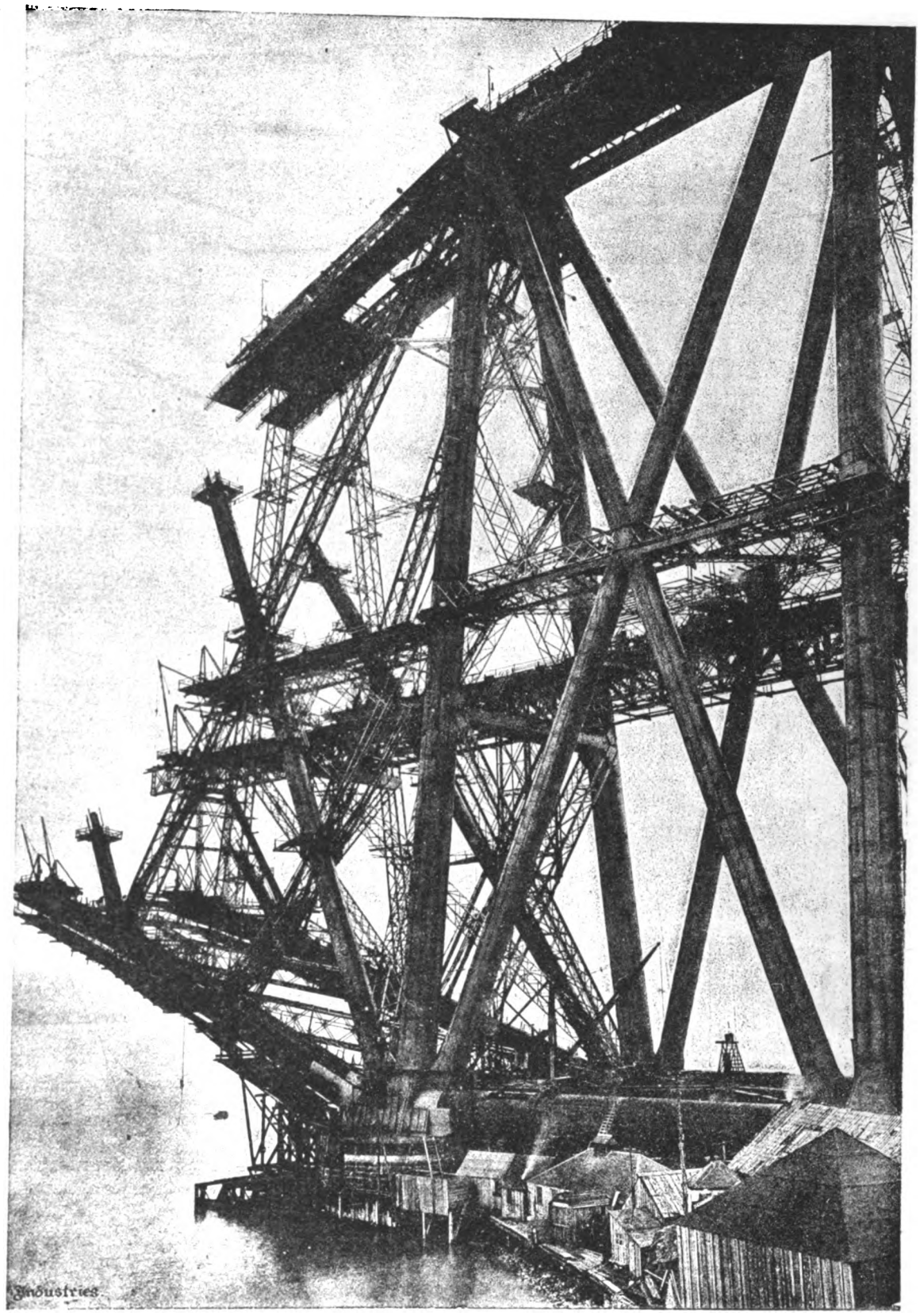
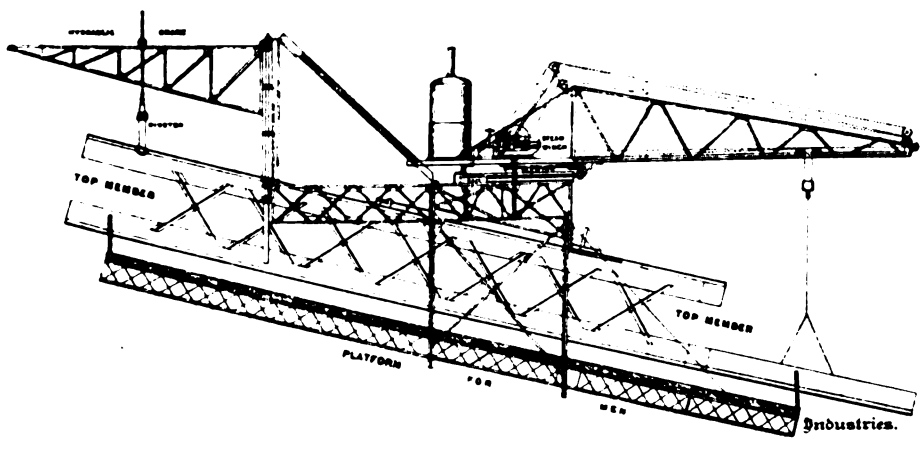
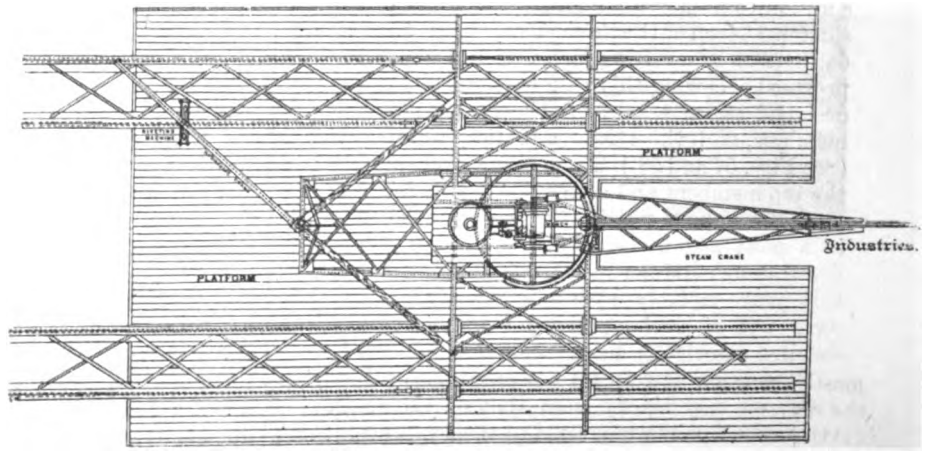


FIG. 56.—ANOTHER VIEW OF SOUTH CANTILEVER OF THE FIFE MAIN PIER, 1888. SEE PAGE 30.





FIGS. 57 AND 58.—CRANES FOR THE ERECTION OF THE TOP MEMBERS, ETC. SEE PAGES 26 AND 30.

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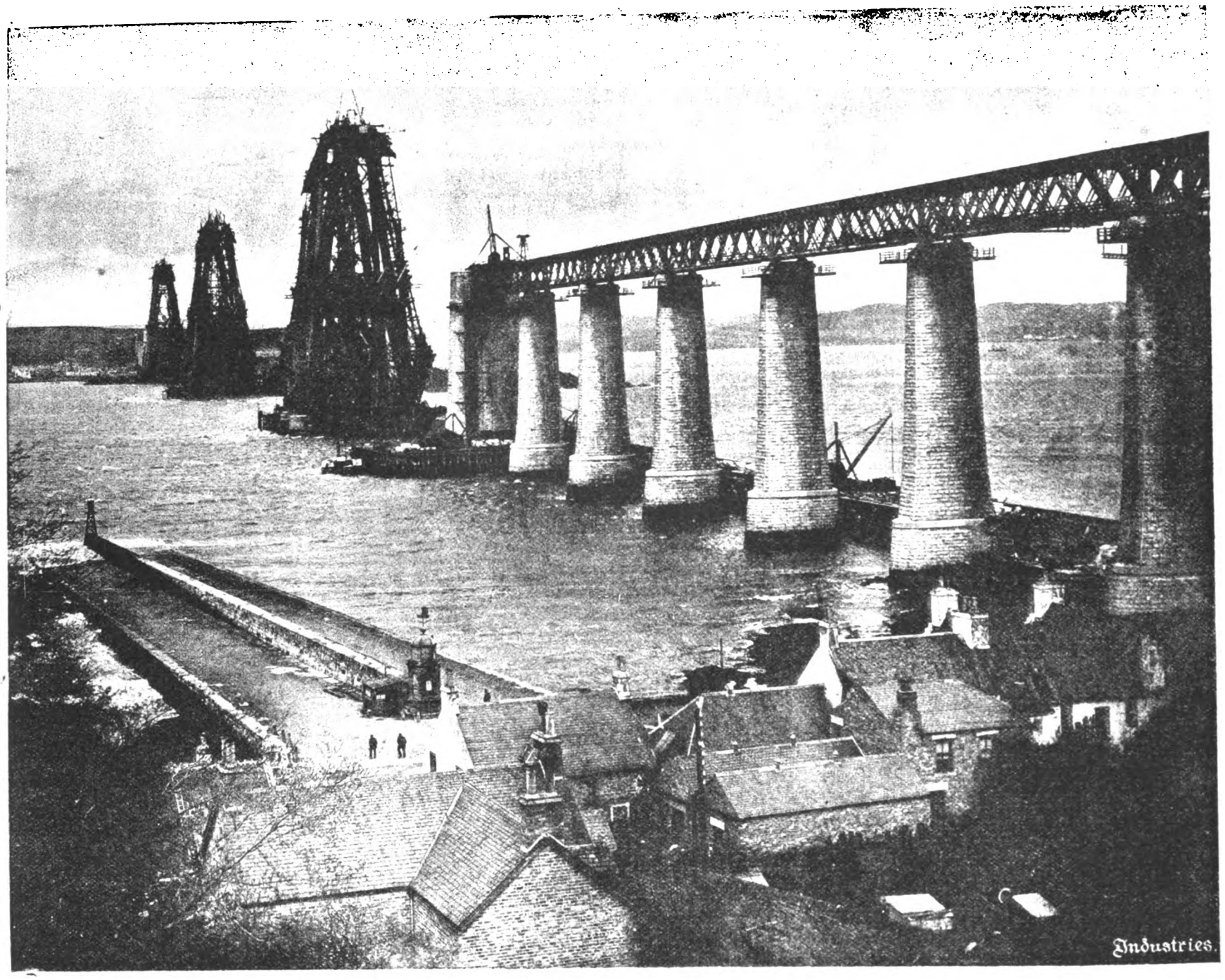


FIG. 59.—GENERAL VIEW OF THE WORK FROM THE SOUTH-WEST, 1888. SEE PAGE 30.

"In building the pieces together, they are connected by service bolts, until the hydraulic riveters are brought into action."

PROGRESS DURING 1887.

The temporary work executed in this year was almost wholly with reference to the erection. In addition to numerous stagings and minor platforms, shelters at each of the three piers, capable of accommodating 200 men during meals or bad weather, were provided. During this year four out of six specially designed steam cranes for the erection of the top members, and the struts and ties, were provided. (See Figs. 57 and 58.) These cranes were attached to the top members, and as they gradually followed the work throughout erection they commanded the work in a most advantageous manner. (See subsequent description.) Much other minor plant was added this year—notably hydraulic rams, &c., but they were not of such special interest as to merit a detailed description here.

Passing on now to the masonry executed during 1887, we may briefly state that on the south side the viaduct piers were raised to their full height and completed, the south cantilever pier carried up to about rail-level, and the south abutment raised to the springing of the arches. On the Fife shore the north approach viaduct piers were also carried up to full height and finished, the completion of the north abutment being similarly effected, whilst the north cantilever pier was raised some 15ft. higher than that which corresponded to it on the south side. The total amount of masonry executed up to the end of this year was as follows: Granite delivered, about 570,000 cubic feet, of which some 560,000 were set, whilst upwards of 120,000 cubic yards of rubble masonry and concrete had been built.

At Queensferry (See Fig. 41) the erection of the steel work during 1887 was vigorously prosecuted, and by the end of the year the columns had been carried up to their full height, the diagonal tubes between them (See Fig. 47) completed, and the top members between them erected. In short, the superstructure over the piers, which, including the internal viaduct, forms the central portion of the cantilever, was practically erected. The southern bottom members had been carried out to nearly the end of bay 1, and the first bay of bracing between them erected. (For method of erection of bottom members, see subsequent account; also Figs. 38, 39, 40, 44, 54, &c.) The first ties and struts were also well advanced, and the erection of wind bracing of the latter had been commenced, whilst the first vertical ties, with their bracing, and the support to the internal viaduct, had been erected.

At the north end of Queensferry main pier the bottom members were slightly further advanced, whilst the first ties and first struts had been built to their junction with each other, and the first vertical ties had been similarly erected. In all nearly 5,000 tons of work were riveted up at this pier by the close of 1887.

At Inch Garvie (See Fig. 42) the vertical columns had reached full height by the close of the year, and the erection of the junctions at the tops were well advanced, whilst good progress had been made with the top members between the vertical columns. Nearly the whole of the bracing between the vertical columns was erected and riveted, and the horizontal bracing for staying the columns at mid-height was completed. The internal viaduct over the piers was finished. The southern bottom members had been carried out some 150ft., and a commencement made with the wind bracing between them. Ties 1 and struts 1 were well advanced. Similar progress on the northern side had been made with the bottom members and ties 1 and struts 1. In all some 6,000 tons of riveted work had been executed at this point by the close of the year under consideration. (For progress, see Figs. 45 and 49.)

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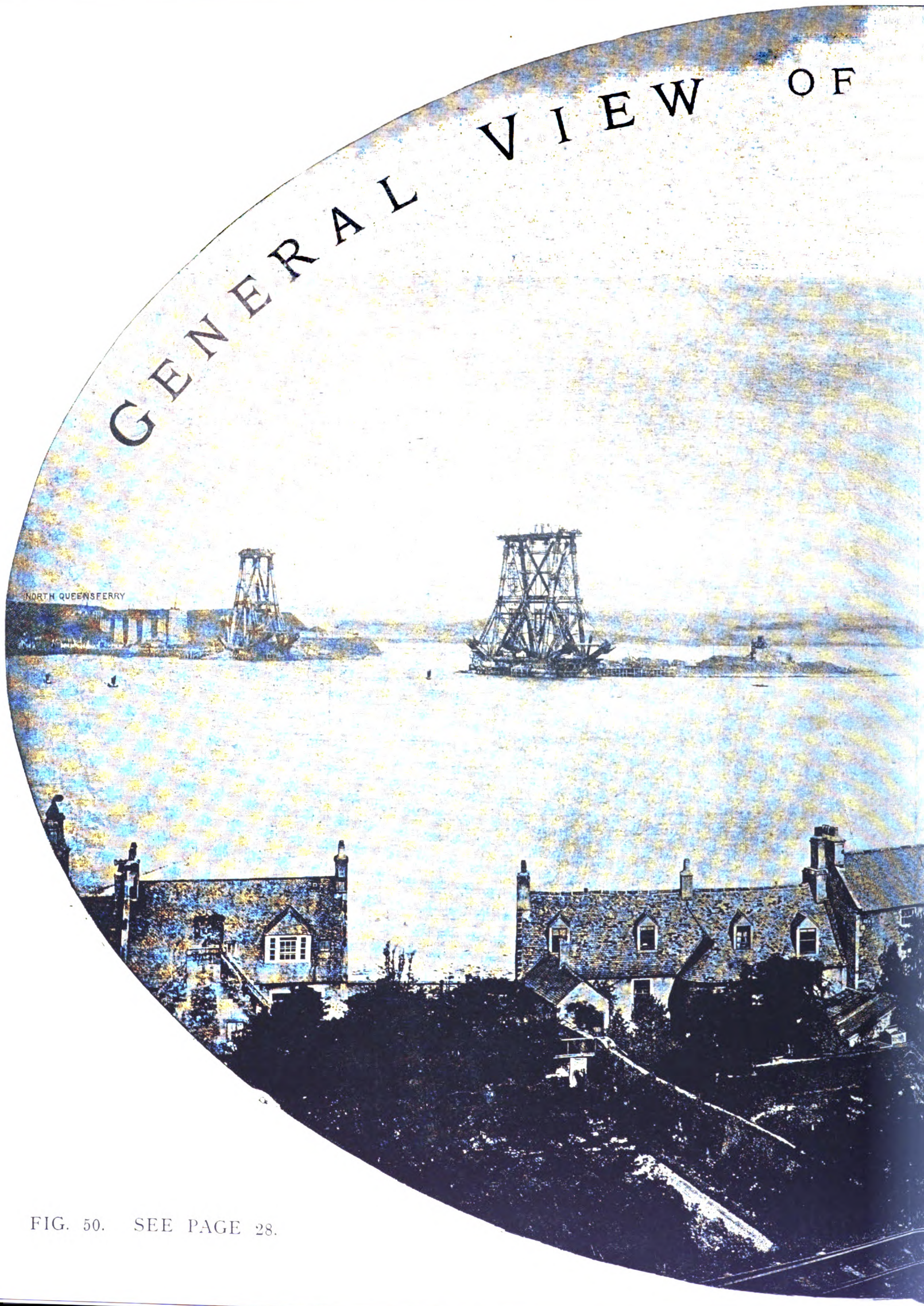
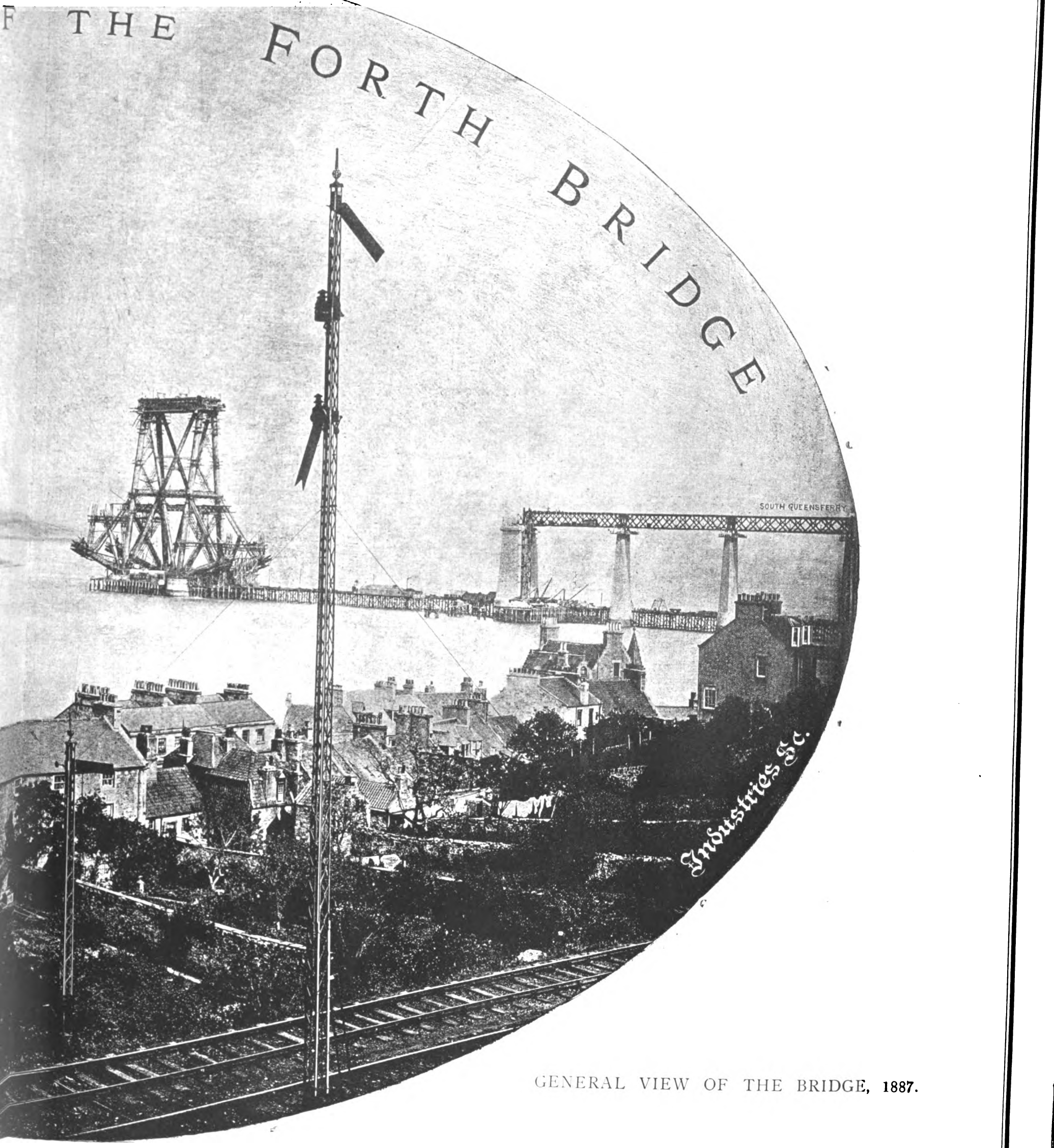


FIG. 50. SEE PAGE 28.

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GENERAL VIEW OF THE BRIDGE, 1887.

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B. Baker

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Williams Arrol

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DIRECTORS OF THE FORTH BRIDGE RAILWAY COMPANY.



LORD COLVILLE OF CULROSS, K.T.



SIR MATTHEW WHITE RIDLEY.



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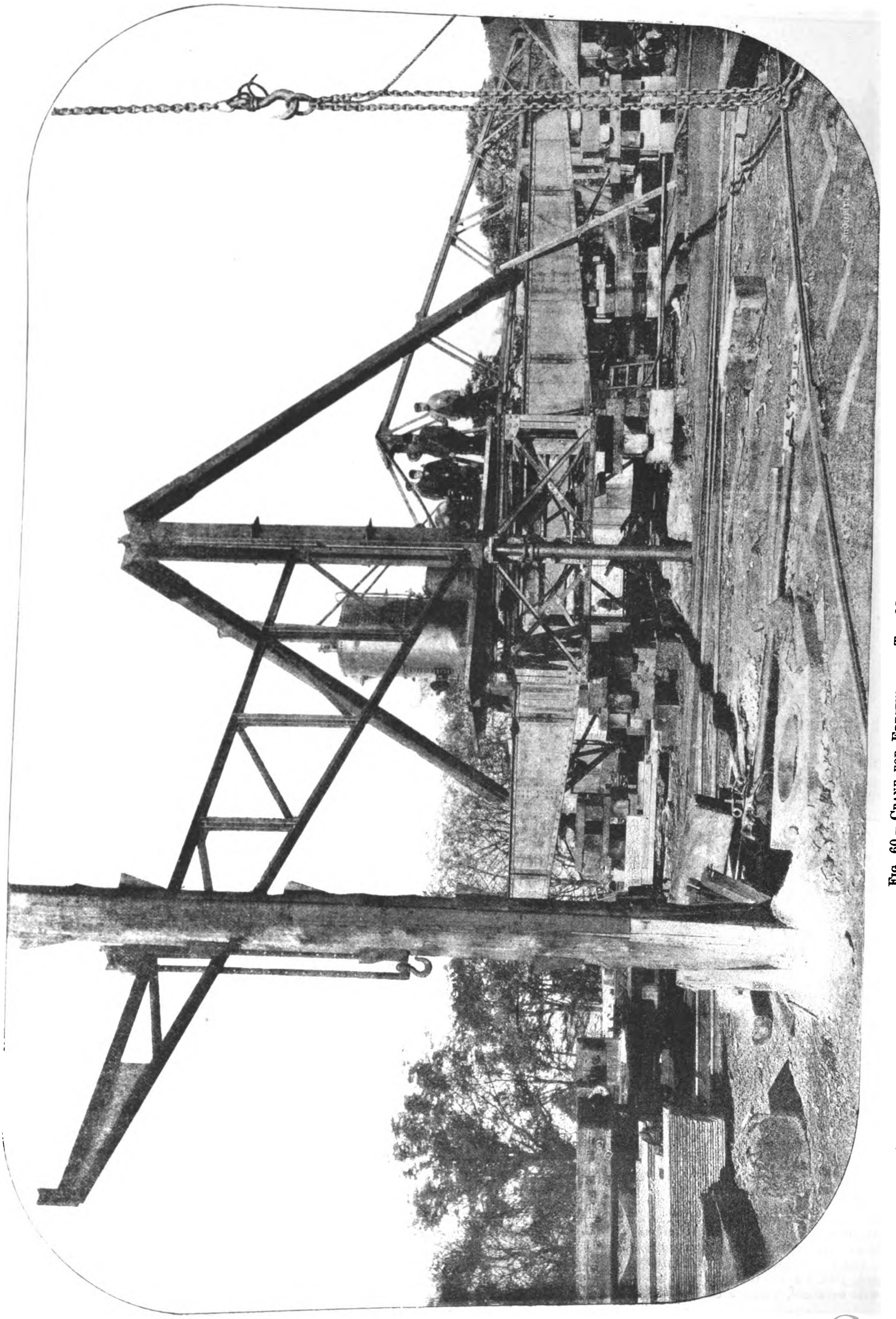


FIG. 60.—CRANE FOR ERECTING THE TOP MEMBERS. SEE PAGE 30.

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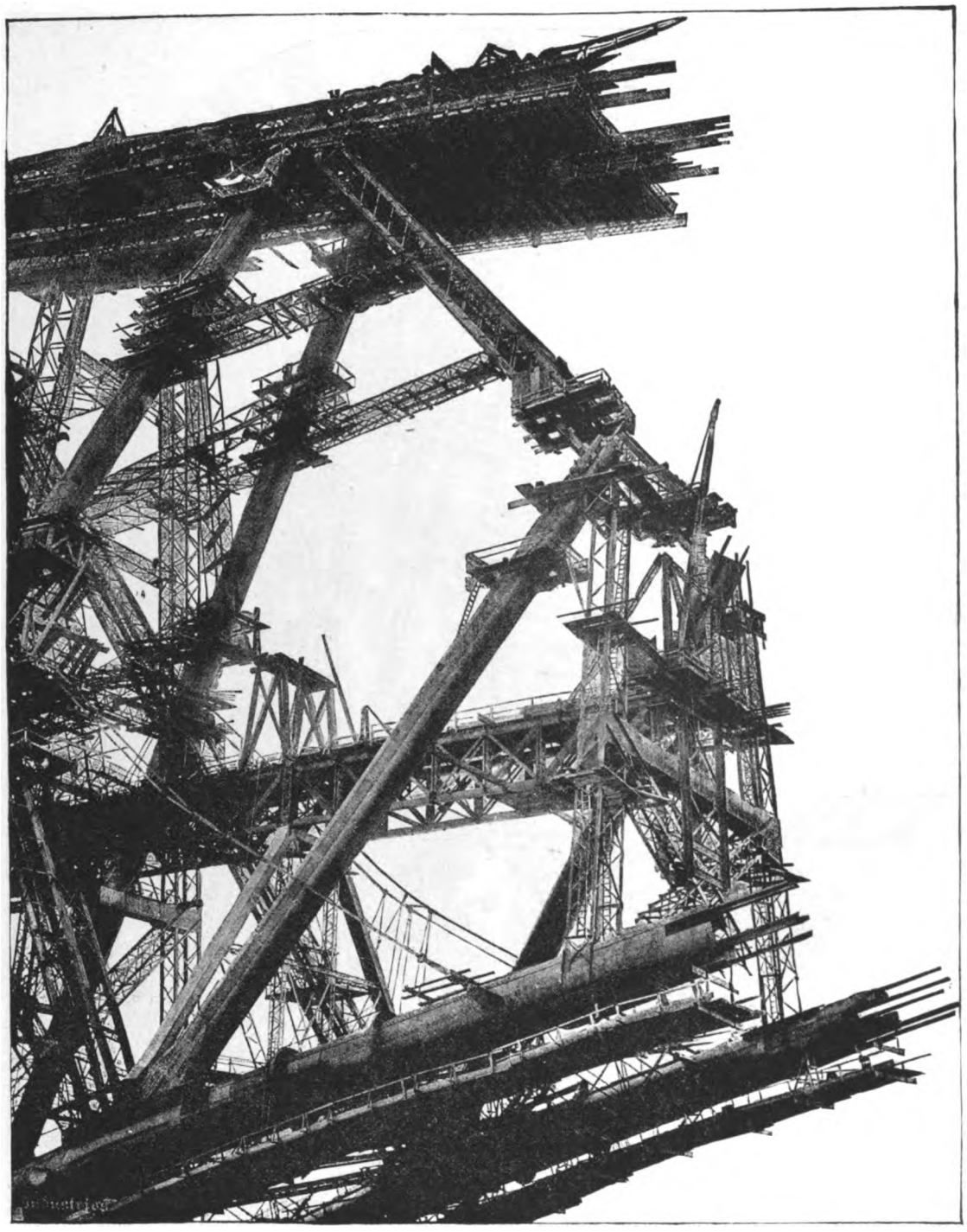


FIG. 61.—CANTILEVER FACING THE FIFE SHORE, 1888. SEE PAGE 30.

Passing on to the Fife side, the vertical columns had here also reached full height, and the top members between them had been erected; also the internal viaduct. The southern bottom members had been carried out some 170ft., and nearly two bays of wind bracing between them erected. The ties 1 and struts 1 had been well advanced, and the vertical ties 1, with their bracing, were complete. On the northern portion the bottom members were nearly as far advanced as those to the south, whilst the ties 1 and struts 1 were well in hand, and similar progress to that on the southern portion had been made with the first vertical ties and internal viaduct. In all upwards of 6,000 tons of material at this pier had been riveted up before the close of the year.

Progress in the shops and on the drill roads had been steadily maintained at all points during this year, and the whole of the bottom junctions for bays 1 were completed and ready for erection; the bottom junctions for bays 2 were all in hand, whilst all those for the top of bay 1 had advanced towards completion. The drilling of all the top members for bays 2, and the bottom members for bays 4, was completed, that for struts No. 3 and ties No. 5 being well advanced, whilst a commencement had been made with drilling the top member of bay 4 Some 48,000 tons of steel were delivered by the end of the year.

The number of men employed during the year averaged about 3,500. (For general progress during 1887, see Figs. 43 and the double-page supplement).

ERECTION OF THE BOTTOM MEMBERS.

Figs. 40 and 44 illustrate the method of building the tubular overhanging bottom member of the cantilever. This was 12ft. in diameter at the starting point, being reduced by $\frac{1}{8}$in. to the foot, and was sufficiently rigid to carry itself for a length of 120ft., supporting besides its own weight (which amounts to about 30cwt. per foot run) a steel cage or envelope, with the necessary crane and riveting machine. The envelope was rectangular, measuring 19ft. square, and was divided into six duplicate parts or panels, which were interchangeable. It was supported upon the tube by two circular rings, which were attached to the finished portion, and carried a 2-ton hydraulic crane of special design, on a travelling frame running upon the tops of its sides. As the tube was being built at the front end, the riveting was done between the two supporting rings, at the after part of the cage, by a machine similar to those employed on the columns of the steel pier. On the completion of a length of 16ft. (being that of one course), the supporting rings were moved forward, and two segments of the cage, which were each 8ft. wide, were passed from the after to the forward end, by means of the hydraulic crane; the riveting machine was then drawn up the tube 16ft., and the operations went on as before. The length of the first bay of the cantilever was about 180ft., and as the weight of this caused a greater bending moment than could be safely carried by the tube, it was supported by a temporary tie, formed partly of the links from the old Hammersmith bridge, and partly of plates taken from bay 3 of the top member, this being fastened to the columns about 150ft. up from the centre of the bottom member. (See Figs. 53, &c.)

The hydraulic crane referred to above had a simple form of construction, and possessed three independent movements, viz:—(1) Lifting and lowering the load; (2) describing a complete circle; (3) traversing the full length of the cage. As in the case of the lifting platforms for the erection of the vertical columns, the objects kept in view in the design of this apparatus were large working platforms for the men, together with cranes for dealing with the material, actuated by hydraulic power, and having a short lift. The several vertical movements which took place in the bottom members may here be noted: (1) a gradual fall, owing to increased weight as the tubes were gradually built out, and the leverage of the weight of the temporary plant increased; (2) a rise due to the pull occasioned by the weight of the link ties; (3) a rise caused by the increased pull on the link ties when the platforms and main plate ties were placed in position; (4) a rise as the hydraulic rams raised the member; (5) a gradual fall on account of the stretching of the main plate ties as the weight of a portion of the first bays of the cantilever and plant was transmitted to the ties; (6) a rise due to a temporary pull put in force before connecting the permanent ties; (7) a gradual fall as the cantilevers were built out, thus leaving the bottom members with only the normal initial stress when the bridge was completed.

ERECTION OF LOWER PORTION OF BAY 1.

The erection of the lower portion of bay 1—*i.e.*, the lower portion of struts 1, the first vertical tie and support to the internal viaduct—was by means of a lifting platform similar, but smaller, to those already described, and raised in a like manner by hydraulic jacks placed in the vertical ties and on the vertical columns. (See Figs. 46, 49, and 51.) Before describing this platform, it may be here explained that it was originally intended to have carried it up to the top members, and indeed to have built them on it, but the project was abandoned, as it was found that the men could work without such platforms being used.

"The experience gained," says Mr. Cooper, in addressing the Iron and Steel Institute in 1888, "up to this time, as to the ability of the men to work unaffected in situations more exposed than was at first deemed advisable, as well as the ease with which large and heavy pieces of material could be raised great heights by ordinary cranes and tackle, with little interruption from anything but a strong wind, rendered it possible for a great modification to be made in the mode and apparatus made use of, and these platforms were carried no higher than the level of the intersection of the first ties and struts. The appliances used on the erection up to this point, though amply fulfilling all the conditions of the problem, were necessarily slow in action, and costly to make, put together, and take down; and it must be borne in mind that when the vertical columns, with their bracing, and top and bottom members connecting them, were completed, an immensely powerful support was available, from which the other members of the cantilever and the internal viaduct could be held up by temporary stays as securely as if supported by staging on the solid ground below."

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The Riveting.

The riveting of the bottom members, vertical columns, and diagonal struts between them, was performed by specially designed hydraulic riveters. (See Figs. 29 and 30.) The apparatus consisted of two heavy steel girders, 22ft. apart, with angle distance pieces as framing, which, when covered with netting, made a complete cage, from which nothing could fall. Independent rams were employed for the holder-up and snap, and were capable of being raised or lowered on slides by a small hydraulic jack. The action of the riveter is thus summed up by Mr. Cooper: "The rivet, properly heated, was placed from the inside into the hole, the holder-up was brought opposite to it, the valve admitting the water was turned on, the holder-on thrust the rivet in up to the head, and held it there whilst the ram on the outer girder closed the rivet, the same valve admitting water to both rams; but a slight check in the branch leading to the outer ram permitted the rivet to be sent home by the inner ram before the pressure was applied to form the snap." About 800 rivets could be closed by this apparatus in ten hours. The cylinders, both inside and outside, were capable of putting a pressure of 40 tons on the point of the rivet on any part in a length of 17ft. The inside girder did not travel bodily like its fellow outside, but rotated, as shown in the illustration, upon trunnions at its ends. The ordinary portable hydraulic riveter used on the works is shown in Fig. 31, whilst the method of riveting up the junctions by hand is illustrated in Fig. 63, and by this machine again in Fig. 64.

Rivet Furnaces.

Figs. 32–35 illustrate the small reverberatory furnace employed for heating the rivets, often required at the rate of three or four per minute, in confined spaces. The heat was derived from the combination of blast-furnace residual oil delivered through a special disintegrator, in a fine spray, by air at about 20lb. per square inch pressure. The furnace itself was a small fireclay-lined iron box, rounded at the end admitting the oil. A galvanised iron tank, holding 15 gallons, supplied fuel sufficient for about 4½ hours. The following is a further description of this furnace: "In the centre of the domed top of this tank there is fixed a cross-piece, having one 1in. and three ½in. branches. The inch branch is made fast to the top of the tank, and has passed down through it a ½in. pipe, which reaches to within an inch of the bottom. Air at 20lb. per square inch is conveyed through the flexible hose H to one of the two horizontal arms of the cross-pieces, its admission being controlled by a small brass plug cock. The air pressing on the surface of the oil forces it up the central pipe already mentioned, from whence it is carried by the flexible hose H_1 to the branch B on the side of the burner. The second horizontal branch of the cross-piece is connected by the flexible hose H_2, through which the air passes to the end D of the burner. The burner, as can be seen from the sectional elevation, is something like an injector; the central pointed nozzle through which the air passes is moved longitudinally by means of a butterfly nut A, regulating by its motion the quantity of oil passed into the furnace, which, as already stated, is forced by the air through the branch B into the annular space round the nozzle. The quantity of air passing through the burner is controlled by the cock C. To light the furnace when it is all connected as described, the air is turned on at the cock H, which controls the supply, and the oil is forced into the burner through the branch B. The nozzle is then drawn back by the butterfly nut the necessary amount, and the air passing up its centre disintegrates the oil into a fine spray, when it can be ignited by a match or lighted piece of waste. The air which passes through the nozzle is not nearly sufficient for combustion, the remainder being drawn along the upper heated passage in the furnace already described, and, coming down through the holes in the arched roof, meets the spray just as it enters. The furnace is less costly than a coal one large enough to do the same work, and it has the additional advantage of being about one-sixth of the weight. The regulation of the heat is complete; rivets are heated uniformly, and the apparatus is under perfect control, and in every respect a complete success. A small furnace, 1½ft. square and 4ft. long, will," Mr. Cooper states, "heat 2,000 rivets per day at a cost of about four shillings."

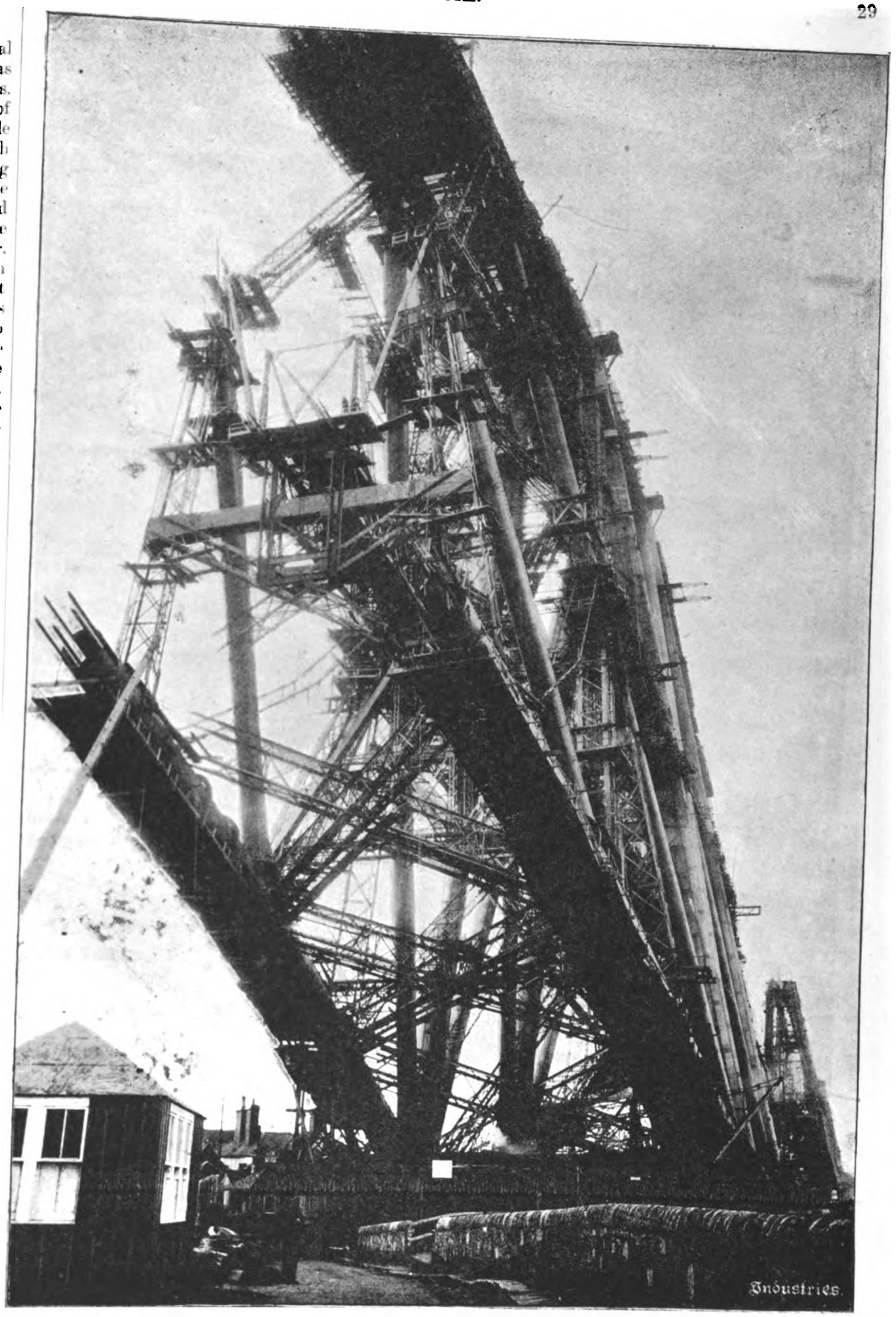


Fig. 62. North Side of Fife Main Pier, 1888. See Page 30.

PROGRESS DURING 1888.

As in the previous year, the temporary plant added during 1888 had reference almost solely to purposes of erection, and comprised the remainder of the double derrick cranes, with detached winches, for the erection of the internal viaducts, and subsequently of those portions of the bottom members and other parts within reach; a large quantity of staging for riveting and erecting purposes; an addition to the timber jetty at South Queensferry, and numerous hand derrick cranes of the ordinary type; winch to hydraulic riveters; and further hoisting gear and cages. The masonry work executed during this year is comprised within brief limits. The south cantilever pier was carried up some fifty additional feet, and the arches of the south abutment completed. On the Fife shore similar progress had been effected with the building of the north cantilever pier. The total quantity of granite delivered up to the end of 1888 was about 615,000 cubic feet, of which about 610,000 cubic feet had been built in position, whilst over 113,000 cubic yards of rubble masonry and concrete work had been placed in the piers and abutments.

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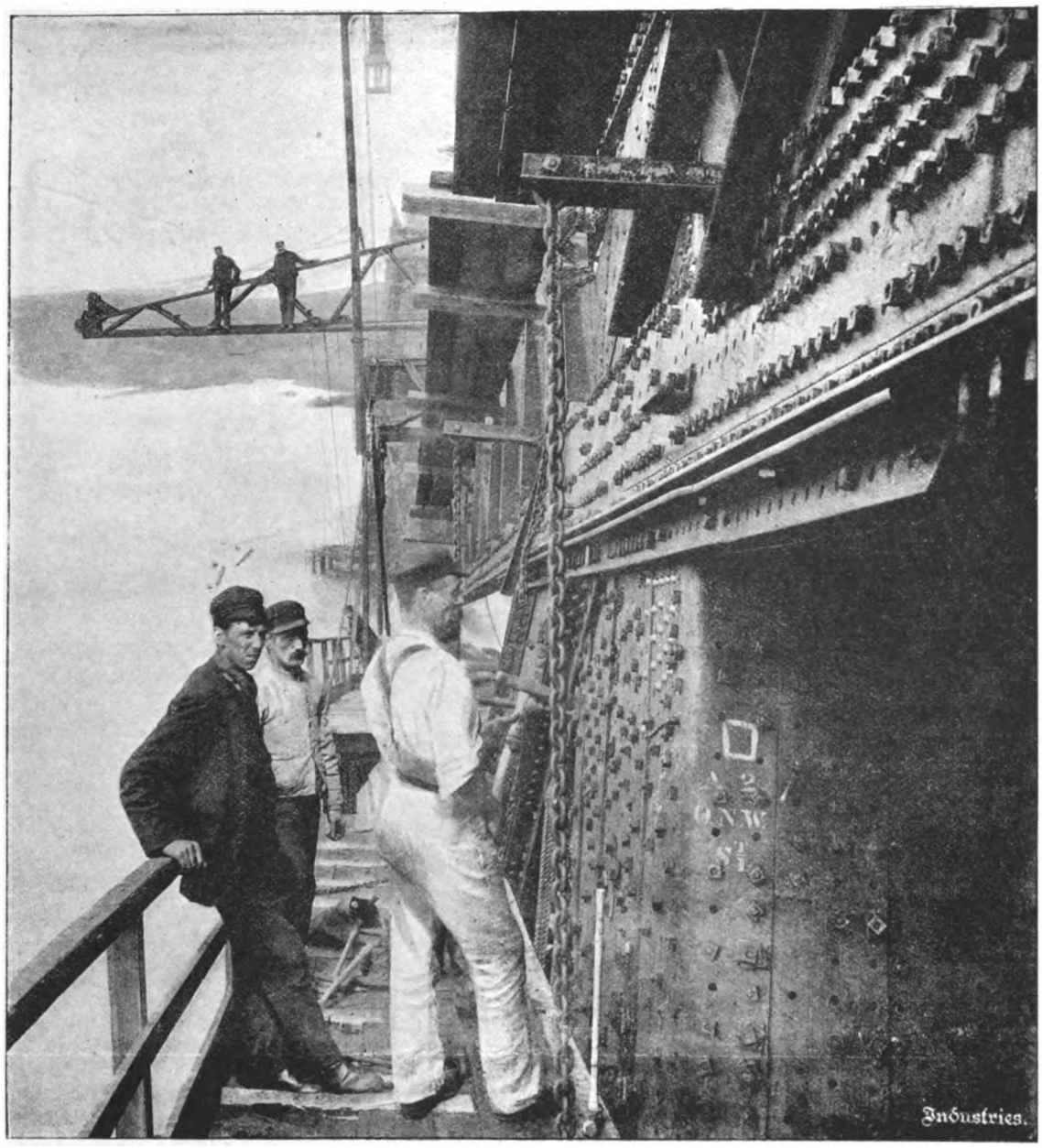


FIG. 63. RIVETING THE TOP OF STRUT 1 OF NORTH QUEENSFERRY PIER. SEE PAGE 29.

Progress with the erection of the steel work during 1888 made rapid strides. (See general views, Figs. 59 and 65.) Commencing at Queensferry, and with the southern cantilever, the junctions of ties 1 and struts 1 were duly made (See Fig. 52), and these members carried out to their junctions with the lower and upper members respectively (See Fig. 53); the second bay was practically completed, and the third bay well advanced towards being finished; the top members had been carried out some 420ft. from the vertical columns, and more than half this distance had been riveted up (See Fig. 65); the main girders and bracing of the internal viaduct had been extended over 400ft. from the vertical columns (See Fig. 48). On the northern cantilever progress was even more marked. By the end of the year under consideration the principal members of the third bay were erected, the junctions at the ends of the bottom members in place, and those at the ends of the top members well advanced. The fourth struts were also commenced. Over 300ft. of the bottom members were riveted and some 260ft. of the upper ones similarly completed. Upwards of 11,000 tons of material had been riveted up at South Queensferry by the close of 1888.

Turning now to progress at Inch Garvie, and commencing with the southern cantilever, practically the whole of the first and second bays were completed at this date, and the bottom members of bay 3 had been built out to a distance of more than 400ft. from the vertical columns; the top members were built out for a distance of 400ft. from the vertical columns, of which about half was riveted up, whilst the girders and bracing of the internal viaduct had been extended to about 400ft. from the vertical columns.

On the north cantilever progress had been made as follows: Bays 1 and 2 were practically completed, and the second about half riveted up; the bottom members of the third bay had been built out about 350ft. from the vertical columns, of which some two-thirds had been riveted up; the top members had been built for a distance exceeding 300ft., also about two-thirds riveted up; whilst the girders and bracing of the internal viaduct had been carried out some 360ft. from the vertical columns. In all about 13,000 tons of riveted work had been executed at Inch Garvie by the close of 1888. (See Figs. 54 and 65.)

At North Queensferry south cantilever bays 1 and 2 had been completed, and the latter about two-thirds riveted, and the bottom members for bay 3 carried out to the end of the bay, whilst a commencement had been made and good progress attained with the ties and struts of this bay. The bottom members were built for 450ft. from the vertical columns, which all had been riveted up with the exception of some 50ft. The top members had similarly reached a distance of about 450ft., more than half of which had been riveted up. The whole of the vertical ties and the trestle at the centre of bay 3 were in position, and the girders and bracing of the internal viaduct had been erected to the end of that bay, or 425ft. from the vertical columns.

In the second bay of the north cantilever similar progress had been made to that in the southern one. The bottom members had reached about 450ft. from the vertical columns, of which about three-fourths had been riveted. Struts 3 were well in hand, and the top members carried out some 400ft., of which more than half had been riveted. The girders and bracing of the internal viaduct had been carried some 450ft. from the vertical columns. A total quantity of 11,000 tons of steel work had been riveted up at North Queensferry by the end of this year. (See Figs. 51, 55, 56, 61, and 62.)

In the workshops excellent progress was maintained throughout this year, and by its close progress stood as follows: Bays 1 and 2 drilled and fitted; bays 3, the whole of steel drilled, and fitting practically completed; bays 4, all the main members, the internal viaduct, and cross girders for internal viaduct drilled, fitting of top and bottom junctions well advanced; bays 5, all the main members drilled; bays 6, the top members drilled, and the main ties put in hand. About 54,000 tons of steel were delivered up to the end of 1888, and the average number of men employed at the close of the year was about 3,000.

ERECTION OF TOP MEMBERS AND UPPER PORTIONS OF STRUTS AND TIES.

The upper members and the upper portions of the struts and ties were erected by specially designed cranes, resting on the upper members, and following up the work as the cantilever advanced. Figs. 57, 58, and 60 (See also Fig. 66) illustrate the plant under consideration. The horizontal jib of the steam crane which projected towards the end of the cantilever was 35ft. long, and was capable of being slued 115 degrees on each side of the centre line of the bridge. The material was lifted by a steam winch, the main drum of which was constructed to coil about 400ft. of $1\frac{3}{4}$in. wire rope. The whole arrangement was mounted on a sliding steel framework, to which a large platform for the men was suspended. At the back a second crane, actuated by hydraulic power, was placed, along the horizontal jib of which ran the supports for the hydraulic riveter. Underneath the top member, and rigidly attached to the crane carriage, four longitudinal girders carried a platform 76ft. long by 45ft. wide, of such length as to extend from the extremity of the steam crane to that of the hydraulic one. When a length had been finished in front of the crane, the whole arrangement, as already stated, was slid forward on the part just completed, and another length was commenced. When, in the case of bay 1, the overhang was 125ft., and the stress on the vertical bracing (temporarily doubled) had nearly reached the working stress of $6\frac{1}{2}$ tons per square inch, with the end of the members deflected about 8in., a temporary continuation of the vertical tie in the centre of the bay was built up to the underside of the top members, and, jacks being interposed, the latter were raised the amount they had deflected, and secured by wedges. Similar extensions of the vertical ties in the other bays were subsequently made, in order to temporarily support and adjust the top members above them. These cranes were similarly employed in building down and in building up the ties and struts respectively, small timber stages (See Figs. 52 and 53) being built around these members for the men, and raised or lowered by ordinary tackle to follow the erection. To prevent undue strain on unsupported lengths of both struts and ties, temporary struts from the vertical columns, light girders and wire ropes, were extensively employed, as shown in the various diagrams and illustrations of the erection of the cantilevers.

ERECTION OF THE INTERNAL VIADUCT.

The internal viaduct (See Fig. 72), which was composed of lattice girders with spans from 39ft. to 145ft., and a buckle plate floor with trough girders, was erected by cranes with two masts and jibs of the derrick type, the former in line transversely with the axis of the bridge and 16ft. apart, strongly braced together, and secured to a movable timber frame, advancing along the outer rail troughs.

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"Each jib," writes Mr. Cooper, "is raised and lowered by means of a wire rope passing round a drum on the mast, but the wire rope lifting the material is passed through a sheave at the extremity of the jib; thence it is led over a sheave down the centre of the mast, and, by means of guide-pulleys, to some convenient point on the finished structure, whence to a steam winch. The object of separating the power from the crane is to lessen the weight concentrated at that point, the viaduct there being extended much in advance, and as a rule acting as a cantilever, its outer end being temporarily supported by wire ropes to some part of the finished structure. When the viaduct girders are being extended by these cranes little staging is required, the men being able to do the bolting up standing in the trough forming the top and bottom booms."

PROGRESS DURING 1889.

We now pass to the year in which the bridge was joined and the gigantic undertaking successfully finished. But little temporary work falls to be recorded during the year, beyond the addition of sundry hydraulic riveters, hand derricks, and minor plant.

The completion of the south abutment was accomplished this year, and nothing remained to finish the north and south cantilever piers, carried up to a height of 213ft. O.D., save the dressed granite cappings at the top, which were delivered, and only awaited the final arrangements of the ballast boxes at the cantilever ends to be built into position. (See Fig. 73.) The total quantities of masonry work executed are given elsewhere. The erection of the steel work executed during 1889 naturally divides itself into two sections—the completion of the cantilevers and the erection of the central girders—and is accordingly so treated.

The Completion of the Cantilevers.

The interest of the work executed in 1889 mainly centres in the erection and joining up of the 350ft. spans connecting the cantilever ends, and subsequently described. The erection of the remaining portions of the cantilevers had been carried out and completed in a manner similar to that already fully dwelt on, and by appliances and methods described in detail. Up to the close of May in this year 14,000 tons had been riveted up at South Queensferry, over 16,000 at Inch Garvie, and upwards of 14,000 tons at North Queensferry. By November 7th the entire structure was erected and joined up. By the end of the year the riveting completed, and the permanent way rapidly pushed on, whilst painting, both internal and external, was under execution. The joints of the tubes were made tight with tar concrete, with which the skewbacks had also been filled.

Referring to the illustrations which we are enabled to place before our readers for the year 1889, Fig. 67 shows the South Queensferry pier, looking westward from Long Craig pier. H.M.S. "Devastation," on the right hand, gives a scale to the bridge, whilst the nearness of completion of the undertaking is evidenced by the rapid approach of the southern cantilever towards the south cantilever end pier. The different cranes on the top members stand out sharply against the sky line, and explain themselves. Fig. 69 shows a view taken from the internal viaduct on Inch Garvie, between the two northern vertical columns, looking northwards. The rail troughs are clearly illustrated, whilst struts 1, 2, and 3 on either side will be observed. The corresponding ties are also clearly brought out, whilst the cross bracing of struts No. 2 stands markedly out in the foreground of our illustration. The top members at the upper portion of the picture will also be noted; and the various temporary stages and platforms for erection lend additional interest to the subject. In the background the southern Fife cantilever appears as a confused mass of steel work. Fig. 68 gives a view taken from the riveting stage on Garvie southern cantilever, then resting on bay 3. The upper members of bays 1 and 2, and the platforms and gangways for the erectors, are clearly shown.

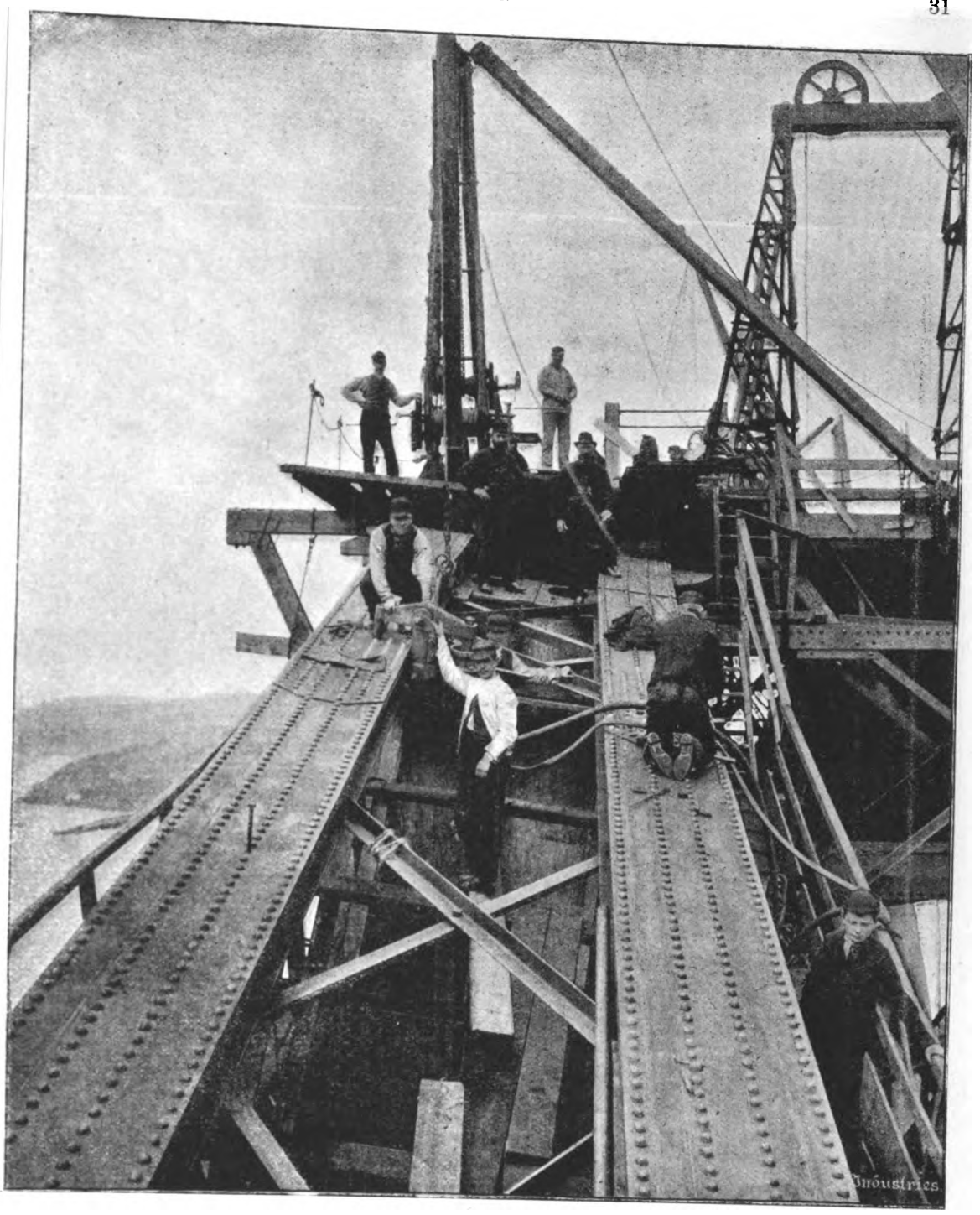


Fig. 64.—Riveting the Top Members of the Cantilevers. See Page 29.

Fig. 71 portrays a curious effect produced by looking towards Inch Garvie from between the main northern circular piers of Queensferry whilst standing on the timber jetty. The wind bracing between the bottom members of Queensferry northern cantilever is clearly shown in the upper portion of the picture; and a similar view is obtained of that between the Inch Garvie bottom members of the southern cantilever. The old castle on Inch Garvie stands out to the left of the illustration, surmounted by the different wind gauges, by means of which a careful record of the force of wind visiting the Forth is duly recorded. The northern or Fife shore is seen in the background. Fig. 70 was taken from the south cantilever end pier, when standing at rail level, and looking northwards at the Queensferry southern cantilever. On either side of the picture, the vertical columns connecting the bottom members with the junctions of ties 5 and struts 5 are clearly marked. Behind them struts 5 are seen; the bottom members in bay 5 are shown in cross section, and the cross-girder connecting them is prominently indicated. Below, the wind bracing between the bottom members appears in a confused mass; whilst above, an even more intricate and hopelessly entangled forest of bracings, struts, and ties appear, forming an almost solid mass, interwoven and interlaced beyond all possible recognition. The method employed in erection is well shown by this view, the various timber platforms on the different members, supported variously by chains and steel ropes, indicating with remarkable clearness the *modus operandi* adopted in erection. A curious piece of perspective may be noticed in connection with the bottom members, which at the bottom are 120ft. apart from centre to centre, whilst at the middle of bay 5, where the ends of the tubes appear in the illustration, the dimension from centre to centre, which looks nearly double the width of the members at the bottom, is only 40ft. Such is the curious effect produced in perspective by the narrower end being some 600ft. nearer the spectator than the wider lower portion of the bottom members. Fig. 80 represents the cantilever end pillars on the drill roads—that portrayed being the one for Queensferry north cantilever—the non-expansive end of the 350ft. central girder. This span is free to move at its northern end at the pillar at the end of bay 6, Garvie south cantilever. The brackets for the pin joints on the upper and lower crossed girders may be seen in the illustration.

Fig. 85 was taken from Inch Garvie looking in a south-westerly direction. The first bay of the central girder of the south main span is shown in place,

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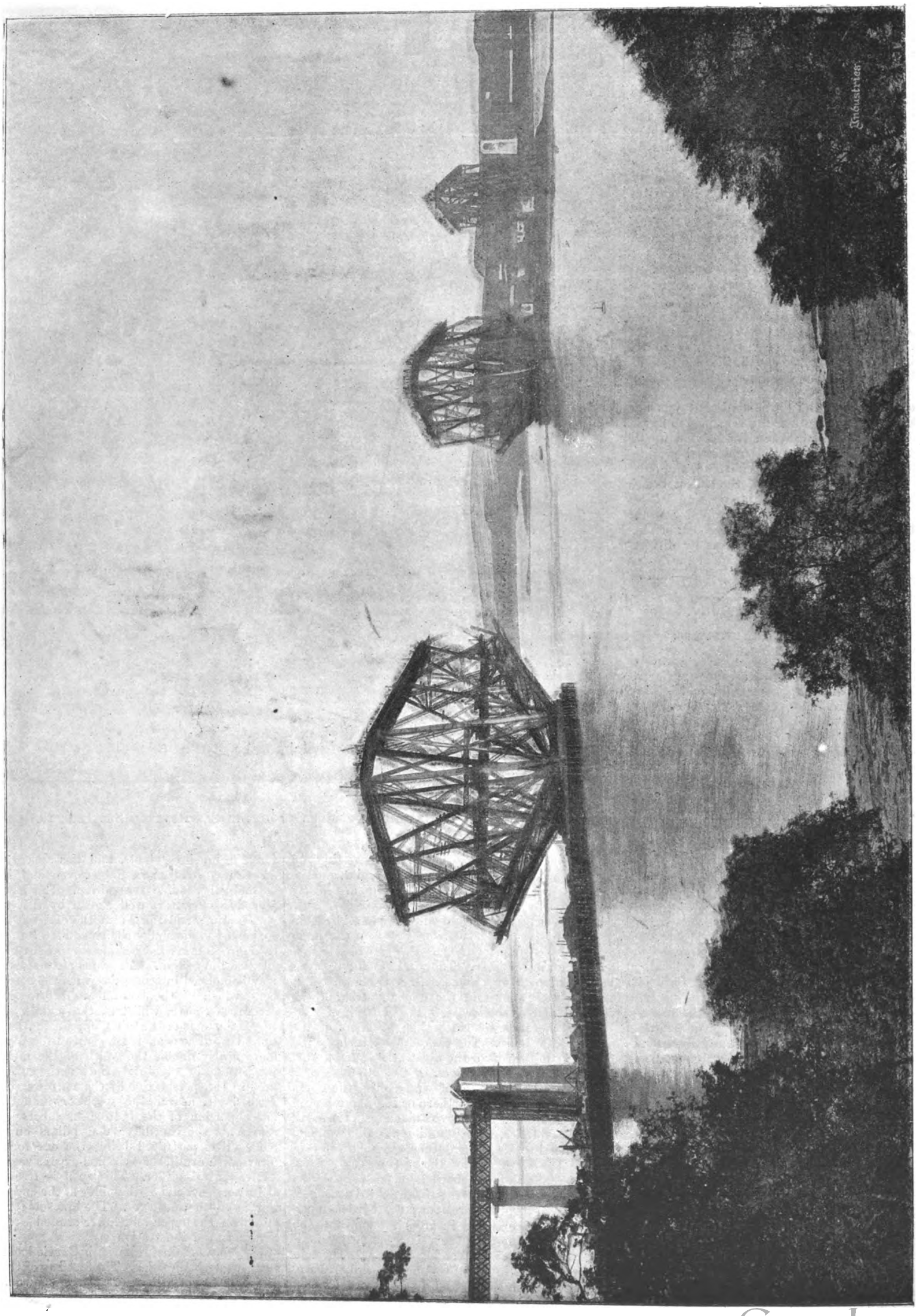


FIG. 65.—GENERAL VIEW OF THE CANTILEVERS, 1888. SEE PAGE 30.

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FIG. 66.—THE CANTILEVER PIER ON THE FIFE SHORE, 1888. SEE PAGE 30.

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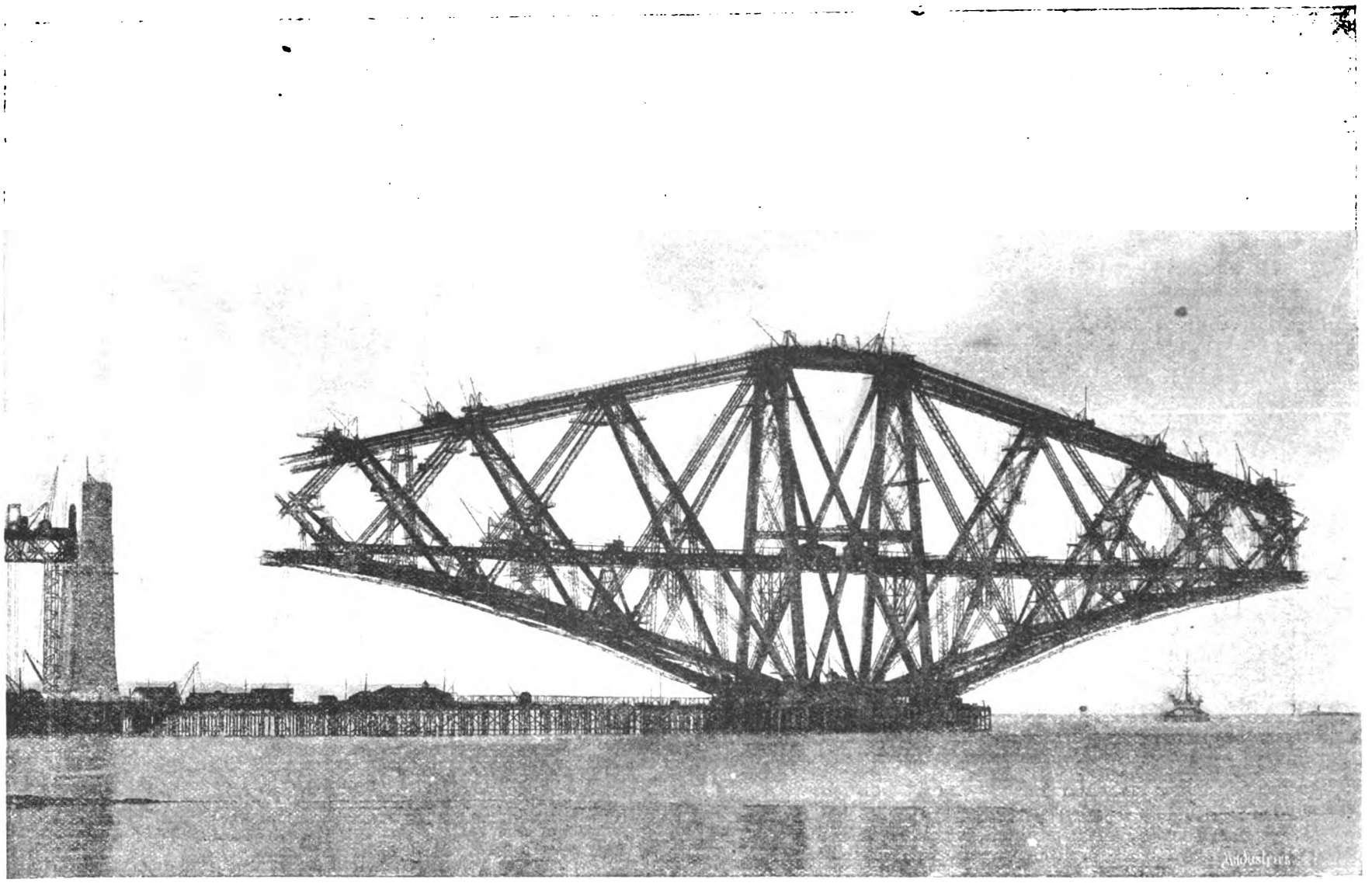


FIG. 67.—GENERAL VIEW OF SOUTH QUEENSFERRY CANTILEVER, 1889. SEE PAGE 31.

and the top member crane is shown resting on the main temporary tie which then connected these portions of the structure. Fig. 81 is a general view of the bridge from the east, as it appeared on the 17th September, 1889. The Queensferry cantilever is shown on the left, the Inch Garvie cantilever in the middle, and a few bays of the North Queensferry cantilever on the right. At the time the picture was taken the south central girder was complete, and only about 25ft. of the northern remained to be built.

In Figs. 82, 83, and 84 we give outline sketches to show the progress of the structure at different periods, the dark lines representing the parts erected at the several periods.

Fig. 86 is an end view of the central girder when about half built, taken from the extremity of the opposite side advancing to meet it.

When the southern or fixed arm of the Queensferry cantilever had been built out sufficiently to enter the recess in the masonry pier at that point, it became possible to ascertain exactly the longitudinal and transverse alteration of position in the former due to changes of temperature, and a simple apparatus was made use of to register these, so long as the end of the cantilever was free to move. To the lower plate of the last bottom member a board about 18in. square was fixed. Upon this was secured a sheet of drawing paper. Attached to the masonry was a bracket of timber, through which a pencil, with its point resting on the paper, was passed, free to move vertically, but rigidly fixed otherwise. As the cantilever end, affected by temperature, moved about, the pencil marked on the paper the character and extent of this movement. A few of the diagrams thus drawn have been reproduced in full size, and are shown in Figs. 74, 75, 76, 77, 78, and 79. They are specially interesting as being drawn by a giant arm 670ft. in length, and weighing about 5,000 tons. The maximum movements observed were recorded on the 21st and 22nd June, 1889, when that transversely was 5·2in., and longitudinally 1·1in., the shade temperature ranging at the time from 53° to 71° F.

THE CENTRAL GIRDERS.

Mr. Baker foreshadowed in his paper on the Forth Bridge, read at the Southampton meeting of the British Association in 1882 (before any contract had been entered into, or the final studies completed), the method which has been adopted in the erection of the central girders. He then said: "The central girders will also probably be erected on the overhanging system, temporary connection being formed between the ends of the cantilevers and the central girders. The closing lengths or key-pieces, at the centre of each 1,700 feet span, will be put in on a cloudy day, when there is little variation in temperature; and the details will be so arranged that the key-piece can be completed and the temporary connections cut away in a few hours, so as to avoid any temporary inconvenience from expansion and contraction." Notwithstanding this plain statement of opinion, many engineers, and most of the general public, have rigidly held to the idea that the central girders would be built on the shore, floated out on pontoons to the site, and then gradually raised into position by hydraulic appliances.

The putting in place of large girders, where the great height above the water level generally debars the use of scaffolding, has almost universally in Britain been accomplished by the method above mentioned, that is to say, building on shore, floating out, and raising by hydraulic power. The main spans of the Britannia, Saltash, and Tay Bridges are familiar instances of this, and it would naturally occur to many people that the method so successful in these ought to have been adopted in the present case. But circumstances alter cases, and it became obvious to those who carefully thought out the matter that the cantilever system offered special advantages for the building of the central girders in their final position, so that practically the launching and raising method of erection received little if any consideration. It was justly maintained that when the arms of the cantilevers, weighing about 5,300 tons each, and projecting out from the piers 680ft., had been successfully built in place, it would be found but child's play, so to speak, to continue them as a temporary part of the central girders 175ft. further with an extra weight of about 400 tons.

The composite girders are each composed of two side girders with cross-girders attached to their bottom booms, which cross-girders carry the troughs in which the rails are placed; buckled plates form the flooring of footpaths at the sides and of the spaces between the troughs. Each side girder is hog-backed (See Figs. 87 and 89), and in cross section (See Fig. 88) is inclined inwards, just like the outer faces of the cantilevers. The length of each is 350ft., the depth at the centre is 51ft. 5in., and at the ends 40ft. 2in. The top and bottom members are open troughs, formed of side plates 3ft. deep, and bottom and top plates respectively 3ft. wide, of varying thickness. The bracing is formed of plates, struts, and ties, stiffened as required, dividing the girder into eight bays, each 43ft. 4in. in length. From the intersection of each strut and tie a vertical tie supports the bottom member, and plate cross-girders, 4ft. deep at the centre, are attached to the bottom members, at the foot of each main tie and vertical tie. The alteration in form of the cantilevers due to the effects of temperature, wind, and rolling load necessitated

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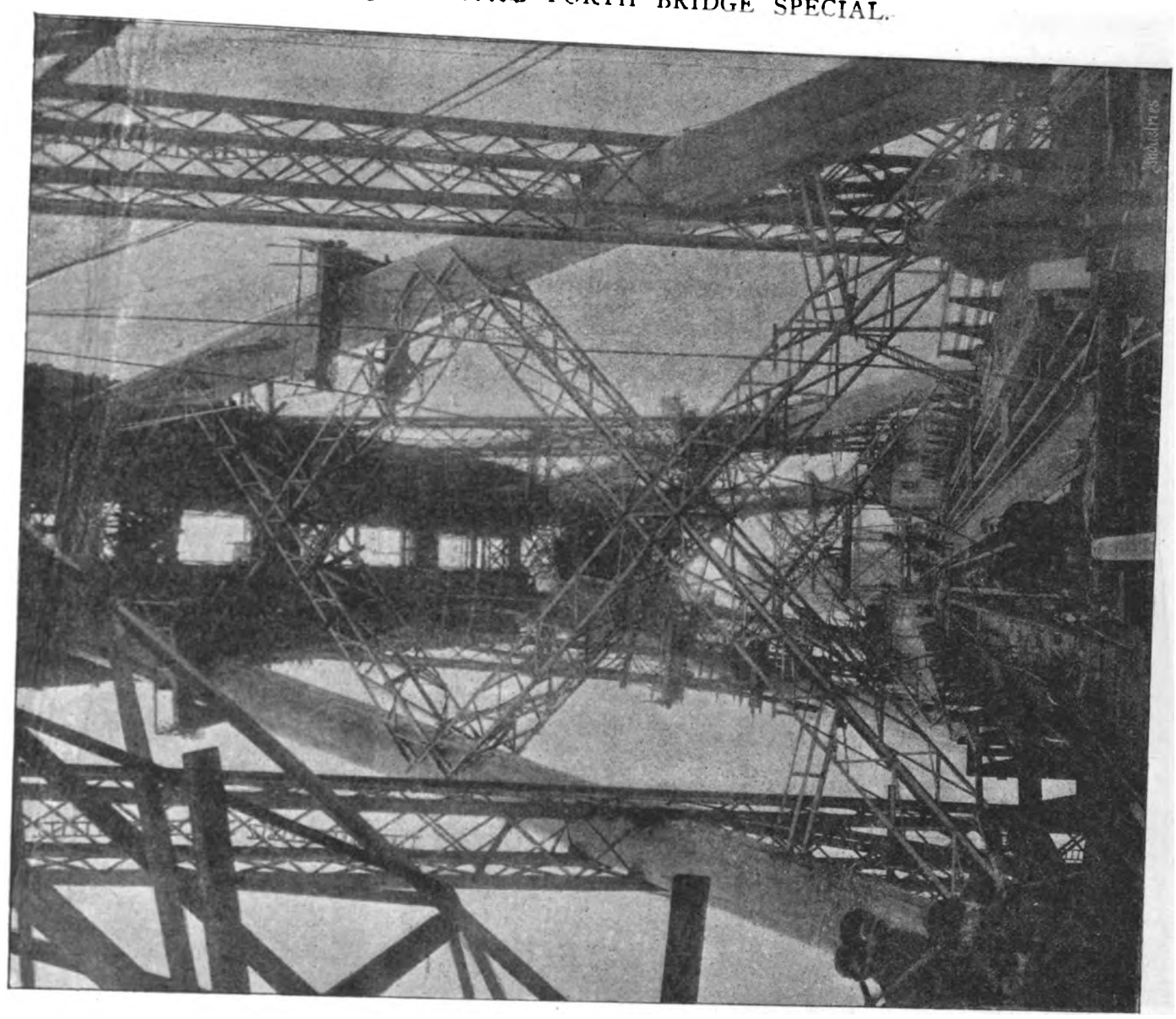


FIG. 69.—VIEW OF INTERNAL VIADUCT ON INCH GARVIE, 1889. SEE PAGE 31.

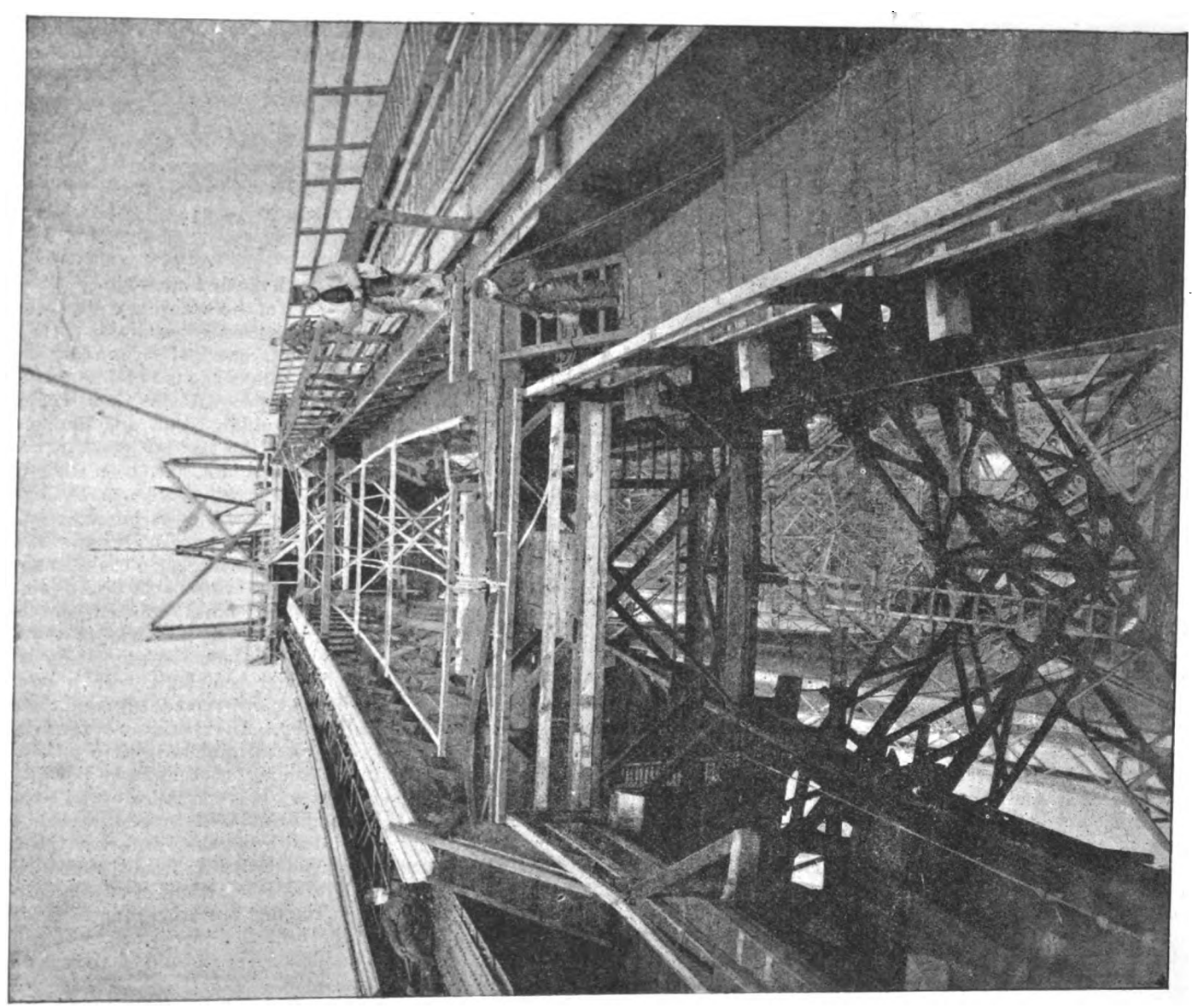


FIG. 68.—VIEW OF RIVETING STAGE ON INCH GARVIE SOUTH CANTILEVER, 1889. SEE PAGE 31.

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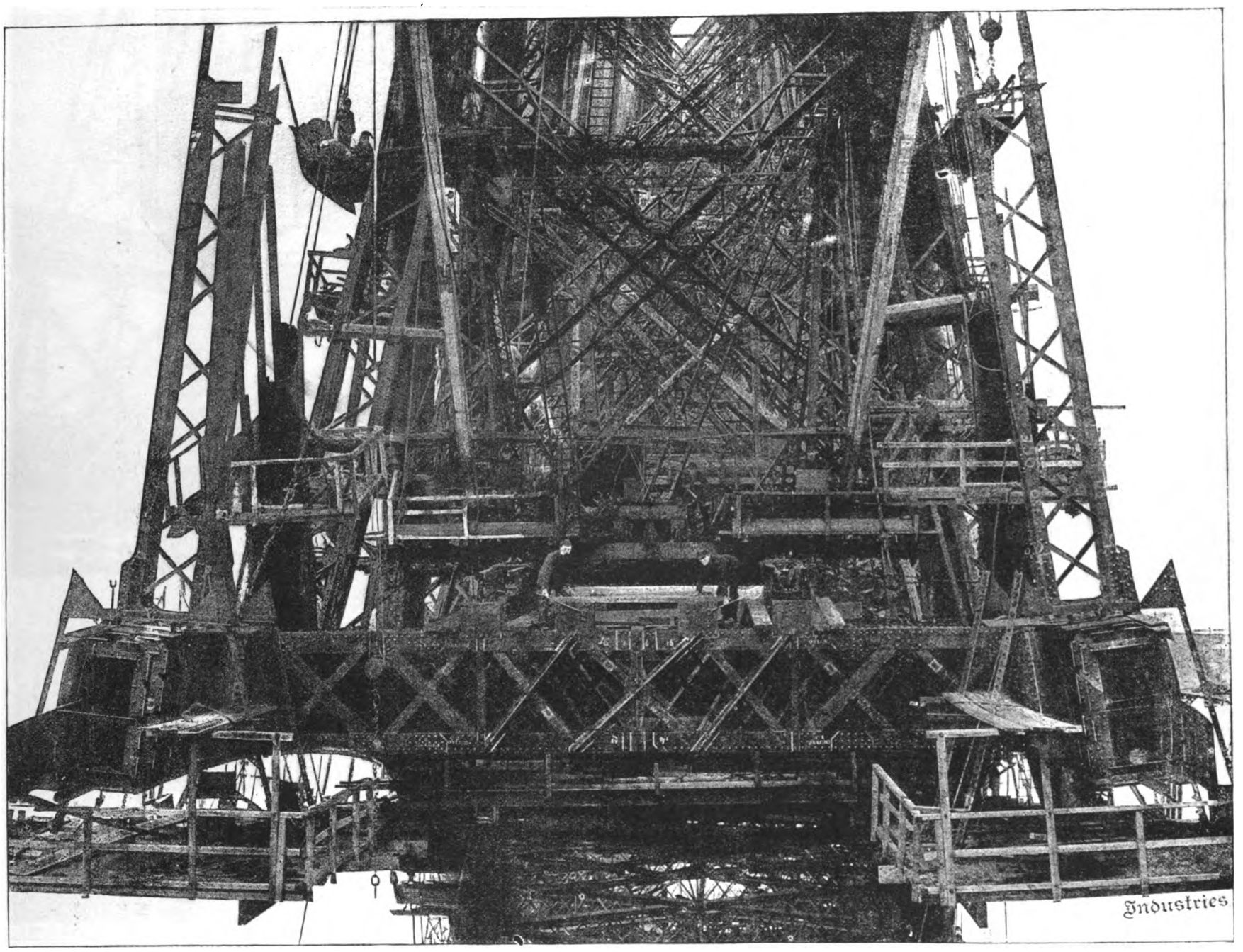


FIG. 70.—END VIEW OF THE QUEENSFERRY SOUTH CANTILEVER, 1889. SEE PAGE 31

very careful consideration of the method of the attachment of the ends of the central girders to the cantilevers supporting them, in order that under the varying conditions no part should be subject to the destructive action of racking or excessive strain thus arising. Each of the three main cantilevers is, as regards movements longitudinally and transversely, rigidly attached by one skewback to one of the four masonry piers forming its base. At Queensferry and Garvie the north-east skewback, and at Fife the south-east, is thus fixed. It therefore necessarily follows that at some point in each portion of the superstructure between these points allowance must be made for the variation in its length produced by change of temperature. The portion between Garvie and Queensferry is 1,970ft., and that between Garvie and Fife 1,710ft. in length, and the maximum provision as regards length is 24in. in each portion, and is located at each end of the Inch Garvie cantilever. The connection here between one end of each side of the central girder and the end of the cantilever is made through a long rocking post, with ball and socket joint ends (See Figs. 88 and 89), which transmits the weight from the upper portion of the end post of the former to the lower part of the end post of the latter. At a mean temperature, taken as 51° F., the rocking post will stand vertical, and as the superstructure lengthens or contracts through change of temperature the posts will rock backwards or forwards, permitting the centre girder to advance towards or retire from the cantilever at that point. A massive tongue X (See Fig. 91) projects horizontally from the last cross-girder of the cantilever, and passes through the first cross-girder of the central girder. In this tongue is a slotted-hole Y with faced sides, along which travels a block Z, 15in. square, secured by a bolt V, 9in. in diameter, to the first cross-girder of the central girder. A similar arrangement, though of a lighter character, is provided between the top bracings of the end posts of the cantilever and the central girder. These together completely control the movement due to change of temperature, compelling it to be longitudinal alone, without lateral or vertical divergence. The effects of temperature, which cause most important changes by enlarging the structure in a longitudinal direction, also necessitate careful consideration as regards warping action. During summer, when the sun shines with great power on one side of the cantilever, and when on the opposite side at the same time a cold wind may be blowing, the outer end of the cantilever will be deflected away from the sun some inches, a similar effect being produced by wind blowing at right angles to the bridge. If this be the case with any two cantilevers supporting a central girder, it is obvious that the axis of the central girder will not be in the same straight line with the axes of the cantilevers in their deflected position; consequently the central girder will appear to revolve in a horizontal plane about the bolt connecting the block with the first cross-girder of the central girder. The ends of the rocking posts, being formed with ball and socket connections, permit this revolving movement, but had suspending links, which are more usually made use of for making such a connection, been adopted here, they would by this movement be subject to an undesirable torsional strain. Therefore the rocking posts, a rare but not altogether novel idea, have been made use of in preference to suspending links, partly for this reason, and partly because the bearing area of a ball having a 12in. radius in a socket 22in. in horizontal diameter is so much greater than could be obtained in a link and pin of reasonable dimensions. At the other ends of the central girders, where they are supported respectively on the ends of the Queensferry and Fife cantilevers, the connection is made by upper and lower bed-plates, with a large steel pin 8in. diameter interposed between them, as shown in Fig. 90. The horizontal revolving movement of the central girders is simply that provided for by the sliding of the lower bed-plates on steel base plates. It is controlled by an arrangement of bolt and block similar to that at the other end of the girder already described, but the faced side of the tongue projecting from the cross-girder of the cantilever does not admit of any longitudinal movement.

The first operation connected with the building of the central girders was to attach a stage to the undersides of the end of the cantilevers, sufficiently

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large and strong to permit of the building thereon of the end post and adjacent half of the first bay of the central girder. On account of the end post of the central girder being enclosed on three sides within that of the cantilever, it was necessary to put this part together and rivet it in a position in advance of its ultimate site, and when this was done to thrust it back until it rested either on the long rocking posts or upon the bed-plates, according to which end of the central girder was being operated upon. As soon as these first half-bays had been thus placed and adjusted in their ultimate positions, their top members were attached to the top members of the cantilevers by heavy ties (See Fig. 89), one on each side of each girder, there being four in all at each end of each central span. These ties were composed of three flat plates, 50ft. long, 26in. wide, and ⅞in. thick. The attachments at either end were made partly by rivets and partly by turned bolts, sufficiently numerous to make them of ample strength. The calculated stress on each of these ties at the maximum was about 280 tons. Similarly the continuity of the compressive stresses between the lower members of the cantilever and of the central girders, whilst the latter were prolongations of the former, was secured by two steel wedges interposed between faced steel frames attached to the ends of these bottom members. These wedges were 3ft. long, 8in. wide, and tapered from 5in. to 1¼in. in thickness. The thrust upon them at a maximum, including the effect of winds, was about 500 tons.

These temporary connections having been made, and the crane used in building the top members of the cantilever having been pushed along over the temporary ties, and adjusted to its altered level by steel-covered wooden wedges, the operations of building the central girders were then briskly proceeded with. For each bay these were generally as follow: The cross-girder at the centre of the bay was hoisted and held in correct position by special derricks, supported on the outer rail troughs. Next, the inner side plates of the bottom members were connected to those already built, and the ends of the cross-girders secured to them. The outer side plates were then added, and the struts and ties were built up and down respectively to their intersection. The vertical tie from that point to the bottom member was put in place, the struts were then extended for their whole length, and the top member, plate by plate, extended to them. The cross-girder at the end of the bay was next hoisted into position, and the bottom members completed past it, and secured to it. The ties were then built down and connected—thus completing a bay. The time occupied in building one such bay, 40ft. in length, in some cases did not exceed 36 working hours. A slight variation was made in some cases by building out the top member first, and using that as a point of attachment for the tackle by which the cross-girders were placed in position, which, as a rule, was the last thing done in each half-bay. From what has already been remarked with reference to the effect of temperature upon the superstructure between the fixed points, it will be obvious that making the joint between the two halves of each central girder, and converting them from temporary prolongations of the cantilevers into independent girders, was by no means a simple matter, but one to which the Engineers and Mr. W. Arrol had devoted much consideration, inasmuch as the physical connection had to be arranged in such a way that it could speedily be made of ample strength, and also that during the operations no part of the permanent structure should be subject to excessive strain. The method adopted was as follows: To each end of the flange plates of the bottom members of the two half girders, temporary covers, G H (See Fig. 93), 1in. thick, were attached by bolts. Sandwiched between these on the outside of the vertical webs D were inserted the steel plates F, 8in. wide, 1⅞in. thick, and on the inside between the vertical webs were placed, as shown, three plates, of about the same thickness. At the Garvie end these thick plates were formed with slotted holes, 1⅞in. wide and 4in. long. After the bottom members were in place, with their ends so arranged as to be 4in. apart at a temperature of 60° Fahr., observations, extending over three days or so, were made to ascertain what effect the temperature during that time produced in opening and closing the gap, and, as soon as sufficient information had been obtained, the small holes in the covers of the Queensferry or Fife ends of the centre girders were templated at, as near as possible, the probable maximum temperature at the time when the joint was arranged to be made. The thick plates were then drilled from these templates, and bolted up between the covers of the Queensferry or Fife ends.

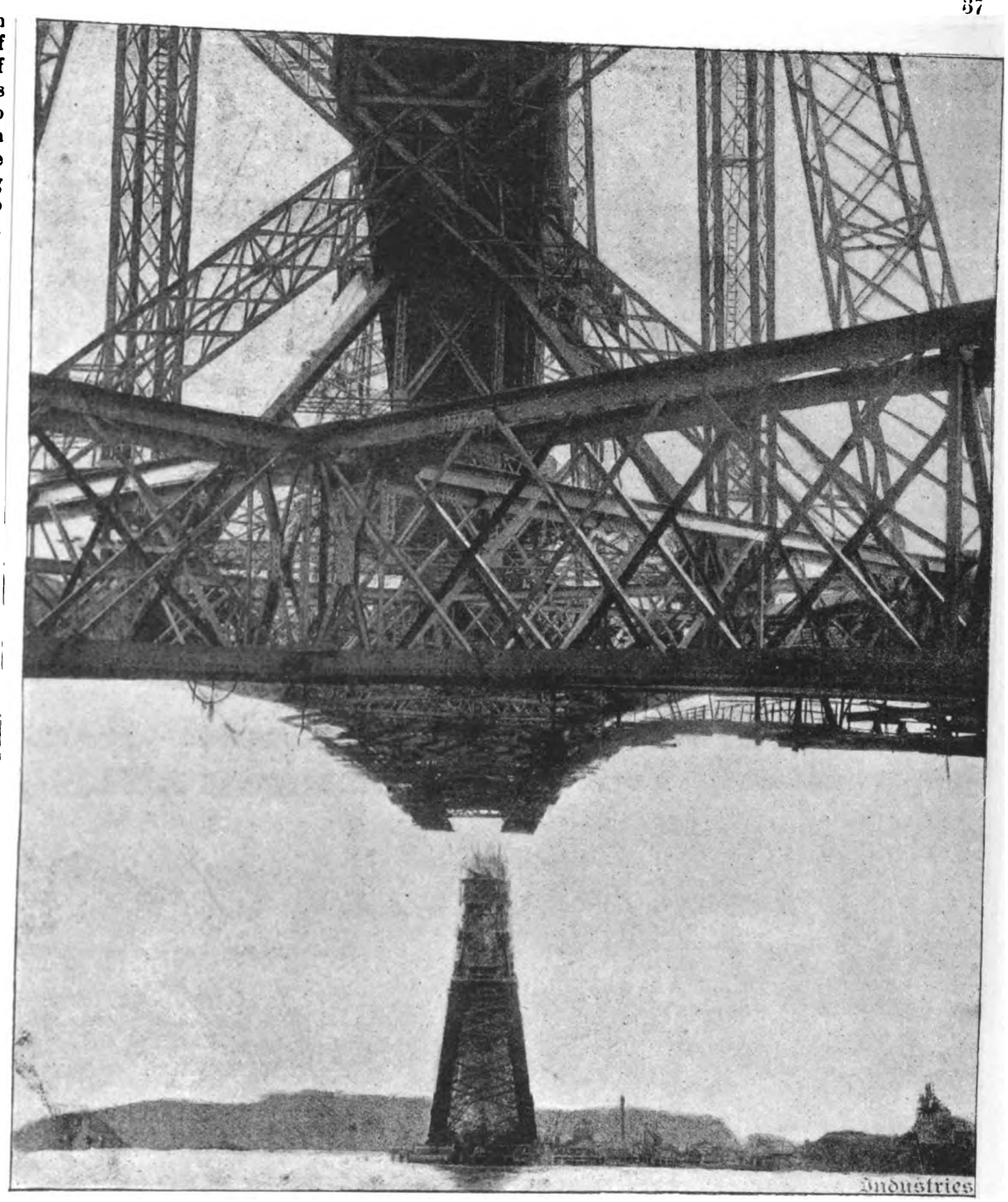


FIG. 71.—VIEW LOOKING NORTHWARD FROM UNDERNEATH QUEENSFERRY CANTILEVER, 1889. SEE PAGE 31.

When this was completed, and the maximum temperature attained, hydraulic power was applied to assist in closing the gap to the desired extent, and the 1⅞in. bolts were rapidly inserted into the holes prepared for them, and tightly screwed up. This operation completed the temporary connection of the two halves of the bottom members of the central girder sufficiently to deal with the tensile stresses (about 480 tons) arising at that point when their transformation into an independent girder took place.

As this connection was made at the maximum temperature of the day, contraction of the superstructure between the fixed points before mentioned made itself felt, and the result was that the central girder was raised to a slight extent, sufficiently to relieve much of the pressure on the wedges between the bottom members of the cantilever and central girder, and enabled them to be withdrawn. Before doing this, however, it was requisite to make good the 4in. gap between the ends of the top members at the centre of the central girders, which was accomplished as follows:—The ends of the vertical webs of each top member were reinforced by the addition, on each side, of a plate ⅝in. in thickness, D D (See Fig. 92). Outside these again, on each side, were covers F F, ½in. thick, extending across the joint, and riveted to the webs on the Garvie side, but not connected to the webs on the other side. Three vertical angle bars, 4in. by 4in. by ½in., on a ½in. plate, on each side, stiffened the ends of the webs, and temporary horizontal plates G H (See Fig. 92) were used to stiffen the top flange plates and the lower edges of the vertical webs. When it had been ascertained that the minimum temperature had been reached, and that the wedges at the bottom members could be removed, large cottars or wedges, 3ft. 6in. long, 2in. wide, tapering 1 in in. 36, and of sufficient thickness to fill the gap, were inserted between the reinforced ends of the webs of the top members. The removal of the wedges at the bottom members, together with the faced plates against which they rested, and the expected rise in temperature, threw the top members of the central girders into compression, and the bottom members into tension, and the operation as a temporary measure was completed. The next proceeding was to put on, and rivet up, permanent covers to the sides of the vertical webs of the bottom members, and to the flanges of the top member, securing, at the same time, the loose ends of the

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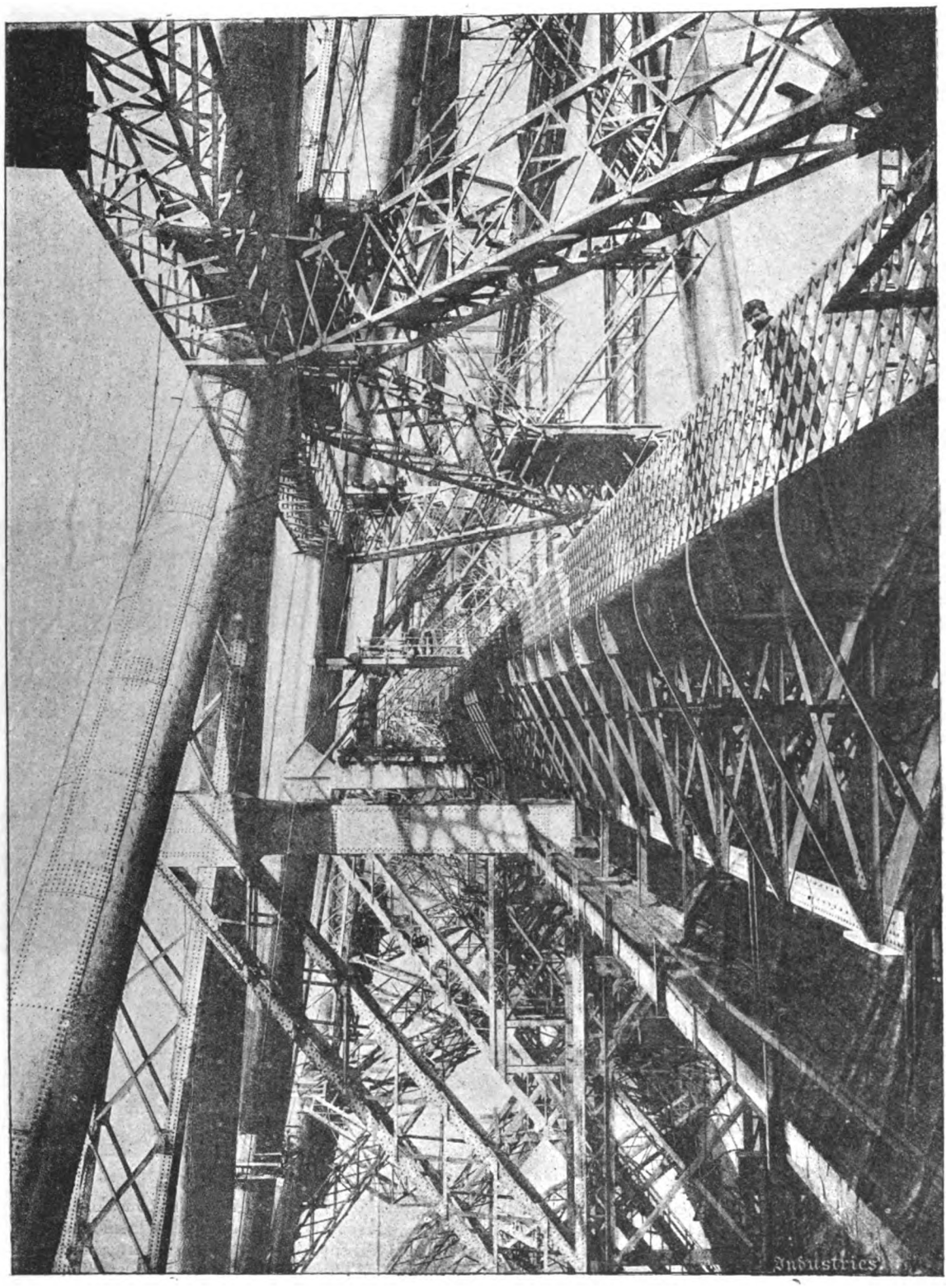


FIG. 72.—OUTSIDE VIEW OF INTERNAL VIADUCT. SEE PAGE 30.

covers to the vertical webs. When this was accomplished the temporary plates were removed from the flanges of the bottom members and the permanent covers fixed and riveted, thus finally completing the permanent connection. In view of the ends of the two half girders, at the commencement of the operation, not coming exactly opposite each other, they were adjusted horizontally by pulling one from the other, and vertically by loading the cantilevers to the necessary extent.

THE PLANT USED IN BUILDING THE BRIDGE.

HYDRAULIC BENDING AND SETTING MACHINERY.—The bending and setting of the plates and angles for the tubes and their connections were a prominent part of the labours of the workshops, and formed, along with the other plant, the subject of a valuable paper read by Mr. William Arrol, in Edinburgh, on August 2nd, 1887, before the Institution of Mechanical Engineers. Figs. 94 and 95 illustrate the largest of these presses, which was capable of exerting a pressure of 1,600 tons between the dies.

The cylinders were 24in. diameter, and rested on two longitudinal girders bedded on concrete. The fixed overhead table, to which was attached the upper block, was connected with each cylinder by two iron columns. The lower table was fastened to the rams, and rose and fell with them. Blocks of different curvatures were employed to suit the varying diameters of the tubes. The two gas-heating furnaces were placed at the end of the press, and were connected with it by an iron table with rollers, so that the heated plates were drawn direct by means of hydraulic power into the bending press. A final squeeze to each plate after cooling adjusted any curvature that might have taken place during that process.

Numerous smaller presses were employed, consisting mainly of a simple ram fixed to the upper of two girders, which were bound together at the ends, the lower girder supporting the block on which the material to be operated upon rested.

PLANING MACHINERY.—The edges of the plates were planed by specially designed machinery. Some idea of the amount of planing that had to be executed may be formed when it is stated that no sheared edges were permitted in the structure, the "distress" occasioned to the metal being in every case removed by planing, whilst, as a certain percentage of the stress in compression had to be taken up by the butting of the plates, instead of wholly by rivets, as in the tension joints, such planing had to be performed with the best possible workmanship. Figs. 96 and 97 illustrate the machine for dealing with the side edges of the curved plates, which was practically an ordinary planing machine, with some modifications. It was provided with special double side cheeks, between which were fixed two swivelling tool boxes, one on each side of the machine. The curved blocks (shown in the figures) were securely fixed to the sliding table, and carried the plate to be dealt with. Both the tools acted at the same time, and cut both on the backward and forward travel of the table.

The planing of the ends of the curved plates was performed by a specially designed tool. (See Figs. 101 and 102.) In this machine the plate was firmly secured to a fixed table, and the tool, attached to a swinging pendulum, was driven backwards and forwards by a connecting rod. The length of the pendulum was adjustable to suit the varying diameter of the tubes. The tool, which was fed by hand, cut on both strokes. At the other end of the connecting rod an ordinary planing machine, similar to that subsequently described, was arranged for planing the edges of flat plates.

Figs. 98, 99, and 100 show the usual pattern of planing machine for dealing with the edges of rectangular plates. In this machine an addition was made, viz., a second cutter working at right angles to the first one, thus enabling two side edges to be simultaneously treated. In this machine, therefore, all four edges could be planed in two settings, with the certainty of the edges being truly at right angles to each other. In other machines of a similar type two saddles were placed upon the main slide; in others, again, both tools were fixed to the same saddle. The tees, angles, and other sections were faced as a rule by cold steel saws, in order to secure good butting.

DRILLING MACHINERY.—"The principle kept in view," says Mr. Arrol, in his paper already referred to, "is that, wherever possible, girders, tubes, &c., should be drilled only while their various parts are temporarily built and held together by bolts in the position they will finally occupy in the finished structure; in this way the highest class of work is obtained."

Figs. 103 and 104 represent the drilling machines, each complete in itself, for drilling the tubes. Each machine, which was large enough to embrace the entire circumference of the tube, consisted of a wrought iron under-frame, which carried, besides the engine and boiler driving the drills (the former only shown in our illustrations), two large cast iron annular rings, or head-stocks, round which ten drilling slides travelled circumferentially. The slides moved around the rings, and, as each drill had also a longitudinal motion parallel to the tube, any hole in the work could be dealt with along a length of 8ft. The tube rested on timber blocks, and the machine travelled forward after completing each length of 8ft.

In the case of the lighter tubes, the rate of drilling was as high as 12 lineal feet of tube per shift of 10 hours; this represented about 800 holes drilled.

Figs. 105, 106, 108, and 109 illustrate the drills used for dealing with the booms of all girders, which moved along rails, running on each side of the work, fixed to blocks. These machines consisted of a double carriage with upright columns, connected by a cross-beam to other framings for shafts, pulleys, &c. Nine drills on slides, attached to the columns and cross-beam in front, and four drills on as many radiating arms at the back, were capable of boring either vertically or horizontally. The fixed drills, which were self-feeding, served for all holes of the regular pitch, whilst the movable ones, which were fed by hand, dealt with the odd holes. By this machine

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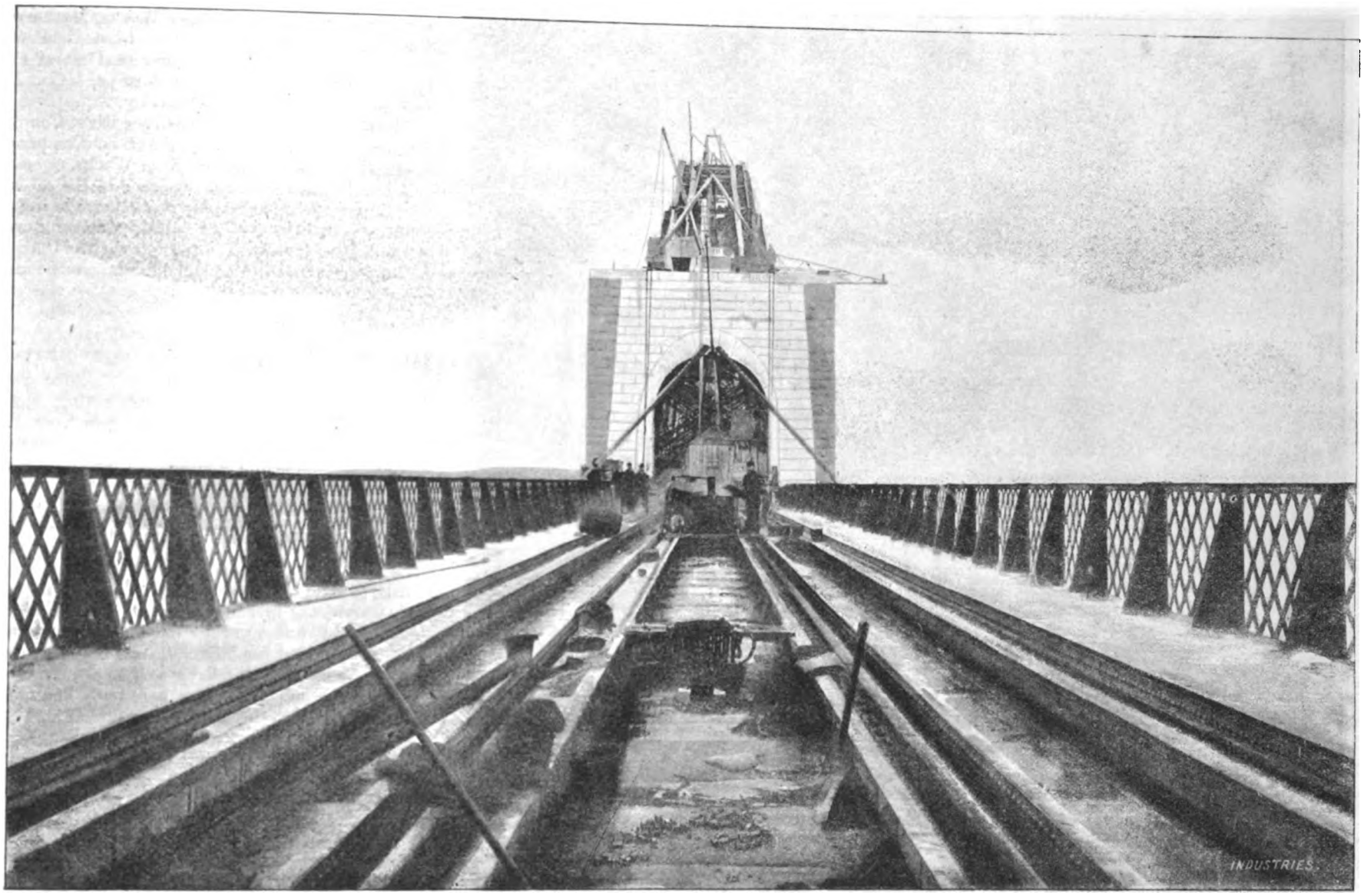


FIG. 73.—VIEW OF SOUTH QUEENSFERRY VIADUCT AND CANTILEVER PIER, OCTOBER, 1889. SEE PAGE 31.

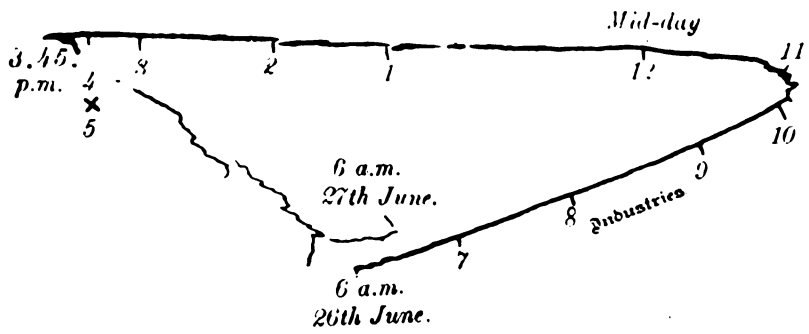


FIG. 74.

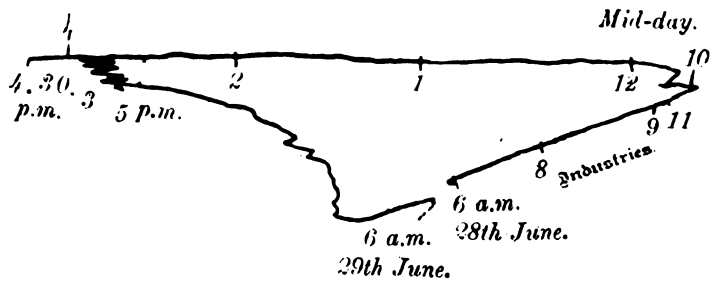


FIG. 75.

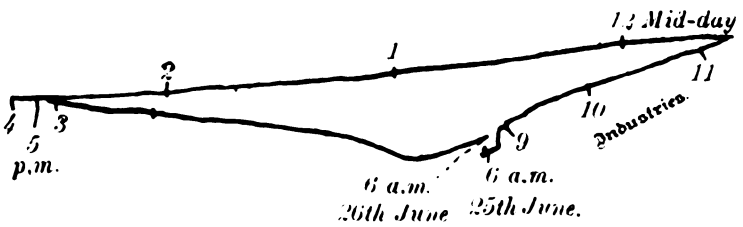


FIG. 76.

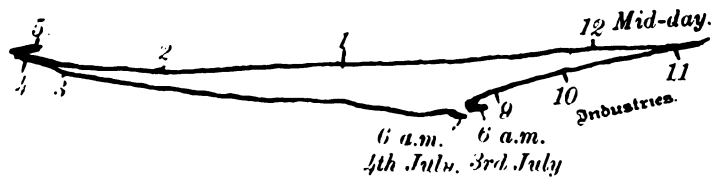


FIG. 77.

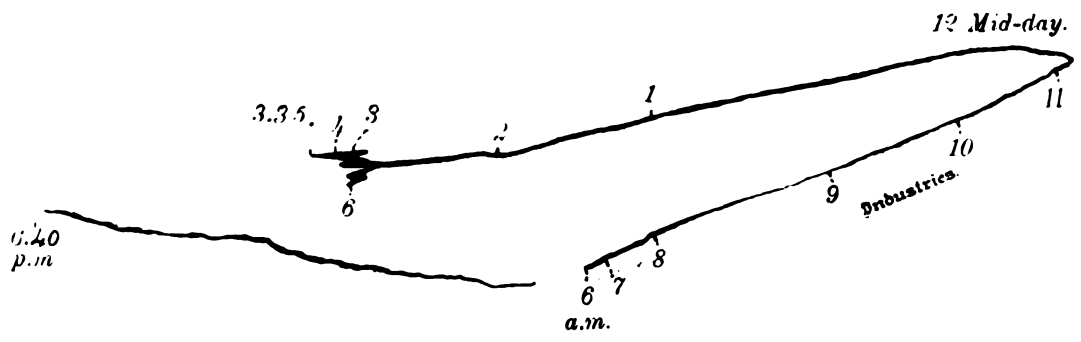


FIG. 78.

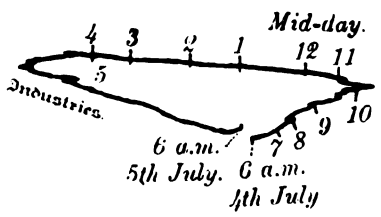


FIG. 79.

TEMPERATURE DIAGRAMS. SEE PAGE 34.

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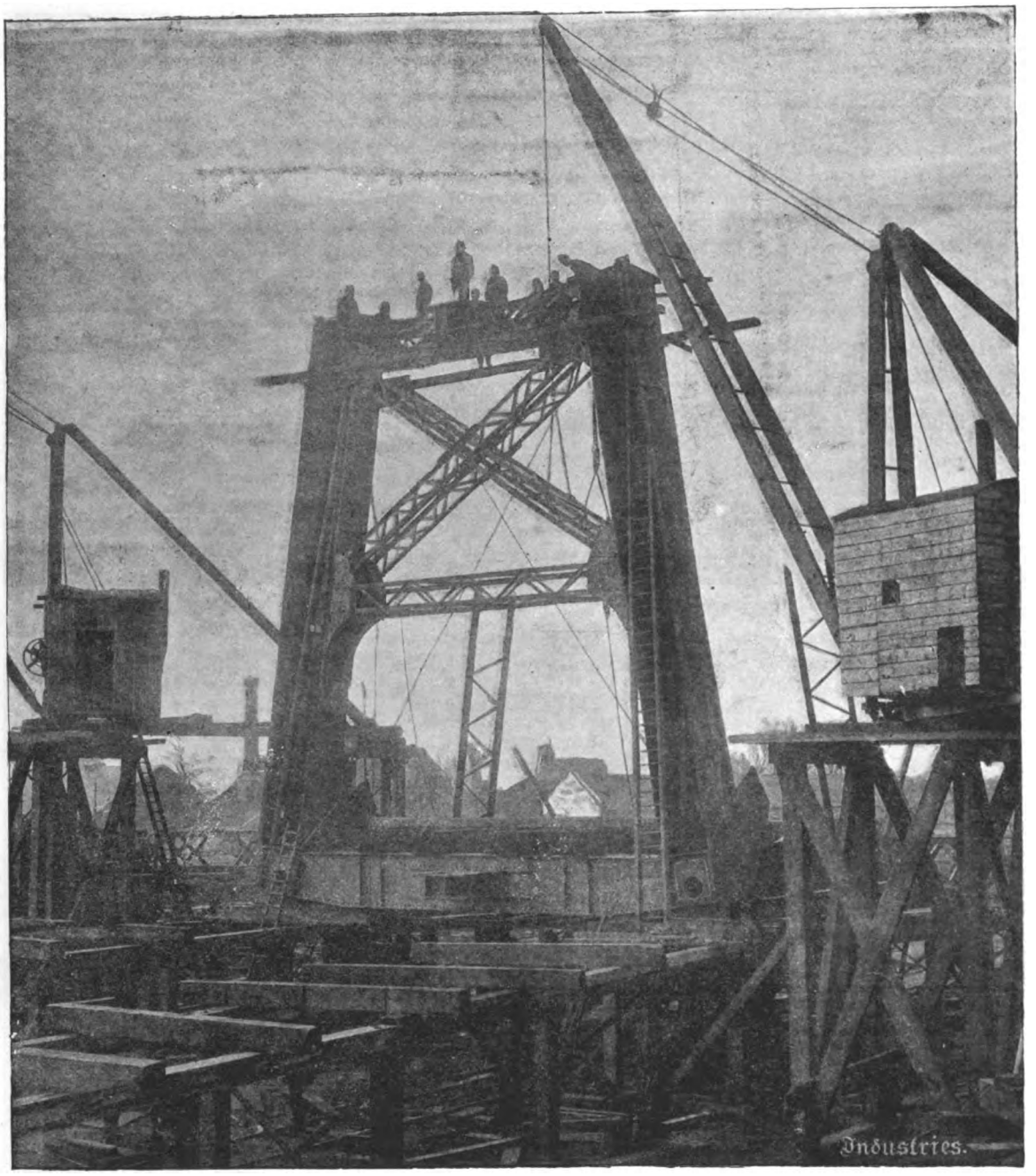


FIG. 80.—THE CANTILEVER END PILLARS ON THE DRILL ROADS, 1889. SEE PAGE 31.

thirteen holes could be drilled simultaneously in a single boom.

The single-arm radial drilling machine, shown in Fig. 107, operating one drill, was a very serviceable tool, and will be readily understood from our illustration. The machine made a complete revolution round the supporting column.

THE STEEL USED IN THE CONSTRUCTION.

Passing on to the steel, which forms so large an item in the undertaking, the tests may be briefly summarised. For material subject to tensile strains an ultimate tensile strength of from 30 to 33 tons per square inch of section was required from strips, cut either with or across the grain, with an elongation of at least 20 per cent. in a length of 8in.; for steel subject to compression a tensile strength of from 34 to 37 tons per square inch of section was required, either lengthways or crossways, with an elongation of at least 17 per cent. in a length of 8in. Bend tests were also taken from each slab or bar: these, either cold, or after being heated uniformly to a low cherry red and cooled in clear water at 82° Fahr., were required to stand bending double to a curve whose inner radius was equal to 1½ times the thickness of the plate or bar. The strips, either tempered or cold, were 1½in. wide, and cut either lengthways or crossways. A tensile test was taken from every 50 slabs or bars. The usual requirements as to freedom from lamination and injurious surface defects, &c., were specified.

The rivet bars had a tensile strength from 26 to 30 tons per square inch, with an elongation of at least 20 per cent. in 8in.; and, either cold or tempered, they had to stand bending to a curve whose inner radius was equal to 1½ times the thickness of the bar. All holes were drilled, no punching being permitted. Similarly every edge was planed, effectually removing the distress caused to the edges by shearing.

Particular attention was paid, in dealing with heated plates and bars, to put no "work" on them when at blue heat, the dangerous limit of temperature between about 600° and 400° Fahr. Annealing was carefully performed on all junction plates, bars, &c., which had been subjected to a large amount of work; and due precautions were taken, when such annealing could not be done simultaneously on the whole plate or bar, that no abrupt termination of the line of heat was permitted. The bending, planing, drilling, &c., are dealt with in describing the special appliances for these operations under the head of "Workshops and Plant."

About 54,000 tons of Siemens-Martin steel were used in the entire structure. The principal makers were the Steel Company of Scotland (Blochairn and Hallside Works), where the labours of the metallurgists, Mr. James Riley, seconded by Mr. F. W. Dick, succeeded in producing a material eminently adapted in all respects to fulfil the requirements of the engineers. The following firms also supplied lesser quantities:—The Landore Company, Messrs. Colville & Sons, Dalzell Steel Works, Motherwell; the Mossend Steel Works, the Clydesdale Steel Works, the Parkhead Forge, Messrs. Coats of Coatbridge (now Messrs. Goodwins, Jardine, & Co., Ld.), and the Clydebridge Steel Company.

The rivets were made by the Clyde Rivet Company from bars manufactured by the Steel Company of Scotland or by the Dalzell Steel Works.

A small quantity of iron was used in the caissons. Cast iron was employed only in the form of weights to fill the boxes at the free ends of the cantilevers. A small quantity of cast steel formed the bearings, &c., of the ends of the central girders on the cantilever ends.

THE WIND PRESSURE ON THE BRIDGE.

A series of valuable and interesting experiments on the subject of wind pressure have been carried on at the bridge since its commencement by the Engineers, who held that the high pressures occasionally recorded were due possibly to the small area of pressure-board operated on by the wind, and that such high blasts were of very local area. To test these points by direct observations they caused three wind gauges, or pressure-boards, to be erected on the top of the old castle on Inch Garvie, the first presenting an area of no less than 300 square feet to the wind, and facing east and west. The second has a circular disc only 1½ square foot area, and is fixed similarly to the first. The third gauge has the same area (1½ square feet), and is free to swivel square to the wind in any direction.

As the results of a series of experiments Mr. Baker, writing in 1884, says: "I think it is pretty well established, by our two years' experiments, that the effective pressure per square foot on a large and comparatively heavy board averages only about two-thirds of that indicated by an ordinary light anemometer."

Two heavy gales occurred on December 12th, 1883, and January 26th, 1884, the latter being of exceptional violence, as evidenced by widespread havoc throughout the country. The small fixed gauge on Inch Garvie on this occasion registered as high as 65lb. per square foot; and, but for the fact that the pointer was unable to move further, might have indicated a greater pressure. Mr. Baker, distrusting the anemometer, experimented with it, and found that the sudden application of a pressure not exceeding 20lb. caused 65lb. to be registered. The recording apparatus of the wind gauges was accordingly altered. On March 30th, 1886, during a westerly gale, the pressures recorded by the large, small fixed, and revolving gauges were 19lb., 31lb., and 26lb. respectively. In December of the same year the large gauge recorded 9lb., and in January and February, 1887, the highest readings in each month were 10lb. and 15lb. respectively, while in the autumn of the same year 10½lb. per square foot was the maximum reading.

In November, 1888, a gale of exceptional severity swept over the northern portion of the British isles. The first three days were stormy and unsettled on the Firth of Forth, and a gale from the south-west set in, accompanied by heavy showers of rain. The violence of the gale may be judged from the fact that the North British Railway Company's ferry boat plying between Port Edgar and North Queensferry was unable to make a mid-day trip, owing to the high sea running.

The wind gauges at the Forth Bridge, placed on the old castle on Inch Garvie, registered high pressures. The large gauge, which presents an area of 300 square feet, and is fixed parallel to the centre line of the bridge, registered a maximum pressure of 27lb. per square foot. The small fixed gauge parallel to the same line, and presenting an area of 1½ square feet, registered 41lb. per square foot, a pressure equivalent to a speed of wind of about 90 miles per hour. The revolving gauge on Inch Garvie, which is described above, indicated a pressure of 35lb. per square foot. The severity of the gale was abundantly shown by the damage done on land and on sea. The Firth of Forth was the scene of several shipping disasters,

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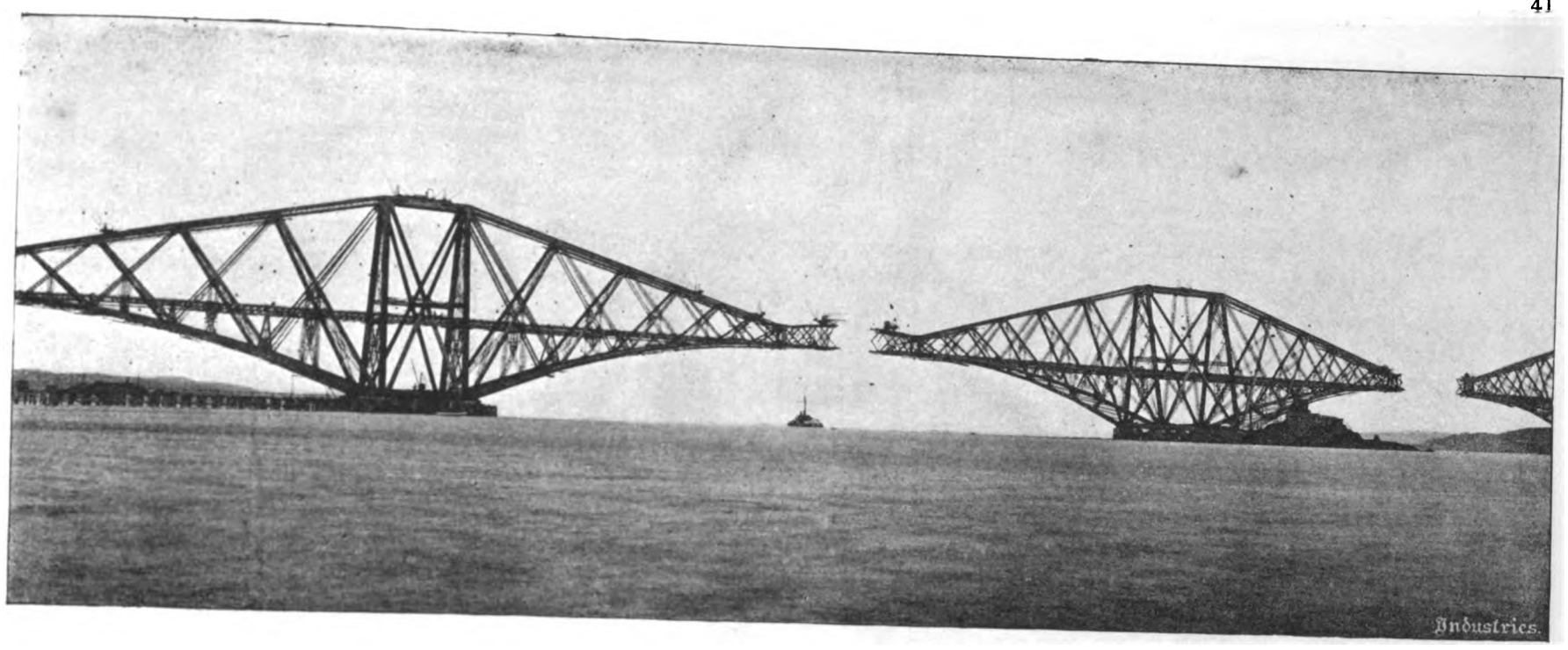


FIG. 81.—VIEW OF BRIDGE FROM THE EAST, SEPTEMBER, 1889. SEE PAGE 34.

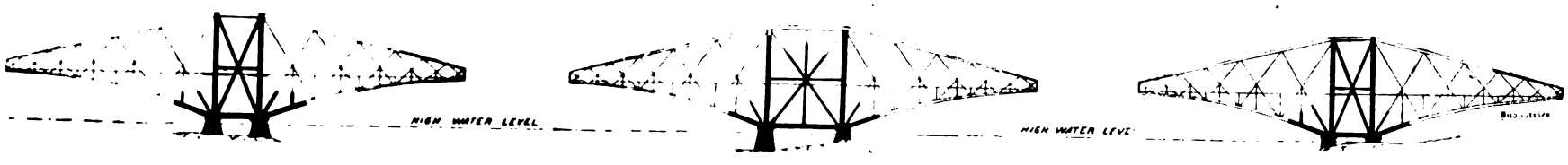


FIG. 82.—SHOWING PROGRESS OF BRIDGE IN JULY, 1887. SEE PAGE 34.

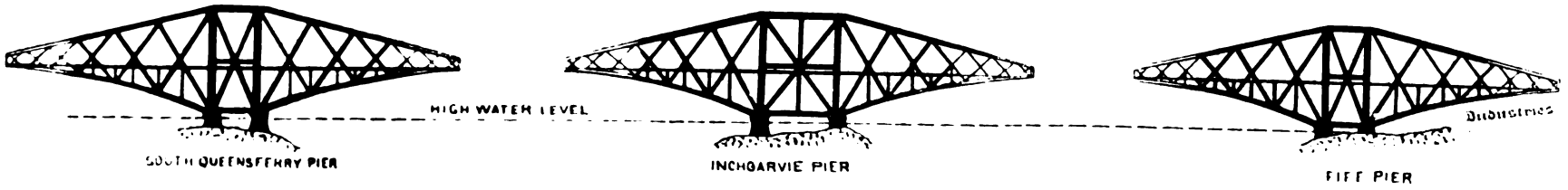


FIG. 83. SHOWING PROGRESS UNTIL THE END OF DECEMBER, 1888. SEE PAGE 34.

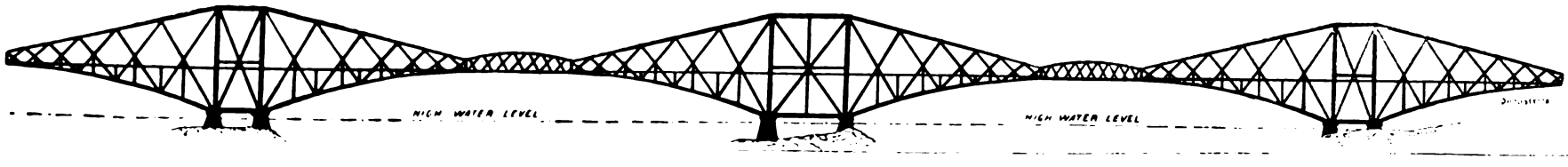


FIG. 84.—SHOWING COMPLETE BRIDGE, JANUARY, 1890. SEE PAGE 34.

and the appearance of Leith Harbour, where vessels had put in to repair after the storm, bore ample testimony to the severity of the weather they had experienced.

Under such circumstances, it is satisfactory to note that, beyond some slight damage to the temporary timber stagings of the Forth Bridge, some unimportant injury to the sheds, and the displacement of loose planking, no harm was done to the permanent erection, or to any temporary steel structure of any description. Work was, of course, suspended during the gale; and, considering the many casualties reported from elsewhere, it is pleasing to state that, beyond a minor accident to one of the men, who was slightly injured by a plank being blown against him, no accident of any kind happened during one of the severest and most prolonged gales experienced in Scotland for many years. The huge structure in all respects realised the anticipations of its designers.

"A pressure of 56lb. per square foot has been allowed for in designing the bridge, this pressure striking the whole or any part of the bridge at any angle with the horizon and acting square or obliquely upon an area equivalent to twice the plane surface of the front girders, with a deduction of 50 per cent. in the case of tubes. The total wind pressure so derived amounts to 2,000 tons on the 1,700ft. span and 7,900 tons on the whole superstructure of the bridge included between the two cantilever end piers." The strength of the structure to withstand wind force is abundantly demonstrated by Mr. Baker's remarks before the British Association in 1882. He then said:—"The Forth Bridge as designed will be relatively stronger than any other bridge yet constructed. Owing to the large deadweight and the spread of the girders at the piers, a wind pressure equivalent to 2cwt. per square foot upon the surface of one girder would be required to overturn the bridge, assuming it not to be held down by bolts. The holding-down bolts provided, however, about double the resistance to overturning. So 4cwt. of wind pressure per square foot upon the single surface would be required to upset the bridge; and under this ideal pressure, though the wind bracing would, it is true, be on the point of failing, none of the great tubes or tension members of the main girders would even be permanently deformed."

It will thus be seen that, with a wind pressure eight times in excess of that allowed in calculation, the bridge would still stand, with a further margin of strength.

During the great gale in November, 1888, the large fixed gauge registered 27lb., or almost exactly half the 56lb. required by the Board of Trade to be provided for, and if the small fixed gauge, presenting 1½ square feet only, registered 41lb. per square foot at the same time, and a reduction to 27lb. per square foot was found with an area augmented to 300 square feet, a still greater diminution may be hoped for in actual pressure per square foot on the bridge when the area operated upon has a maximum length of 1 mile by a maximum height of 361ft. The force of the wind during the storm known as the Tay Bridge gale, from the unhappy accident caused, was stated by experts to be 30lb. per square foot.

THE APPROACH RAILWAYS.

In dealing with the approach railways, we propose to sketch in brief outline those immediately connected with the Forth Bridge itself and owned by that company. (See Map, Fig. 122.)

The North Queensferry and Inverkeithing Railway was commenced in September, 1887, and this line, about two miles in length, has presented many fea-

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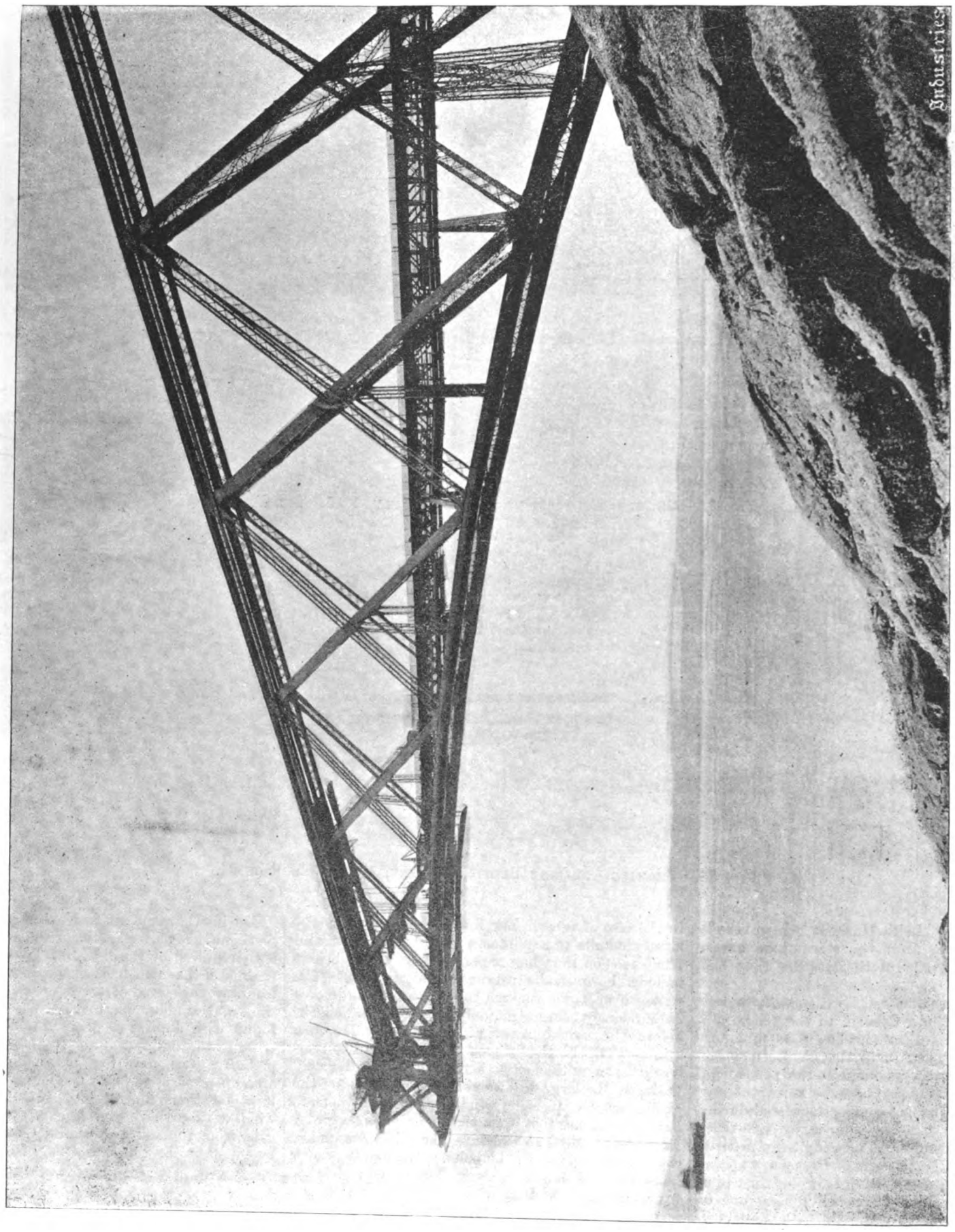


FIG. 85.—GENERAL VIEW OF INCH GARVIE SOUTH CANTILEVER, SEPTEMBER, 1889. SEE PAGE 31.

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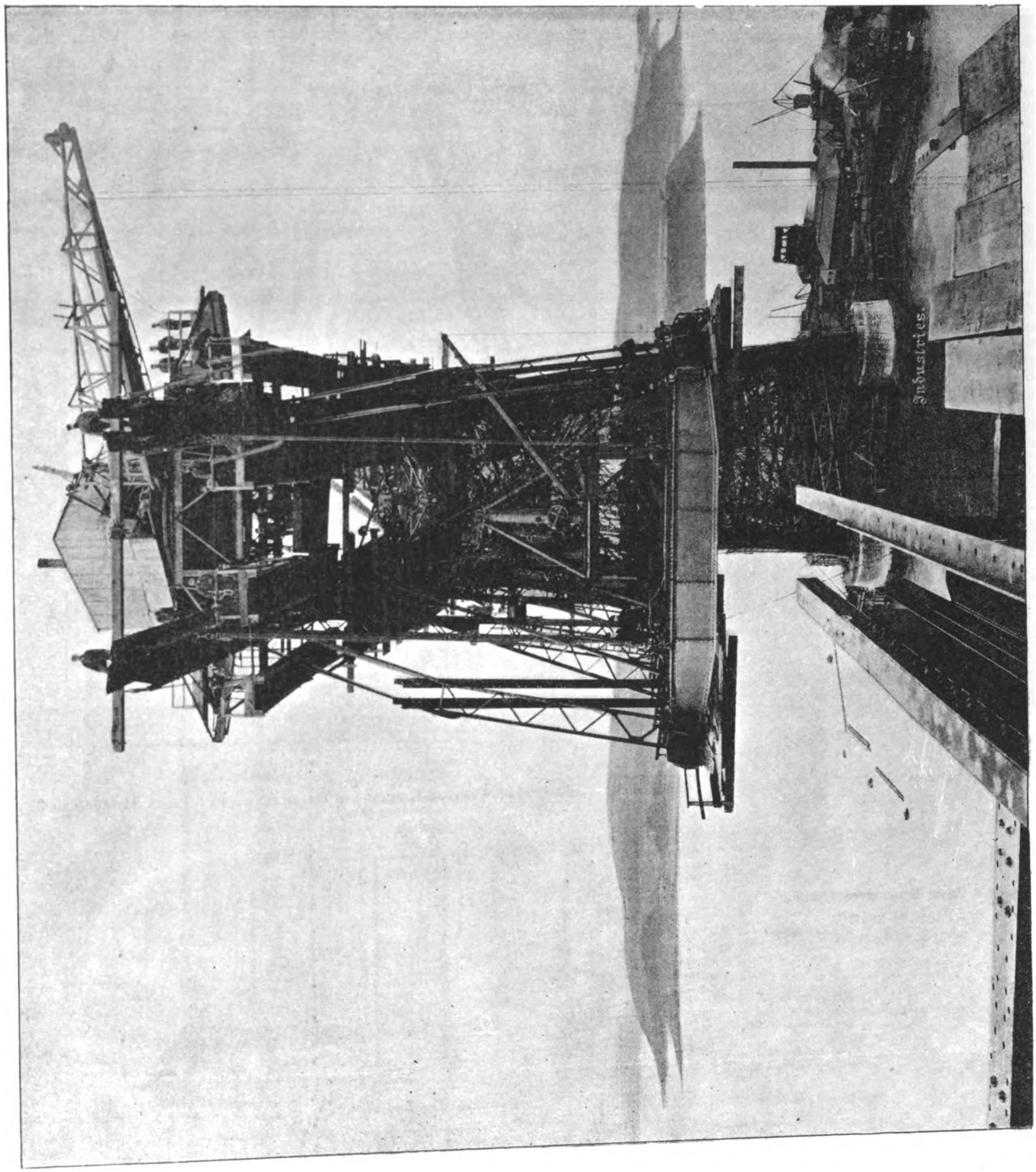


FIG. 86.—VIEW ACROSS GAP NOW FILLED BY SOUTHERN CENTRAL GIRDER, SEPTEMBER 1889. SEE PAGE 34.

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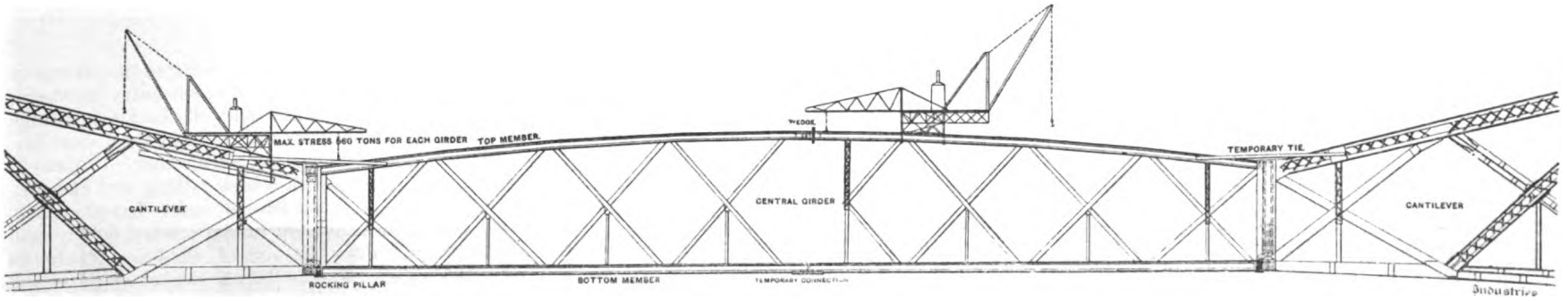


FIG. 87.—SIDE ELEVATION OF CENTRAL GIRDER. SEE PAGE 34.

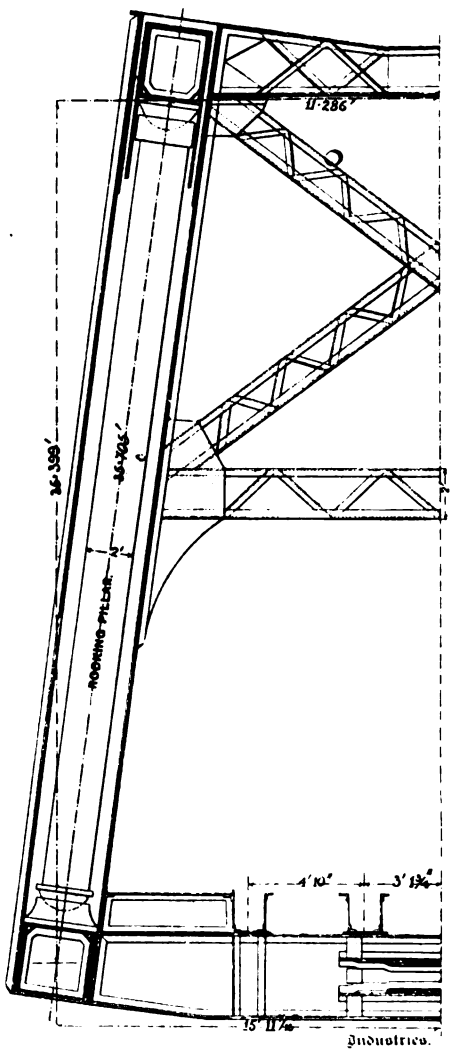


FIG. 88.—CROSS SECTION OF GIRDER.
SEE PAGES 34 AND 36.

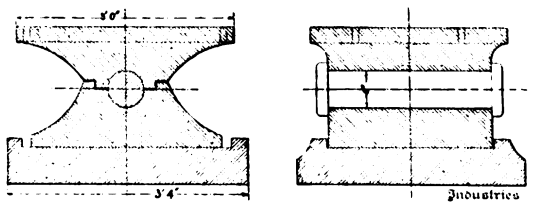


FIG. 90.—BED-PLATES AND PIN FOR JUNCTION OF GIRDER AND CANTILEVER. SEE PAGE 36.

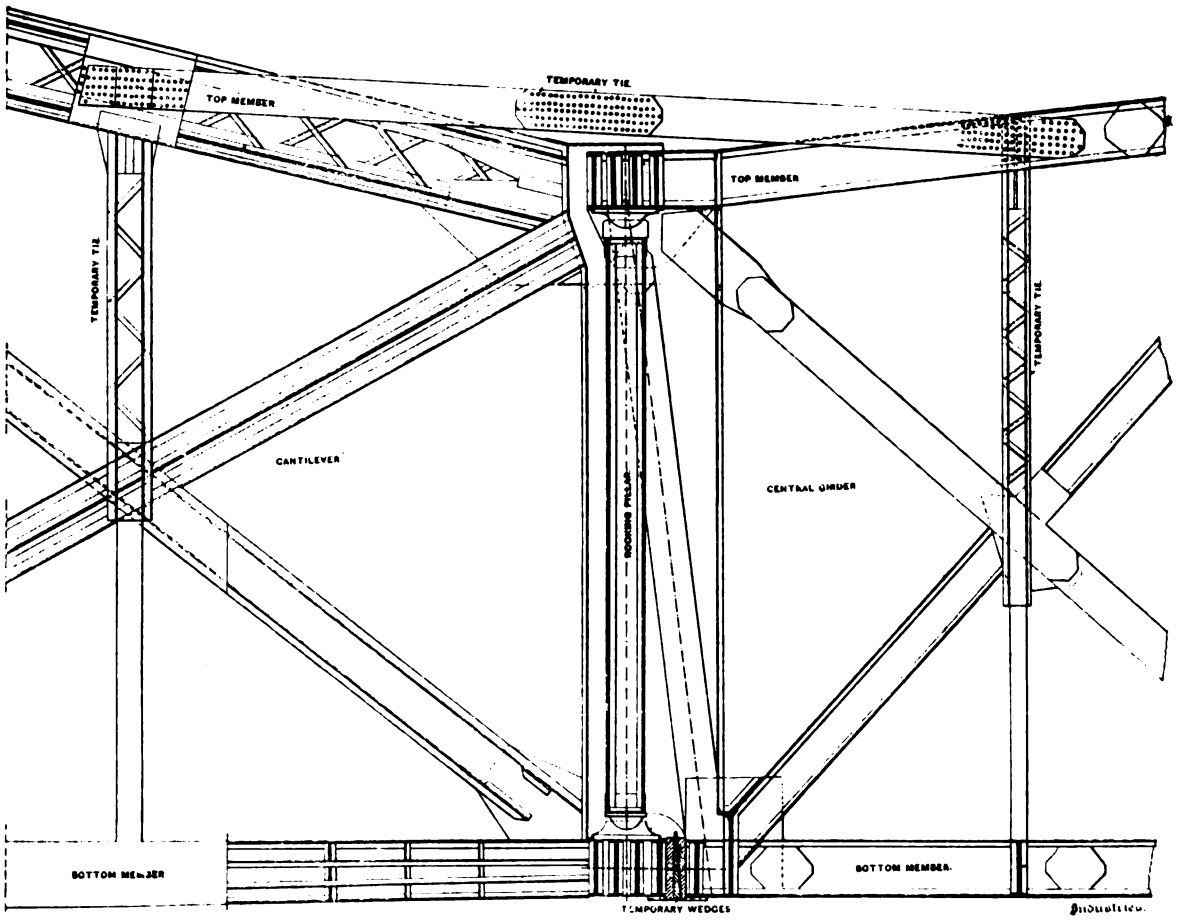


FIG. 89.—JUNCTION OF CENTRAL GIRDER AND CANTILEVER. SEE PAGES 34, 36, AND 37.

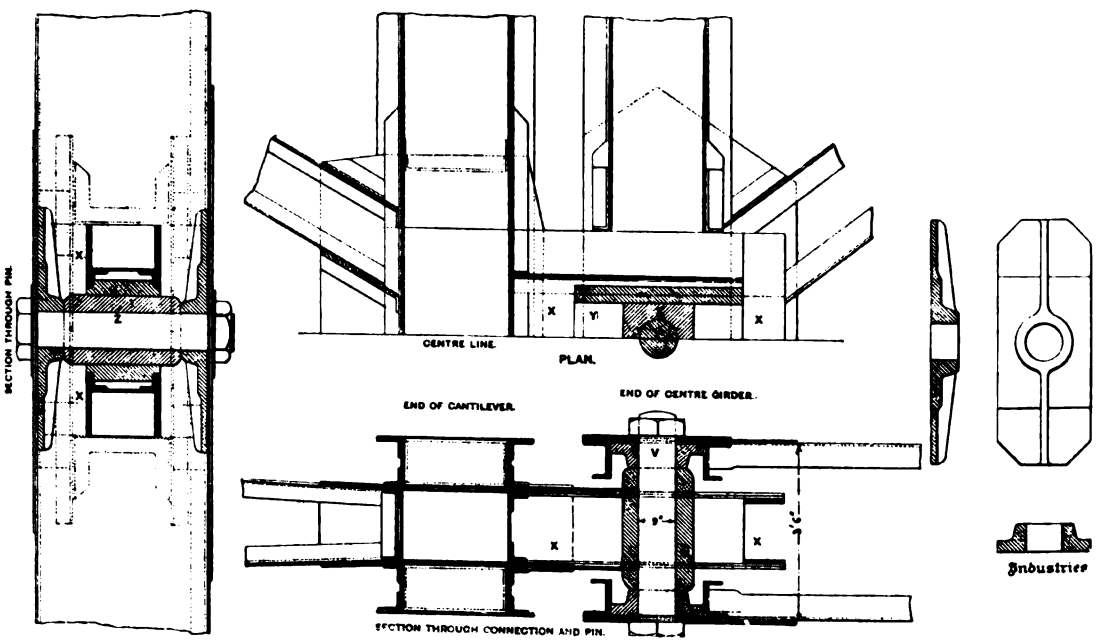


FIG. 91.—DETAILS OF JUNCTION OF CENTRAL GIRDER. SEE PAGE 36.

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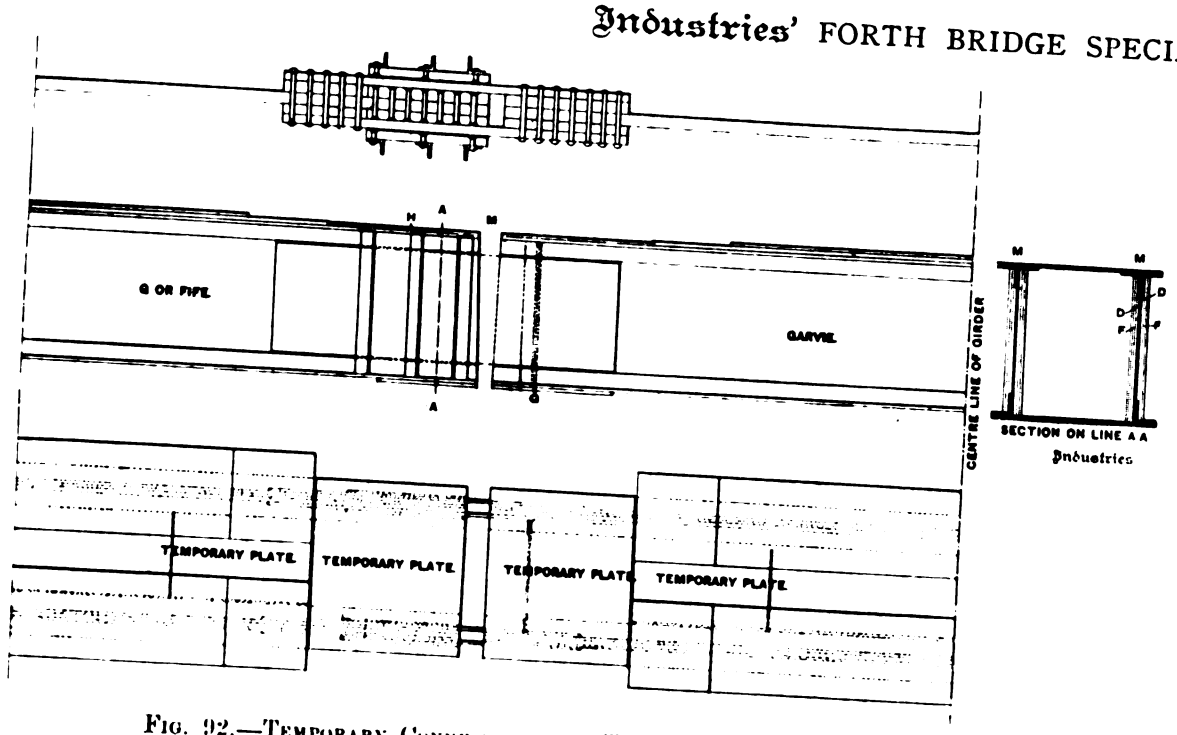


FIG. 92.—TEMPORARY CONNECTIONS FOR TOP BOOM OF CENTRAL GIRDERS.

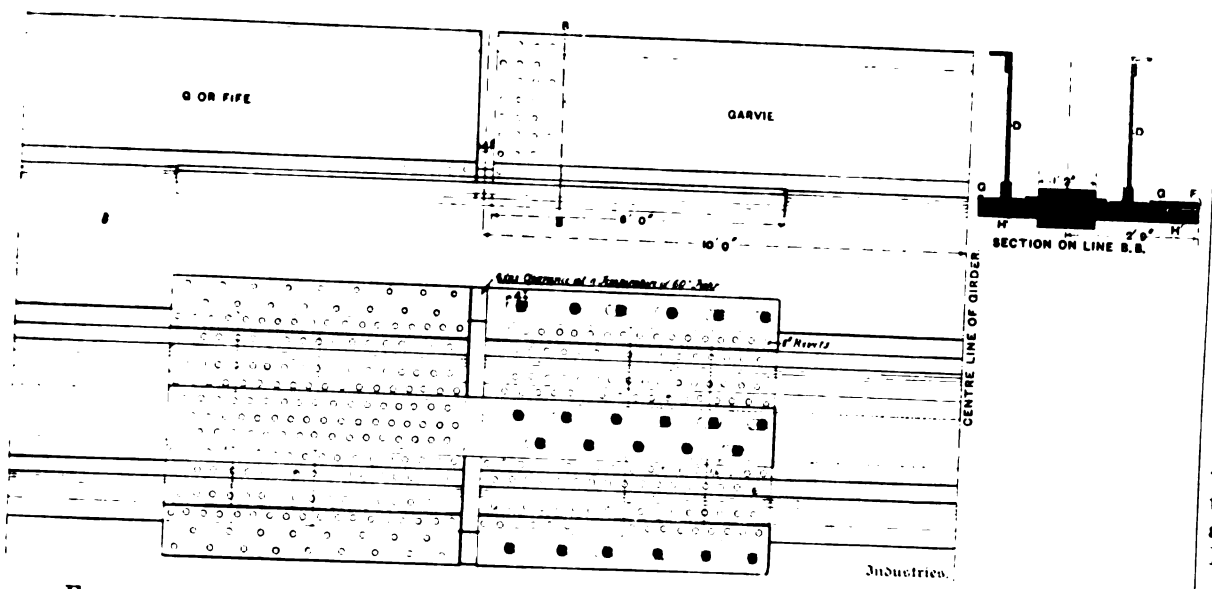
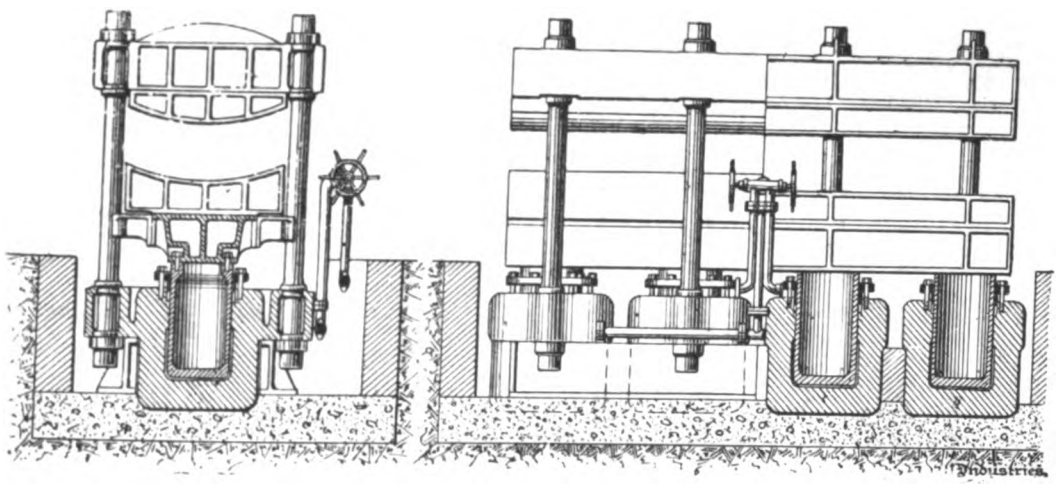
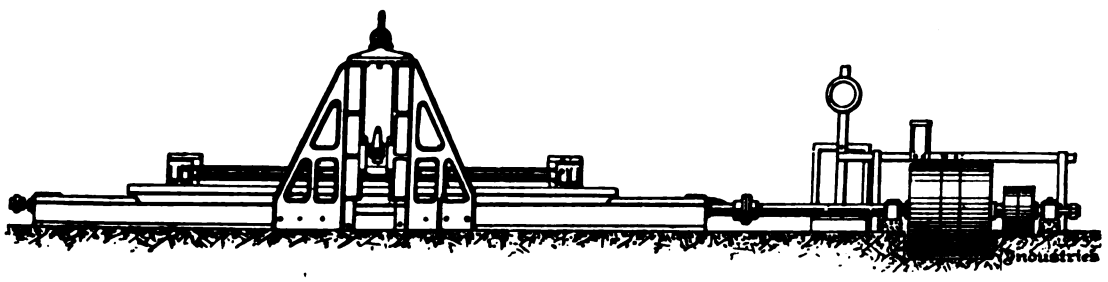
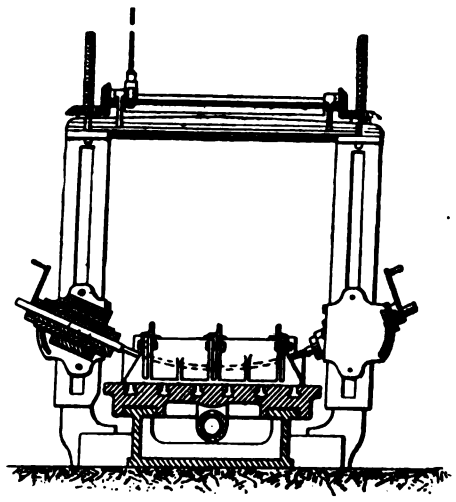


FIG. 93.—TEMPORARY CONNECTIONS FOR BOTTOM BOOM OF CENTRAL GIRDERS. SEE PAGE 37.



FIGS. 94 AND 95.—HYDRAULIC PRESS FOR SHAPING PLATES. SEE PAGE 38.





FIGS. 96 AND 97.—MACHINE FOR PLANING THE SIDES OF PLATES. SEE PAGE 38.

tures of exceptional difficulty, owing to the extremely irregular and rocky nature of the country traversed. After leaving the north end of the Forth Bridge the line is carried on an embankment for a short distance; then, traversing a tunnel, another embankment is reached; after which a rock cutting and embankment terminate in the tunnel under Inverkeithing. The second embankment caused much difficulty and delay, being over the site of what is pronounced by geological experts to be an extinct volcano, and into which over 100,000 tons of material had to be thrown before the bank would stand.

The bridges present no features of special interest, the principal one being a steel viaduct of four spans, which carries the line across the main road from North Queensferry to Inverkeithing. (See Fig. 110.) The cost of this line is about £90,000, the total amount of excavation being estimated at about 300,000 cubic yards.

The contract was secured by Messrs. William Arrol, & Co., contractors for the Forth Bridge, and was, with the South Approach Railway, next described, the special care, amongst his other duties, of Mr. Thomas Scott.

The South Approach Railway, some three-quarters of a mile in length, was also constructed by Messrs. Tancred, Arrol. & Co., for the Forth Bridge Railway Company, and runs from the southern abutment of the Forth Bridge to Dalmeny. The line, the total cost of which is about £10,000, presents no characteristic calling for detailed remarks; the northern portion consists of an embankment, that to the south cuts through clay and rock. The former was dealt with by means of one of Dunbar & Ruston's 10 h.p. steam navvies, made by Messrs. Ruston, Proctor, & Co., engineers, Lincoln, working in the boulder clay, and filling two hundred waggons in the day of twelve hours, viz., about 600 cubic yards. Had the material under excavation been less difficult to deal with, a considerably larger quantity would have been tipped. (See Fig. 112; also *Industries*, Vol. V., pages 252 and 256.)

A station is in progress at the north end of this line, on the road near Rosshill, which in a short time will be the scene of much marshalling of trains and interchange of traffic travelling by the Forth Bridge route.

The Winchburgh and Dalmeny Line, 4½ miles in length, forms a direct and important communication between Dalmeny and the main line between Edinburgh and Glasgow, and places Glasgow in direct communication with the Forth Bridge. Work was commenced in August, 1889, and is being pressed forward rapidly, with a view to completion in March.

The contract was secured by Mr. William Arrol, and the estimated cost is placed at about £45,000. Upwards of 200,000 cubic yards of excavation are required, whilst seven larger bridges, and a number of lesser ones, together with heavy culverts, have to be built. The line traverses a pleasant agricultural district, well wooded, through properties belonging

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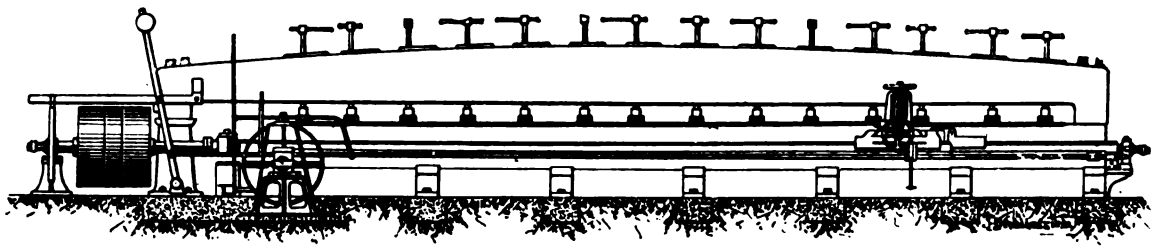


FIG. 98.—ELEVATION OF MACHINE FOR PLANING RECTANGULAR PLATES. SEE PAGE 38.

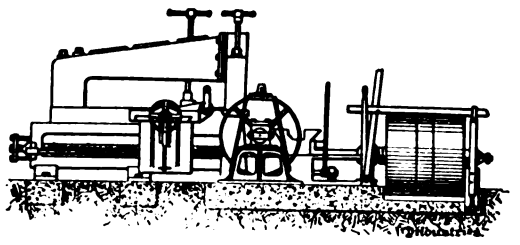


FIG. 99.—SIDE ELEVATION OF PLANING MACHINE. SEE PAGE 38.

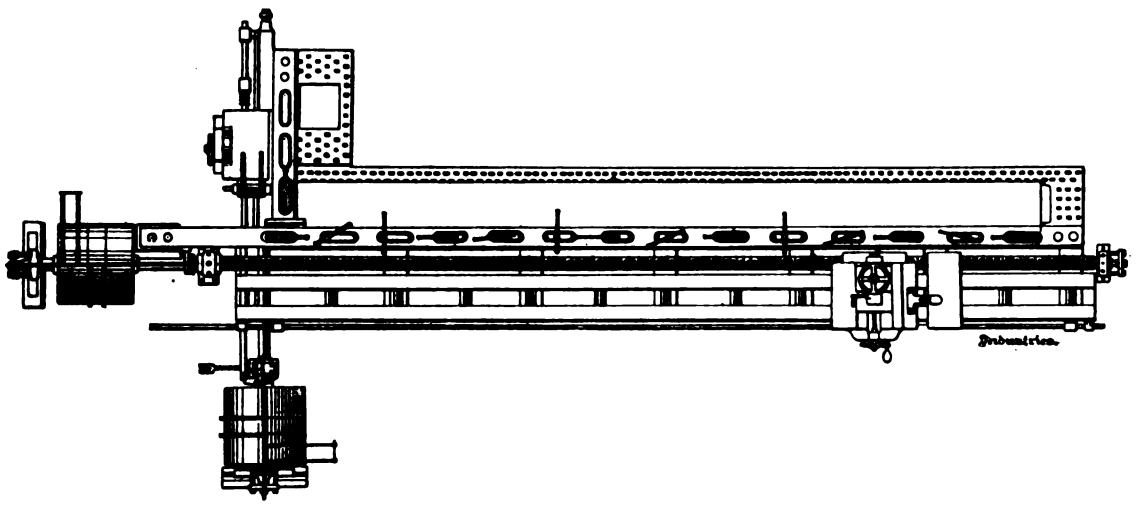


FIG. 100.—PLAN OF MACHINE FOR PLANING RECTANGULAR PLATES. SEE PAGE 38.

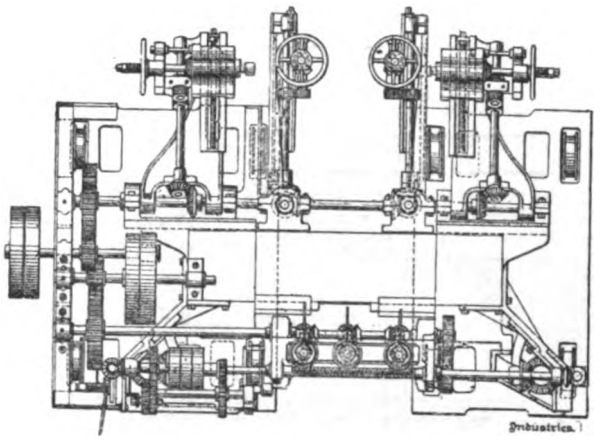


FIG. 105.—PLAN OF MULTIPLE DRILLING MACHINE. SEE PAGE 38.

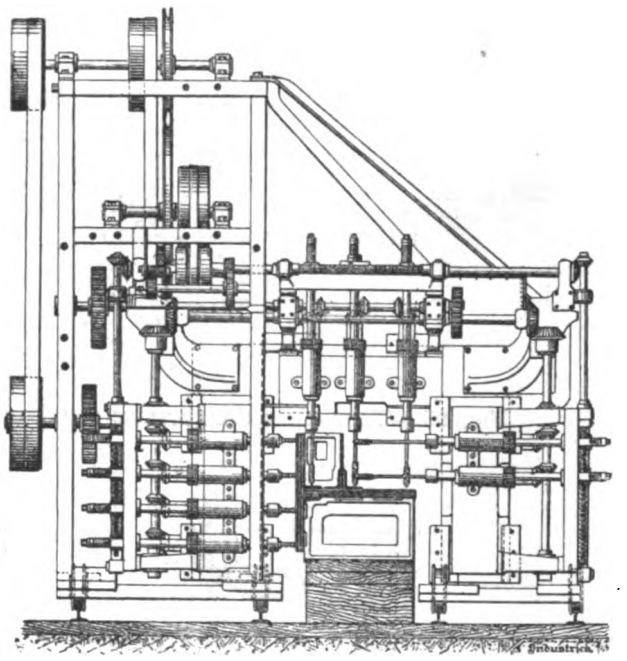
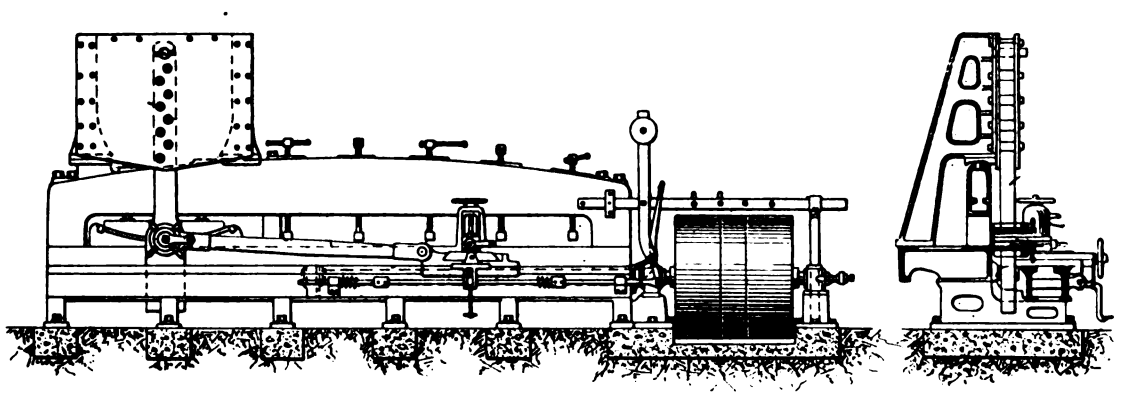
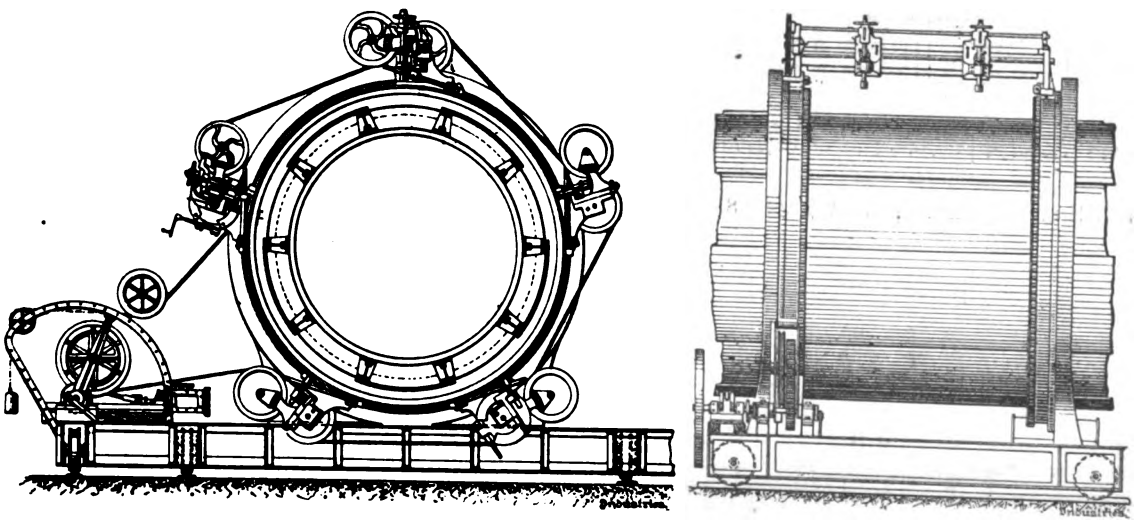


FIG. 106.—ELEVATION OF MULTIPLE DRILLING MACHINE. SEE PAGE 38.



FIGS. 101 AND 102.—MACHINE FOR PLANING THE ENDS OF CURVED PLATES. SEE PAGE 38.



FIGS. 103 AND 104.—FRONT AND SIDE ELEVATIONS OF TUBE DRILLING MACHINES. SEE PAGE 38.

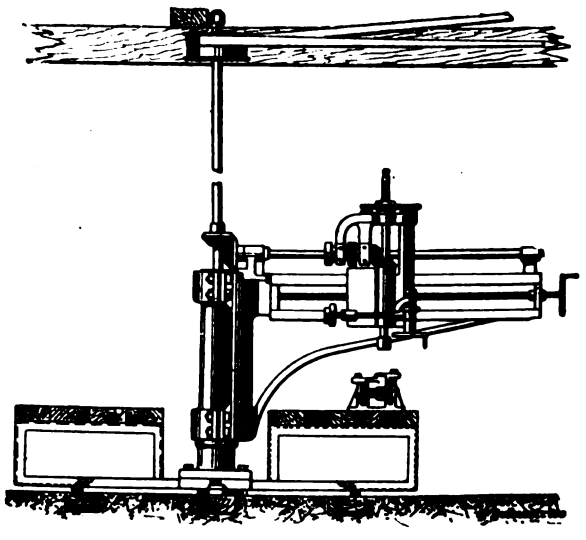
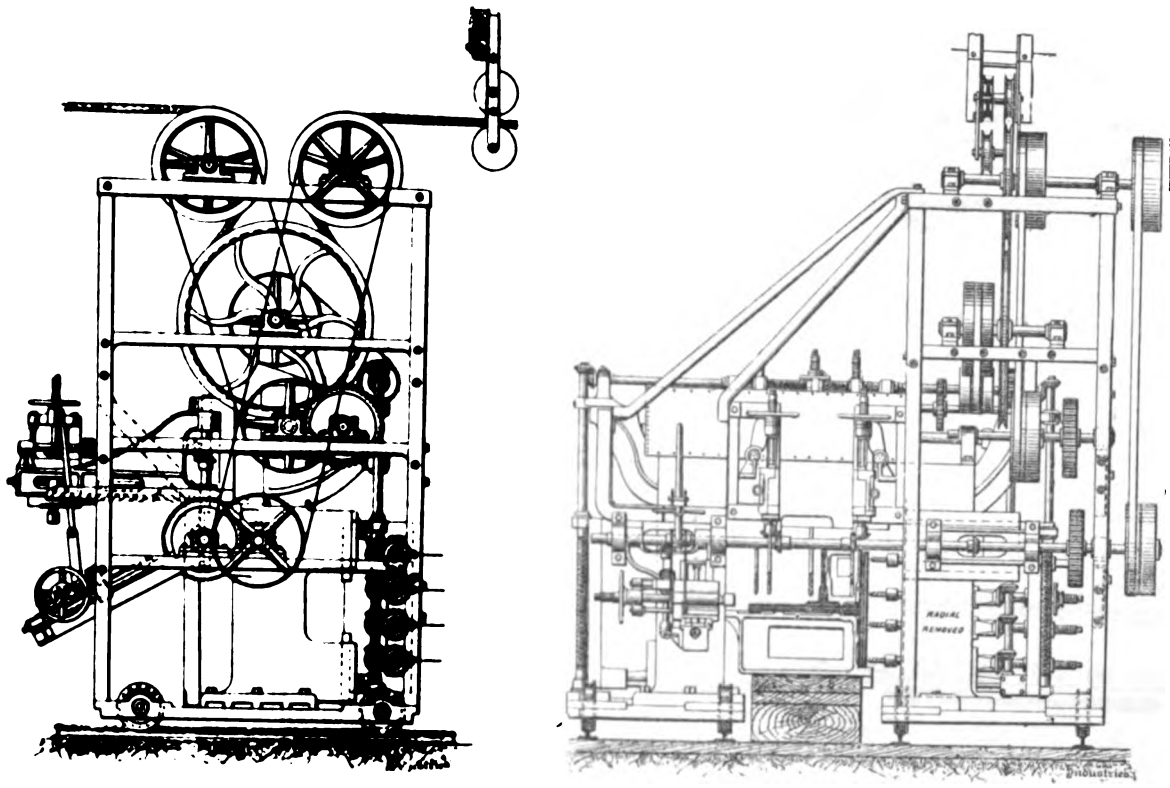


FIG. 107.—RADIAL DRILLING MACHINE. SEE PAGE 40.

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FIGS. 108 AND 109. SIDE AND END ELEVATIONS OF MACHINE FOR DRILLING THE BOOMS.

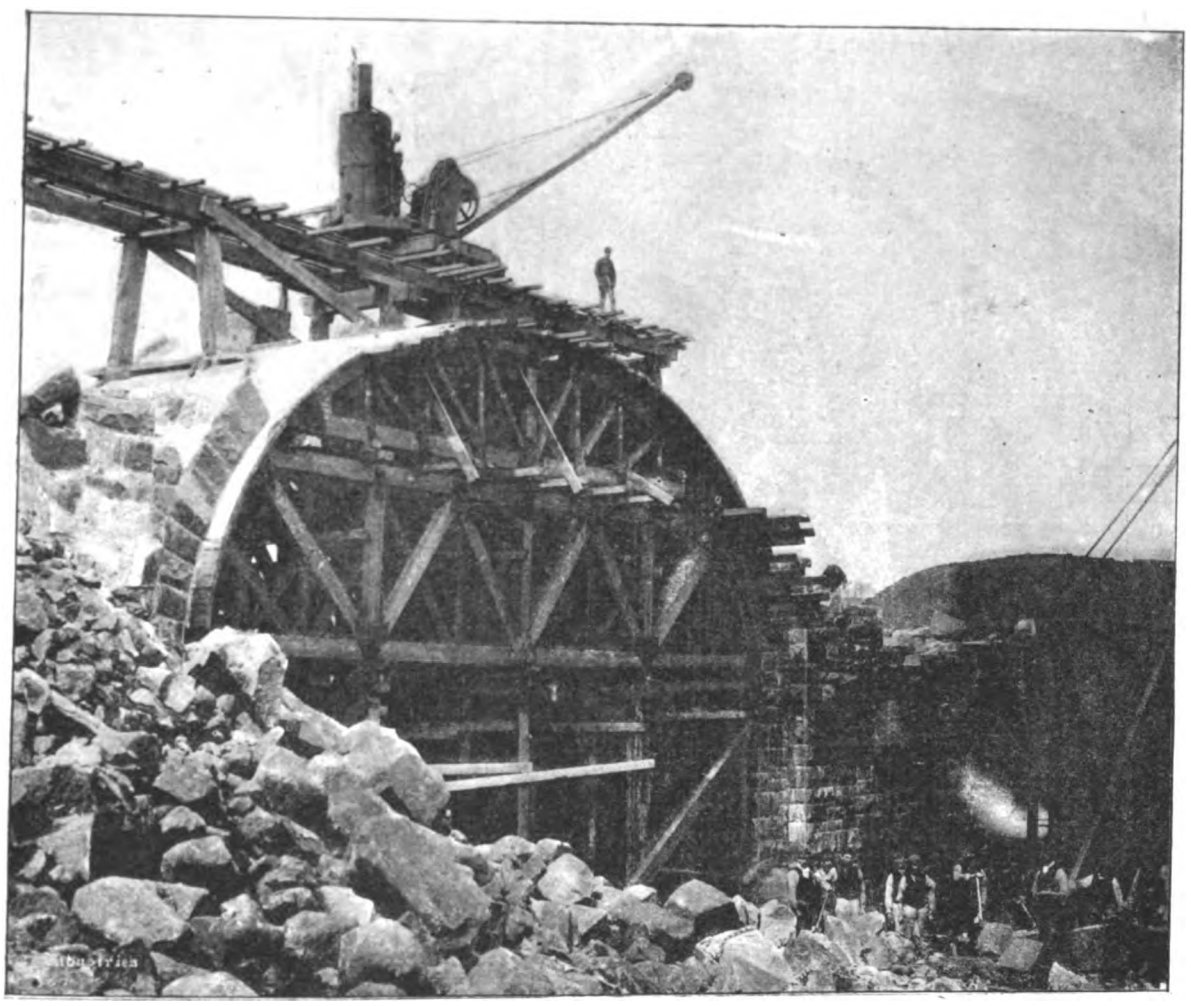


FIG. 110.—A BRIDGE ON THE NORTH QUEENSFERRY AND INVERKEITHING APPROACH RAILWAY.
SEE PAGE 45.

to the Earl of Hopetoun, the Earl of Rosebery, and Mr. Russell.

The Corstorphine and Dalmeny Line forms the direct communication between the Forth Bridge and Edinburgh, running from Dalmeny to Corstorphine on the main line between Edinburgh and Glasgow. This line, which is five miles in length, is being carried out by Mr. William Arrol, and presents no features of exceptional interest. The heaviest cutting occurs near the Dalmeny end, under Craigiehill, and is about half a mile in length, and requires the excavation of some 300,000 cubic yards of boulder clay. Three steam navvies have been in active operation continually at this point since the inception of the undertaking. The largest bridge is that crossing the River Almond, to the east of Boathouse Bridge, and consists of three spans, the central one 140ft., and those of each side 45ft. The line, which presents no special engineering difficulty, traverses a quiet rural part of the country, somewhat intersected by roads, as evidenced by the necessity of constructing no fewer than twenty-eight bridges between Dalmeny and Corstorphine.

The total quantity of excavation is estimated at half a million cubic yards, and the cost of the entire undertaking (exclusive of land acquired) at some £60,000. The railway station at Corstorphine, in anticipation of the large increase of traffic, has been entirely rebuilt and remodelled, on a considerably larger scale, by Messrs. S. Young & Sons, of Edinburgh.

Operations on the Inverkeithing and Burntisland Line, which is seven miles in length, were commenced in 1887. The line leaves the present Inverkeithing and Dumfermline route a little to the north of the former burgh, and, after traversing an undulating farming district, strikes the shore and skirts the Firth of Forth until Burntisland is reached. A colliery railway, running down to the small harbour of St. David's, is crossed, and heavy works, including the lowering of this line for some three-quarters of a mile, were necessitated. The line passes through the woods between Aberdour and Burntisland, skirting the shore; and the beauty of the surroundings will doubtless prove no small attraction to visitors. The embankments are protected by stone pitching from the waves of the Forth. Much rock was encountered in the cuttings, and the total amount of excavation in the line is estimated at about 600,000 cubic yards. Numerous bridges (in all about thirty) occur for various road crossings, &c., but call for no special remark. The cost of the undertaking is estimated at about £145,000. The engineers are Messrs. Galbraith & Church, and Messrs. Waddell & Sons, of Edinburgh, secured the contract.

A short line, known as the Cowdenbeath Line, some three miles in length, from Cowdenbeath to Kelty, saves a considerable loop in the present system. This work was executed by Messrs. Charles Brand & Co., of Glasgow, and presents no features of special interest.

A similar remark applies to the undertaking of widening the Inverkeithing and Dumfermline Railway, a work of some five miles in length. Originally constructed, so far as bridges, embankments, and cuttings are concerned, for a double line, though worked only as a single one, little else was requisite beyond the laying of permanent way for a second line, and the erection of new stations, to adapt it for main line traffic.

In the widening of the Kelty and Mawcarse Line, some ten miles in all, the bridges, being formerly built only for single line traffic, had to be taken down and rebuilt, care being taken, of course, not to interrupt in any way the usual service of trains. The stations have been similarly removed and reconstructed on a larger scale. The work presented no features of special engineering note, but the country traversed—the Loch Leven district, and the surroundings of the Lomond Hills—is rich in historic interest and pleasant pastoral scenery. The expense of the widening and reconstruction of the stations is placed at about £50,000. Mr. James Carswell was the engineer, and the contract was secured by Mr. John Best, of Leith.

The important branch known as the Glen Farg Line was commenced in 1888, and runs from Mawcarse to Perth. The first three miles, from Mawcarse to Damhead, necessitated the carrying out of ten cuttings and nine bridges. The valley of the River Farg is then reached, and numerous diversions of the river were necessitated by the narrowness of the glen. Two tunnels are constructed through a spur of the Ochil Hills, and further on an earthwork bank, of some 300,000 cubic yards, near Bridge of Earn, is required. The line throughout has been of a very heavy nature, upwards of a million cubic yards of excavation having been executed, of which some fifty per cent. was rock. The cost of this line, including that of the Cowdenbeath section referred to above, is estimated at about a quarter of a million. Messrs. Charles Brand & Sons, Glasgow, are the contractors.

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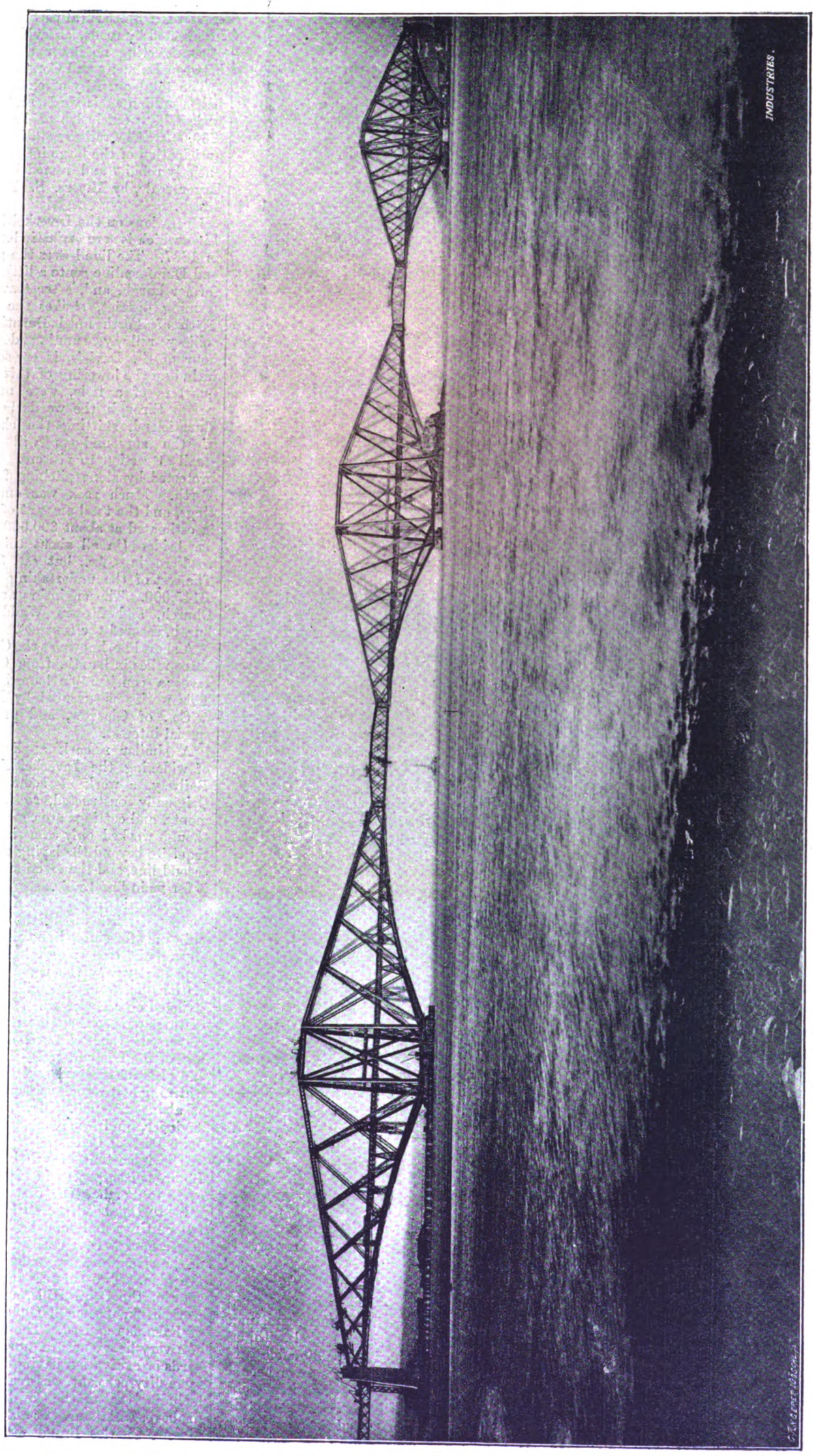


FIG. 111.—THE COMPLETE BRIDGE.

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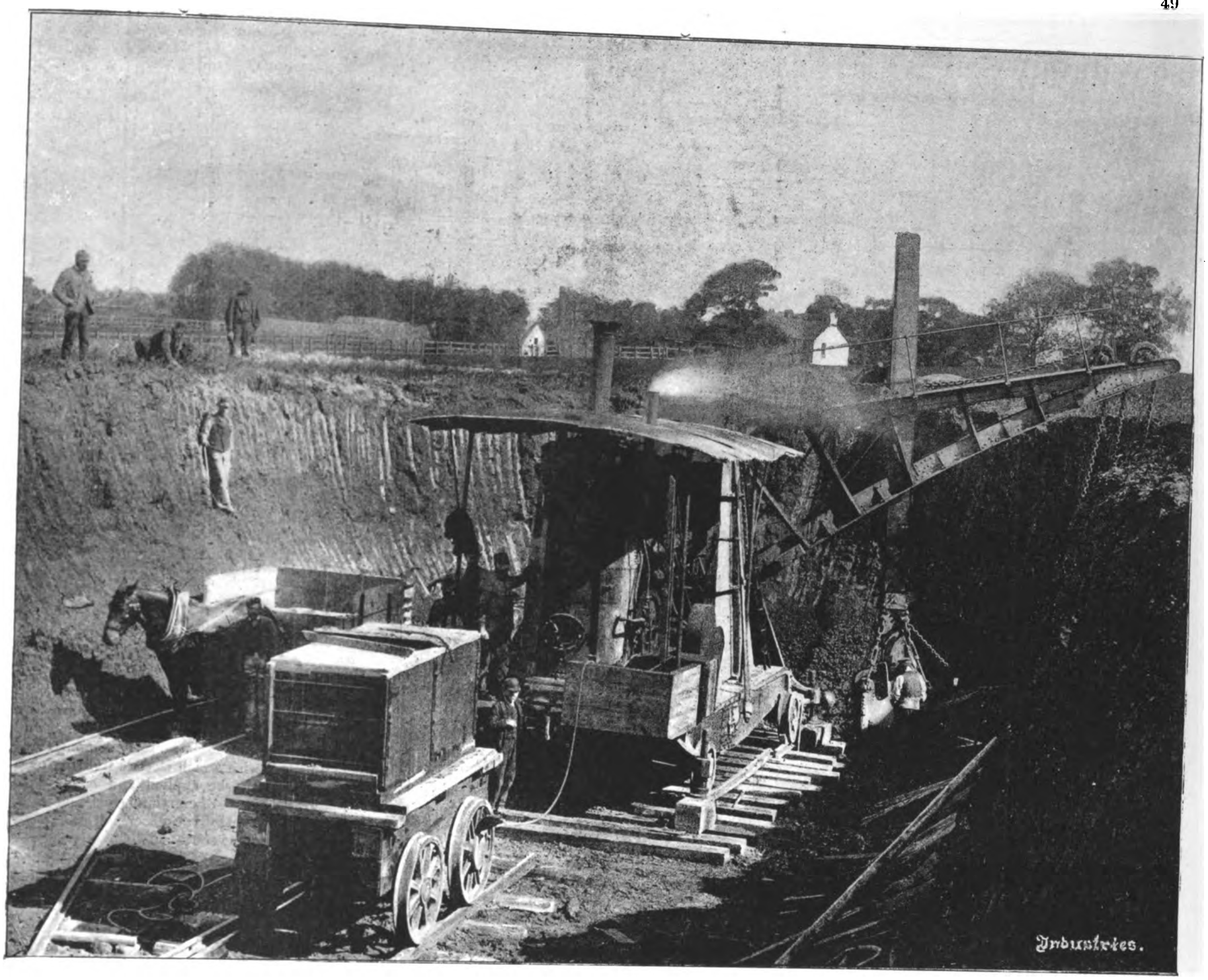


FIG. 112.—DUNBAR AND RUSTON'S STEAM NAVVY ON THE SOUTH APPROACH RAILWAY. SEE PAGE 45.

SIR JOHN FOWLER.

Sir John Fowler, K.C.M.G., the engineer in chief of the Forth Bridge, is the eldest son of the late Mr. Fowler, of Wadsley Hall, Ecclesfield, Sheffield, and was born in 1817. His early training was under the late Mr. Towlerton Leather, the eminent hydraulic engineer, under whom he received practical instruction during the construction of the Sheffield Waterworks, and of railway work in Yorkshire. At the termination of his pupilage Mr. Fowler became assistant to the late Mr. Rastrick, who was then engaged, amongst other works, in the construction of the London and Brighton Railway. Mr. Fowler was subsequently appointed as resident engineer of the Stockton and Hartlepool Railway. He came prominently forward about this time as a witness before Parliamentary Committees, displaying those acute and sound qualities of mind which have at all times marked his distinguished career. At the age of twenty-seven he was appointed to construct the Manchester, Sheffield, and Lincolnshire Railway, and the numerous works connected with that undertaking, comprising a dock, floating pier, large hydraulic works, and a steam ferry, and he was subsequently engaged in designing and carrying out numerous railway enterprises, both at home and abroad. The Metropolitan Railway, in London, carried out by Sir John Fowler, would alone serve to stamp his name on the roll of famous engineers of the nineteenth century.

A mere enumeration of the many projects which have occupied his busy life would form a formidable list, suffice it to point out that, besides the Victoria and Pimlico line, in connection with which he built the first railway bridge spanning the Thames, and many railway projects both in England, Scotland, and Ireland, Sir John was for a time engaged in Egypt, and as consulting engineer to the Khedive and Egyptian Government rendered valuable professional services. Sir John Fowler is consulting engineer to numerous railways, amongst others the Great Western and Great Northern Companies. In 1885 he was created a Knight of the Order of St. Michael and St. George, in recognition of important services rendered during the Soudan Campaign, and he was President of the Institution of Civil Engineers in 1866.

MR. BENJAMIN BAKER.

Mr. Baker, partner with Sir John Fowler, and associated with him as engineer of the Forth Bridge, has seen varied and extensive practice, from the construction of the Metropolitan Railway in London to that of the Forth Bridge, and is at present engaged in carrying out the Chignecto Ship Railway in Canada, and the tunnel under the Hudson River at New York, in addition to numerous other undertakings, in different parts of the world. Mr. Baker is the author of several standard works on engineering, which are justly held in high estimation, and, as the writer of numerous authoritative papers on kindred topics, has appeared before most of the learned societies in this country. He possesses a large practice in arbitration cases, parliamentary evidence, and consultation work, his opinion being eagerly sought both at home and abroad, whilst on the American Continent the frequent requisition of his services abundantly testifies to the high esteem in which his engineering capacity is there held. Mr. Baker, who is still a young man, is a member of the Council of the Institution of Civil Engineers, an honorary

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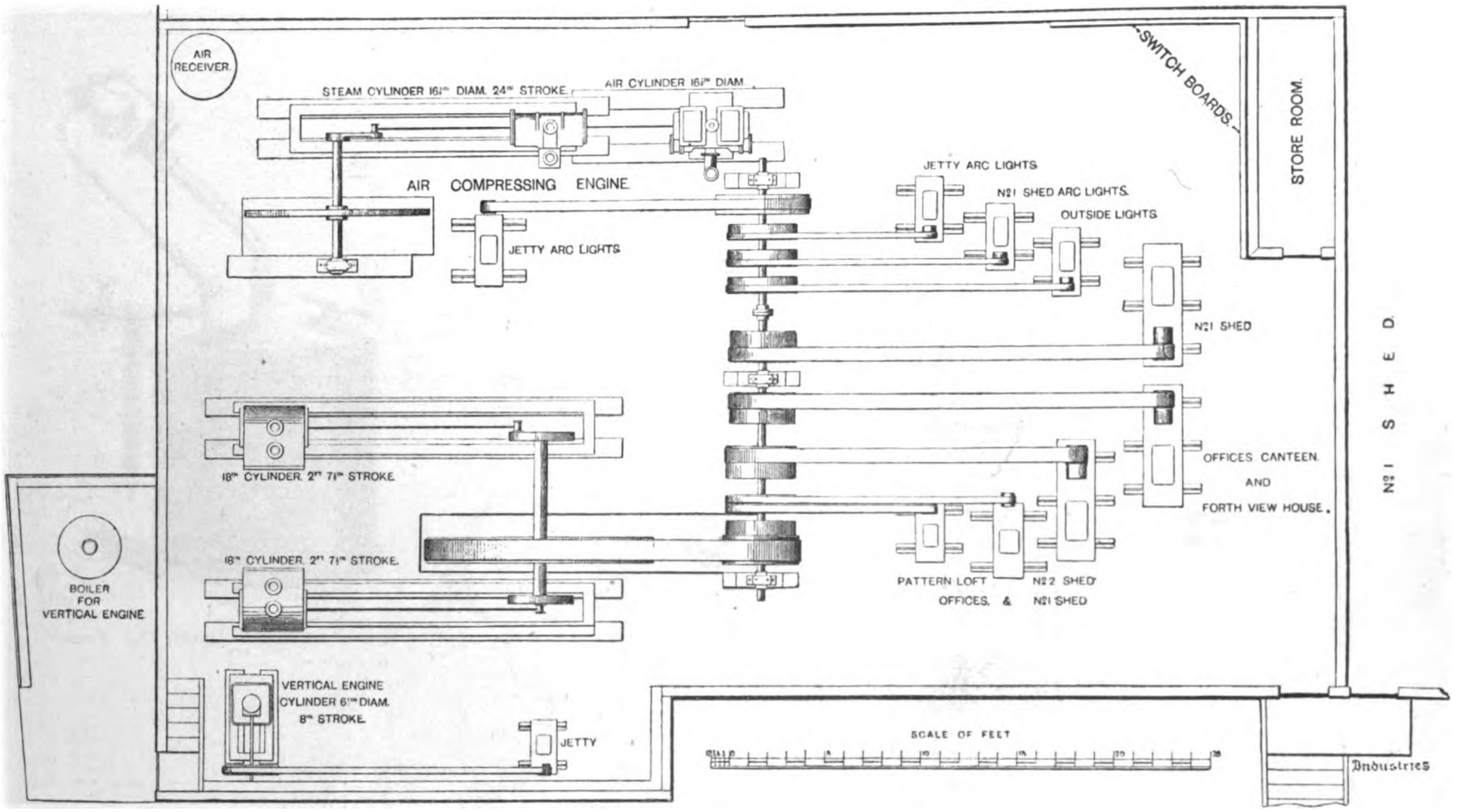


FIG. 113.—PLAN OF THE ELECTRIC LIGHTING INSTALLATION AT THE BRIDGE WORKS. SEE BELOW.

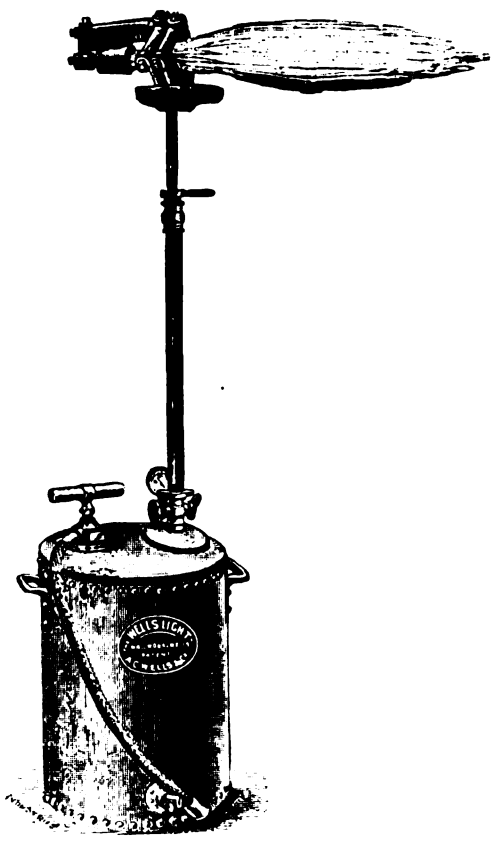


FIG. 114.—THE "WELLS" LIGHT. SEE PAGE 52.

member of the Council of the American Society of Mechanical Engineers, a civil member of the Ordnance Committee, a Lieutenant-Colonel in the Volunteer Engineer Staff Corps, a Fellow of the Royal Society, and a Past President of the Mechanical Section of the British Association.

MR. WILLIAM ARROL.

Mr. William Arrol was born at Paisley, and at the early age of nine worked as a "piecer" in a cotton mill, being subsequently apprenticed as an engineer. Removing, after he had served his time, to Port Glasgow, he was employed as a mechanic by the firm of Messrs. Blackwood & Gordon, subsequently becoming a foreman in the boiler and bridge departments of Messrs. Laidlaw & Son's Works, Glasgow. In 1866 Mr. Arrol commenced business on his own account, with capital saved from his earnings. The workshops he laid out at Dalmarnock were conspicuous for the special machinery designed by himself for manipulating girder work. From this small beginning contracts of greater size were secured, and Mr. Arrol built the bridges on the Glasgow, Hamilton, and Bothwell Railway, the large viaduct across the Clyde at Glasgow on the Caledonian Railway, the South Esk viaduct at Montrose—in addition to various other bridges both for this country and abroad. Mr. Arrol then secured his first large contract—viz., that of building the new Tay Bridge, a work carried out from first to last with the utmost success. In 1882 Mr. Arrol, in conjunction with the firm of Messrs. Tancred & Falkiner, entered upon the Forth Bridge. The whole practical working of this gigantic undertaking has fallen upon Mr. Arrol, and forms a lasting monument to the indomitable energy and infinite resource of the contractor.

At the present time Mr. Arrol is engaged amongst other things in executing the steel superstructure of the Tower Bridge, London; also in carrying out the order for a number of bridges for the Manchester Ship Canal Company.

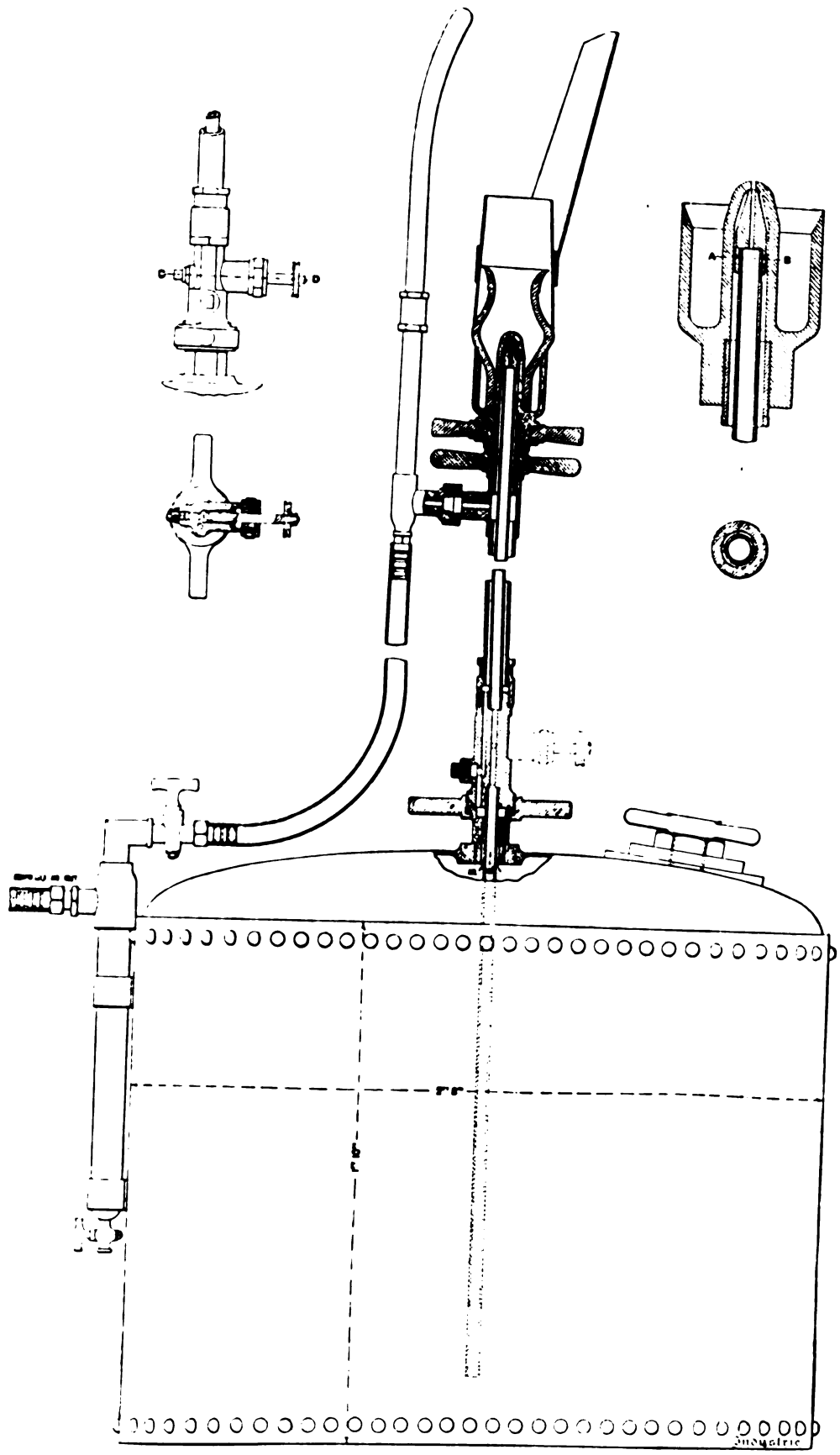
THE LIGHTING OF THE WORKS.

Among the earliest of the operations at the site of the Bridge Works was the arrangement of the electric light installations, which were somewhat extensive, as it was determined to provide sufficient artificial light to allow large numbers of men to be employed at night. There were many interesting features about those temporary installations, and there can be no doubt that they clearly demonstrated the ease and speed with which electric lighting on a considerable scale can be applied and adapted to large structures in course of erection. (See Fig. 113.)

The contracts for lighting the offices, machine shops, yards, and jetties on the south side of the river were entrusted to Messrs. Siemens Bros., and the smaller contracts on Inch Garvie and at North Queensferry to Messrs. Crompton & Co. During the sinking of the foundations electric lighting was extensively applied, and in several instances was of very special value. In the working chambers of the caissons, for example, where the men were working under trying conditions, the atmosphere being at a pressure of 32lb. per square inch, the aid of a powerful and reliable light was invaluable. Siemens differential arc lamps, with triple sets of carbons, were used for this purpose. The divers working on the exterior of the caissons were provided with incandescent lamps enclosed in strong protecting globes.

On the completion of the caisson work all the electric apparatus was re-arranged and much extended to provide for the erection of the superstructure. The installations, as remodelled and enlarged, may be described as follows:—At South Queensferry, where the engineering shops and yards for the preparation of the steel covered an area of 50 acres, there were three Siemens S.D.[6] dynamos, each supplying 120 amperes at 110 volts; one Crompton and one Siemens dynamo, each supplying 50 amperes at the same e.m.f.; and five Siemens S.D.[8] machines for series arc lighting, each with a current of 15 amperes at 300 volts. There was also a Crompton machine for the same purpose, wound for 15 amperes at 1,200 volts. Seven of these dynamos were driven by horizontal non-condensing coupled engines, indicating 120 h.p., by Messrs. Davey, Paxman, & Co., of Colchester, while separate incandescent lighting dynamos were driven by two smaller engines indicating respectively 30 and 10 h.p. On Inch Garvie, at the central cantilever, a pair of coupled "Caledonian" engines, by Messrs. Shanks, supplied

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FIGS. 115, 116, 117, 118, AND 119.—DETAILS OF "LUCIGEN" LIGHT, AS USED AT THE BRIDGE.



FIG. 120.—"LUCIGEN" LIGHT, OLD FORM.

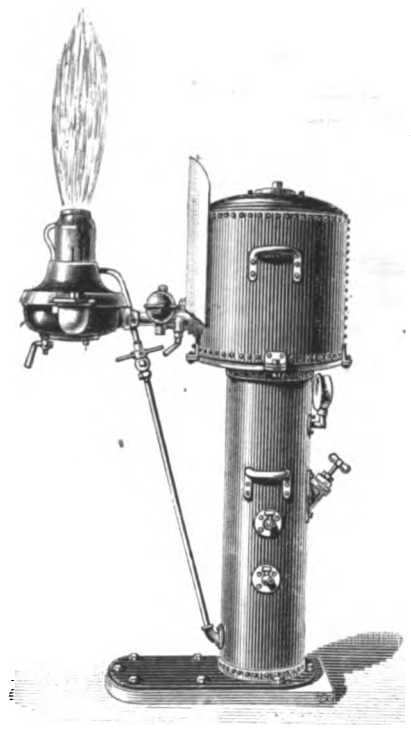


FIG. 121.—"LUCIGEN" LIGHT, PRESENT FORM.

power to four Crompton-Bürgin machines, two for arc and two for incandescent lamps. There was also a large Crompton dynamo for arc lighting, supplying 15 amperes at 1,200 volts. This machine was driven by Gwynne engines, coupled. At North Queensferry there was an installation almost exactly similar to that on Inch Garvie. The machine shops and sheds were lit by Siemens arc lamps, arranged in parallel circuits of two lamps in each, and distributed among the cantilevers were about 100 Crompton arc lamps. The "Sunbeam" incandescent lamps of the Sunbeam Company, of Gateshead, were also extensively used both on the erection and in the shops, and were found to be very economical and effective. It will be readily understood that the arrangement of the wires for such work presented many difficulties. The plan adopted was briefly as follows:—Overhead wires were run from the dynamo stations to distributing boxes at each of the piers, and flexible cables, tied to ropes, were led from these to the lofty stagings on the structure. Where such loose flexibles were impracticable, armoured cables were carried out along the girders. Groups of lamps in series with other groups were provided with automatic cut-outs and equivalent resistances to isolate the effects of accidents to the conductors. All arrangements were necessarily extremely portable, as the stagings were rapidly advanced with the progress of the work.

The "Lucigen," amongst other rival means of illumination, was tried at the bridge works, and proved itself the most formidable opponent of the electric arc. This light was described in *Industries*, Vol. IV., p. 599. The light is obtained by forcing creosote oil, or other heavy hydrocarbon, in the form of a spray, through a small nozzle, by means of air-pressure. The flame is about 3ft. 6in. long, and emits a light of great intensity and diffusive power. To maintain the air pressure for each light of 2,500 c.p. only ·25 h.p. is required. When first applied at the bridge, the oil, a bye-product in the manufacture of illuminating gas, was exceedingly cheap, and it seemed as if the new light would speedily extinguish its rivals. Such expectations were not realised: the price of the oil rose very considerably, and some disadvantages were experienced; but the makers have now brought out a portable "Lucigen," which gets over the trouble, and at a much reduced cost. We illustrate in Figs. 115–120 the old form of the "Lucigen" light, Figs. 115–119 giving details of the construction of the apparatus, and Fig. 120 a general view. Fig. 121 shows one of the latest forms.

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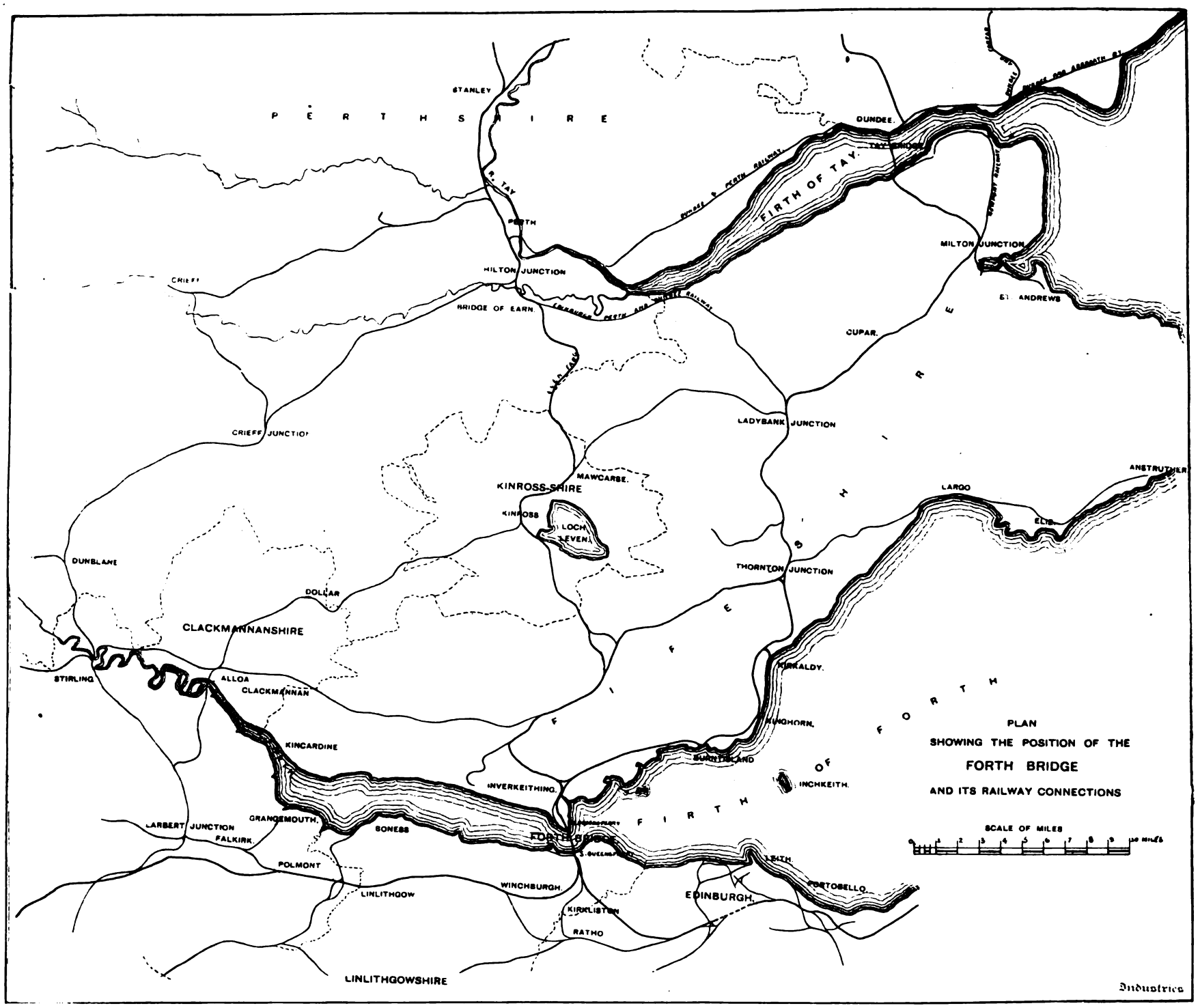


FIG. 122. MAP OF THE ENVIRONS OF THE FORTH BRIDGE. SEE PAGE 41.

The "Wells" light (Fig. 114) was also used in some parts of the Forth Bridge works, but, owing to this form of light only being placed in the market a year or two after the bridge was commenced, its use there was not so extensive as it might otherwise have been. Some "Wells" lamps were successfully used on the Inverkeithing Railway, on the Aberdour Railway, and also at South Queensferry.

Those who watched the erection of the bridge will long remember the striking aspect it presented on a dark night, when the outlines of the great cantilevers were thrown into bold relief by the long lines of brilliant lights.

CONCLUSION.

On Sunday, January 19th, 1890, the bridge received an undesigned testing from a severe gale, during which the wind gauges on Inch Garvie recorded a pressure of no less than 37lbs. per square foot. No damage of any kind resulted from this high wind, and the maximum lateral movement of the great cantilever was less than 1in. Two days later Sir John Fowler and Mr. Baker tested the two 1,700ft. main spans by placing on the centres two trains, each made up of fifty loaded coal waggons and three of the heaviest engines and tenders, the total load thus massed upon the spans had the enormous weight of 1,800 tons, or more than double that which the bridge will ever be called upon in practice to sustain. The observed deflections were in exact accordance with the calculations of the Engineers, and the bridge exhibited exceptional stiffness in all directions.

On January 24th, 1890, the first train was driven across the structure by the Marchioness of Tweeddale, and on the 7th of the present month the directors made a similar crossing.

The opening ceremony is fixed for March 4th, and will be performed by H.R.H. the Prince of Wales.

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